XIV. Troubleshooting

DANGER

- **Explosion Hazard. Electrical Shock Hazard. Burn Hazard. This boiler uses flammable gas, high voltage electricity, moving parts, and very hot water under high pressure. Assure that all gas and electric power supplies are off and that the water temperature is cool before attempting any disassembly or service.**
- **Do not attempt any service work if gas is present in the air in the vicinity of the boiler. Never modify, remove or tamper with any control device.**

WARNING

- **This boiler must only be serviced and repaired by skilled and experienced service technicians.**
- **If any controls are replaced, they must be replaced with identical models.**
- **Read, understand and follow all the instructions and warnings contained in all the sections of this manual.**
- **If any electrical wires are disconnected during service, clearly label the wires and assure that the wires are reconnected properly.**
- **Never jump out or bypass any safety or operating control or component of this boiler.**
- **Read, understand and follow all the instructions and warnings contained in ALL of the component instruction manuals.**
- **Assure that all safety and operating controls and components are operating properly before placing the boiler back in service.**

The following pages contain information for use in diagnosing control problems. When using this information 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 XI (Start-up and Checkout).
3) 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.

A. Using the Display to Troubleshoot

The display communicates problems in one of three ways, depending upon the nature of the problem:

Hold – A condition exists that, when cleared, will allow burner to automatically fire. This is similar to what is sometimes called a "soft lockout", except that Holds also occur during normal operation (for example while the control is waiting for the fan to come up to the pre-purge speed). When a Hold is present, "Hold" is shown on the home screen as shown in Figure 14.0. If the Hold persists, the home screen will alternately flash the outlet temperature and the Hold Code as shown in Figure 14.1. A list of these codes, and their meanings, are shown in Table 14.4.

Lockout – An abnormal condition exists that, when cleared, will require manual reset of the control. When a Lockout is present, "Lockout" is shown on the home screen as shown in Figure 14.2 and the home screen will alternately flash the outlet temperature and the Lockout Code as shown. A list of these codes, and their meanings, are shown in Table 14.4. Codes used for Holds and Lockouts are the same and in some cases a hold condition that lasts long enough will become a Lockout. Lockouts can be cleared by either pressing the LH button as shown in Figure 14.3, or pressing the reset button on the control itself. The most recent Lockout can be seen, and cleared, on the "Lockout screen" shown in Figure 12.7 (interrupting power to the boiler also clears this history).

Alert – Not used in this application.

B. Troubleshooting when the Display is Blank

Use the flow chart in Figure 14.5 to locate the problem when the display is blank or is not readable.

C. Operation and Troubleshooting of Boiler Limits, Switches and Sensors

For the location of the controls described below, see Figure 14.6.

Thermal Fuse – The thermal fuse is designed to prevent boiler operation in the event that the heat exchanger is damaged by excessive flue gas temperatures. It is set to open at 358F and is a one shot non-replaceable device. If this fuse opens, the heat exchanger must be replaced. The thermal fuse is essentially a back-up to the flue gas sensor, which is designed to prevent boiler operation if the flue gas temperature exceeds 210F. Note, however, that it is possible for the thermal fuse to open even though the flue temperature limit is working properly. If the thermal fuse is suspected of having opened, unplug the wire heading to it and check continuity directly across the thermal fuse. If no continuity is present, the heat exchanger needs to be replaced. If continuity is present, the fault lies elsewhere.

WARNING

Asphyxiation Hazard. Fire Hazard. Do not attempt to jump or replace the thermal fuse. Doing so may cause a breach of the heat exchanger casing resulting in property damage, personal injury or loss of life.

Sump Pressure Switch (SPS) – This pressure switch is normally closed and monitors the difference in pressures between the boiler cabinet and the sump (the sump pressure is very close to the pressure at the boiler's vent connection). This switch is piped as shown in Figure 14.7. The SPS is calibrated to open at 3.15 +/- 0.10 inches water column. A blockage in vent system that causes the vent pressure to exceed the SPS set point will cause the burner to shut down and recycle. Likewise, a blockage in the air intake system that causes the vacuum in the cabinet to fall below -3.15 inches will also cause the boiler to shut down and recycle. If this switch opens, look for a blockage in the vent or air intake system.

Air Proving Switch (APS) – This pressure switch is normally open and is connected to the outlet tapping on the gas valve as shown in Figure 14.7. During pre-purge, when the gas valve is closed, the APS is monitoring the pressure drop across gas-air mixer (venturi for the 80-120, swirl plate on the 150 and 180). Greater air flow through the mixer causes this pressure reading to increase. The APS is calibrated to close when this pressure rises to 1.05 +/- 0.05" wc, which is a pressure at pre-purge corresponding to adequate air flow. After the gas valve opens, this pressure will drop very close to zero, regardless of the actual air flow rate through the boiler. For this reason, the APS is ignored after pre-purge. In the event that the burner fires continuously for two hours, the boiler control will recycle the burner to verify that the APS still closes and that adequate airflow is still present. If the APS opens, look for the following:

- Blockage in the vent or air intake system.
- Disconnected, loose or blocked APS tube.

Flow Switch – The paddle type flow switch is calibrated to close at a water flow rate of approximately 3.2GPM. This switch is intended to do two things:

- Prove that there is water in the boiler (no water means no flow at this switch)
- Prove that there is enough flow for the supply and return temperature sensors to accurately measure the water temperatures entering and exiting the heat exchanger.

The minimum flow rate required for all models is significantly above 3.2 GPM (Table 9.1). The boiler control verifies that there is adequate flow through the boiler by monitoring the temperature rise through the boiler; the flow switch merely assures that the measured rise is accurate. The boiler control starts to limit the firing rate when the temperature rise exceeds 53F and the boiler goes into a Hold if the rise reaches 63F. If the flow switch does not close, look for the following:

- No water in the boiler
- Trapped air in the boiler or system - make sure that a steady stream of water exits the manual air vent shown in Figure 11.1 when it is opened.
- Valve closed in boiler loop piping
- Fouled Y strainer in boiler loop piping

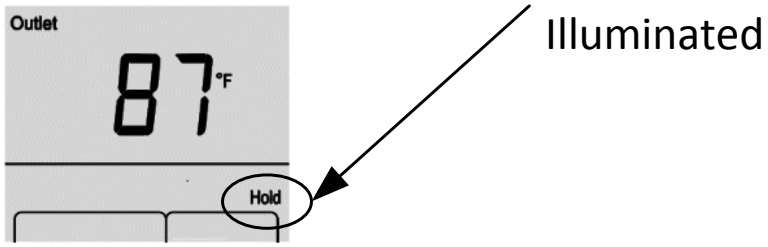

FIGURE 14.0: HOLD SCREEN

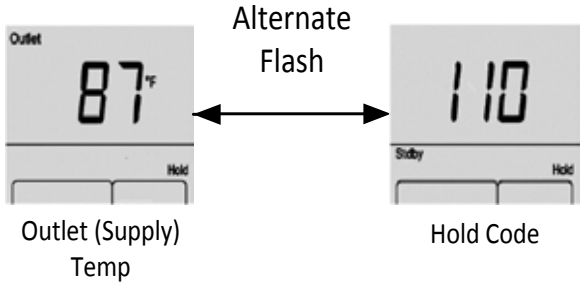

FIGURE 14.1: SUSTAINED HOLD

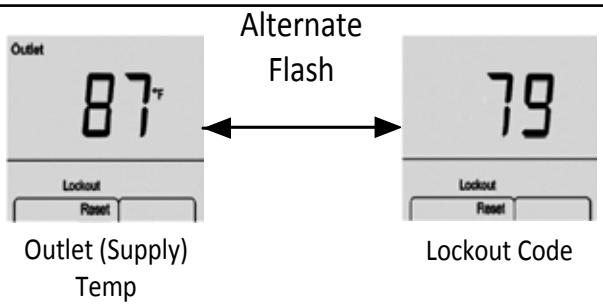

FIGURE 14.2: LOCKOUT SCREEN

Supply Sensor – The boiler control infers the supply temperature based on the resistance measured at the supply sensor. Table 14.8a shows this resistance as a function of water temperature. Because the control/supply sensor is used as the boiler's water temperature limit control, there are actually two "thermistors" in the supply sensor wired in parallel (Figure 10.5). The control compares the resistances across these two thermistors and prevents boiler operation if there is a significant difference between the readings.

Return Sensor – The boiler control infers the return temperature based on the resistance measured across a single thermistor in the return sensor. Table 14.8a shows this resistance as a function of water temperature.

Flue Temperature Sensor – The boiler control infers the flue gas temperature based on the resistance measured at the flue temperature sensor. Table 14.8a shows this resistance as a function of flue temperature. There are actually two "thermistors" in the flue temperature sensor wired in parallel (Figure 10.5). The control compares the resistances across these two thermistors and prevents boiler operation if there is a significant difference between the readings.

Outdoor Sensor – The boiler control infers the outdoor temperature based on the resistance measured across a single thermistor in the outdoor sensor. Table 14.8b shows this resistance as a function of temperature.

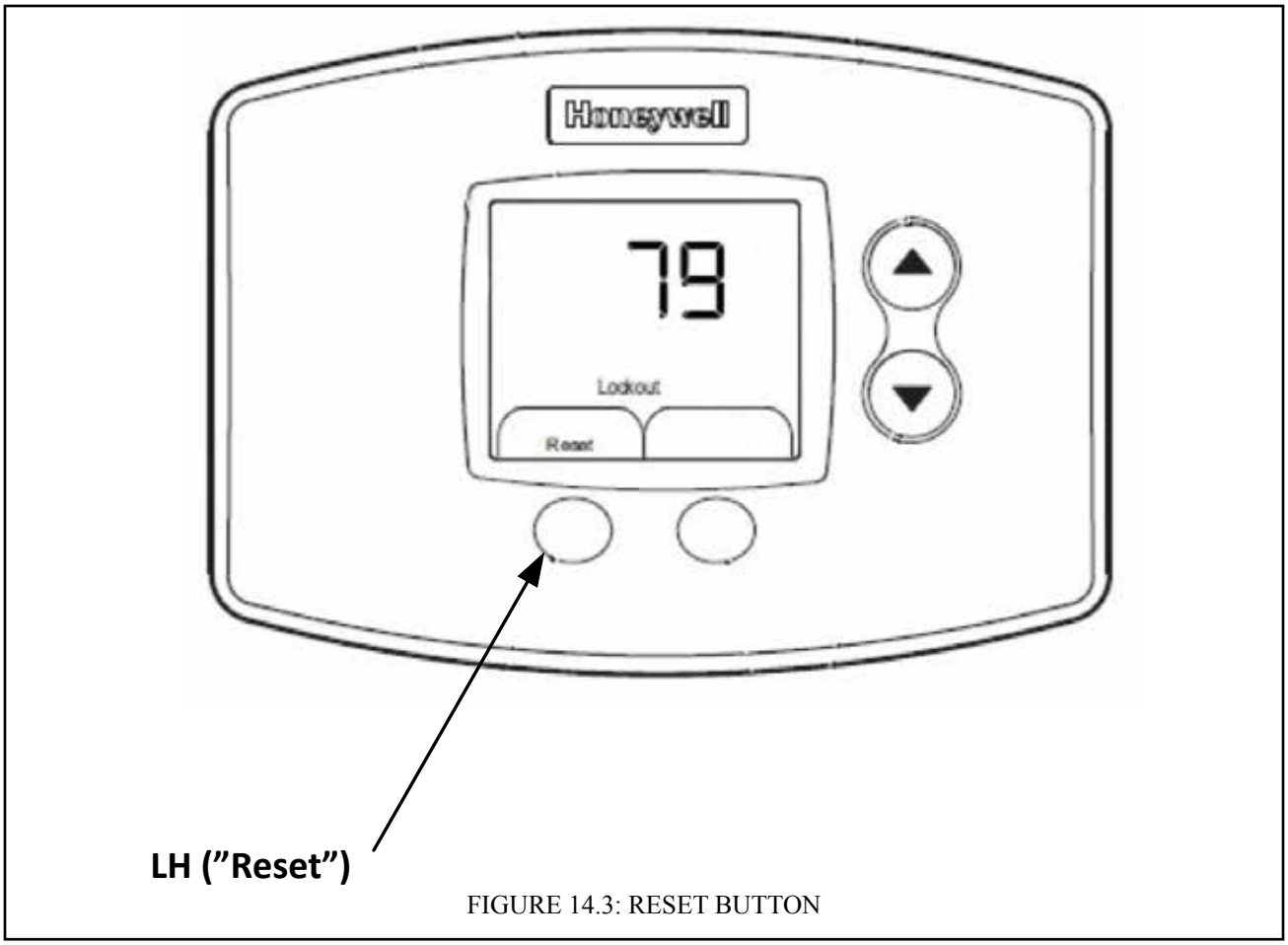

FIGURE 14.3: RESET BUTTON

Condensate Trap – The condensate trap allows condensate to leave the boiler while containing flue gasses. In the event that this trap becomes blocked, condensate will start to back up in the trap. To prevent a rising condensate level from backing up into the heat exchanger, both a ground wire and the flame rod wire are bonded to this trap in such a way that an abnormally high condensate level will conduct flame current directly to ground (Figure 10.5). The boiler control will interpret this as a loss of flame and enter a Hold. See Figures 7.25 or 13.3 for trap location.

Combustion Fan – The combustion fan pushes air-fuel mixture into the burner and the speed of this blower determines the firing rate. There are two electrical connections at this fan:

- 120V Plug – Supplies 120VAC Power to the Fan
- Speed Control Plug - Delivers a PWM (speed control) signal from the boiler control to the fan. This plug also includes
` tachometer connections so that the boiler control can monitor the actual fan speed.

In the event that there is 120volts at the boiler, but no signal at the speed control plug, this fan will run at its maximum speed. Specific causes of this include:

- Disconnected speed control plug
- Loose J2 Plug
- Loose L2 or L3 Plug
- Defective 24V Transformer

Gas Valve – The gas valve used on this boiler has either one or two 24VDC coils (the gas valve used on all boiler models is redundant). The gas valve output from the boiler control is 24VAC. A rectifier module is installed between the gas valve and the wiring harness on the 80, 100 and 120 models (Figure 11.4a). The rectifier is built into the gas valve plug itself on the 150 and 180.

FIGURE 14.4: LOCKOUT/HOLD CODES

Code	Meaning	Possible Causes/Remedies
0	No hold or lockout present	
47	Flame rod to ground leakage	• Damaged flame rod • Blocked condensate drain • Shorted or mis-wired flame rod wiring
49	Voltage supplied to control is outside of acceptable range.	• Line voltage supply to boiler is outside acceptable range. • Defective transformer • Bad connection between transformer and control.
50	Control modulation parameters are incorrectly set.	If this is seen after restoration of parameters from PIM (Appendix C), attempt to restore a second time. If problem persists replace control.
61	Boiler is waiting for anti-short cycling (ASC) time to pass before starting ignition sequence.	Normal operation if anti-short cycle time (ASC) is not set to zero. Indicates that required time has not yet elapsed between last call for heat and this one. Boiler should respond to call for heat when this time has passed.
62	Waiting for fan to reach pre-purge/ignition speed.	Normal when fan is ramping up to pre-purge speed. Should clear after a few seconds.
63	One of the following limits is open: 1. Auxiliary limit 2. Thermal fuse 3. Sump pressure switch	• Look for open external limit or, if none is installed, loose/missing external limit jumper • Check continuity directly across thermal fuse and replace heat exchanger if none is present. Also see text. • Blockage in vent or intake system.
65	Waiting for air proving switch to close during pre-purge	Normal Hold during pre-purge. Should clear after a few seconds.
66	Air proving switch (APS) is closed when it shouldn't be.	• Jumped APS • Defective or incorrect APS. • Loose connection between terminal J2 and DC fan plug
67	Flow switch not closing.	• Air in heat exchanger (bleed as shown in Figure 11.1) • Inoperable boiler pump • Undersized boiler pump • Air in system • Excessive pressure drop in boiler loop (P/S piping not used when it should be)
79	Supply water temperature exceeded 210F	• Defective pump or inadequate boiler water flow (see causes for error code 67). • Heating load far below boiler's minimum firing rate • No flow through system loop
81	Temperature rise across boiler exceeded 63F	Inadequate water flow through boiler (see causes for Error code 67).
82	Flue gas temperature exceeded 214F	• Dirty heat exchanger • Incorrect air-fuel ratio • Excessive firing rate.
85	Return temperature is higher than supply.	• Boiler pump or connections to boiler are reversed. • Supply/return sensor wiring reversed • Supply or return sensor is defective
88	Supply temperature climbing too quickly.	• See causes for error code 79
91	Inlet (return) sensor fault	• Break in sensor wiring • Short in sensor wiring • Check for defective inlet sensor using the resistance table 14.8a.
92	Outlet (supply) sensor fault	• Break in sensor wiring • Short in sensor wiring • Check for defective inlet sensor using the resistance table 14.8a.
95	Stack sensor fault	• Break in sensor wiring • Short in sensor wiring • Check for defective inlet sensor using the resistance table 14.8a.
105	Flame signal detected when no flame should be present.	• Defective gas valve (verify inlet pressure is less than 14.0" wc before replacing) • Electrical noise.
110	Burner failed to light or flame not detected.	• Gas valve switch turned off (80-120 only) • Inadequate gas pressure • Gas line not completely purged of air • Incorrect air-fuel ratio (CO_2) • Loose gas valve connection • Defective or dirty ignition/flame rod electrode • Loose or defective ignition cable • Loose flame rod connection • Plugged condensate drain • Loose burner ground connection • Defective gas valve (check for 24VAC across red and yellow leads at gas valve plug during trial for ignition before replacing)
122, 123	Fan failed to reach correct ignition speed.	• Loose or miswired fan harness • Loose J2 Plug • Loose connection in 120V fan wiring • Defective fan
136	Air proving switch (APS) failed to close during last pre-purge.	• Blockage in vent or intake system • Abnormal air or flue gas restriction through boiler (e.g. fouled heat exchanger) • Closed outlet tapping on gas valve • Loose or blocked hose between APS and gas valve
137	Flow switch failed to close during last cycle.	• See causes for error code 67
173, 177	Gas valve output error (power detected at control's gas valve output when none should be present)	Verify wiring is correct, then reset control. If problem persists replace control.
All other codes	Various	Reset control. If problem persists, replace control.

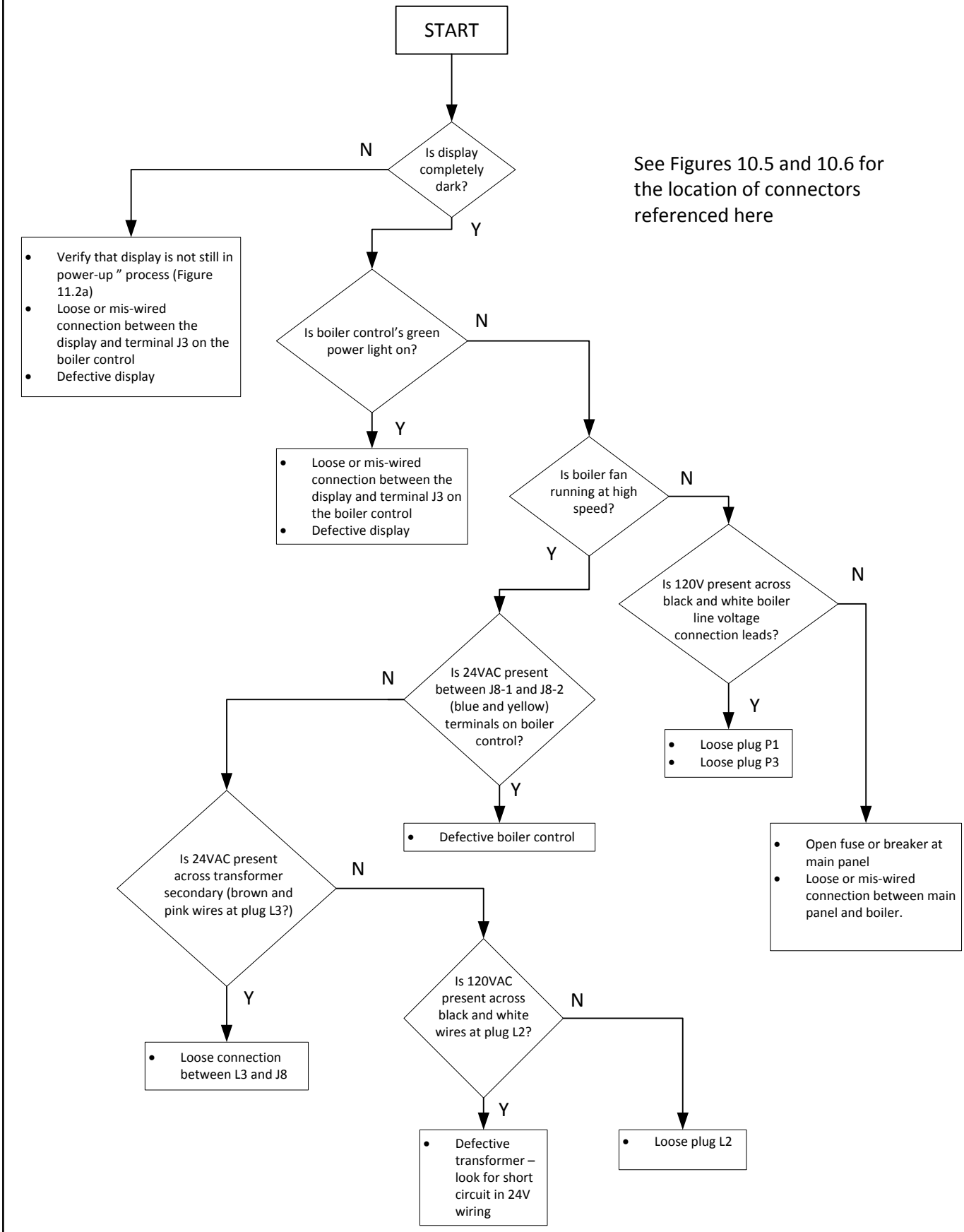

FIGURE 14.5: TROUBLESHOOTING BLANK DISPLAY

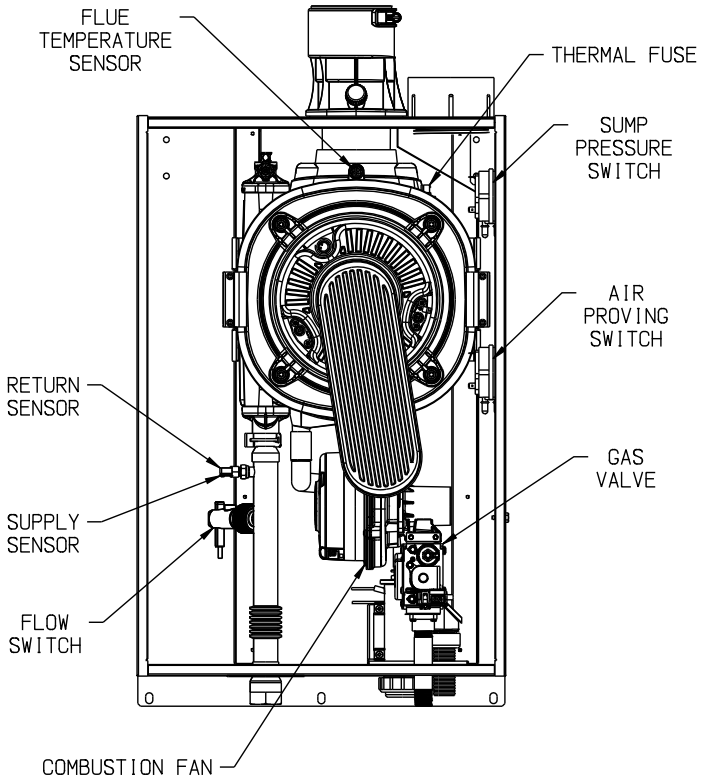

FIGURE 14.6: CONTROLS LOCATION

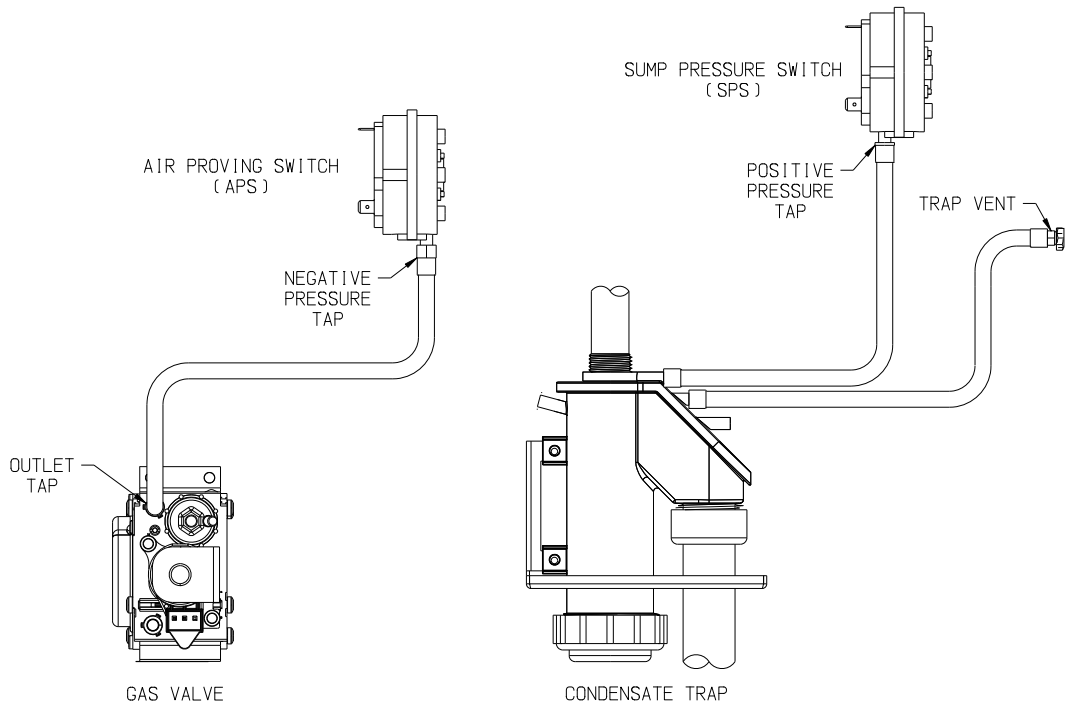

FIGURE 14.7: PRESSURE SWITCH TUBING CONNECTIONS

Table 14.8a: Supply, Return and Flue Temperature Sensor Temperature versus Resistance

Temperature		Ohms of Resistance
°F	°C	
32	0	32624
50	10	19897
68	20	12493
77	25	10000
86	30	8056
104	40	5324
122	50	3599
140	60	2483
158	70	1748
176	80	1252
194	90	912
212	100	674
230	110	506
248	120	384

Table 14.8b: Outdoor Air Temperature Sensor Temperature versus Resistance

Outdoor Temperature		Ohms of Resistance
°F	°C	
-20	-28.9	106926
-10	-23.3	80485
0	-17.8	61246
10	-12.2	47092
20	-6.7	36519
30	-1.1	28558
40	4.4	22537
50	10.0	17926
60	15.6	14356
70	21.1	11578
76	24.4	10210
78	25.6	9795
80	26.7	9398
90	32.2	7672
100	37.8	6301
110	43.3	5203
120	48.9	4317