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 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 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 Diagnostics Menu

The plain text display provided with this boiler provides an easy means of identifying most common problems. In the event that the control system detects a problem, such as an open limit or defective sensor, the Active Fault button shown in Figure 14.0 will appear and flash on both the Home Screen and the Burner Status Screen. Touching either Active Fault button will take the user to the Diagnostics Menu. From here, press the flashing button on each successive screen to reach a list of possible causes. In the case of a defective temperature sensor, a defect indicator will also show up on the status screens where the corresponding temperature is normally displayed. See Figure 14.0 for an example of this.

The complete Diagnostics Menu is shown in Figure 12.7. The screens on this menu provide the following information:

1) **For Service Contact** - Displays the service contact information entered in Section XII, Step D.

2) **About** - Displays the software versions for both the boiler control (R7910B) and the display

3) **Fault Menu** - Provides status of different types of faults by category. When a particular fault exists, the button for that category of faults will flash (see Figure 14.0 for an example of a faulty supply sensor). In the example shown in Figure 14.0, both the Sensor and Soft Lockout buttons flash on the Fault Menu because a defective supply sensor also causes a soft lockout. Fault categories include:

a) **Soft Lockout** - A soft lockout prevents the boiler from firing until the problem has been corrected and, in some cases, a specified amount of time (up to 1 hour, depending on the nature of the fault) has passed. An example of the Fault Menu structure during a soft lockout is shown in Figure 14.0

b) **Hard Lockout** - A hard lockout prevents the boiler from firing until the problem has been corrected AND the boiler has been manually reset. This can either be done at the boiler control itself or on the hard lockout screen. An example of the Fault Menu structure during a hard lockout is shown in Figure 14.2

c) **Sensors** - The Sensor Screens show the status of all sensors. Possible states of the sensors include:

- **None** - The boiler control (R7910B) is not looking for an input from this sensor
- **Normal** - The sensor is working normally
- **Shorted** - There is a short between the boiler control (R7910B) and the sensor or the sensor is defective
- **Open** - There is a break in the wiring between the boiler control (R7910B) and the sensor or the sensor is defective
- **Out of Range** - The sensor is defective or is being subjected to electrical noise.
- **Unreliable** - The sensor is defective or is being subjected to electrical noise.

d) **Limit Status** - The Limit Status Screen shows the status of all safety limits. Each of these limits is either shown as being ON or OFF. It is important to remember that since all of limits are wired in series, any limit which is in the OFF state will cause all limits "downstream" of it to also appear on this screen as being OFF, regardless of whether or not they actually are. The limits are wired in the following order (also see Figure 10.5):

1. External Limits, including LWCO if used.
2. Air Proving Switch (APS)
3. Sump Pressure Switch
4. Flow Switch

Therefore, in the example shown in Figure 14.1, the Auxiliary limit is known to be closed, the LWCO is known to be open, and the High Limit and Air Pressure switches could be either open or closed.

B. Troubleshooting when the Display is Blank

Use the flow chart in Figure 14.3 to locate the problem when the display is blank or is not readable.

C. Operation and Troubleshooting of Boiler Controls Other than the Sola

For the location of the controls described below, see Figure 14.4.

Fuses – This boiler is equipped with two 5 x 20mm fuses:

- **Pump Fuse** – This fuse protects the relay contacts in the boiler control from excessive current draw caused by an oversized or seized pump. The fuse supplied with the boiler is a 6.3A, slow blow type. A replacement fuse is supplied with the boiler. If this fuse blows, look for a seized pump, a short circuit in the pump wiring, or an oversized DHW or system pump. When a Taco 0013 is supplied for the boiler pump, the total draw of the DHW and system pumps cannot exceed 4.3A.

- **24V Fuse** – This fuse protects the transformer from excessive draw and is a 1.6A slow blow type. If this fuse blows, look for a short circuit in the 24V wiring before replacing. A short circuit to ground in field wiring (such as a thermostat wire touching a pipe) will cause this fuse to blow. A replacement fuse is supplied with the boiler

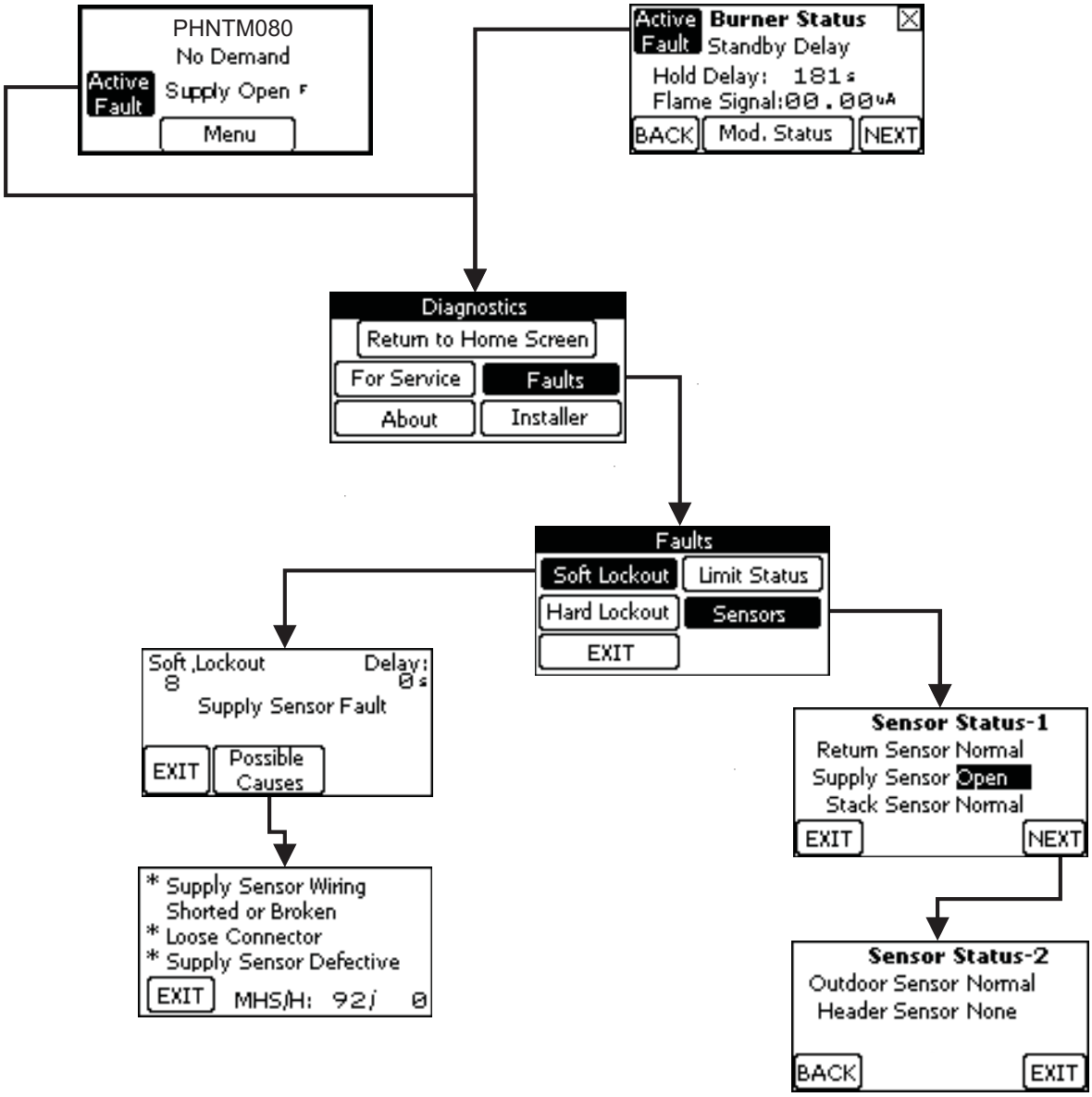

FIGURE 14.0: EXAMPLE OF DIAGNOSTIC MENU DURING SOFT LOCKOUT

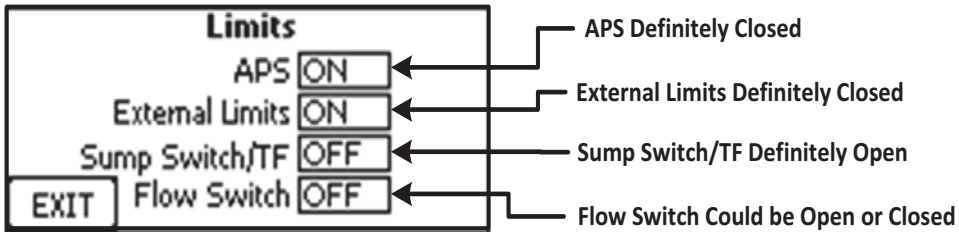

FIGURE 14.1: READING LIMIT STATUS SCREEN

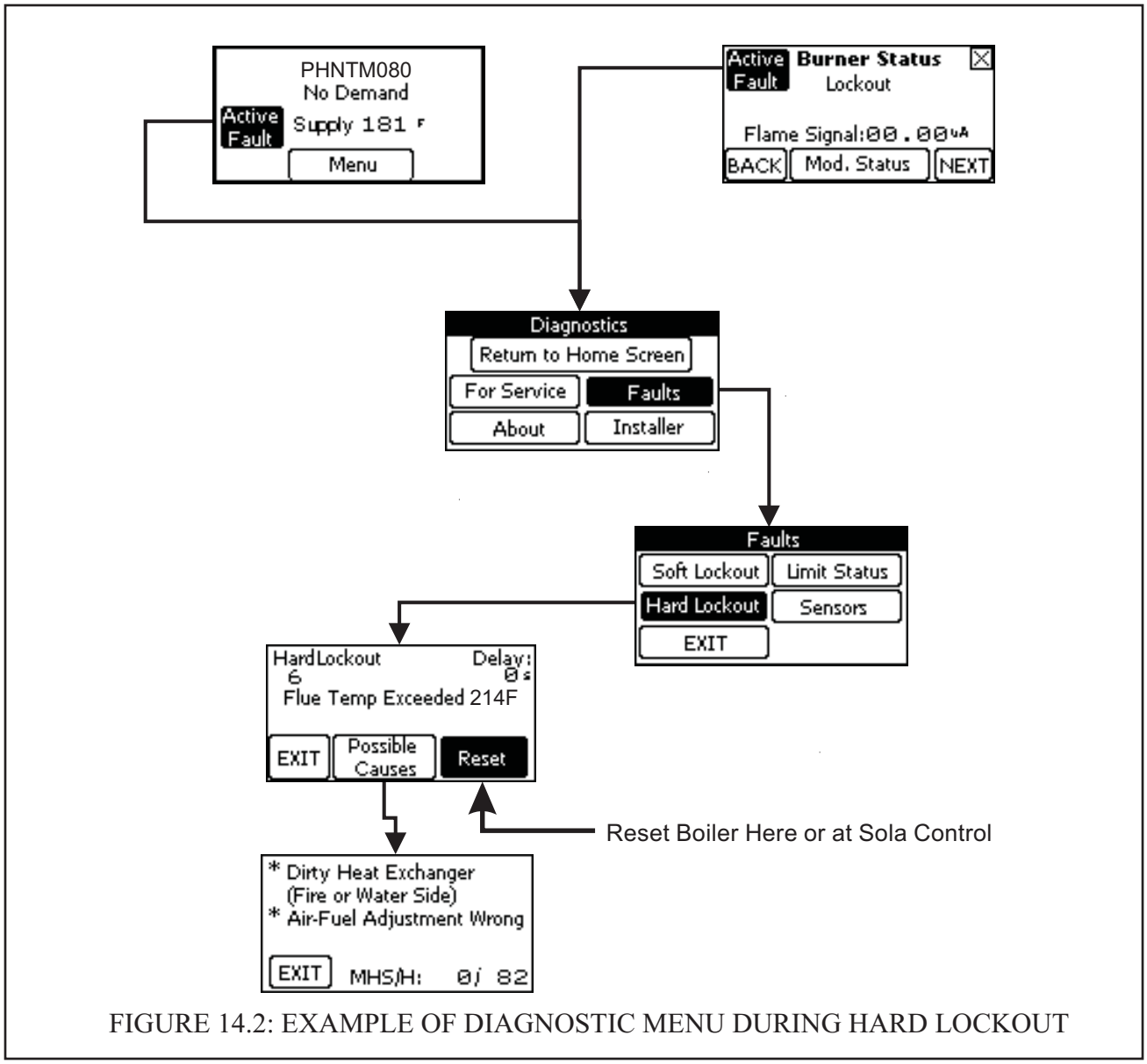

FIGURE 14.2: EXAMPLE OF DIAGNOSTIC MENU DURING HARD LOCKOUT

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. .

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 14.5. 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.

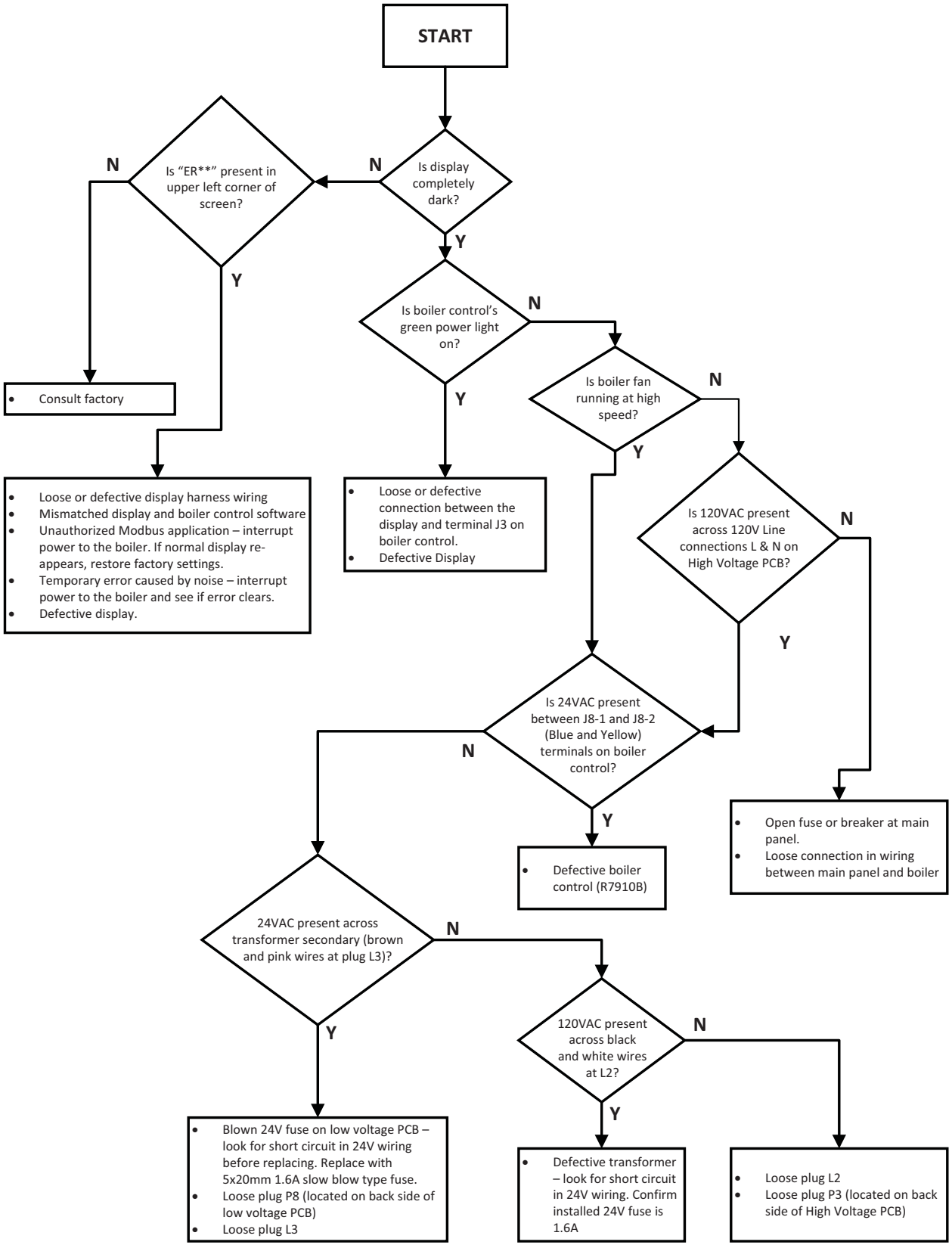

FIGURE 14.3: TROUBLESHOOTING BLANK OR UNREADABLE SCREEN

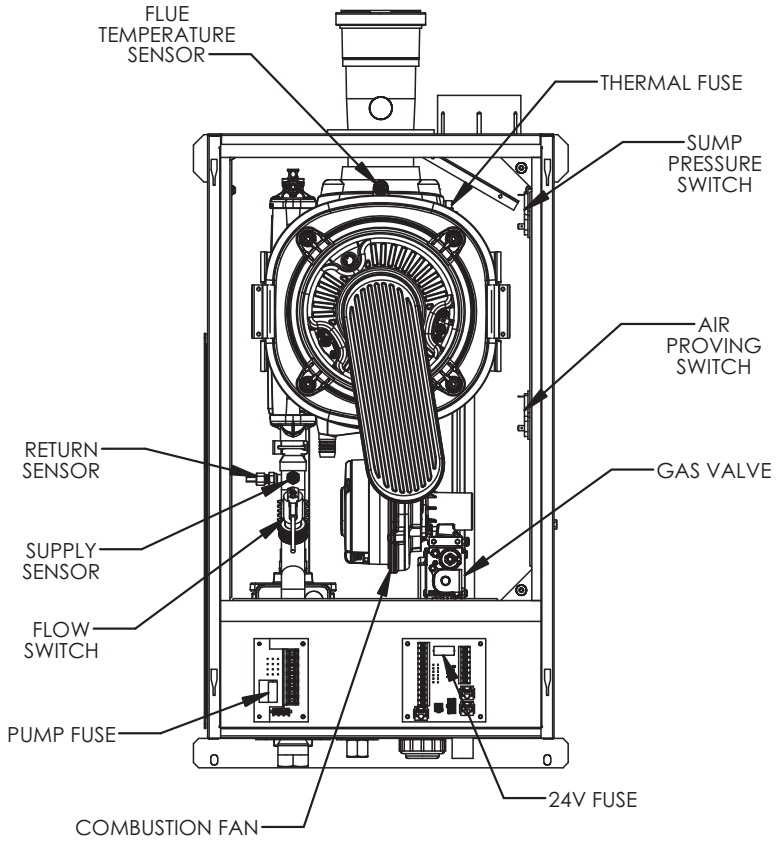

FIGURE 14.4: CONTROLS LOCATION

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 14.5. During pre-purge, when the gas valve is closed, the IAS 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 one hour, 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 soft lockout 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

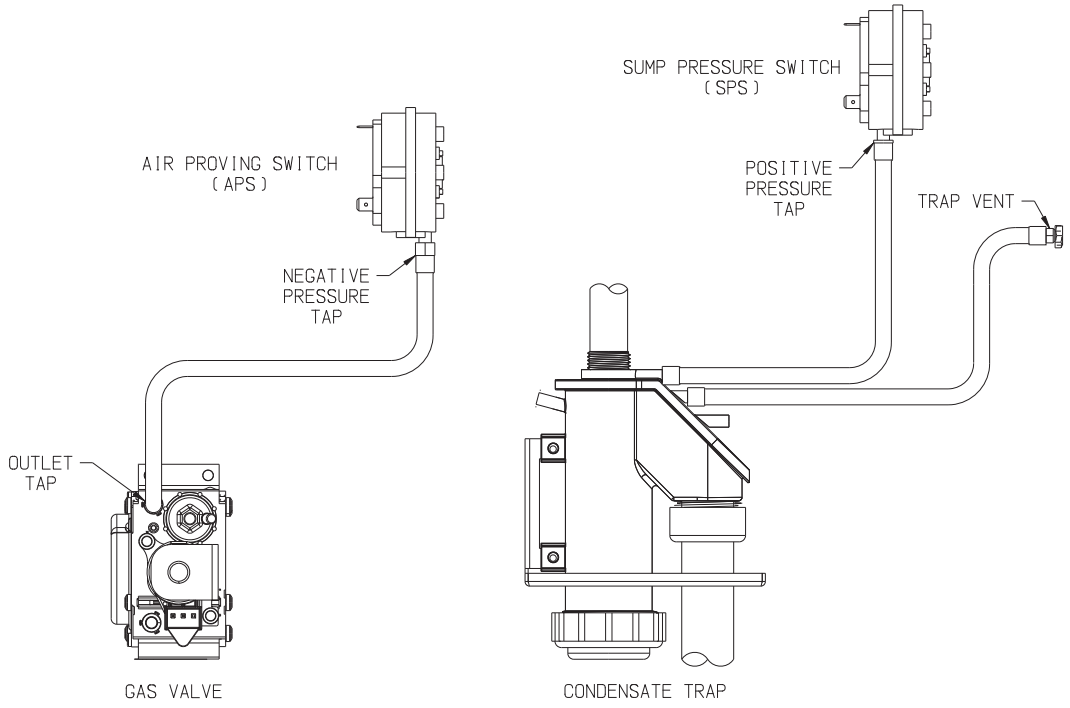

FIGURE 14.5: PRESSURE SWITCH TUBING CONNECTIONS

- Seized or disconnected boiler pump
- Blown Pump Fuse

Supply Sensor – The boiler control infers the supply temperature based on the resistance measured at the supply sensor. Table 14.6a 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 14.6a 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 14.6a 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 14.6b shows this resistance as a function of temperature.

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 soft lockout. See Figures 7.35 or 13.3 for trap location.

Table 14.6a: 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 14.6b: 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

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
- Blown 24V fuse.
- Loose J2 Plug
- Loose P8 plug (P8 is on back side of low voltage PCB)
- Loose L2 or L3 Plug

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.