

Sequence of Operation

Troubleshooting high-efficiency gas water heaters requires an understanding of the Sequence of Operation.

CENTRAL CONTROL BOARD (CCB)



Central Control Board (CCB)

The Sequence of Operation is controlled by a computer called the CCB. This board looks at two temperature probes to determine the temperature of the water in the tank and compares that to two settings on the display: the Set Point and the Differential.

• Set Point

The Set Point is the desired water temperature. Once the Set Point is reached, the heating cycle is terminated.

• Differential

The Differential is the number of degrees the tank temperature is allowed to drop before initiating a “call for heat” and starting a heating cycle.

Example:

If the Set Point is 140°F and the Differential is 8°F, the CCB will start a heating cycle when the tank temperature reaches 132°F (140° - 8°) and will end the heating cycle when the tank reaches the Set Point of 140°F. The factory preset differential is 8°F. If the Differential is set to a very low number (such as 2°), the water heater will cycle much more frequently than if the Differential is set to 8° or 10°. Short cycling caused by the Differential being set too low can cause frequent igniter replacement. The display can show you how many cycles the water heater has operated since installation. You can also use the display to adjust the Differential. Set the Differential to the highest number the customer can accept (usually 8° to 10°) for the lowest operating cost. The maximum differential setting allowed is 20° F.

• Call for Heat

When the tank temperature drops by the amount of the Differential, the CCB will initiate a call for heat. Before beginning the heating cycle, the CCB first looks at the position of several pressure switches.

PRESSURE SWITCHES



Low Gas Pressure Switch

Pressure Switches have a plastic diaphragm that opens or closes an electrical switch, depending on the pressure of the air or gas and depending on whether the switch is normally open or normally closed and also whether the switch responds to positive pressure or negative pressure (vacuum). Pressure switches are activated by either a positive pressure or a negative pressure (vacuum) depending on the type of switch. The activation pressures are typically small (measured in inches water column). Pressure switches are designed to operate at a very specific pressure and must be replaced with the exact replacement part recommended by the manufacturer. Never substitute a “similar” pressure switch. Always use



Pressure Switch

the exact replacement part listed in the Owner’s Manual or Service Handbook.

• Normally Open

In a Normally Open pressure switch, the electrical contacts are separated and there is no electrical continuity until the activation pressure (positive or negative) is reached. At that point, the contacts close.

• Normally Closed

In a Normally Closed pressure switch, the electrical contacts are touching and there is electrical continuity until the activation pressure (positive or negative) is reached then, the switch opens.

• Positive Pressure

Some pressure switches change state (open to closed or closed to open) when the positive air (or gas) pressure reaches a specific point.

• Negative Pressure

Other pressure switches change state (open to closed or closed to open) when the negative air pressure (vacuum) reaches a specific point.

• Testing Pressure Switches

There are several ways you can determine if a pressure switch is open or closed. The display screen “Heater Status” lists all the pressure switches and shows their current state. You can also use a meter set to Continuity to determine if a pressure switch is open or closed. Your meter will beep if the pressure switch is closed and will not beep when the pressure switch is open.

You can also determine what pressure the pressure switch is seeing by using a manometer (with a plastic tee and a plastic tube). Determine what the correct activation pressure is supposed to be (from the Service Manual). If the pressure switch receives the correct pressure input but does not change state, replace the switch. If the pressure switch does not receive the correct pressure, check the sample tube and sample port for a blockage.

• Low Gas Pressure Switch

The first thing the CCB will check is the Low Gas Pressure Switch. This pressure switch is a Normally Open switch that will CLOSE when the minimum gas pressure is supplied to the unit. The required gas pressure is listed on the unit’s data plate. This switch must be closed during operation. If the gas pressure drops below the minimum at any point in the operating cycle, a “Low Gas Pressure” error message will be displayed. If the actual gas pressure is correct, replace the Low Gas Pressure Switch. Otherwise, determine why the gas pressure is too low.

Note: The Blocked Inlet and Blocked Exhaust Switches will cause a hard lockout when the activation pressure is reached. A manual restart is required to start the heater.

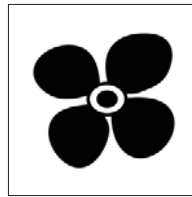
• Blocked Inlet Pressure Switch

The Blocked Inlet Pressure Switch is a Normally Closed switch that OPENS if the negative pressure (vacuum) in the inlet pipe is too high.

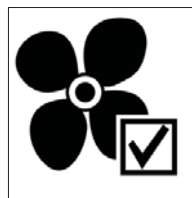
• Blocked Exhaust Pressure Switch

The Blocked Exhaust Pressure Switch is a Normally Closed switch that OPENS if the positive pressure in the exhaust pipe is too high.

Note: The Low Gas Pressure Switch, the Blocked Inlet and Blocked Exhaust Pressure Switches must be CLOSED before a heating cycle can begin. Typically, the Low Gas Pressure Switch is closed as soon as gas is supplied to the unit and all three pressure switches usually stay closed the life of the unit.



Blower should be running



Checkmark proves blower is operating



Checkmark means Hot Surface Igniter is good and is getting hot



Gas Valve icon indicating Gas Valve should be on

• Blower Prover Pressure Switch

The Blower Prover Pressure Switch is different from the other pressure switches. The Blower Prover Pressure Switch is a Normally Open pressure switch that CLOSES when the pressure switch senses an increase in air pressure from the blower housing. The Blower Prover Pressure Switch must be OPEN at the beginning of a heating cycle (or you will get a Blower Prover Failure error message). A Blower Prover Failure almost always means the pressure switch has failed in the closed position. Next, the blower is powered up you will see the fan symbol. At this point in the Operating Sequence, the Blower Prover should CLOSE. If it stays open, you will get a “Blower Prover Open” error message. This error can also mean the switch has failed, but also check the sample tube and sample port for any blockage and also check the blower for operation.

If the Blower Prover Pressure Switch is open at the beginning of the heating cycle and closes when the blower is powered, you will see the Blower Prover Check Box next to the fan symbol. You have “proved” the blower is operating.

If the Blocked Inlet and Blocked Exhaust Pressure Switches stay closed, you don’t have a blocked inlet or blocked exhaust, so the next step is to power the Igniter.

HOT SURFACE IGNITER

The lightning bolt symbol means the igniter is being powered. A current sensor in the CCB will read the actual amp draw through the igniter. If the igniter is good and the amp draw is about 2 amps or higher, you will see the Igniter Check Box meaning the igniter is getting hot. If the current is too low (or zero), you will get a “Low Igniter Current” error message.

In most cases, this means the igniter has failed and should be replaced. The normal igniter current (amp draw) on a new igniter is between 3 and 4 amps.

GAS VALVE

With the blower running and the hot surface igniter hot, the next step is to open the Gas Valve. You will see an animated gas valve symbol turn from Off to On. At this point, the gas valve should open and supply gas to the burner.

