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FLAME RECTIFICATION

DIRECT BURNER IGNITION

Direct ignition systems are much safer than standing pilot systems due to their quick reaction time. They react to the presence or absence of flame in less than 1 second. According to Honeywell, thermocouples can take up to 3 minutes to react the flame outage.

Most spark or hot surface direct ignition controls utilize a process called flame rectification to insure that the gas exiting the burners is lit. This is accomplished in a very short time. If combustion is not sensed in the lockout time, normally less than 7 seconds, the gas flow from the gas valve is interrupted. At this time the control locks out the ignition sequence, or retries an ignition sequence if the retry function Is built into the ignition controller.

Flame rectification is a simple process but is not understood by many technicians. In a word, it is the process of using flame to rectify (change) current flow.

FLAME RECTIFICATION

Flame can be used as an electrical conductor **from** a flame sensor **to** ground. A piece of rust can also be a conductor, however, the system does not simply use the conductive properties of the flame to detect proper combustion of the gas. The characteristics of the flame are also used to change what would normally be an A.C. (alternating current) to a D.C. (direct current) flow. The direct ignition control system is designed to accept only a D.C. current flow from the sensor, through the flame, back to the ignition control through ground. If the control senses A.C. current flow the process is stopped and the control locks out.

A difference in surface area between the sensor electrode and the ground electrode (see *figure 1*) is necessary to change what would normally be an A.C. current flow into D.C. If the surface areas were equal, a flame would cause A.C. current to flow from the sensor to ground.

The ground electrode is normally the burner surface. Lifting flames due to high gas pressure or excessive air will cause the system to lose the path for electron flow and the system will lock out. The sensor is approximately 1/4 the surface area of the burner. Dirt or corrosion on the sensor or burner can also cause insufficient current flow and cause the system to lockout. Regular cleaning of the sensor and burner is required for reliable operation.

This flame rectification circuit current flow is measured in microamperes D.C. (µA DC). One µA is equal to 1 millionth (1/1,000,000) of an ampere: a small current flow indeed.

Flame signals normally range from 0.1 microamperes to over 10 microamperes. Consult individual manufacturers for the flame signal minimum for a specific control you are testing.

TESTING FLAME SIGNAL

To measure current in the flame sensing circuit place your DC µA meter in series with the flame rod. Your meter should be capable of measuring .1 to 10.0 µA DC and have a resolution of .1 micro amps (some older systems may require more than 10 µA).

Before you connect any meter to the flame sensing circuit you must determine if the system uses a separate flame sensing rod (called remote sensing) or uses the igniter as both the igniter and sensing rod (called local sensing). Typically the flame sensing rod is separate from the igniter, in which case it's easy to connect to the circuit. Some systems use a combination igniter / sensor. Do not hook your micro ammeter in this circuit since the ignition and sensing circuits are established using the same electrode. The current experienced on the ignition side of the sequence will likely overload your micro ammeter.

For the more common type of direct ignition systems, where the flame rod and igniter are separate, you simply hook your micro ammeter in series with the sensor wire.

When the flame is established, there should be a measurable µA DC signal which is at least the minimum specified by the manufacturer.

When systems use the igniter for sensing and ignition you need an adapter to measure the flame current. During the ignition part of the cycle the current flow and/or voltage can be too high for your micro ammeter. After the ignition cycle is finished, the igniter will perform the function of a flame sensing rod. One meter cannot measure high current and then a split second later measure very small currents. Robertshaw makes an adapter (model 900-041) which has a switch that is normally open and routes the flame sensing circuit through your multimeter when the pressed. This should be done only after the ignition cycle has been completed.

IMPORTANT

Test the lockout function on every service call by interrupting the gas flow during an normal sequence. Controls do malfunction and fail to lockout when flame has not been established. You will know this only if you test the flame failure function of these controls during each and every service call.

GROUND CRUTIAL

Since we are talking about extremely small current flows, the path from the sensor, through the flame, and back to ground on your ignition control must be very low resistance. With a clean sensor, sometimes an intermittent problem can be corrected by installing a ground wire directly from the burner to the ignition control.

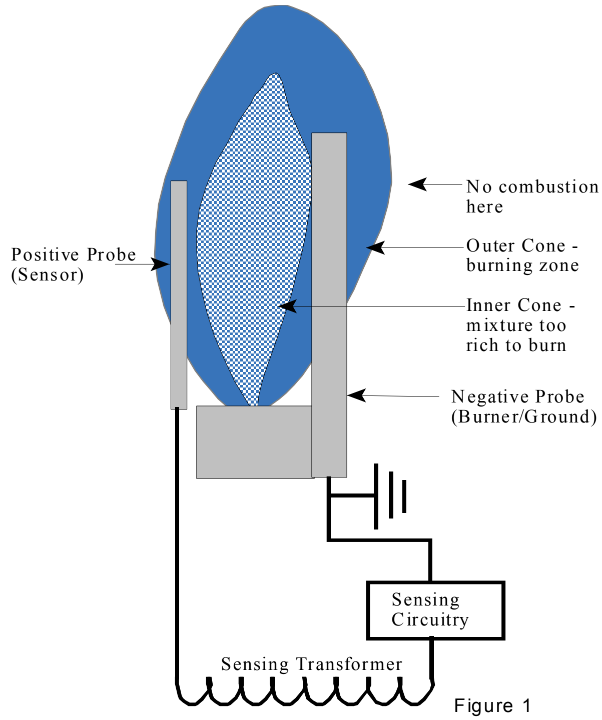

Figure 1

Our Hot Surface / Spark Ignitions Seminar covers this subject in detail.

Coming in the spring, service and installation tips for air conditioners and heat pumps.

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