

TECHNICALLY SPEAKING

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Systematic Approach to Flame Rectification

One of the more common problems that the technicians encounter during the heating season is a lack of flame sensing. Flame rectification has become the primary means of flame sensing in virtually all new residential and commercial gas fired HVAC equipment. The job of the flame sensing rod is to tell the controller that the main gas burners have ignited. If no flame is present after a certain amount of time, the controller will shut off the gas to the burners.

Here's how it works: The controller applies an AC voltage between the flame sensing rod and the base of the flame (ground). On Ruud furnaces this voltage is typically greater than 90 volts AC. When gas is properly burned the flame has electrical properties and becomes ionized. These ions in the flame provide a high resistance current path between the tip of the flame sensor and the burner ground. Because the surface of the base flame is larger than the sensing flame rod, more electrons flow in one direction than the other. This results in a very small DC current measured in microamps (1 millionth of an amp, symbol μ A). If there is a flame present, the DC current is detected by the controller, which tells the gas valve to remain open. If there is no current flow, the controller will close the gas valve and the system will purge any remaining gas before trying to re-ignite. If there are 4 flame failures in 1 heating cycle the unit will go into a soft lockout condition for 1 hour and the IFC will flash a fault code of 1.

It's very important that the flame sensing system works properly. Improper power polarity, transformer phasing, dirt, corrosion, reduced flame sensor voltage or bad connections in the flame sensing circuit can cause the controller not to sense flame and the unit to lock out.

Let's take a systematic approach to flame sensing problems by looking at the complete system. First, we must establish that the **power supply is correctly polarized**. With a voltmeter, test the incoming power supply and verify that 120 volts is present at the unit. Then test L1 to ground, you should read 120 volts. Next check common to ground, the volt meter must read 0 volts. If you read 120 volts between neutral and ground the polarity of the unit is incorrect. If you measure any other voltage between neutral and ground that indicates a bad ground.

Next, verify that the transformer is properly phased. To do this, measure the voltage of the transformer primary, Let's assume it is 120 volts. Next, measure the secondary voltage again assuming you measured 24 volts. (If your readings are not close to these you need to find out the reason). Now measure the voltage between L1 on the primary and the power output of the secondary (typically R). If you read 96 volts then the transformer is properly phased. If you read 144 volts then the transformer is not properly phased. Seeing that you have verified proper power polarity swap the 2 leads of the secondary.

Now we want to check flame sensor voltage. If the voltage is not within range there will not be enough electrical pressure to push the current through the flame. With your voltmeter, check the voltage between the sensor wire and the burner - it should be 90-107 volts AC. If the voltage is low at the sensor disconnect the molex plug from the circuit board and check the voltage at the corresponding pin on the board. If you have proper voltage from the board and not at the sensor then the wire is bad. If you do not have proper voltage at the board then the board is bad.

Once it has been verified that the incoming power is correctly polarized, the control power is in phase and the sensor voltage is acceptable, we must establish that the **furnace has been properly grounded**. **There must be a dedicated ground wire run from the power panel to the furnace**. Also a good system (chassis) ground is absolutely essential for any furnace that utilizes a flame rectification system. With flame rectification a small DC current is generated by the IFC through the burner flame to ground via the flame rod. That is why the burners must be properly grounded or the flame signal will not be detected. The following is a quick and simple test procedure to determine a proper ground. Set the ohmmeter to the lowest setting and then test from the burners to the common on the IFC. The reading should be 0 ohms, however 1 to 2 ohms is acceptable. Next, test from the IFC common to ground - once again it should read no more than 1 to 2 ohms resistance. The last test is from the furnace ground to a cold water pipe and the reading must be no more than 1 to 2 ohms. On Ruud Furnaces If the resistance readings check out ok, then pull apart the molex connectors in the furnace cabinet to ensure that they are dry and clean. Moisture within the connectors may cause a flame sense failure.

Finally, it's time to check for the proper micro amp signal using a meter. The meter must be capable of measuring 1 to 10 microamps DC and have a resolution of .1 microamps. The microamp meter is wired in series with the flame sensor and is left in the system during operation of the burner. If the sensing circuit is working properly, it's not uncommon to read a signal between 0.5 and 7.0 microamps (but typically around 3.5 microamps), but you may experience, no signal or 0 microamps, a low reading of less than 0.5, or a fluctuating reading that won't stabilize. Here are some possible causes for each type of reading:



0 microamps: Look for an open or grounded sensor wire or flame rod, or a defective module. The wire and rod can be diagnosed with an ohmmeter. Check the flame sensor. Make your diagnosis of a defective module after all other possibilities have been checked.

0.5 microamps or more, with a steady reading: With this reading and no 24 VAC to the main gas valve, the module is defective.

Fluctuating reading: Check for a steady pilot flame. Drafts from air leaks can blow the flame away from the flame rod. A dirty orifice can also cause an unstable flame. Check the flame sensor.

Less than 0.5microamps: Look for a too-small pilot flame that's not properly engulfing the rod or pilot hood. Also check the ground connection back to the module. Make sure the flame sensor is clean.

Always condemn the module last. Beware of the impulse to change out the module. Make sure that you have checked all of the possible reasons listed above for lack of flame sensing. Many ignition modules that are replaced as defective are actually good. Taking a systematic approach to troubleshooting flame sensing problem will help eliminate misdiagnosis and costly mistakes.

* For additional support contact Meier Supply at any of our locations *

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