777 Education and Consulting, Inc. **January 2006 – Newsletter**

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Oil Burner Flame Detection

For safe operation, all oil burners require a flame detection system. If the flame is not proven to be lit shortly after a call for heat, the control system must stop the flow of oil into the combustion chamber. Failure to detect the flame, and stop the burner if it's presence is not sensed in a short time, could result in oil continuing to be pumped into the combustion chamber until the oil tank is empty. Lockout time is normally 15 - 60 seconds depending on control design. At the end of the lockout time, if flame is still not sensed, power to the burner motor will be interrupted. Since the burner motor also drives the oil pump, oil flow will stop as well.

The control which contains this flame supervising function is called a primary control. There are two types of primary controls: stack-mounted primary (thermal detection system), and cadcell primary (visual detection system).

THERMAL DETECTION

Thermal detection systems were the first to employ a bi-metal heat sensing element. This element is inserted into the combustion side of the furnace or boiler, usually the vent pipe or the top of the heat exchanger. This element is in direct contact with the products of combustion. A call for heat energizes the stack-mounted primary control and it starts the burner motor and ignition transformer. When the burner motor is energized it begins to drive the combustion air fan and oil pump. If flame is not sensed within the proper time the primary control will go into "lockout" which de-energizes the burner motor and stops the oil flow.

Lockout can occur due to a faulty ignition transformer, cracked ignitors, defective oil pump, broken pump coupler, defective burner motor, loss of oil supply, dirty bi-metal, excessive combustion air, plugged oil nozzle, faulty primary control, etc.

VISUAL DETECTION

The second method of detection is a more recent innovation - visual detection. As the name implies, the visual detection system actually "sees" the flame. Since this method does not rely on the heat of the flue products, it can be set to respond much more rapidly to a flame or no flame condition. Therefore, the lockout period is usually much shorter than the that of a thermal detection system.

The sensing device is a **cadmium sulfide detector**, or, cadcell for short. It connects to the primary control with 2 wires, often yellow in color, connected to the two "F" terminals.

When the cadcell sees light the resistance across the yellow wires decreases. Less light on the cadcell lens causes higher resistance. Therefore, a service technician requires an ohmmeter to test the performance of a cadcell.

Troubleshooting A Cadcell

1. Shut off the power.
2. Disconnect the cadcell wires from the primary control.
3. Connect your ohmmeter to the cadcell wires. Use a low resistance scale.
4. Start the burner. It should operate with the cadcell disconnected for safety timing period of the control. Measure the resistance while the burner is still operating. Resistance should be **less than 1,500** ohms for nearly all controls, however, see manufacturer's specifications for your control. If your resistance is greater than 1,500 ohms one or more of following may be the cause.

   - Dirty cadcell lens (can't see the flame)
   - Improper view of the flame
   - Defective cell or cell wires
   - Dirty or off center flame
   - No flame

If not corrected, high resistance will cause the control to go into lockout causing a no heat complaint.

5. To test the lockout function of the control, allow it to run with the cadcell wires disconnected. It should lockout in the safety timing shown on the control. If it doe not, replace the primary control. It is important to test the lockout function of any type of primary control on each and every service call.

6. You should also check the "dark" cadcell resistance. With the burner off and your ohmmeter still connected to the yellow wires, measure the dark cadcell resistance. It should be **greater than 100,000** ohms. Remember to switch your ohmmeter to a sufficiently high scale to read this high resistance. If your resistance is less than 100,000 ohms either the cell is seeing excessive light during an off cycle, or the cadcell or cell wires are shorted. The primary control cannot start the burner if the cadcell sees light upon a call for heat. This is a flame simulating condition which would be unsafe if the primary control was not designed to remain off in this circumstance.

Coming

For February 2006 we will discuss the concept of flame rectification and how to test the flame signal with a microammeter (μA).

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