Flame Supervision Systems

5 COMMON COMBUSTION SAFEGUARD MISTAKES

By Steve Ogonek

Flame supervision, used in systems as diverse as industrial process ovens, bakery ovens, asphalt heaters, hot water heaters and more, is an important part of the safe operation of any combustion system.

The 2003 edition of the National Fire Protection Standard 86 for ovens and furnaces equates the terms "flame supervision" with "combustion safeguard." They are defined in paragraph 3.3.10 as:

> *A safety control directly responsive to flame properties; it senses the presence or absence of flame and de-energizes the fuel safety valve in the event of flame failure within 4 seconds of the loss of flame signal.*

The use of combustion safeguards is mandated by Section 7.9.1, which states that "each burner flame shall be supervised by a combustion safeguard that has a maximum flame failure response time of 4 seconds or less, that performs a safe-start check, and that is interlocked into the combustion safety circuitry." This means that each burner on an oven must have a combustion safeguard.

Most combustion safeguards are composed of a sensor, an amplifier and a control circuit. The most common sensor types are ultraviolet, flame-rod and infrared. While often handled by an equipment supplier, sensor selection and the correct application of flame supervision to a combustion safety system is ultimately the responsibility of the oven owner and operator.

Placing responsibility with the owner and operator makes sense when you think of it this way: Who has the most to lose when operating a combustion system? NFPA 86 does require the use of approved devices, so look for flame safeguards that have been tested and approved by a reputable testing agency.

In operation, a combustion safeguard is only effective when selected, installed and maintained correctly.

Not using a combustion safeguard remains the No. 1 failure in meeting code compliance for flame supervision. But there are other serious mistakes and omissions. If you are the person responsible for ensuring the integrity of the combustion safeguards on your oven, or if you have a vested interest in ensuring such integrity because you work with or near the oven, here are five common combustion safeguard mistakes. As with all combustion equipment, it is wise to consult with a combustion expert if you have questions or problems.

1. Electrically Defeating the Combustion Safeguard (Jumping It Out)

Whether the combustion safeguard relay is bypassed for maintenance purposes or, even worse, to eliminate the nuisance of a system shutdown, this remains one of the biggest problems with combustion system safety. Defeating the safeguard means there will be a continuous signal to

Selecting the Flame-monitoring Sensor

Sensor type	Operating Principle	Pluses	Challenges
Ionization/Rectification (Flame Rod)	Conductive flame envelope	Inexpensive Fail safe	Can droop in some burner installations. Works only for gaseous fuels.
Ultraviolet (UV)	UV light wave emissions of flame	Very sensitive Medium cost	Can fail in the "on" state. Ignition spart emits UV radiation. Water vapor absorbs UV
Infrared (IR)	Infrared light wave emissions of flame	Inexpensive Fail safe	Can sense glowing refractory.

the control system that everything is okay, which allows your gas safety-shutoff valves to remain open even if there are serious problems in maintaining good combustion. If the jumpers are in place to prevent nuisance shutdowns, you must solve the underlying combustion problem. Do not bypass the very safety device that is telling you that you have a problem. Employee training and strictly enforced procedures are two solutions.

2. Using Multiple Sensors to Allow One Combustion Safeguard to Monitor Multiple Flame Signals

Using multiple sensors and associated relay circuitry to allow one combustion safeguard to monitor multiple flame signals is a more subtle version of jumping it out. This problem usually is seen on piloted burners where one sensor cannot see both the main and pilot flames from a single mounting location. You may think everything is working fine until you realize that the associated relay circuitry is defeating the safe-start check for the main flame sensor by switching that sensor off during the ignition sequence of the burner. This prevents the combustion safeguard from detecting a failed sensor. Don't forget that some sensors can fail in the "on" position. Replace these dangerous circuits with a combustion safeguard specifically designed to monitor two flame sensors, or use two separate combustion safeguard devices.

3. Mechanically Defeating the Combustion Safeguard

This one is always difficult to believe. However, you still can find operations that use a mechanical device to provide a permanent reset to the combustion safeguard. I have seen this done with a nail used to wedge a reset switch permanently "on," and I have even seen a welding rod bent and positioned so that it permanently holds in the reset switch. More sophisticated combustion safeguards prevent this dangerous game by monitoring reset switches to ensure they are not permanently engaged (and signaling an alarm condition if they are).

4. Improperly Mounting The Flame Sensor

Improperly mounting the flame sensor is yet another way some operators circumvent safety controls. A flame sensor must be mounted to sense only the flame it is intended to monitor. Failure of the sensor to detect the flame is frustrating (because you get continual nuisance shutdowns of the combustion system), but at least it is a safe condition since it causes the safety-shutoff valves to close. A sensor that detects the wrong flame (such as the flame of another burner in the oven) or otherwise falsely indicates flame when a flame does not exist is truly dangerous.

For either condition, the sensors must be repositioned to detect only the flames they are intended to monitor. This is true for both line-of-sight sensors, which detect ultraviolet and infrared emissions, and flame-rod sensors, which detect flame using the electrical conduction properties of a flame envelope. If this cannot be done, there is a chance your system is using the wrong sensor.

5. Selecting the Wrong Sensor Has Consequences

The sensor should be related to the burner design, oven or furnace design and the user's overall process (roughly in that order). Burners that do not retain flame near the base of the burner (i.e., the flame "walks" off the base of the burner) will not work well with flame rods. Processes that produce excessive moisture may not work well with ultraviolet because water vapor absorbs ultraviolet emissions. Infrared sensors are subject to "wash-out" in the presence of high background flame and may sense glowing oven surfaces as flame. While a combustion specialist can certainly help in determining the best sensor for your application, testing the combustion safeguard is the best way to ensure that you have selected the most appropriate sensor.

Peace of mind knowing that your personnel, your operation and your business are safer is well worth the small investment needed to meet code and is far less expensive than dealing with the consequences of an oven filled with gas and air that finds a source of ignition.

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