

INSPECTION & TESTING OF COMBUSTION SAFEGUARDS FOR FUEL-FIRED EQUIPMENT

ALLIANZ RISK CONSULTING



This Tech Talk discusses the potential fire and explosion hazards of fuel fired equipment and Allianz Risk Consulting (ARC) recommendations.

INTRODUCTION

Explosion and fire are inherent hazards associated with fuel-fired equipment such as boilers, ovens, dryers, and furnaces. A critical time is during startup or shutdown when the equipment is in transition.

A fuel explosion occurs when an accumulated combustible mixture is ignited within a confined space, such as an oven or furnace enclosure. Fires occur when combustible products or the accumulation of combustible residue are ignited, such as inside ovens and exhaust ducts.

All fuel-fired equipment must be equipped with a combustion safeguard system to reduce the potential for explosion or fire, which could lead to property damage and loss of production. Safety controls must be in good working order, properly set, maintained, and tested to assure reliable operation.

There are many basic safety devices and interlocks, depending on the complexity of the fuel-fired equipment and often includes:

- Main burner fuel safety shutoff valves (SSOVs)
- Flame safeguard system (scanner or flamerod)
- Main flame and pilot flame establishing period
- Fuel oil pressure and atomizing air pressure interlocks
- Combustion airflow interlocks
- Pre- and post-firing purge cycle (time and airflow volume)
- Low fire start interlocks
- Low water level (steam boilers)
- High or low gas pressure interlocks
- High temperature interlocks

Not every device listed above is provided or necessary depending upon the specific equipment. Many processes have multiple burners or other unique process features which may warrant additional safeguards.

ARC RECOMMENDATIONS

While not all inclusive, the following basic combustion safeguard loss prevention recommendations can greatly reduce the potential for explosions and fires caused by fuel-fired equipment:

1. Install, operate, inspect, test and maintain combustion safeguards in accordance with the following:
 - a. Applicable local and national recognized codes and standards, such as National Fire Protection Association (NFPA) 85, *Boiler and Combustion Systems Hazards Code*, and NFPA 86, *Standard for Ovens and Furnaces*.
 - b. Equipment manufacturer's recommendations.
2. Combustion safeguard inspection, testing and maintenance should be performed by well trained personnel who are familiar with the equipment, in accordance with detailed written procedures.
3. Review and update operator training at least annually on safe startup, shutdown and lockout procedures.
4. Safety devices should never be bypassed electrically or mechanically due to nuisance shutdowns.
5. Fuel-fired equipment should not be allowed to operate until all defective combustion safeguards are repaired, retested and confirmed fully operational.

6. All test results should be documented and retained for review by Allianz Risk Consulting. Any deficiencies should be promptly corrected.

VISUAL INSPECTIONS

7. The following list includes common operational visual inspections which should be completed by trained operators and/or maintenance staff at least once each operating shift to confirm the equipment is in good operating condition:
 - a. Burners, air-fuel ratios, and combustion characteristics
 - b. Flame safeguard systems for proper operation
 - c. Operating temperatures and high/low set points
 - d. Combustion airflow and air blower filters
 - e. Blowers, fans, belts, etc. for unusual bearing noise and shaft vibration
 - f. Position of valves, dampers, actuators, etc., for free actuation
 - g. Piping, valves, and other components for leaks, corrosion, etc.
 - h. Linkages and controller of fuel-air-ratio control dampers
 - i. All electrical components for loose connections, corrosion, arcing, etc.

SAFETY INTERLOCK INSPECTION, TESTING AND MAINTENANCE

8. Inspect, test and maintain commonly provided devices and safety interlocks as follows :

Device / Safeguard	Task	Frequency
Fuel piping, valves, control systems, fans, damper interlocks, safeguard controls, relays, wiring, electrical connections, etc. (check for leaks, corrosion, loose connections, etc.)	Inspect	Weekly
Preventive maintenance for blowers, fans, filters, belts, etc.	Maintenance	Weekly
Low water level cutoffs (steam boilers)	Test	Weekly
Ovens, dryers & ducts where combustible residues accumulate	Inspect / Clean	Weekly/Monthly ⁽¹⁾
Flame safeguard system (scanner or flame rod)	Test	Monthly
Inspect & clean all burners and pilot burners	Maintenance	Annually
Pressure & explosion relief devices	Inspect / Test	Annually
Main burner safety shutoff valves (leak tests)	Test ⁽²⁾	Annually
Main burner & pilot flame establishing periods	Test	Annually
High & low gas or fuel oil pressure interlocks (set points)	Test	Annually
Combustion airflow interlocks	Test	Annually
Pre- and post-purge (verify time and airflow volume)	Test	Annually
Low fire start interlocks	Test	Annually
High temperature interlocks (accuracy & set points)	Test	Annually

Notes:

1. The inspection / cleaning frequency should be at least weekly until sufficient experience is obtained to determine the necessary frequency to prevent the accumulation of combustible residue inside ovens and ducts from exceeding 1/8 inch (3 mm). No specific schedule can apply to all ovens as the rate at which deposits accumulates varies with each type of oven / process.
2. See ARC Tech Talk Volume 1 for details on leak testing of safety shutoff valves.

Local codes and standards may require additional inspection, testing and maintenance and/or increased frequencies, which would take precedence over the above table.

An inspection should be completed annually to verify that all designed safety interlocks are present, and have not been bypassed or rendered ineffective. Each safety interlock should be verified by manually failing the device in accordance with manufacturer's instructions.

Many processes have multiple burners or other unique process features which may warrant additional combustion safeguards and increased inspection and testing. Equipment manufacturer's recommendations should be followed.

REFERENCES

- NFPA 85, *Boiler and Combustion Systems Hazards Code*
- NFPA 86, *Standard for Ovens and Furnaces*

QUESTIONS OR COMMENTS?

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