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

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

**SAFETY INTERLOCK INSPECTION, TESTING AND MAINTENANCE**

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

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

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.

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.
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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Tech Talk is a technical document developed by ARC to assist our clients in property loss prevention. ARC has an extensive global network of more than 100 property risk engineers that offers tailor made, customer focused risk engineering solutions.