Ignition Sources:
Recognizing the Causes of Fire
In today’s highly competitive business environment of just-in-time production and tightly woven interdependencies, a fire at your facility could mean more than just damage to your property. It could affect your ability to resume normal business operations, causing an extended period of downtime. When a company can’t provide product, its customers go elsewhere, its brand evaporates, competitors move in and shareholder value tumbles.

At FM Global, we believe the foundation of any sound property protection program is understanding. To protect your facility from the hazards that threaten it, you first must understand those hazards and how they will affect continued business operations. To protect your facility from fire and explosion, you need to be able to recognize potential ignition sources and which could prove problematic.

An ignition source need only connect with combustible material in the presence of oxygen to quickly ignite a fire or explosion. With knowledge of what it takes to cause a fire at your facility, you can better prevent or control fire. You can take action to isolate ignition sources inherent to an operation, or prevent the introduction of others. And, you can educate and train employees to watch for specific hazards, perform safely and respond correctly to minimize danger if a fire does start.
Although ignition sources are as numerous and varied as the facilities in which they hide, they can be grouped into three categories. Essentially, the three types of ignition sources include those that are:
- inherent in processes or equipment
- caused by equipment failure, improper design or lack of needed protection systems
- introduced by human intervention or other occupancies

While your FM Global engineer can provide tailored recommendations to meet your specific business needs, this brochure will help you understand the different types of ignition sources that threaten productivity and the safeguards you can take to help ensure against a fire or explosion at your facility.

**Ignition Sources Inherent in Processes or Equipment**

When you think about the types of processes and machinery that are used in any given manufacturing facility, it’s not surprising that this category of ignition sources poses such a significant threat.

Many processes and types of equipment use open flames, produce hot surfaces or create arcs/sparks—all sources of ignition included among the 10 most costly listed below. While these ignition sources are inherent to the process or equipment and generally cannot be eliminated, there are steps you can take to safeguard your property from the likelihood of them causing a fire or explosion.

The most important step is isolating the ignition source from combustible or flammable material.

Of the 10 most costly ignition sources, those that are considered to be inherent in processes or equipment include:
- **Electricity**, or more specifically, the small arc that is created every time you turn on and off an electrical switch. If flammable gas is present, the switch becomes an ignition source.

### Top 10 Ignition Sources ( Ranked by Dollar Value)

**FM Global Insured Fires and Explosions, occurring 2007 – 2011**

<table>
<thead>
<tr>
<th>Cause</th>
<th>Number</th>
<th>Gross Loss (USD) (Indexed to 2012)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electricity</td>
<td>994</td>
<td>$1.278 billion</td>
</tr>
<tr>
<td>Hot Work</td>
<td>181</td>
<td>$713 million</td>
</tr>
<tr>
<td>Spontaneous Ignition/Chemical Action</td>
<td>145</td>
<td>$543 million</td>
</tr>
<tr>
<td>Hot Surfaces/Radiant Heating</td>
<td>272</td>
<td>$367 million</td>
</tr>
<tr>
<td>Arson/Incendiariism</td>
<td>403</td>
<td>$342 million</td>
</tr>
<tr>
<td>Overheating</td>
<td>246</td>
<td>$331 million</td>
</tr>
<tr>
<td>Miscellaneous Spark</td>
<td>92</td>
<td>$325 million</td>
</tr>
<tr>
<td>Open Flames (Excluding Hot Work)</td>
<td>100</td>
<td>$297 million</td>
</tr>
<tr>
<td>Friction</td>
<td>68</td>
<td>$227 million</td>
</tr>
<tr>
<td>Exposure</td>
<td>268</td>
<td>$100 million</td>
</tr>
</tbody>
</table>
Static electricity/static charges are generated by several different mechanisms, including friction from making and/or breaking contact between solid surfaces. Common processes that can create electrostatic charges through friction include:

- A conveyer belt running over rollers
- Paper running through a printing press over a coating roll
- A powder material flowing into a bin or silo
- An operator removing plastic shrink-wrap from a pallet load of bagged raw material.

- **Hot surfaces/radiant heating**, which can be produced by electrical heating equipment, such as immersion heaters and extruders, pipes, boilers, furnaces, ovens, dryers, flues and ducts. Examples of possible scenarios include:
  - A hot firebox igniting unburned fuel oil
  - Hydraulic oil leaking from a hose onto a hot surface
  - A hot incandescent bulb igniting combustible material that is stored too close
  - A hot grinding wheel igniting dust in a woodworking occupancy

- **Open flames**, such as pilot lights, which typically are found in industrial heating equipment and cooking appliances—boilers, furnaces, space heaters, ovens, burners. (Hot work is considered an open flame, but treated as a separate ignition source.)

Examples of possible scenarios include:

- A heating appliance igniting a spilled ignitable liquid or released dust cloud
- Burner flames in boilers, dryers, ovens and furnaces igniting explosive concentrations of fuel vapor or unburned fuel
- Burner flames igniting fuel, hydraulic fluid or other ignitable liquid leaking from a pipe

- **Molten substances**, which, typically, are either glass or metal that have been heated in a furnace to such a degree, the substance has melted and turned to liquid.

If allowed to come into contact with combustible or flammable material, these ignition sources can cause a fire, and, possibly, costly physical damage and extended downtime, especially if the damage is to equipment that is hard to replace or critical. In the case of molten substances, the potential for explosion also is likely.
Ignition Sources Resulting from Equipment Failure, Improper Design or Lack of Needed Protection Systems

Equipment that is electrically fed or has moving parts can produce unintended ignition sources if not properly maintained, designed or provided with needed protection systems. Loose or improperly maintained electrical connections, for example, can overheat or produce arcs. Undersized electrical power cables can overheat, and moving parts that are not adequately lubricated can produce frictional heating or sparks.

To safeguard your property from this group of ignition sources, it’s essential to follow good maintenance practices and ensure proper design of equipment. Of the 10 most costly ignition sources, those that typically result from equipment failure, improper design or lack of needed protection systems, are:

- **Electricity**, or more specifically, faulty wiring and electrical equipment. While arcing, short circuits, electrical overloads and electrical sparks all factor into the electricity-related loss reported in the table on page 2, wiring and faulty electrical equipment often prove to be the source of ignition.

- **Wiring**. Improper installation or poor operating conditions can result in loose connections and arcing. Undersized electrical cables can overheat. Or, poor maintenance can allow heat, moisture, oil, corrosion, vibration, abrasion or impact to damage wire or cable insulation.

- **Electrical equipment**. Electrical equipment needed for the distribution and utilization of power in facilities can malfunction or overheat as a result of corrosion, loose connections or overload. If needed protection systems, such as ground fault interrupters (GFI) and circuit breakers, are not in place or of the proper size, you’re left without safeguards to protect against such deficiencies.

- **Friction**, which results when you fail to properly lubricate rotating and/or sliding equipment. Proper lubrication not only minimizes friction, but also provides cooling in the contact area. While it’s natural to consume some lubricant in the process of normal operation, leaks or poor maintenance can aggravate the situation. If the lost supply is not replaced, the motion between the surfaces can generate enough heat or sparking to ignite residue, dust or other combustible material in the area, including remaining lubricating oil.

- **Overheating**, which occurs when liquid, such as cooking oil and asphalt or material being processed in ovens, are heated beyond their points of ignition.

Severe damage could prove costly, especially if it brings production to a halt.
As with ignition sources that are inherent in processes and equipment, electricity, friction and overheating can spark a fire capable of producing extensive damage. Depending on the severity, this damage could prove costly, especially if it brings production to a halt. Damage to equipment that is critical to your production process can result in extended business interruption, especially if a spare is not available or the equipment is unique in design and hard to find.

In the case of friction, the potential for explosion also is likely if dust is in the area. Between 2007 and 2011, FM Global clients have experienced 139 fires or explosion losses involving dust, totaling an estimated US$336.7 million* in damage to their facilities. The average gross loss for a dust fire is US$1.9 million*; the average gross loss for a dust explosion is US$5.3 million*.

**Ignition Sources Introduced by Human Intervention or Other Occupancies**

In addition to ignition sources that either are inherent in or created by processes and equipment, there are those that can be introduced through the actions—or inactions—of employees and contractors, or even fire spread from outside the facility. These ignition sources simply don’t exist until something happens or someone does something to put the facility at risk.

For example, employees or contractors may conduct cutting and welding operations to repair equipment—operations that are performed with open flames and frequently produce sparks. If they’re careless, workers easily could introduce a possible source of ignition that previously didn’t exist within the facility. In fact, the actions people take—or don’t take—account for roughly 70 percent of all property losses reported by FM Global clients each year.

Similarly, visitors may carelessly discard improperly extinguished smoking material, which could smolder unnoticed until a fire is ignited. Or, a fire in an adjacent, uninsured occupancy or nearby forest could spread to your facility. Again, neither of these ignition sources existed within the facility until they were introduced by outside forces.

Of the 10 most costly ignition sources, those that typically are introduced by human intervention or other occupancies include:

- **Hot work**, which can be defined as any temporary operation that involves open flames or produces heat and/or sparks: welding, brazing, cutting, grinding, soldering, and using torches to apply roofing material. During the past five years, one out of every 15 fire losses was attributed to improperly managed hot work. The average cost for each loss was US$3.9 million. Many of these losses were preventable.

- **Arson**, which can strike day or night, targeting abandoned and well-protected facilities alike, to cause significant damage each year worldwide. Although no facility is immune to this hazard, analysis of losses reported by FM Global clients since 1985 reveals that certain types of industry are more vulnerable than others.

* Gross Loss figures indexed to 2012
The five classifications reporting the most arson fire losses in North America include:

1. Manufacturing plants
2. Hotels, motels and apartment complexes
3. Warehouse storage facilities
4. Department stores and malls
5. Mercantile and retail businesses

- **Exposure** to fire in outdoor combustible material such as storage, trash, vegetation, nearby forests, adjacent buildings or neighboring property. If conditions are right, one fire can ignite another fire—called an exposure fire—and possibly threaten your facility. Although loss history indicates such incidents occur most frequently in yard storage, nearby vegetation or combustible trash accumulation, an exposure fire starting in separate, unsprinklered structures also can reach insured facilities. While automatic sprinklers and firefighters typically are able to control the fire and prevent it from spreading through the exposed building, heat, water and smoke damage still can be considerable.

- **Smoking.** Carelessly disposed smoking material can smolder undetected and ignite nearby combustible material. If ignitable liquid is in the area, the results can be devastating.

To safeguard your facility from this group of ignition sources, it’s essential to develop and implement a strong human factor management program. In the case of hot work, however, it’s also important to combine education with effective use of the FM Global *Hot Work Permit System* or similar policy.

If not managed properly, hot work can pose a serious threat to your facility and its operations, causing significant property damage and/or business interruption. By its nature, uncontrolled hot work can be a roving fire hazard in your facility. Sparks can fall into areas that are concealed or not easily seen and smolder for several hours unnoticed before breaking.
out into open flames and becoming well-established—possibly long after your facility has shut down for the day and workers have left the premises.

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As a result, it’s essential to strictly control and monitor hot work operations through use of the FM Global Hot Work Permit System. Designed to ensure this potentially hazardous process is conducted in the safest manner possible, the Hot Work Permit System requires use of a Hot Work Permit whenever hot work is conducted. This permit serves as a visual reminder of hot work hazards and provides a required precautions checklist that highlights important steps to take during hot work operations.

In addition, familiarize contractors and employees with your hot work policy and ensure they follow all requirements, including the final safety inspection that should be conducted when work is complete. Require contractors to read and sign your operating procedure for hot work before they start work.

### Additional Resources

While your FM Global engineer is always your best resource, FM Global publishes a wide range of educational material designed to increase property protection awareness and understanding. This material includes publications, learning kits, CD-ROMs, videos and **FM Global Property Loss Prevention Data Sheets**—engineering guidelines written to help reduce the chance of property loss due to fire, weather conditions and failure of electrical or mechanical equipment.

In addition, FM Global, together with its affiliate Emergency Response Consultants, offers a variety of training programs designed to provide the information you need to help protect your business. For more information about these programs or other FM Global resources, visit our website at fmglobal.com or refer to our Online Resource Catalog at fmglobalcatalog.com.

The following is a list of data sheets and publications available to help you better understand today’s 10 most costly ignition sources, as reported by FM Global clients:

**Electricity**
- Data Sheet 5-20, *Electrical Testing*
- *Maintaining Power for Productivity* (P9702)

**Arson/Incendiaryism**
- Data Sheet 10-6, *Protection Against Arson and Other Incendiary Fires*
- *Pocket Guide to Arson and Fire Investigation* (P7923)
- *Reducing the Arson Threat* (P7721)
**Hot Work**
- Data Sheet 10-3, *Hot Work Management*
- *Don’t Get Burned by Hot Work* (P9802)
- *Hot Work Permit System Wall Hanger* (P9311)
- *Managing Hot Work Using FM Global’s Hot Work Permit System* online training course is available to FM Global clients only at training.fmglobal.com
- *Pocket Guide to Hot Work Loss Prevention* (P9602)

**Smoking**
- *Human Factor Management: How to Make Your Program Work* (P9703)

**Open Flames**
- Data Sheet 6-0, *Elements of Industrial Heating Equipment*

**Exposure**
- Data Sheet 1-20, *Protection Against Exterior Fire Exposure*
- Data Sheet 7-44/17-3, *Spacing of Facilities in Outdoor Chemical Plants*
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