



Don't Get Burned
by Hot Work





All hot work fires and explosions are preventable. Yet every year hundreds, if not thousands, of preventable hot work causes fires and explosions—placing facilities, business operations and people at risk. Preventing fires and explosions ignited by hot work takes collaboration between facility management, personnel and contractors. Senior managers need to be involved to endorse the hot work management policy and procedures, and ensure resources are available to effectively implement them. And, facility personnel and contractors have to do their part in following these procedures, no matter how insignificant they may seem.

This brochure defines the key elements of a successful hot work management program. It outlines for senior management ways to establish and implement an effective hot work management policy. And, it details for facility personnel, as well as contractors, guidelines for safely performing hot work operations.

No Industry Is Safe

Hot work—any operation that produces flames, sparks or heat—is a leading cause of fire and explosions throughout the world. FM Global loss history shows there is no industry or type of facility immune to this ignition source hazard. Torch or radial-saw cutting, welding, brazing, soldering, grinding, and torch-applied roof covering or plastic shrink-wrap are all examples of hot work.

From 1995 to 2014 (a 20-year period), FM Global clients experienced 736 hot work ignited fires or explosions with a total indexed gross of US\$1,907 million in property loss and business interruption, and an average gross loss of US\$2.6 million per incident. All losses could have been prevented with proper hot work management.

A Hot Work Permit is a tool. Effective hot work management requires a policy, procedures and trained personnel.

Companies that utilize the FM Global Hot Work Permit say their success in preventing fires caused by hot work would not be possible without senior management's support of a strong hot work program.

Recurring Breakdowns in Hot Work Management Lead to Hot Work Fires and Explosions

The following hot work management oversights prevail every year in incidents of fire and explosion:

- Lack of a formal hot work management program at the facility.
- Failure to recognize and safeguard combustible, ignitable or flammable material in the hot work area.
- Inadequate during work fire watch including breaks (i.e., not continuous).
- Delegating hot work management to contractors without training or supervision.

Implementing a Hot Work Management Program

- Minimize hot work permitting by considering alternative cold work methods or relocating the work to a hot work designated area.
- Establish a formal policy and procedures for hot work management endorsed by senior management.
- Train personnel and contractors on the hot work policy and procedures, and on the facility-specific fire and explosion hazards.
- Retain hot work management documentation for program audits (e.g., completed Hot Work Permits, incident reports and near miss reports).
- Audit the program (not just the documentation); evaluate active hot work areas; and review the facility for physical or personnel changes that impact the program.

- Manage and supervise contractors conducting hot work within the facility.



Loss studies show that the following three steps in hot work permitting are often neglected. Make sure your hot work management program emphasizes them.

1. **Consider alternatives to using hot work permitting.** Use an alternative cold work method to join, trim or sever without compromising mechanical integrity. Switching to a cold work method eliminates the hot work fire and explosion risk. Otherwise, relocate the work to a hot work designated area within the facility. These areas are designed and maintained to be free of combustibles and confine hot work ignition sources to that area.
2. **Properly prepare and maintain the hot work area and/or equipment.** Follow the hot work 35-foot (10-meter) rule

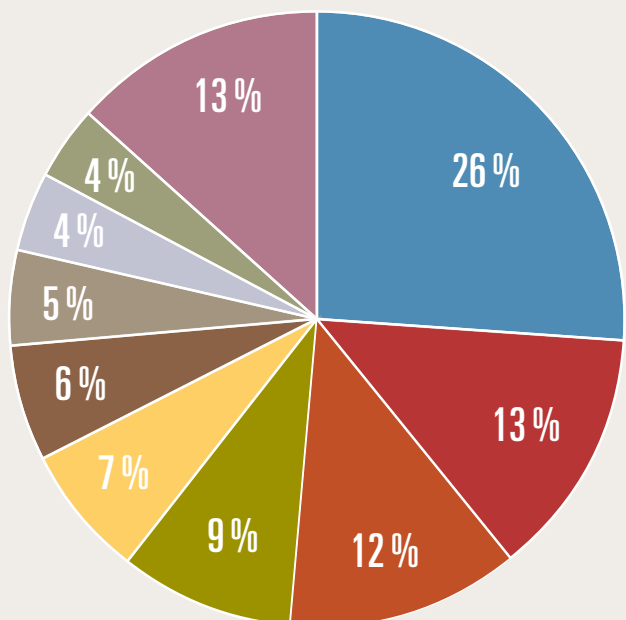
on page 8 and emphasize these precautions:

- Identify and cover combustible construction in the hot work area.
 - Remove moveable combustible contents, or cover with FM Approved blankets or pads.
 - Remove ignitable liquid, combustible dust/lint and combustible deposits/residues.
 - Shut down process equipment that could release combustible, ignitable or flammable material into the hot work area.
 - Shut down ventilation and conveying systems capable of transporting hot work ignition sources outside the hot work area.
 - Purge equipment and interconnected equipment of flammable gas/vapor.
- Provide a fire watch in the hot work area from start of work to work completion, even during breaks, to ensure the required precautions remain implemented and the hot work area is firesafe.
 - Provide a second fire watch on the opposite side of floors, walls, ceilings or roofs when unprotected openings are present, or when working on thermally conductive materials passing through.
3. **Ensure both fire protection and hot work equipment work properly.** Make sure the sprinklers, water supply and other fixed fire protection systems are in service.
 - Provide operable fire extinguishers in the hot work area.
 - Ensure hot work equipment is in good working condition.

Top Ignition Sources of Fire and Explosion (2000 through 2004) (gross loss in percentages)

Every year, hot work is among the top five causes of increasingly severe and frequent fire and explosion at FM Global insured properties.

■	Electricity	26 %
■	Hot Work	13 %
■	Operating Conditions	12 %
■	Arson	9 %
■	Hot Surface	7 %
■	Friction	6 %
■	Spark/Ember	5 %
■	Overheating	4 %
■	Exposure From Outside Property	4 %
■	Other	13 %



How Effective Is Your Hot Work Management Program?

- Do you have a written management policy covering plant or corporate intention to control hot work? Is it clearly communicated to all employees and contractors?
- Do you clearly communicate detailed, written hot work management procedures to all employees and contractors?
- Do the procedures include all of the following:
 - a requirement to consider alternative cold work methods to hot work, particularly during the design phase of all new construction, repair and maintenance projects, or relocating to a hot work designated area
 - an assigned, named position to manage the hot work program
 - an assigned, trained hot work permit authorizer
 - employee education and empowerment to stop unsafe hot work operations
 - trained and supervised contractors
 - a process to properly evaluate and understand fire and explosion hazards within your facility, including identifying hot work high-risk areas?
 - formally stated consequences for violating hot work procedures

- Are permit authorizers:
 - knowledgeable in fire and explosion hazards pertaining to building contents, operations and facility construction, and in predetermined post-work fire watch and monitoring durations in the various facility areas
 - available (or on call) 24 hours a day
 - contacted for all hot work (inside and outside of facility buildings)
 - authorized to stop all hot work
 - required to visit all hot work areas prior to authorizing the permit and start of work
 - required to personally complete the Hot Work Permit? (This tag is conspicuously posted at the job site by the fire safety supervisor.)

Managing Outside Contractors

The trend toward outsourcing maintenance and renovations has its risks. A contractor may have the technical expertise to perform hot work, but most likely does not have a full understanding of the facility's fire and explosion hazards, nor the hot work management policy and procedures.

Before allowing contractors to start any job, it's crucial you make sure they:

- sign a contract agreeing to faithfully follow your hot work policy and understand the job will not proceed without one

- demonstrate proficiency in your company's hot work safety training program and ability to carry out procedures; and
- understand they will be properly supervised by your employees.

Empowering Personnel and Making Them Accountable

Combustible material capable of being ignited by hot work ignition sources are present just about everywhere—in offices, storage, manufacturing sites, even resorts. As a result, it's crucial that facility personnel do their part to manage hot work by following the policy, procedures and Hot Work Permit System, including every required precaution, no matter how insignificant it might seem. Cutting just one corner undermines the entire hot work management effort and creates opportunity for another near miss or major incident. Furthermore, property loss can amount to job loss. (For more information on the role of facility personnel, see page 7.)

The Importance of Fire Protection

Manual fire protection (extinguishers, hoses, etc.) should be operating and in place before the job starts. If automatic sprinkler protection is provided for the area, make sure the system is in service. The presence of sprinkler protection means the area contains, or is constructed of, combustible material. And that one word—combustible—is a critical reason for conducting hot work with great care.

Facility-Personnel: Know the Hazards, Follow the Policy

Other FM Global Hot Work Resources

Be sure to take advantage of these FM Global resources for more information on controlling hot work:

- FM Global Property Loss Prevention Data Sheet 10-3, *Hot Work Management*
- *Hot Work Permit* form (F2630)*
- *Pocket Guide to Hot Work Loss Prevention* (P9602)*

*available in several languages.

Fire and explosion hazards within facilities are often not readily apparent, even to the most experienced workers. For example:

- Almost everything around you can burn. Sparks and molten globules become uncontrolled ignition sources, often flying or rolling long distances. One spark landing on or near combustible material—like insulation, wood particles or ignitable liquid—is enough to start a fire.
- Sparks can settle in areas you can't see, such as the tops of high ledges, floor openings, vents, recessed walls or ceiling openings. And, they can smolder unnoticed for hours before igniting a fire.
- Combustible material is not always visible. Cutting into a metal wall can ignite the inside wall. With enough heat, anything combustible on the other side—or close to it—can catch fire.
- The flame of an oxygen-acetylene torch can exceed 6,000°F (3,316°C). Hot work on/in vessels or tanks can ignite residual ignitable deposits/vapor or flammable gas, unless the vessels or tanks are properly cleaned, inerted, and inspected before and during hot work activities.

Therefore, it's important that facility personnel do their part to minimize the risk posed by hot work ignition sources. Although the permit authorizer and fire watch are responsible for specific duties, as outlined below, all employees need to assume accountability for following the precautions outlined in your hot work policy.

Owner of the Hot Work Permit – the Permit Authorizer

The permit authorizer's duties include implementing the company's hot work policy and permit procedures. Before authorizing any hot work job, the authorizer must ask:

Is a hot work permit the only option? Consider alternatives such as cold work methods or relocating the work to a hot work designated area. Can either of these alternatives be employed? Often, the answer is yes.

Alternative cold work methods may include:

- cutting with a hand or reciprocating electric saw, or pipe cutter;
- using a mechanical bolting method;
- using hand-filing instead of grinding;
- installing threaded or press clamped pipe instead of welded or soldered where local codes permit; and
- avoiding roofing torches (many types of FM Approved roof coverings can be installed without torches).

Facility-Personnel: Know the Hazards, Follow the Policy (continued)

Authorizing the Hot Work Job

If there is no alternative to conducting hot work requiring a permit, and the area in question is firesafe, the fire safety supervisor uses the two-part FM Global Hot Work Permit to authorize the hot work. Before signing the permit, the authorizer discusses with the hot work operator and the fire watch exactly what the work will involve, and ensures all needed required precautions identified on the permit have been implemented prior to the start of work (see the discussion below on the Hot Work Permit Required Precautions). Then, Part 2 of the FM Global Hot Work Permit is displayed prominently in the work area, while Part 1 is posted in a visible, central area (e.g., maintenance office) to alert personnel that active hot work is in progress within the facility.



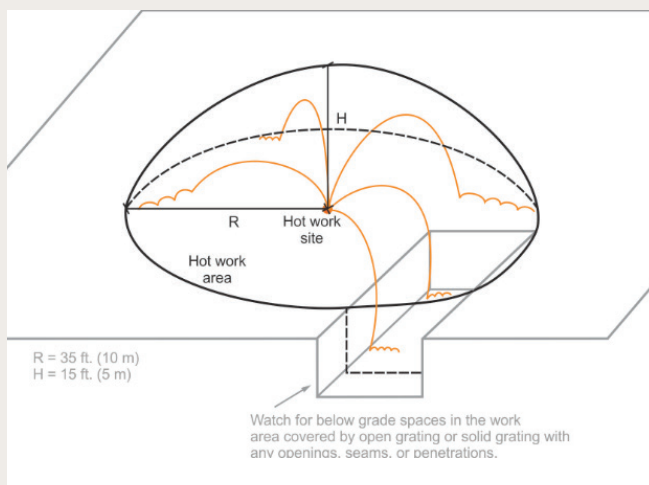
Hot Work Permit – Required Precautions

The required precautions listed in the right column center upon: controlling combustible, ignitable and flammable material in the hot work area or in equipment; maintaining hot work ignition sources within the hot work area; and providing fire protection for the hot work area. Control of combustibles and ignition sources are intended to prevent a fire or explosion, while fire protection mitigates the fire risk in the event prevention controls fail due to a mistake or error in judgment, which unfortunately happens on occasion.

- Verify the hot work equipment is operable and properly arranged.

Protecting the Hot Work Area

- Verify automatic fire protection systems are in service, if provided (e.g., automatic sprinklers).
- Verify onsite water supplies serving fire protection systems are in service (i.e., pumps in automatic mode and suction tanks full).
- Verify there are no active or planned fire protection system impairments near the hot work area during the work or during the post-work fire watch and fire monitoring periods. If protection is not provided or is impaired, consider delaying work until protection is restored, or alternatively treat the unprotected area as a hot work high-risk area and provide Additional Required Precautions (e.g., laying charged firefighting hose streams and stationing trained firefighting personnel in the hot work area, or requiring permit authorization by senior management).
- Provide manual firefighting equipment, including supplemental fire extinguishers (in addition to those extinguishers required by local codes).



Preparing the hot work area

When preparing for permitted hot work, the hot work area first needs to be defined. Use the 35-ft. (10-m) rule to define the hot work area horizontally from the hot work site, and a minimum of 15 ft. (5 m) above the hot work site. If conducting elevated hot work, consider expanding the hot work area horizontally to 50 ft. (15 m). Once defined, provide the following required precautions to control combustibles and hot work ignition sources within the hot work area.

- Remove combustibles from the hot work area. If combustibles are nonmoveable, isolate materials from ignition sources by shielding/covering them with FM Approved welding blankets.

Facility-Personnel: Know the Hazards, Follow the Policy (continued)

- Remove combustible accumulations from within the hot work area (e.g., combustible debris, oil residues or combustible dust/lint).
- Identify and isolate potential sources of flammable gas, ignitable liquid and/or combustible dust/lint that may be released into the hot work area during work. Conducting a job safety analysis may identify sources of these materials and whether the systems need to be just de-energized, or if additional protection is warranted such as isolation, drain and purge.
- Test the hot work area for flammable vapor/gas prior to work and as needed during work.
- Protect or shut down ventilation and conveying systems that may transport combustible material into the hot work area or hot work ignition sources out of the area.
- Extend the hot work area to the opposite side of a building assembly (floor, wall, ceiling or roof) when openings exist through which hot work ignition sources may pass through, or working on thermally conductive materials that may transfer heat through the building assembly. In both cases, combustibles on the other side of the wall may be exposed to hot work ignition sources.
- Identify and safeguard combustible-lined equipment, piping or ductwork within the hot work area that have openings that may allow the ingress of hot work ignition sources.
- Treat the following as hot work high-risk operations and provide Additional Required Precautions:
 - Hot work on thermally conductive materials at or near a penetration into a combustible building assembly (e.g., remove portions of the building assembly and install noncombustible replacement materials, monitor temperature of the thermally conductive material before the penetration, temporarily installing a thermal sink on the thermally conductive material before the penetration, or perform fire watch using an infrared camera to inspect the thermally conductive material and wall for hot spots).
 - Hot work on combustible building assembly including cutting through non-FM Approved insulated steel deck roof assembly or insulated metal panels (e.g., developing a specific fire emergency response plan, including conditions under which the fire service should be called and verifying fire service access to the site; stopping work immediately if material appears to be smoking; performing fire watch using an infrared camera to inspect the materials for hot spots).
 - Torch-applied roofing systems including installation of, repair of or alteration to the roof cover (e.g., developing a specific fire emergency response plan including conditions under which the fire service should be called and verifying fire service access to the site stopping work immediately if material appears to be smoking; performing fire watch using an infrared camera to inspect the materials for hot spots; locating the asphalt kettle a minimum of 25 ft. (7.5 m) away from the building or combustible yard storage; and closing all valves on fuel-fired equipment when unattended).

Prepare for Hot Work on/in Equipment

When preparing for permitted hot work on/in equipment, the following precautions may need to be considered in addition to preparing the hot work area around the equipment.

- Identify and isolate interconnected equipment and piping that contain flammable gas, ignitable liquid or combustible dust/lint.
- Drain ignitable liquid and purge flammable vapor/gas from equipment and interconnected piping.
- Test equipment and/or piping for flammable vapor/gas prior to work and as needed during work. Consider testing even if the equipment does not normally contain these materials but could if a process stream is contaminated by a process leak (heat exchanger or wastewater treatment) or decaying organic material (wood pulp).
- Remove combustible debris, dust/lint and residues from the equipment and interconnected piping.
- Treat hot work on combustible-lined equipment, piping or ductwork as a hot work high-risk operation (again consider using an alternative cold work method, label combustible-lined equipment, flood equipment with water or continuously wet down the interior during work and post-work, identify access ports upstream and downstream of the work site and lay out firefighting hose, or isolate equipment upstream and downstream of hot work site using non-thermally conductive material for a blank).

Facility-Personnel: Know the Hazards, Follow the Policy (continued)

Fire Watch and Monitor of the Hot Work Area

- During work, perform a continuous fire watch over the hot work area. The continuous fire watch should consist of the following:
 - Extend from start to end of work uninterrupted. If needed, the fire watch responsibilities should be passed temporarily or permanently if the initial fire watch needs to leave the area.
 - Ensure hot work ignition sources remain in the defined hot work area.
 - Maintain the required precautions listed on the Hot Work Permit in place.
 - Notify emergency contacts prior to attempting to extinguish the fire.
 - Stop all work if unsafe conditions are identified, and contact the Permit Authorizer.

The permit authorizer may require an additional (second) fire watch individual if: the hot work area and person performing the work are not both visible from a single vantage point; the hot work area is large, multilevel and/or congested; or an opening or thermally conductive assembly extends through a building assembly.

- After hot work has concluded, perform a continuous fire watch over the hot work area for 30 or 60 minutes depending on the post-work category. Guidance on determining the post-work category is provided in FM Global Property Loss Prevention Data Sheet 10-3, Hot Work Management section 2.0. This fire-watch should have the same responsibilities as mentioned previously in the during-work fire watch.
- After the post-work fire watch, perform fire monitoring within the hot work area for up to 5 hours depending on the post-work category. Guidance on determining the post-work category is provided in Data Sheet 10-3 section 2.0. Methods of fire monitoring may include automatic smoke detection with remote alarm annunciation, security video cameras, operators routinely present in the hot work area or intermittent patrols by personnel (i.e., every 15 minutes).

Post-Work Categorized Areas

Depending on construction and occupancy fire hazards present at a facility, determine the appropriate post-work fire watch and fire monitoring periods using Data Sheet 10-3, section 2.0. Categories range from A, B-1, B-2, C and D differing on the potential to support a smoldering fire, and result in a large uncontrolled fire (based on FM Global loss history).

Hot Work High-Risk Areas

The Required Precautions listed above are general and intended to be applicable in nearly all facilities. Hot work high-risk areas may require Additional Required Precautions, which are above and beyond the standard list of Required Precautions due to the heightened likelihood or consequence of a fire or explosion in the hot work area. Examples of Additional Required Precautions are provided in the previous section "Preparing the Hot Work Area."





P9802 © 2015 FM Global
(09/2016) All rights reserved.
fmglobal.com

FM Insurance Company Limited
1 Windsor Dials, Windsor, Berkshire, SL4 1RS
Authorized by the Prudential Regulation Authority
and regulated by the Financial Conduct Authority
and the Prudential Regulation Authority.

Contact Us:

To report an impairment or to find an FM Global office nearest you, visit fmglobal.com/contact.

Report A Loss:

Dial (1)877 NEW LOSS (639 5677)* to report a property or cargo loss 24 hours a day, seven days a week. Or, to contact your client service team or designated claims office directly, go to fmglobal.com/claims or affiliatedfm.com/claims for location and contact information.

*For clients of FM Global and AFM in Canada and the United States only.

Product Ordering Information:

For additional copies of this publication or other FM Global resources, order online 24 hours a day, seven days a week at fmglobalcatalog.com.

Or, for personal assistance worldwide, contact our U.S.-based customer services team, Monday – Friday, 8 a.m. – 5 p.m. ET:

- Toll-free: (1)877 364 6726
(Canada and the United States)
- Phone: +1 (1)401 477 7744
- Fax: +1 (1)401 477 7010
- Email: customerservices@fmglobal.com