POCKET GUIDE TO

Hot work loss prevention

Sixth edition

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Sixth Edition

Audience

This pocket guide is intended for those involved with hot work management at client facilities. This includes FM clients and contractors hired by clients to perform hot work at their properties.

Terminology

Hot work is any operation involving open flames or producing heat or sparks, including welding, brazing, soldering, torch or radial saw cutting, grinding and torch-applied roofing.

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Introduction

Sensible precautions—that's all it takes to prevent a hot work fire or explosion. Yet, every year, hot work is among the top causes of fires and explosions at FM client facilities.

The goal of every hot work program should be to prevent hot work ignition sources from coming into contact with combustible and flammable material. When such a program is conducted properly, hot work incidents can be prevented.

All hot work fires and explosions are directly linked to lack of supervision.

People in general don't believe preventable accidents will happen to them. They may think hot work safety precautions are unnecessary extras, or someone else's job—both of which are quite untrue. Anyone who spends time in a hot work environment should consider safety a primary responsibility.

Unfortunately, hot work fires and explosions can cause devastating losses to facilities, businesses and people. All it takes is one relaxed or ignored procedure, or a general lack of awareness of a hazard. The absence of

good work practices and/or lack of proper training of employees and contractors on the hazard associated with performing hot work may be costly to your business. In fact, contractors are often left unsupervised, when they should be under constant watch. This is particularly important because the trend toward outsourcing creates more opportunities for contractors (who are not experts or may not have knowledge of your specific fire hazards including combustible construction or occupancy contents); and so they may unknowingly conduct unauthorized hot work operations that expose your facility.

A Hot Work Permit is not the sole requirement to correct these errors. The permit is a tool that, when used improperly, often impedes the process of safely controlling hot work ignition sources. While the permit is essential, it does not indicate all precautions for every hot work application. Most Required Precautions listed on the permit are generic and apply to many, but not all, hot work areas. If you have a question about hot work management, please review FM Property Loss Prevention Data Sheet 10-3, *Hot Work Management*, or contact your FM engineer.

Your first considerations

Prior to issuing a Hot Work Permit, consider the alternatives: using a cold work method or relocating the work.

In the planning stages, rather than at the last minute, evaluate if an alternative cold work method could be utilized in place of hot work. Another option may be to relocate to a hot work designated area. The Hot Work Permit System should be used only as a last resort. Controlling fuel and ignition sources outside a designated area can be difficult.

Examples of alternative cold work methods:

- Mechanical removal and relocation of frozen piping to a heated area vs. thawing of piping in place with any form of hot work
- Manual hydraulic shears vs. saw/torch cutting
- Mechanical bolting vs. welding
- Screwed or flanged pipe vs. sweat soldering
- Reciprocating saw vs. radial saw
- Standard mechanically attached/fully adhered FM Approved roof system vs. torch-applied roof system

- Mechanical pipe cutting vs. torch or radial saw cutting
- FM Approved self-drilling or compressed air-actuated steel roof deck fasteners vs. puddle welding
    - A roof covering system that is not torch-applied vs. one that is torch-applied

Hot work designated areas are maintained free of combustible and flammable material, often enclosed to control hot work ignition sources from escaping the area, and are protected by automatic sprinkler systems. These construction, occupancy and protection features make hot work designated areas an ideal location to conduct hot work (without warranting a Hot Work Permit System). For guidance on constructing, limiting combustibles and protecting hot work designated areas, refer to Data Sheet 10-3.

As a last resort, use a Hot Work Permit System to manage hot work ignition sources within the facility. When using a Hot Work Permit, protect the facility by removing or isolating combustible/flammable material from the hot work area; confining hot work ignition sources within the hot work area; protecting the hot work area with automatic and manual fire protection systems and equipment; and supervising the hot work area during work and following work completion.

The emphasis of the permit system should be on preventing a fire or explosion by controlling combustibles and hot work ignition sources; however, loss history indicates mistakes can be made preparing and maintaining the hot work area free of combustibles or controlling ignition sources. In these instances, in-service fire protection systems and post-work fire watch and monitoring remain an important contingency to mitigate the consequences of a hot work fire. Use a Hot Work Permit System that meets the guidance in Data Sheet 10-3.

Implementing a hot work management program

Hot work fire and explosion prevention begins with management's dedication.

Personnel who supervise a hot work management program are the key to preventing a hot work fire and explosion. Getting the job done right means taking care of fire prevention requirements first. It's true that costs are involved in managing loss prevention, but these costs seem next to nothing when compared with those of a preventable loss of property or production. Even with fixed protection

systems in service, the average hot work loss is still more than US$0.3 million per incident, and over ten times this figure when protection is not provided or is impaired.

Establish a hot work policy and procedures, and make them available.

The facility's senior management should endorse the hot work policy, citing specific responsibility, accountability and the consequences for failure to abide by the hot work management program. The policy should mandate thorough and effective hot work procedures that spell out the requirements of the program, including the first two steps when planning any hot work: (1) considering alternative cold work methods; and (2) relocating work to a hot work designated area. If neither option is feasible, and as a last resort, conduct the work within the facility using a Hot Work Permit System. The Hot Work Permitting section should cover the various Hot Work Permit areas within the facility (e.g., categorized post-work watch and monitoring, designated, high-risk), permit authorizing, permit expiration and contractor supervision expectations. The policy should also spell out the requirements for training, incident and near miss reporting, document retention and auditing.

All employees at the facility should be aware that a hot work policy exists, while the policy and procedures should be accessible to those authorizing, supervising and conducting hot work. Being able to implement effective control for any human element program requires support from all employees involved. The key? Teamwork, education and a clear understanding of the hazards and risks.

Train and certify employees.

Conduct initial training for all employees involved in the hot work management program. Following the initial training, provide refresher training for personnel at least annually. Cover general hot work management topics as well as the facility-specific elements of the program. Facility-specific elements may include:

- The various Hot Work Permitting areas (e.g., categorized areas for post-work fire watch and fire monitoring periods, hot work designated areas and/or hot work high-risk areas)
- Permit authorizing process
- Permit expiration and reauthorization procedures, if permitted
- Contractor supervision expectations

- General, non-facility-specific hot work training resources are available from FM online (fm.com/resources/hot-work-resources).
- Records of all employee training

Train and certify contractors.

Review all contracts with the contractor. Remind contractors—verbally and in writing—about hot work ignition source hazards, what constitutes hot work at the facility (i.e., a list of all hot work operations), and how to obtain a Hot Work Permit prior to starting work. It's important to explain hot work policies, procedures and responsibilities; make hot work policy and procedures available to all contractors involved with hot work; and describe the consequences for failing to follow the hot work management policy and associated procedures as well as their potential liability should a fire or explosion occur.

Continually audit and update the hot work program.

As part of the program audit, cover the following areas of the program:

- Review hot work fire and explosion incidents, and equally as important, near miss incidents.

- Review completed inspection forms and Hot Work Permit documentation for thoroughness and correctness.
- Visit and evaluate active hot work sites, and make sure you have associated documentation.
- Evaluate for facility and/or personnel changes that require updating the policy or procedures.

At a minimum, conduct audits annually, but adjust the frequency based on the findings. From the audit, develop corrective actions to address deficiencies and strengthen the effectiveness of the overall program.

Hot Work Permit – required precautions

Protecting the hot work area

- Verify the hot work equipment is operable and properly arranged.
- Verify automatic fire protection systems are in service, if provided (e.g., automatic sprinklers).
- Verify on-site 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

- Define the hot work area as 35 ft. (10 m) horizontally from all hot work sites and a minimum of 15 ft. (5 m) above all hot work sites. When performing elevated work or work in drafty environments, consider extending the hot work area horizontally to 50 ft. (15 m).

- 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 or pads.
- Remove combustible accumulations from within the hot work area (e.g., combustible debris, oil residues, 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 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 may pass, or there's a presence of thermally conductive material 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. In addition to removing combustibles, a second fire watch may be warranted on the opposite side of the building assembly.

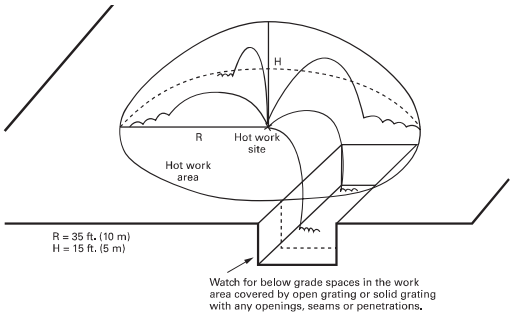
- Identify and safeguard combustible-lined equipment, piping or ductwork within the hot work area that have openings that may allow the ingress of hot work ignition sources.

Treat the following as hot work high-risk operations and provide Additional Required Precautions:

- Hot work on thermally conductive material 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., develop a specific fire emergency response plan including conditions under

which the fire service should be called and verify fire service access to the site; stop work immediately if material appears to be smoking; perform 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., develop a specific fire emergency response plan that includes conditions under which the fire service should be called and verify fire service access to the site; stop work immediately if material appears to be smoking; perform fire watch using an infrared camera to inspect the materials for hot spots; locate the asphalt kettle a minimum of 25 ft. (7.5 m) away from the building or combustible yard storage; and close all valves on fuel-fired equipment when unattended).



Prepare for hot work on/in equipment

- Identify and isolate interconnected equipment and piping that contains 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 a non-thermally conductive material for a blanket).

Fire watch and monitor of the hot work area

During work, perform a continuous fire watch over the hot work area. The 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.
- 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 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 one hour. This fire watch should have the same responsibilities as mentioned previously for the during-work fire watch.

After the post-work fire watch, perform fire monitoring within the hot work area for three hours. 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).

If combustible construction with unprotected concealed cavities is present or torch applied roofing is being conducted, use Data Sheet 10-3, section 2.0 to determine post-work fire watch and monitoring periods. If favorable factors are present, Data Sheet 10-3 can be used to reduce post-work fire watch and monitoring periods. For FM clients, this should be done in consultation with FM.

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 (Hot Work Permitting – Required Precautions under the section on Preparing the Hot Work Area).

FM Hot Work Permit System

FM's Hot Work Permit (F2630) is a two-part form that helps establish the hot work plan prior to start of work (Part 1) and tracks each step during work and post-work (Part 2). Part 1 of the Hot Work Permit should be posted in a central, visible location within the facility to alert personnel of an active Hot Work Permit within the facility (e.g., maintenance office work board). Part 2 of the Hot Work Permit should be hung in the hot work area to be used as a reference for the fire watch (Required Precautions and emergency contacts), to record

completed actions from the hot work plan (completion times) and act as warning (for bystanders smelling or seeing smoke).

On the front of both Parts 1 and 2, there are four sections: (a) the top header with suggestions on avoiding having to use a Hot Work Permit, as well as warnings; (b) instructions in the top left column; (c) fields for recording information about the work on the lower left column; and (d) Required Precautions in the right column. On the back of Part 2 is a place for the emergency contacts.

Using the FM Hot Work Permit System

When the decision is made to use an FM Hot Work System, the following procedure is recommended:

The Permit Authorizer ultimately owns the permitting process, including ensuring the hot work plan is appropriate for the hazards present (Required Precautions) and the Required Precautions are in place prior to starting work.

The white-shaded fields on the yellow permit highlight fields that may need to be completed during the permitting process.

Pre-Work

- Consider using an alternative cold work method or relocating the work to a hot work designated area (Permit Authorizer).
- Fill in the fields in the left column of Part 1, specify the Required Precautions to take on the right column of Part 1, along with method of fire monitoring on Part 2 lower left column; fill in the emergency contacts on the back of Part 2 and submit to the Permit Authorizer for approval.
- Implement the Required Precautions and any Additional Required Precautions.
- Verify the Required Precautions (and any Additional Required Precautions), fill in the permit expiration information, and print and sign authorizing the start of work (Permit Authorizer).
- Issue Part 2 to the person performing the work, to be hung in the hot work area (person performing work).
- Post Part 1 in a central, visible location (e.g., maintenance office work board) until the work and post-work periods are completed.
- Fill in the start of work on Part 2 left column (person performing work).

During work

- Verify the Required Precautions remain in place, the scope of work is restricted to that specified on the permit, hot work ignition sources remain in the defined hot work area, and the hot work area is firesafe. This fire watch should be performed continuously from start of work to work completion (fire watch).
- When needed, record Lower Explosive Limit (LEL) readings (fire watch).
- Upon work completion, record time on Part 2 left column (person performing work).

Post-work

- Following work completion, perform a continuous fire watch of the hot work area for the specified duration to verify the Required Precautions remain in place and the hot work area is firesafe (post-work fire watch).
- Record post-work fire watch completion time, and if specified in the Required Precautions, hand off the hot work area to the fire monitor (post-work fire watch).

- If specified in the Required Precautions, perform fire monitoring within the hot work area for the specified duration to verify Required Precautions remain in place and the hot work area is firesafe (post-work fire watch).
- If specified in the Required Precautions, record the fire monitoring completion time and notify the Permit Authorizer (fire monitor).
- Following the conclusion of the post-work fire watch and/or fire monitoring, conduct a final check of the hot work area for firesafe conditions to close out the active permit (Permit Authorizer).
- Combine Parts 1 and 2 and retain the completed Hot Work Permit.

Resources

- FM property loss prevention data sheet 10-3, *Hot Work Management*
- Don't get burned by hot work (P9802)
- Understanding the hazard: hot work (P0032)
- Cargo care guide: preventing losses from hot work (P16062d)
- Hot work permit (F2630)
- Hot work permit system wall hanger (P9311k)
- Construction hazards: preventing damage to buildings and facilities under construction (P7933)
- Managing hot work using FM's hot work permit system (P0686a)
- Advancing your hot work skills (P12062)

(Online training courses are available exclusively to FM clients and their hot work contractors at fm.com/training-center)

Note: Above items with P- or F-numbers are available separately and can be ordered from our website at fmcatalog.com.

CONTACT US:

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