HOT WORK

INTRODUCTION

Hot work processes such as soldering, brazing, welding, grinding, and cutting are necessary during construction, renovation, and repair activities in buildings, vehicles, and equipment. These processes, which generate high levels of heat, sparks, and fumes, pose significant fire and explosion risks, potentially resulting in property damage, injury, or death.

A robust Hot Work Program is essential to minimize these hazards and ensure safety. This guidance aims to provide a comprehensive framework to manage hot work operations effectively and comply with standards such as NFPA 51B, OSHA 1910.252, and OSHA 1926.352.

DEFINITIONS

Conduction: Process where heat travels from a warmer object to a colder object by direct contact.

Convection: Process by which heat travels from a warmer object to a colder object through air, water, and other gases or liquids.

Designated Area: A specific area designated and approved to perform hot work operations such as welding, torching, grinding, cutting, etc. A maintenance shop or detached outside location, noncombustible or fire resistant, free of combustible or flammable contents, and suitably segregated from adjacent areas.

Fire Monitor: monitoring may include automatic smoke detection, security camera, security or maintenance checks, or workers in the area.

Fire Watch: Employee(s) or contractor(s), trained for and continuously observing the work area for the presence of fire or hazardous conditions, and equipped for responding to emergencies within the hot work area before, during, and for at least 30 minutes after the hot work.

Hot Work: Hot work is any work that involves burning, welding, cutting, brazing, soldering, grinding, using flame or spark-producing tools, or other work that produces a source of ignition.

Hot Work Operator: The employee or contractor performing hot work.

Hot Work Permit: A document, required when the task involves the use of a flame, heat, or sparks sufficient to be a source of ignition.

Permit Authorizing Individual (PAI): Construction or shop superintendent, or their designee, responsible for all hot work operations, program compliance, and for issuing Hot Work Permits. The PAI performs a risk assessment, determines the need for hot work, appropriateness of the location, and the necessary precautions, including the need for, scope, and duration of a fire watch.

Permit Required Area: Any location, other than a designated area, approved for hot work and made safe by removing or protecting combustibles from ignition sources.

Radiation: Process where heat travels from a warmer object to a colder object separated by material colder than both objects.

HOT WORK OPERATIONS

The following operations are examples of hot work operations that can occur within or outside of a designated area.

- Soldering - a process in which two or more items are joined together by melting a filler metal and putting it into the joint. The filler metal has a lower melting point than the adjoining metal. Soldering is commonly used in plumbing, electrical, and roofing. This is the lowest temperature form of hot work, generally between 360° and 450°F, depending on the type of solder. Lower temperature, lead-based or soft, solder typically uses an electric soldering iron or “gun.” Higher temperature, silver-based or hard, soldering may use a torch.

- Brazing – a form of soldering above 450°F, usually between 1,150° and 1,550°F, where the filler (copper, brass, bronze, aluminum, iron, alloy) metal is stronger than soft or hard solder. Brazing generally uses a torch.

- Welding - joins materials using high temperature to melt the parts together, and allowing them to cool, causing fusion. A filler material is typically added to the joint to form a pool of molten material (the weld pool) that cools to form the joint. Welding is distinct from brazing and soldering, which do not melt the base metal. There are multiple types of welding, such as arc, MIG, TIG, and oxyacetylene. Temperatures can range from 5,600° to 15,000°F.

- Powder-driven fastening – involves the use of a specially designed gun (also known as Hilti or Ramset) to drive threaded or un-threaded nail-like fasteners. The mechanism of driving the fastener is essentially a blank firearm cartridge, typically .22 caliber. They may be single-shot or magazine-fed, manual or automatic cycling.

- Oxy-fuel metal cutting – involves the use of a fuel, like acetylene or propane, in the presence of oxygen to burn the metal into a metal oxide that flows off as slag along the line of cut.

- Metal grinding – grinding is a subset of cutting, as grinding is a true metal-cutting process, using a portable or bench mounted grinding wheel as the cutting tool.

- Miscellaneous heating – hot work equipment may be used to loosen mechanically connected objects (bolted), where the connection point is rusted or corroded, by expanding the nut and/or burning off contaminants in the threads. Heat may also be applied by torch to thaw ice blockage in frozen pipes (a risky process, see the MML Risk Control Solution *Frozen Water Lines*, for additional information)

HAZARDS

Hazards are generally the transfer of heat, sparks, smoke and metal fumes, and intense light.

The heat from hot work can vary from 330°F to more than 15,000°F. Combustible or flammable materials close enough to be heated by conduction, radiation, or convection may melt, char, or vaporize and ignite or explode. Sparks form when a cutting or welding electrode is brought into contact with the workpiece then moved away, allowing air to be ionized between the two metals and electrons to jump across the gap. As a result, heat and bright light are generated. The temperatures of the welding spatter can range from 1,000° to 2,200°F. Grinding spark temperatures are typically above 1,000°F, as is welding slag. Combustible or flammable materials in the immediate area may ignite or explode if not properly shielded (examples 4 & 5 listed below).

High temperatures can cause working materials to produce smoke and vaporized metal fume, and nearby materials may produce vapors dangerous to breath or be explosive. See example 6 below. Intense light can damage unprotected eyes. Clothing can ignite if proper technique or personal protective equipment (PPE) is not used (example 7 listed below).

The hazard is not always in the immediate vicinity. Sparks, spatter, or slag can fall through cracks or other openings to lower levels, starting fires in concealed areas. Moving conveyors or ductwork may carry sparks or slag to other areas (example 1 below). Work on pipes or other metal equipment may conduct heat to nearby combustible partitions or insulation, igniting fires on the opposite side of a roof, floor, or wall. Once torch work stops, the torch head may remain extremely hot for several minutes and melt or ignite combustibles it comes in to contact with (example 2 listed below).

The hazard is not always immediately observed. Ignition may be immediate, and explosive (example 8 below), or char, slag, and sparks may result in a slow smolder in wood, insulation, or other material, that takes an hour or more to develop into an open fire (example 3 below).

Between 2013-2017, the US averaged 4,630 structure fire per year, resulting from hot work. Nonhome property accounted for 57% of the fires, and 43% occurred in or on homes, including one and two family, apartments, and other multi-family buildings. These fires resulted in an average of 15 civilian deaths, 198 civilian injuries, and $355,000,000 in direct property damage per year. Between 2001-2018, five firefighter deaths resulted from four hot work-caused fires

Examples of hot work-caused fires and injury include:

1) A grinder was used to cut commercial laundry dryer ductwork while the dryer was operating. Sparks ignited lint in the duct. The resulting blower-driven flames vented seven floors above.

2) A butane torch was used, turned off and placed on a plastic storage shelf. Parts of the torch were still hot. The shelf ignited and melted, triggering the fire alarm and sprinkler system.

3) Embers from a torch, used earlier in the day, started a fire on the roof of an electrical closet attached to one of 19 apartment buildings under construction. All 19 were damaged or destroyed.

4) In a garage used for bus maintenance, a worker standing in a pit below a bus began welding a vehicle's chassis. Sparks ignited combustible debris that had accumulated in the pit, and fire spread to the bodies of several buses parked near each other.

5) Workers welded a bracing system in a bathroom of a 22-story Colorado hotel that was under construction. The spray-on insulation on an interior wall ignited.

6) A worker was using a welding torch and solder to repair a food refrigeration case in a grocery store and inhaled residual refrigerant that had oxidized when heated. Afterwards, he felt ill and subsequently died from the exposure.

7) A man was welding when sparks ignited his jacket causing second-degree burns to his forearm.

8) A worker was cutting lids off four 55-gallon drums containing the solvent methyl ethyl ketone, using a torch. Before cutting the fourth, he placed his torch on top of it. The drum exploded. The worker was struck by the drum's top, suffering facial fractures and head trauma.

HAZARD CONTROL

It is management's responsibility to have a hot work plan for each location that uses, or might use, hot work. Minimally, the plan includes avoidance, the use of designated areas, and permit required areas.

Management establishes, and maintains, a hot work permit process that includes a risk assessment for the location, contents, and work to be performed. Ensure all cutting and welding equipment is in satisfactory condition and good repair.

Designate a Permit Authorizing Individual (PAI) who conducts the risk assessment for any work outside designated areas, determines the hazard controls, authorizes hot work by issuing a physical hot work permit, and maintains records.

Any work requiring a hot work permit, regardless of the person performing the work, whether employee or third-party contractor, must follow your plan and permit process.

KEY COMPONENTS OF THE HOT WORK PROGRAM

Avoidance of Hot Work

Evaluate Necessity: Before proceeding with any hot work, evaluate whether an alternative method that doesn't generate heat or sparks can be used.

This could include using mechanical fasteners, press connections, or cold work techniques. Examples include using saws, shears, or mechanical tools instead of grinders; employing adhesive roofing materials in place of torch-applied roofing; or using cold pipe connections instead of soldering or brazing.

Designated Areas for Hot Work

Controlled Environment: Whenever possible, hot work should be carried out in areas specifically designated for it. These areas should be constructed to control sparks, spatter, molten slag, and intense light, and should be equipped with ventilation and fire suppression systems.

Workers should use appropriate personal protective equipment (PPE) based on hazard assessments.

Permit Required Areas

Hot Work Permit Process: If hot work must be performed outside of designated areas, a permit is required.

A Permit Authorizing Individual (PAI) must perform a site-specific inspection of the area and assess all potential fire hazards. The PAI should establish necessary precautions, including ventilation, fire watch, and other controls before issuing the hot work permit.

Fire Watch Requirements

Continuous Monitoring: A fire watch must be established during all hot work activities, and for at least 30 minutes after completion. Fire watch personnel must be trained to recognize fire hazards and have the authority to stop the work if unsafe conditions arise. The fire watch must also ensure that adequate fire extinguishing equipment is readily available and know how to activate alarms if necessary.

Extended Monitoring: Based on the risk level and materials involved, fire monitors may be required to extend the monitoring period beyond the initial 30 minutes.

The PAI should assess the construction type, materials, and any concealed spaces to determine appropriate watch and monitor times.

Training and Competency

Initial and Refresher Training: All workers involved in hot work operations must receive training on the hazards, equipment operation, and safety procedures. This training should cover key topics such as: safe operation of hot work tools, handling and storage of flammable materials, fire extinguisher use, fire watch duties, and PPE selection and usage.

Refresher Training: Hot work operators and supervisors must undergo refresher training at least every two years to ensure they stay up to date with safety practices and any changes to the hot work program.

Fire Prevention Measures

Removing Combustibles: Before hot work begins, remove all combustible materials within a 35-foot horizontal distance and 15-foot vertical distance from the work area. If this is not possible, shield combustibles using fire-resistant materials such as welding blankets or curtains.

Cover Openings: Any floor, wall, or ceiling openings within the hot work area must be covered to prevent sparks or slag from spreading to other levels or concealed spaces. Properly sealing ducts, conveyor systems, and other openings will reduce the spread of sparks.

Smoke Detection and Alarms: Notify the fire detection system or alarm service before disconnecting or temporarily disabling fire alarms. Fire detection systems must not be covered or disabled during hot work unless absolutely necessary.

Hot Work Permit System

Permit Issuance and Compliance: A hot work permit must be issued by the PAI before any work begins in a non-designated area. The permit should detail the location, scope of work, responsible parties, and required safety precautions.

Permits should not exceed one shift unless necessary, and work must be re-inspected by the PAI for each subsequent shift.

Recordkeeping: All hot work permits must be retained for at least one year, and logs should be maintained to ensure compliance with safety standards and protocols.

Program Evaluation and Audit

Annual Program Review: The hot work program should be evaluated at least annually using an audit checklist. This review should be conducted by the PAI, department heads, hot work operators, and the organization's safety officer.

Deficiencies identified in the program must be corrected promptly, and updates to the written program should be made as necessary.

Incident Reporting and Learning

Post-Incident Analysis: If a hot work-related fire or incident occurs, a thorough investigation should be conducted to determine the cause and assess whether safety protocols were followed.

Lessons learned should be integrated into training programs and used to revise safety procedures to prevent future incidents.

Best Practices for Fire Watch and Monitor Durations

Depending on the type of construction, contents, and concealed spaces, fire watch and monitor durations should be adjusted.

Use an infrared camera to reduce monitor times, especially for roofing and other high-risk areas.

Below is a guide for fire watch and monitor times:

Occupancy	Construction					
	Non-combustible		Combustible – no concealed spaces *		Combustible – concealed spaces	
	Watch	**Monitor**	**Watch**	**Monitor**	**Watch**	**Monitor**
Apartments, offices, museum, library, telecom, jails, healthcare **	30-minute	1-hour	1-hour	1-hour	1-hour	2-hour
Parking garage, waste/ recycling, sports arena, utility plants **	30-minute	1-hour	1-hour	1-hour	1-hour	2-hour
Storage, vehicle repair, loading dock, theater/ exhibition, wood/ metal shop **	30-minute	2-hour	1-hour	2-hour	1-hour	3-hour
Bulk storage – paper, wood, bark, coal **	1-hour	3-hour	1-hour	3-hour	1-hour	4-hour
No combustibles or non-combustible containment **	30-minute	0-minute	30-minute	1-hour	1-hour	1-hour
Roofing ***	2-hour	2-hour	2-hour	2-hour	2-hour	2-hour

* Open walls, ceiling, exposed structural members
** If an infrared camera is used, reduce Monitor by half
*** If an infrared camera is used, reduce Watch and Monitor by half

CONCLUSION

By following the framework and procedures detailed above, municipalities and organizations can minimize fire hazards, comply with regulatory requirements, and ensure the safety of workers and the public.

If you have any questions or require further assistance with implementing or reviewing your hot work program, contact MML Risk Management Services or Loss Control Services.

Contact MML Risk Management Services Staff
or your Loss Control Consultant for more information.

Important Phone Numbers

MML Risk Management Services	800.653.2483
Loss Control Services	800.482.2726

Note:
This document is not intended to be legal advice.
It only identifies some of the issues surrounding this topic.
Public agencies are encouraged to review their procedures with an expert
or a competent attorney who is knowledgeable about the subject.

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RISK MANAGEMENT SELF-ASSESSMENT

HOT WORK

Hot work processes are at times necessary but pose significant fire and explosion risks. A robust Hot Work Program is essential to minimize these hazards and ensure safety for personnel and property.

This self-assessment guide presents key elements of related regulations and standards. Evaluate your operations against best practices by asking the questions below. A response of "No" to any question indicates an area that may require further evaluation and an action plan for improvement or correction.

Organization Name	**Building/Shop**	**Room/Area**
Supervisor	**Completed by**	**Date**

Yes	No	n/a	Does Your Organization:
		1.	**General Controls**
			restrict hot work operations to authorized employees?
			restrict hot work to being performed in designated area?
			remove combustible materials to at least 35-ft horizontally from worksite, and 15-ft vertically?
			cover floor and wall openings at least 35-ft horizontally from worksite, and 15-ft vertically?
			have procedures developed and implemented to prevent hot work in the presence of explosive or toxic air contaminants?
			provide fire resistant curtains and/or tinted shields?
			require a Hot Work Permit to be obtained and used?
			ensure that local or general exhaust ventilation is adequate prior to commencing hot work?
			provide and ensure use of appropriate personal protective equipment?
			ensure that appropriate fire extinguisher and/or fire suppression equipment is provided in immediate vicinity of hot work?
			ensure that building fire detection and alarm system are operational during hot work operations?
			ensure that building sprinkler systems are operational during hot work operations?
			have procedures established to maintain fire watch in hot work areas?
		2.	**Confined Spaces**
			have procedures developed for confined space entry and rescue?
			provide ventilation and/or respiratory protection?
			ensure that electrodes are removed from holders and/or gas supply is shut off when operations are suspended for any substantial period?
		3.	**Compressed Gas Cylinders**
			store oxygen and fuel gas cylinders separately with protective valve caps in place?
			ensure that regulators are compatible with gas cylinders?
			use cylinder carts for transport?
			secure cylinders from tipping while in use?

Yes	No	n/a	Does Your Organization:
		4.	**Training**
			train workers in use of hot work equipment, material hazards, and control methods?
			provide and document personal protective equipment and fire extinguisher training?
			where necessary provide and document confined space entry training?

CONCLUSIONS

If you can honestly answer "yes" to all applicable questions, your risk management program for Hot Work is on solid footing – congratulations! Following the recommended practices reduces your organization's exposure to future claims in this area. Remain vigilant for new or changing risks and address them promptly.

If you answered "no" to one or more questions, your organization faces increased exposure to disability discrimination claims and the associated direct and indirect costs. Each "no" response indicates a possible deficiency in your risk management program. You should consider these carefully and take one or more of the actions below:

- Correct any deficiency that may exist;
- Contact MML Risk Management Services at the number below;
- Contact MML Loss Control Services at the number below;

Contact MML Risk Management Services Staff
or your Loss Control Consultant for more information.

Important Phone Numbers

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RISK CONTROL SOLUTIONS

HOT WORK PERMIT

This Permit is required for any operation involving open flames or producing heat and or sparks including, but not limited to: Brazing, Cutting, Grinding, Soldering, Thawing Pipe, Torch Applied Roofing and Welding.

If the measures on the *Hot Work Precautions Checklist* are not in place, do not proceed with work.

Job Name/Number:				
Location/Building & Floor:				
Description of Hot Work:				
Names of Persons Performing Hot Work:				
Persons Performing Hot Work Are:		**Employees**		**Contractors**

Permit Issued/Authorized by:

Printed Name	**Signature**

This Permit is Good for One Shift Only

Permit Expires:

Date:	Time: AM / PM

Hot Work	Start Time: AM / PM	Finish Time: AM / PM
Fire Watch	Start Time: AM / PM	Finish Time: AM / PM
Fire Monitor	Start Time: AM / PM	Finish Time: AM / PM
Final Check	Time: AM / PM	
Final Check Name:		

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RISK CONTROL SOLUTIONS

HOT WORK PRECAUTIONS CHECKLIST

Before initiating any Hot Work, ensure that proper precautions are in place!

General Precautions	
	There is no effective alternative to hot work. (If alternatives exist, use them instead)
	Available sprinkler, hose streams and extinguishers are in service/operational.
	Hot work equipment is in good repair.
Requirements within 35 feet of work	
	Flammable liquids, dust, lint and oil deposits have been removed.
	Explosive atmosphere in area has been tested, eliminated and verified.
	Floors have been swept clean.
	Combustible floors are wet down, covered with damp sand, or with fire-resistant sheets.
	Other combustibles have been removed where possible. If not possible, they have been protected with fire-resistant tarpaulins or metal shields.
	All wall and floor openings are covered.
	Fire-resistant tarpaulins have been suspended beneath work.
Work on walls, ceilings, enclosed areas	
	Construction is noncombustible and without combustible coverings or insulation.
	Combustibles on other side of walls have been moved away.
	Danger of heat conduction into another area has been assessed. If present, preventive measures have been taken.
	Enclosed equipment has been cleaned of all combustibles.
	Containers have been purged of flammable liquids or vapors.
Fire watch / Hot Work area monitoring	
	Fire watch will be provided during hot work and during any coffee or lunch breaks taken.
	Fire watch is supplied with suitable extinguishers.
	Fire watch is trained in use of this equipment and in sounding alarm.
	Fire watch may be required for adjoining areas, or areas above or below the work.

Monitor Hot Work area for at least 30 minutes after job is completed!!!

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RISK CONTROL SOLUTIONS

Training Attendance Report

Training Title or Topic:			
Instructor Name(s):			
Training Location:			
Training Date:	___ / ___ / _____	**# of Hours:**	

Attendee Name	Job Title or Role	Last 4 of SSN	Instructor initials