NFPA 51B
Standard for Fire Prevention During Welding, Cutting, and Other Hot Work

1999 Edition

National Fire Protection Association, 1 Batterymarch Park, PO Box 9101, Quincy, MA 02269-9101
An International Codes and Standards Organization

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NFPA 51B

Standard for

Fire Prevention During Welding, Cutting, and Other Hot Work

1999 Edition

This edition of NFPA 51B, *Standard for Fire Prevention During Welding, Cutting, and Other Hot Work*, was prepared by the Technical Committee on Hot Work Operations and acted on by the National Fire Protection Association, Inc., at its Fall Meeting held November 16–18, 1998, in Atlanta, GA. It was issued by the Standards Council on January 15, 1999, with an effective date of February 4, 1999, and supersedes all previous editions.

This edition of NFPA 51B was approved as an American National Standard on February 4, 1999.

Origin and Development of NFPA 51B

This standard was tentatively adopted at the 1960 NFPA Annual Meeting, and the first edition was adopted in 1962. Subsequent editions were published in 1971, 1976, 1977, 1984, and 1989.

The 1999 edition has been expanded to include other hot work operations, as defined in the document, to clarify the roles of fire watch, and to introduce a defined permit authorizing individual.

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NOTE: Membership on a committee shall not in and of itself constitute an endorsement of the Association or any document developed by the committee on which the member serves.

Committee Scope: This Committee shall have primary responsibility for documents on the prevention of loss of life and property from fire or explosion as a result of hot work. Hot work operations include, but are not limited to, cutting, welding, burning, or similar operations capable of initiating fire or explosion.

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NFPA 51B

Standard for

Fire Prevention During Welding, Cutting, and Other Hot Work

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NOTICE: An asterisk (*) following the number or letter designating a paragraph indicates that explanatory material on the paragraph can be found in Appendix A.

Information on referenced publications can be found in Chapter 5 and Appendix C.

Chapter 1 General

1-1 Purpose. This standard shall provide guidance for persons, including outside contractors and property managers, who manage, supervise, and perform hot work.

1-2 Scope.

1-2.1 This standard shall cover provisions to prevent loss of life and property from fire or explosion as a result of hot work in institutional, commercial, and industrial operations.

1-2.2 This standard shall cover the following hot work processes:

(a) Welding and allied processes
(b) Heat treating
(c) Grinding
(d) Thawing pipe
(e) Powder-driven fasteners
(f) Hot riveting
(g) Similar applications producing a spark, flame, or heat

1-2.3 This standard shall not cover the following:

(a) Candles
(b) Pyrotechnics or special effects
(c) Cooking operations
(d) Electric soldering irons
(e) Design and installation of gas cutting and welding equipment covered in NFPA 51, *Standard for the Design and Installation of Oxygen-Fuel Gas Systems for Welding, Cutting, and Allied Processes*
(f) Additional requirements for hot work operations in confined spaces
(g) Lockout/tagout procedures during hot work
(h) Torch-applied roofing covered in NFPA 241, *Standard for Safeguarding Construction, Alteration, and Demolition Operations*

1-3 Equivalency. Nothing in this standard shall be intended to prevent the use of systems, methods, or devices of equivalent or superior quality, strength, fire resistance, effectiveness, durability, and safety over those prescribed by this standard, provided technical documentation is submitted to the authority having jurisdiction to demonstrate equivalency and the system, method, or device is approved for the intended purpose.

1-4 Retroactivity. The provisions of this document shall be considered necessary to provide a reasonable level of protection from loss of life and property from fire and explosion. They shall reflect situations and the state-of-the-art prevalent at the time the standard was issued.

Unless otherwise noted, it shall not be intended that the provisions of this document be applied to facilities, equipment, structures, or installations that were existing or approved for construction or installation prior to the effective date of the document, except in those cases where it is determined by the authority having jurisdiction that the existing situation involves a distinct hazard to life or adjacent property.

1-5 Definitions.

Approved.* Acceptable to the authority having jurisdiction.

Authority Having Jurisdiction.* The organization, office, or individual responsible for approving equipment, an installation, or a procedure.

Designated Area. Permanent location designed or approved for hot work operations to be performed regularly.

Hot Work. Any work involving burning, welding, or similar operations that is capable of initiating fires or explosions.

Management. All persons, including owners, contractors, and so on, who are responsible for hot work operations.

Permit. A document issued by the authority having jurisdiction for the purpose of authorizing performance of a specified activity.

Permit Authorizing Individual (PAI).* The individual designated by management to authorize hot work. The PAI cannot be the hot work operator.

Shall. Indicates a mandatory requirement.

Standard. A document, the main text of which contains only mandatory provisions using the word "shall" to indicate requirements and which is in a form generally suitable for mandatory reference by another standard or code or for adoption into law. Nonmandatory provisions shall be located in an appendix, footnote, or fine-print note and are not to be considered a part of the requirements of a standard.

Welding and Allied Processes.* Those processes such as arc welding, oxy-fuel gas welding, open-flame soldering, brazing, thermal spraying, oxygen cutting, and arc cutting.

Chapter 2 Responsibility for Hot Work

2-1* Management. Management shall be responsible for the safe operations of hot work activity.

2-1.1 Management shall establish permissible areas for hot work.

2-1.2 Management shall designate a permit authorizing individual (PAI).

2-1.3 Management shall ensure that only approved apparatus, such as torches, manifolds, regulators or pressure reducing valves, and acetylene generators, be used.

2-1.4 Management shall ensure that all individuals involved in the hot work operations, including contractors, are familiar with the provisions of this standard. These individuals shall be trained in the safe operation of their equipment and the safe use of the process. These individuals shall have an awareness of the inherent risks involved and understand the emergency procedures in the event of a fire.

2-1.5 Management shall advise all contractors about site-specific flammable materials, hazardous processes, or other potential fire hazards.

2-1.6 Management shall advise all contractors with regard to flammable materials or hazardous conditions.

2-2 Permit Authorizing Individual (PAI). In conjunction with the management, the PAI shall be responsible for the safe operation of hot work activities.

2-2.1 The PAI shall determine site-specific flammable materials, hazardous processes, or other potential fire hazards present or likely to be present in the work location.

2-2.2 The PAI shall ensure the protection of combustibles from ignition by the following means:

(a) Ensure the work is moved to a location free from combustibles.
(b) If the work cannot be moved, ensure the combustibles are moved to a safe distance or have the combustibles properly shielded against ignition.
(c) Ensure hot work is scheduled such that operations that could expose combustibles to ignition are not started during hot work operations.

2-2.3* If 2-2.2(a), (b), or (c) cannot be met, then hot work shall not be performed.

2-2.4 The PAI shall determine that fire protection and extinguishing equipment are properly located at the site.

2-2.5 Where a fire watch is required, *(see Section 3-4)* the PAI shall see that the fire watch is available at the site.

2-2.6* Where a fire watch is not required, the PAI shall make a final checkup $^1/_2$ hour after the completion of hot work operations to detect and extinguish possible smoldering fires.

2-3 Hot Work Operator. The hot work operator shall handle the equipment safely and use it as follows so as not to endanger lives and property.

(a) The operator shall have the PAI's approval before starting hot work operations.
(b) The operator shall cease hot work operations if unsafe conditions develop and shall notify management, the area supervisor, or the PAI for reassessment of the situation.

2-4 Fire Watch.

2-4.1 The fire watch shall be aware of the inherent hazards of the work site and of the hot work.

2-4.2 The fire watch shall ensure that safe conditions are maintained during hot work operations.

2-4.3 The fire watch shall have the authority to stop the hot work operations if unsafe conditions develop.

2-4.4* The fire watch shall have fire-extinguishing equipment readily available and shall be trained in its use.

2-4.5 The fire watch shall be familiar with the facilities and procedures for sounding an alarm in the event of a fire.

2-4.6 The fire watch shall watch for fires in all exposed areas and try to extinguish them only when the fires are obviously within the capacity of the equipment available. If the fire watch determines that the fire is not within the capacity of the equipment, he or she shall sound the alarm immediately.

2-5 Mutual Responsibility. Management, contractors, the PAI, the fire watch, and the operators shall recognize their mutual responsibility for safety in hot work operations.

Chapter 3 Fire Prevention Precautions

3-1 Permissible Areas. Hot work shall be allowed only in areas that are or have been made fire safe. Hot work shall be performed in either designated areas or permit-required areas.

3-1.1 Designated Area. A designated area shall be a specific area designed or approved for such work, such as a maintenance shop or a detached outside location that is of noncombustible or fire-resistive construction, essentially free of combustible and flammable contents, and suitably segregated from adjacent areas.

3-1.2 Permit-Required Area. A permit-required area shall be an area that is made fire safe by removing or protecting combustibles from ignition sources.

3-2* Nonpermissible Areas. Hot work shall not be allowed in the following areas:

(a) In areas not authorized by management
(b) In sprinklered buildings while such protection is impaired
(c) In the presence of explosive atmospheres (that is, where mixtures of flammable gases, vapors, liquids, or dusts with air exist)
(d) In explosive atmospheres that can develop inside uncleaned or improperly prepared drums, tanks, or other containers and equipment that have previously contained such materials
(e) In explosive atmospheres that can develop in areas with an accumulation of combustible dusts

3-3 Hot Work Permit.

3-3.1* Before hot work operations begin in a nondesignated location, a written hot work permit by the permit authorizing individual (PAI) shall be required.

3-3.2 Before a hot work permit is issued, the following conditions shall be verified by the PAI.

(a) Hot work equipment to be used shall be in satisfactory operating condition and in good repair.
(b) Where combustible materials, such as paper clippings, wood shavings, or textile fibers, are on the floor, the floor shall be swept clean for a radius of 35 ft (11 m). Combustible floors (except wood on concrete) shall be kept wet, be covered with damp sand, or be protected by noncombustible or fire-retardant shields. Where floors have been wet down, personnel operating arc welding or cutting equipment shall be protected from possible shock.
(c)* All combustibles shall be relocated at least 35 ft (11 m) horizontally from the work site. If relocation is impractical, combustibles shall be protected with fire-retardant covers or otherwise shielded with metal or fire-retardant guards or curtains. Edges of covers at the floor shall be tight to prevent sparks from going under them, including where several covers overlap when protecting a large pile.
(d) Openings or cracks in walls, floors, or ducts within 35 ft (11 m) of the site shall be tightly covered with fire-

retardant or noncombustible material to prevent the passage of sparks to adjacent areas.

(e) Conveyor systems that might carry sparks to distant combustibles shall be shielded.

(f) If hot work is done near walls, partitions, ceilings, or roofs of combustible construction, fire-retardant shields or guards shall be provided to prevent ignition.

(g) If hot work is to be done on a wall, partition, ceiling, or roof, precautions shall be taken to prevent ignition of combustibles on the other side by relocating combustibles. If it is impractical to relocate combustibles, a fire watch on the opposite side from the work shall be provided.

(h) Hot work shall not be attempted on a partition, wall, ceiling, or roof that has a combustible covering or insulation, or on walls or partitions of combustible sandwich-type panel construction.

(i) Hot work that is performed on pipes or other metal that is in contact with combustible walls, partitions, ceilings, roofs, or other combustibles shall not be undertaken if the work is close enough to cause ignition by conduction.

(j) Fully charged and operable fire extinguishers that are appropriate for the type of possible fire shall be available immediately at the work area. If existing hose lines are located within the hot work area defined by the permit, they shall be connected and ready for service, but shall not be required to be unrolled or charged.

(k) If hot work is done in close proximity to a sprinkler head, a wet rag shall be laid over the head and then removed at the conclusion of the welding or cutting operation. During hot work, special precautions shall be taken to avoid accidental operation of automatic fire detection or suppression systems (for example, special extinguishing systems or sprinklers).

(l) Nearby personnel shall be suitably protected against heat, sparks, slag, and so on.

3-3.3* Based on local conditions, the PAI shall determine the length of the period for which the hot work permit is valid.

3-3.4* The area shall be inspected by the PAI at least once per day while the hot work permit is in effect to ensure that it is a fire-safe area.

3-4 Fire Watch.

3-4.1 A fire watch shall be required by the PAI when hot work is performed in a location where other than a minor fire might develop, or where the following conditions exist.

(a)* Combustible materials in building construction or contents are closer than 35 ft (11 m) to the point of operation.

(b) Combustible materials are more than 35 ft (11 m) away but are easily ignited by sparks.

(c) Wall or floor openings within a 35-ft (11-m) radius expose combustible materials in adjacent areas, including concealed spaces in walls or floors.

(d) Combustible materials are adjacent to the opposite side of partitions, walls, ceilings, or roofs and are likely to be ignited.

3-4.2 A fire watch shall be maintained for at least $^1/_2$ hour after completion of hot work operations in order to detect and extinguish smoldering fires.

3-4.3* More than one fire watch shall be required if combustible materials that could be ignited by the hot work operation cannot be directly observed by the initial fire watch.

3-5* Hot Tapping. Hot tapping or other cutting and welding on a flammable gas or liquid transmission or distribution utility pipeline shall be performed by a crew that is qualified to make hot taps.

Chapter 4 Public Exhibitions and Demonstrations

4-1 Scope. The following provisions shall apply to oxy-fuel gas welding and cutting operations at public exhibitions, demonstrations, displays, and trade shows (referred to hereinafter as the *site*) in order to promote the safe usage of compressed gases in public gatherings.

4-2 Supervision. Installation and operation of welding, cutting, and related equipment shall be done by, or under the supervision of, a competent operator to ensure the personal protection of viewers and demonstrators as well as the protection from fire of materials in and around the site and the building itself.

4-3 Site.

4-3.1 Location. Sites involving the use and storage of compressed gases shall be located so as not to interfere with the egress of people during an emergency.

4-3.2 Design. The site shall be constructed, equipped, and operated in such a manner that the demonstration will be carried out so as to minimize the possibility of injury to viewers.

4-4 Fire Protection.

4-4.1 Fire Extinguishers. Each site shall be provided with a portable fire extinguisher of appropriate size and type and with a pail of water.

4-4.2 Shielding. The public, combustible materials, and compressed gas cylinders at the site shall be protected from flames, sparks, and molten metal.

4-4.3 Fire Department Notification. The fire department shall be notified in advance of such use of the site.

4-5 Cylinders.

4-5.1 Gas Capacity Limitation. Cylinders containing compressed gases for use at the site shall not be charged in excess of one-half their maximum permissible content. Cylinders of nonliquefied gases and acetylene shall be charged to not more than one-half their maximum permissible charged gauge pressure (psi or kPa). Cylinders of liquefied gases shall be charged to not more than one-half the maximum permissible capacity in pounds (kilograms).

4-5.2 Storage. Cylinders located at the site shall be connected for use. Enough additional cylinders shall be permitted to be stored at the site to furnish approximately one day's consumption of each gas used. Other cylinders shall be stored in an approved storage area, preferably outdoors, but not near a building exit.

4-5.3 Transporting Cylinders. Cylinders in excess of 40 lb (18 kg) total weight being transported to or from the site shall be carried on a hand or motorized truck.

4-5.4 Process Hose. Process hose shall be located and protected so that they will not be physically damaged.

4-5.5 Cylinder Valves. Cylinder valves shall be closed when equipment is unattended.

4-5.6 Valve Caps. If cylinders are designed to be equipped with valve protection caps, such caps shall be in place except when the cylinders are in service or are connected and ready for service.

4-5.7 Cylinder Protection. Cylinders shall be secured so that they cannot be knocked over.

Chapter 5 Referenced Publications

5-1 The following documents or portions thereof are referenced within this standard as mandatory requirements and shall be considered part of the requirements of this standard. The edition indicated for each referenced mandatory document is the current edition as of the date of the NFPA issuance of this standard. Some of these mandatory documents might also be referenced in this standard for specific informational purposes and, therefore, are also listed in Appendix C.

5-1.1 NFPA Publications. National Fire Protection Association, 1 Batterymarch Park, P.O. Box 9101, Quincy, MA 02269-9101.

NFPA 51, *Standard for the Design and Installation of Oxygen-Fuel Gas Systems for Welding, Cutting, and Allied Processes,* 1997 edition.

NFPA 241, *Standard for Safeguarding Construction, Alteration, and Demolition Operations,* 1996 edition.

Appendix A Explanatory Material

Appendix A is not a part of the requirements of this NFPA document but is included for informational purposes only. This appendix contains explanatory material, numbered to correspond with the applicable text paragraphs.

A-1-5 Approved. The National Fire Protection Association does not approve, inspect, or certify any installations, procedures, equipment, or materials; nor does it approve or evaluate testing laboratories. In determining the acceptability of installations, procedures, equipment, or materials, the authority having jurisdiction may base acceptance on compliance with NFPA or other appropriate standards. In the absence of such standards, said authority may require evidence of proper installation, procedure, or use. The authority having jurisdiction may also refer to the listings or labeling practices of an organization that is concerned with product evaluations and is thus in a position to determine compliance with appropriate standards for the current production of listed items.

A-1-5 Authority Having Jurisdiction. The phrase "authority having jurisdiction" is used in NFPA documents in a broad manner, since jurisdictions and approval agencies vary, as do their responsibilities. Where public safety is primary, the authority having jurisdiction may be a federal, state, local, or other regional department or individual such as a fire chief; fire marshal; chief of a fire prevention bureau, labor department, or health department; building official; electrical inspector; or others having statutory authority. For insurance purposes, an insurance inspection department, rating bureau, or other insurance company representative may be the authority having jurisdiction. In many circumstances, the property owner or his or her designated agent assumes the role of the authority having jurisdiction; at government installations, the commanding officer or departmental official may be the authority having jurisdiction.

A-1-5 Permit Authorizing Individual (PAI). This individual is permitted to be, among others, the supervisor, foreperson, property owner or representative, or health and safety administrator. The PAI is aware of the fire hazards involved and is familiar with the provisions of this standard.

A-1-5 Welding and Allied Processes. Refer to the Master Chart of Welding and Allied Processes in ANSI/ASC Z49.1, *Safety in Welding, Cutting, and Allied Processes,* for a list of welding and allied processes.

A-2-1 Management should ensure that the contractor has evidence of financial responsibility, which can take the form of an insurance certificate or other document attesting to coverage or responsibility.

A-2-2.3 Alternate methods to hot work should be considered where practical.

A-2-2.6 The inspection is usually made $^1/_2$ hour after the completion of hot work to detect and extinguish possible smoldering fires. The inspector should be alert for circumstances that can require an extension of the final inspection interval.

A-2.4.4 It is desirable for the fire watch to have experience with test fires.

A-3-2 For additional information on cutting and welding of containers that have held flammable materials, see NFPA 327, *Standard Procedures for Cleaning or Safeguarding Small Tanks and Containers Without Entry,* and ANSI/AWS F-4.1, *Recommended Safe Practices for the Preparation for Welding and Cutting Containers and Piping.*

Additional consideration should be given when performing hot work in areas near the storage of large quantities of exposed, readily ignitible materials such as bulk sulfur, baled paper, or cotton. For additional information on welding and cutting in storage areas, refer to NFPA 231, *Standard for General Storage;* NFPA 231C, *Standard for Rack Storage of Materials;* NFPA 231D, *Standard for Storage of Rubber Tires;* NFPA 231E, *Recommended Practice for the Storage of Baled Cotton;* and NFPA 655, *Standard for Prevention of Sulfur Fires and Explosions.*

A-3-3.1 Examples of hot work permits are shown in Figures A-3-3.1(a) and A-3-3.1(b). These permits can be modified to suit local conditions.

A-3-3.2(c) When hot work is performed at an elevated level, it should be noted that the sparks or slag can fall at a trajectory and land further than 35 ft (11 m) horizontally from a point directly under the hot work operator.

A-3-3.3 It is advisable that the permit should be issued for a maximum period of 24 hours.

Side 1

HOT WORK PERMIT

Date _____

Building _____

Dept. _____ Floor _____

Work to be done _____

_____

Special precautions _____

_____

Is fire watch required? _____

The location where this work is to be done has been examined, necessary precautions taken, and permission is granted for this work. (See other side.)

Permit expires _____

Signed _____
Permit Authorizing Individual (PAI)

Time started _____ Completed _____

FINAL CHECK

Work area and all adjacent areas to which sparks and heat might have spread [including floors above and below and on opposite side of wall(s)] were inspected 30 minutes after the work was completed and were found firesafe.

Signed _____
Permit Authorizing Individual (PAI)

Side 2

ATTENTION

Before approving any hot work permit, the PAI shall inspect the work area and confirm that precautions have been taken to prevent fire in accordance with NFPA 51B.

PRECAUTIONS

❑ Sprinklers in service
❑ Hot work equipment in good repair

WITHIN 35 FT OF WORK

❑ Floors swept clean of combustibles
❑ Combustible floors wet down, covered with damp sand, metal, or other shields
❑ All wall and floor openings covered
❑ Covers suspended beneath work to collect sparks

WORK ON WALLS OR CEILINGS

❑ Construction noncombustible and without combustible covering
❑ Combustibles moved away from opposite side of wall

WORK ON ENCLOSED EQUIPMENT
(Tanks, containers, ducts, dust collectors, etc.)

❑ Equipment cleaned of all combustibles
❑ Containers purged of flammable vapors

FIRE WATCH

❑ To be provided during and 30 minutes after operation
❑ Supplied with a fully charged and operable fire extinguisher
❑ Trained in use of equipment and in sounding fire alarm

FINAL CHECK

❑ To be made 30 minutes after completion of any operation unless fire watch is provided

Signed _____
Permit Authorizing Individual (PAI)

Figure A-3-3.1(a) Sample of a hot work permit.

HOT WORK PERMIT[1]

BEFORE INITIATING HOT WORK, ENSURE PRECAUTIONS ARE IN PLACE!
MAKE SURE AN APPROPRIATE FIRE EXTINGUISHER IS READILY AVAILABLE!

This Hot Work Permit is required for any operation involving open flames or producing heat and/or sparks. This includes, but is not limited to: Brazing, Cutting, Grinding, Soldering, Thawing Pipe, Torch-Applied Roofing[2], and Cadwelding.

INSTRUCTIONS

A. Verify precautions listed at right (or do not proceed with the work).
B. Complete and retain this permit.

HOT WORK BEING DONE BY
☐ EMPLOYEE
☐ CONTRACTOR _____

DATE	JOB NO.

LOCATION/BUILDING & FLOOR

NATURE OF JOB/OBJECT

NAME OF PERSON DOING HOT WORK

I verify the above location has been examined, the precautions checked on the Required Precautions Checklist have been taken to prevent fire, and permission is authorized for work.

SIGNED:

PERMIT EXPIRES:	DATE	TIME	AM PM

NOTE EMERGENCY NOTIFICATION ON BACK OF FORM.
USE AS APPROPRIATE FOR YOUR FACILITY.

THIS PERMIT IS GOOD FOR ONE DAY ONLY!

Required Precautions Checklist

☐ Available sprinklers, hose streams, and extinguishers are in service/operable.
☐ Hot work equipment in good repair.

Requirements within 35 ft (10 m) of work
☐ Flammable liquids, dust, lint, and oil deposits removed.
☐ Explosive atmosphere in area eliminated.
☐ Floors swept clean.
☐ Combustible floors wet down, covered with damp sand or fire-resistant sheets.
☐ Remove other combustibles where possible. Otherwise protect with fire-resistant tarpaulins or metal shields.
☐ All wall and floor openings covered.
☐ Fire-resistant tarpaulins suspended beneath work.

Work on walls or ceilings/enclosed equipment
☐ Construction is noncombustible and without combustible covering or insulation.
☐ Combustibles on other side of walls moved away.
☐ Danger exist by conduction of heat into another area.
☐ Enclosed equipment cleaned of all combustibles.
☐ Containers purged of flammable liquids/vapors.

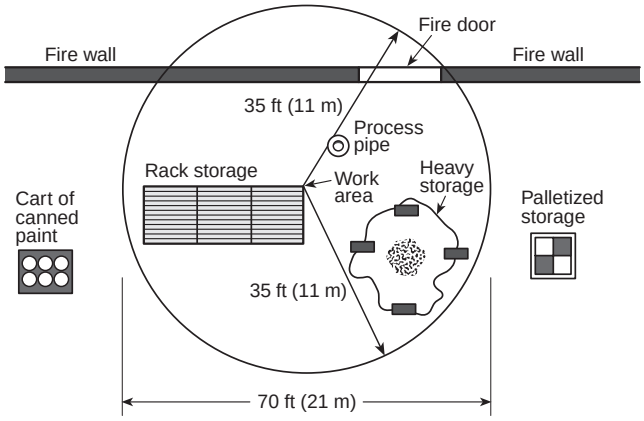
Fire watch/hot work area monitoring
☐ Fire watch will be provided during and for 30 minutes after work, including any coffee or lunch breaks.
☐ Fire watch is supplied with suitable extinguishers.
☐ Fire watch is trained in use of this equipment and in sounding alarm.
☐ Fire watch may be required for adjoining areas, above, and below.
☐ Monitor hot work area for 30 minutes after job is completed.

Other Precautions Taken
☐ Confined space entry permit required.
☐ Is area protected with smoke or heat detection.
☐ Ample ventilation to remove smoke/vapor from work area.
☐ Lockout/tagout required.

_____

Notes:
1. When used in accordance with NFPA 51B, this permit is to be used for, but not limited to, the following: welding, cutting, grinding, open-flame soldering, and thawing pipe.
2. Torch applied roofing is exempt from NFPA 51B per 1-2.3.

Figure A-3-3.1(b) Sample of a hot work permit.



- Remove or shield from sparks all potential fuels within 35 ft (11 m) of the work area. (In this case, the paint cart and palletized storage have been moved.)
- Empty racks on which the work is to be done of all storage.
- Close fire doors and seal floor openings such as the area surrounding process piping with noncombustible caulking.
- Cover heavy combustible storage that is impractical to move with the fire-resistive tarpaulin.

Courtesy of Factory Mutual Engineering Corporation.

Figure A-3-4.1(a) The hot work 35-ft (11-m) rule.

A-3-3.4 In some situations, it is advisable to inspect the area once per shift if conditions warrant.

A-3-4.1(a) Figure A-3-4.1(a) demonstrates the hot work 35-ft (11-m) rule.

A-3-4.3 Situations where an additional fire watch(es) might be necessary include hot work near open shafts, elevated heights, or where sparks can travel through openings, and so on.

A-3-5 For a gas pipeline, see ANSI/ASME B31.8, *Gas Transmission and Distribution Piping Systems*, 841.27.

Appendix B Significant Hot Work Incidents

This appendix is not a part of the requirements of this NFPA document but is included for informational purposes only.

B-1 Hot work processes are a necessary part of our industrial world. Too often, however, the persons (users, supervisors, contractors) involved in the use of these processes do not fully appreciate that their improper use can result in loss of life and property from fire and explosion. In fact, hot work performed improperly is a major cause of fire.

Appendix B is a collection of accounts of fires and explosions caused by improper control of hot work. Its sole purpose is to illustrate how such incidents occur and to emphasize the provisions of this standard.

Kaukauna, WI, Warehouse

While an arc welder was being used on the second floor, sparks dropped through an opening to cardboard boxes below and the boxes ignited. There was no fire watch on the first floor, and when the fire was discovered 15 minutes later, employees could not put it out. They finally called the fire department, but were too late to save the two-story building of ordinary construction. Loss was $1.6 million.

Winnipeg, Manitoba, Food Processing

While an employee was using an oxyacetylene cutting torch to modify a bracket in the boiler room, hot slag ignited canvas and plywood that were being used as a temporary covering over a hole in the wall between the fire-resistive boiler room and the storage room. Fire then spread to waxed cartons and plastic bags in the storage room. Fire fighting was impeded by the windowless walls and thick black smoke. Loss was $650,000.

Halsey, OR, Rolled Paper Storage

A bracket was being welded onto a column adjacent to an aisle, with rolled paper storage not more than 5 ft (1.5 m) away. A welding permit was reportedly issued for the work, but the standard permit form clearly stated that combustibles within 35 ft (11 m) of the work should be removed or shielded. The permit also required the signature of the supervisor certifying that a check of the area had been made. In this case, there was no protection for the combustibles and no signature.

The fire quickly spread into the interior of the storage pile, but sprinklers operated, roof vents were opened, and hose streams were brought into play as the smoke cleared a little. About 300 rolls were burned beyond salvage and other rolls were wet. Loss was $250,000.

Atlanta, GA, Poultry Processing

An employee using an electric arc welder was working in an area above a refrigerated room, which was insulated with polyurethane foam sandwiched between sheets of aluminum. Sparks fell on the exposed ends of the insulation, causing a severe fire. The heat was sufficient to bring about collapse of exposed metal bar joist roof framing, and the total loss was $250,000.

Ontario, OR, Food Processing

An oxyacetylene cutting torch was being used in a metal-lined freezing tunnel, with some pipes passing through the walls of the tunnel and making a loose fit with these walls. Sparks evidently passed through a crack to ignite polystyrene foam insulation. This event happened during a rest period and was not discovered until the rest period was over. Further time was lost during a fruitless effort to extinguish the fire with extinguishers and a small hose. The fire department, when finally called, was confronted with a tough task due to the heavy smoke and the fire spreading to the concealed and undivided attic space. Loss was $2.3 million.

San Pedro, CA, Wharf

Workers were using a gasoline-powered chain saw and cutting torch to repair pilings on a 3700-ft (1128-m) long wharf. While some of the workers were refueling the chain saw from a 2-gal (7.6-L) can, another worker was using a cutting torch far too close to the refueling operation. Gasoline vapors ignited and, during efforts to extinguish the fire, the can was kicked into the water. Burning gas in the water ignited the pilings, and flames spread 370 ft (113 m) along the underside of the wharf before fire fighters could control the fire.

Portland, OR, Lumber Mill

Workers had shut down one of several sprinkler systems in the plant to remove branch lines to facilitate removal of a conveyor. While workers were cutting bolts from the conveyor with welding equipment, some of the sparks went through cracks in the floor and landed in sawdust accumulations below. Smoldering occurred for 3 hours without being noticed by the maintenance employees, who were the only people in the plant. Meanwhile, the area in the region of the

cutting operations, but not the floor below, had been washed down and visited regularly at $^1/_2$-hour intervals.

When the fire was finally noticed, some time was spent in trying to extinguish it before the fire department was called. By the time the fire department arrived, it was too late to save the lumber storage and stacker buildings. Destruction caused loss of $1.25 million.

Austin, TX, University Library

Workers were using an acetylene torch to remove old heating ducts in a utility shaft between the twentieth and twenty-first stories of the tower of a twenty-seven-story university library building. Flying sparks fell through a vent and ignited papers stacked against the vent in a storage room on the twentieth floor. Apparently the fire burned for 20 to 30 minutes before discovery.

There was no fire protection in the upper stories except for portable fire extinguishers, and fire fighters had to connect to the standpipes in the third and fourth stories and pull hose lines up the enclosed stairways to the twentieth and twenty-first stories. They finally controlled the fire in $2^1/_2$ hours, but damage extended to four stories when fire spread by way of nonfirestopped utility shafts and elevator shafts.

The work was being done by two air conditioning installation workers, on contract. They had not investigated the possibility of combustible material being in contact with the old heating duct on which they were working.

Atlanta, GA, Wire and Nail Mill

A small fire started on the mill's built-up wood roof while repairs were made using an acetylene torch for welding. The workers making the repairs believed that they had extinguished the fire, but $3^1/_2$ hours later the fire broke out again and spread on an accumulation of metal dust on overhead beams throughout the unsprinklered, undivided single-story structure. Loss was $2.3 million.

Provo, UT, Hardware Warehouse

An employee was welding a broken metal roof beam in the attic of a one-story brick, wood-joisted, wholesale hardware building. A spark fell through a crack in the attic floor and ignited cardboard boxes in the shelving below. No precautions had been taken to guard against fire, and the welder did not realize that there was a fire until he felt the heat coming up from below. Loss was $131,000.

Thomson, NY, Paper Mill

Production lines were shut down in a tissue paper mill so that maintenance workers could use a cutting torch to remove a drive roll for repairs. The area where the cutting was to be done was cleaned up and wet down as a precaution against flying sparks. Also, an employee with a portable extinguisher acted as fire guard during the cutting operation.

A stray spark ignited paper dust on the floor at the adjacent machine. When the fire watch attempted to extinguish the small blaze, he found that his portable extinguisher was empty. The blaze spread to paper dust and lint on top of an unused overhead heating duct, which was 2 ft (0.6 m) to 5 ft (1.5 m) in diameter. It took fire fighters about 3 hours to extinguish the blaze in the unsprinklered duct. The damage to tissue paper by fire-fighting operations amounted to $25,000.

Jacksonville, IL, Pavement Manufacturing

After partially unloading a tanker of MC 800 road oil at a temperature of about 290°F (143°C), two employees went to the top of the asphalt tank to straighten a pipe through which they measured the oil level. They were using an acetylene torch for this repair work. The torch so heated the top of the tank that flammable vapors within the tank exploded and tore up a large part of the top. Both men were thrown long distances and killed.

Toledo, OH, Tar Manufacturing

Welders were repairing a leak in an odor-scrubbing system when an explosion occurred in a tank connected with the system and containing naphthalene vapors above the hot tar level. It is believed that heat from the torch ignited flammable vapors within the pipe and that the flame was propagated to the tank. The spread of hot tar when the tank ruptured handicapped fire fighters in gaining quick access to the area. Three workers were killed and property damage was $110,000.

New Orleans, LA, Office Building

An outside contractor installing new elevator equipment in a seven-story office building with plank floors set a number of fires as a result of cutting and welding operations, but the contractor's employees extinguished all but one. That fire occurred toward the end of the day's work, and the four employees, without discovering the fire, went home. Later in the evening, the night porter noticed the old elevator penthouse, partly of wooden construction, ablaze as he was summoning the elevator to perform his normal duties. Two hours later, the fire department, using many large hose lines, brought the fire under control. The loss, mainly to the top story from fire and to lower stories from water, was $530,000.

There was no formal fire watch nor, following the last use of the welder, was there any inspection of the area during a set period after the welding.

Hatboro, PA, Chemical Plant

Workers were welding some additional fill-line supports on a 6000-gal (22,713-L) vertical tank containing 3000 gal (11,356 L) of alcohol. Heat transmitted through the metal of the tank ignited alcohol vapors inside, and the tank was blown into the air. Alcohol was dumped into two diked areas containing eight tanks of high-flashpoint liquid, but heavy use of hose streams kept other tanks from rupturing. Loss was $100,000.

New Orleans, LA, Candy Storage

The outside of the walls of this sprinklered metal-frame warehouse were lined with a combustible laminated paper-asphalt vapor barrier and a $^1/_2$-in. layer of foamed polystyrene insulation. A worker was welding metal plates to the base of the structural member when the combustible vapor barrier ignited. While the welder ran to turn in an alarm and to get a portable extinguisher, seven sprinklers operated to control the fire.

Billings, MT, Auditorium

While remodeling the auditorium at the fairgrounds, workers were welding straps on channel iron, which had been placed on each side of 12-in. × 12-in. (30.5 cm × 30.5 cm) wooden uprights to provide more strength to these columns. Heat from the torch apparently caused some smoldering in the columns. Approximately 5 hours later, the caretaker noticed that the roof was ablaze. It was too late then to save the building, which was of ordinary construction and nonsprinklered. Loss was $266,000.

Sorel, P.Q., Passenger Ship Under Construction

A shipyard worker was welding a steel bracket beneath the steel deck of a stateroom when the hot deck plate ignited paper on the floor of the stateroom. Flames then spread to