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NFPA 241 Safeguarding Construction, Alteration, and Demolition Operations 1993 Edition

National Fire Protection Association, 1 Batterymarch Park, PO Box 9101, Quincy, MA 02269-9101

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Policy Adopted by NFPA Board of Directors on December 3, 1982

The Board of Directors reaffirms that the National Fire Protection Association recognizes that the toxicity of the products of combustion is an important factor in the loss of life from fire. NFPA has dealt with that subject in its technical committee documents for many years.

There is a concern that the growing use of synthetic materials may produce more or additional toxic products of combustion in a fire environment. The Board has, therefore, asked all NFPA technical committees to review the documents for which they are responsible to be sure that the documents respond to this current concern. To assist the committees in meeting this request, the Board has appointed an advisory committee to provide specific guidance to the technical committees on questions relating to assessing the hazards of the products of combustion.

Statement on NFPA Procedures

This material has been developed under the published procedures of the National Fire Protection Association, which are designed to assure the appointment of technically competent Committees having balanced representation. While these procedures assure the highest degree of care, neither the National Fire Protection Association, its members, nor those participating in its activities accepts any liability resulting from compliance or noncompliance with the provisions given herein, for any restrictions imposed on materials or processes, or for the completeness of the text.

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Attn: Product Development

NFPA 241

Standard for

Safeguarding Construction, Alteration, and Demolition Operations

1993 Edition

This edition of NFPA 241, *Standard for Safeguarding Construction, Alteration, and Demolition Operations*, was prepared by the Technical Committee on Construction and Demolition and acted on by the National Fire Protection Association, Inc. at its Annual Meeting held May 24-27, 1993, in Orlando, FL. It was issued by the Standards Council on July 23, 1993, with an effective date of August 20, 1993, and supersedes all previous editions.

The 1993 edition of this document has been approved by the American National Standards Institute.

Changes other than editorial are indicated by a vertical rule in the margin of the pages on which they appear. These lines are included as an aid to the user in identifying changes from the previous edition.

Origin and Development of NFPA 241

Work on this subject commenced in 1930 when the NFPA Committee on Construction Operations developed *Recommended Good Practice Requirements for Building Construction Operations*. This text was adopted by the National Fire Protection Association, with revisions in 1933. In 1942 a tentative revision was submitted, and, while no official action was taken, the revision was published subsequently for information purposes in Volume III of the *National Fire Codes*® published by the NFPA.

The NFPA Committee on Building Construction had jurisdiction over this standard when a tentative text prepared by that Committee was adopted at the 1957 NFPA Annual Meeting. That text was unanimously approved by the NFPA in 1958. A complete revision was adopted by the NFPA in 1968 and 1973. An editorial revision was approved in 1975 which brought the standard into conformance with the NFPA *Manual of Style*. The standard was again substantively reconfirmed in 1980.

The 1986 edition represented a complete rewrite. That rewrite represented a comprehensive review by the Technical Committee on Construction and Demolition. When the document was revised in 1980, it came under the Technical Committee on Building Construction.

The 1986 update changed the format in which the safeguards were presented. Chapters 1 through 5 were general in nature and applied to both construction and demolition processes. Chapter 6 presented the specifics associated only with construction processes. Chapter 7 addressed the specifics of demolition. A new Chapter 8 listed mandatory references with which various requirements of the standard required compliance. Nearly 20 NFPA codes and standards were referenced in a mandatory fashion.

That revision expanded the treatment of items related to an overall construction and demolition fire safety plan. Definitions were expanded and added to cover terms with meanings that are unique to the standard. Temporary heating equipment was required to be listed. The section on smoking was expanded. Trash disposal was broadened to include housekeeping. Outside chutes, fire cutoffs, and explosives used in demolition were addressed. Material on temporary standpipes was included from NFPA 14, *Standard for the Installation of Standpipe and Hose Systems*.

The 1989 edition completely rewrote the section on roofing operations and greatly expanded the associated appendix guidance items so as to address torch-applied roofing in additional detail. A whole new chapter was added on underground operations.

For the 1993 edition, extensive editing by the Committee was undertaken to clarify and update the standard.

Technical Committee on Construction and Demolition

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This list represents the membership at the time the Committee was balloted on the text of this edition. Since that time, changes in the membership may have occurred.

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 identification and control of fire hazards associated with the construction, alteration, and demolition of buildings, tunnels, and bridges not otherwise covered by other NFPA standards.

Contents

NFPA 241

Standard for

Safeguarding Construction, Alteration, and Demolition Operations

1993 Edition

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

Information on referenced publications can be found in Chapter 10 and Appendix B.

Chapter 1 General

1-1 Introduction.

1-1.1 Fires during construction, alteration, or demolition operations are an ever-present threat. The fire potential is inherently greater during these operations than in the completed structure due to previous occupancy hazard and the presence of large quantities of combustible materials and debris, together with such ignition sources as temporary heating devices, cutting/welding/plumber's torch operations, open fires, and smoking. The threat of arson is also greater during construction and demolition operations due to the availability of combustible materials on-site and the open access.

1-1.2 Fires during construction, alteration, or demolition operations can be eliminated or controlled through the early planning, scheduling, and implementation of fire prevention measures, fire protection systems, rapid communications, and on-site security. An overall construction or demolition fire safety program shall be developed; essential items to be emphasized include:

(a) Good housekeeping;

(b) On-site security;

(c) Installation of new fire protection systems as construction progresses;

(d) Preservation of existing systems during demolition;

(e) The organization and training of an on-site fire brigade;

(f) A prefire plan developed with the local fire department;

(g) Rapid communication; and

(h) Consideration of special hazards resulting from previous occupancies.

1-1.3 A fire safety program shall be included in all construction, alteration, or demolition contracts, and the right of the owner to administer and enforce this program shall be established, even though the building is entirely under the jurisdiction of the contractor.

1-1.4 This standard presents measures for preventing or minimizing fire damage during construction, alteration, and demolition operations. The public fire department and other fire protection authorities shall also be consulted for guidance. The unique and dangerous situations confronting fire fighters during such operations require that a complete exchange of pertinent information be established and continued during the life of the project.

1-1.5 General requirements applying to construction and demolition are contained in Chapters 1 through 5; specific requirements for construction and alteration activities are found in Chapter 6; those requirements specific to roofing operations are covered in Chapter 7; those requirements specific to demolition activities are covered in Chapter 8; and specific requirements for activities in underground locations are contained in Chapter 9. Alteration activities shall be permitted to require the use of both the demolition and construction activity requirements as applicable.

1-2 Scope. This standard applies to structures in the course of construction, alteration, or demolition, including those in underground locations.

1-3 Purpose. This standard is intended to prescribe minimum safeguards for construction, alteration, and demolition operations so as to provide reasonable safety to life and property from fire during such operations. Nothing in this standard is intended to restrict new technologies or alternate arrangements, provided that the level of safety prescribed by the standard is not lowered.

1-4 Definitions. For the purpose of this standard, the following terms shall have the meanings given below.

Approved. Acceptable to the authority having jurisdiction.

NOTE: 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 or 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, such 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 concerned with product evaluations which is in a position to determine compliance with appropriate standards for the current production of listed items.

Authority Having Jurisdiction. The "authority having jurisdiction" is the organization, office, or individual responsible for "approving" equipment, an installation, or a procedure.

NOTE: 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, 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 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."

Hot Work. Operations including cutting, welding, Thermit welding, brazing, soldering, grinding, thermal spraying, thawing pipe, torch-applied roofing, or any other similar situation.

Listed. Equipment or materials included in a list published by an organization acceptable to the "authority having jursidiction" and concerned with product evaluation, that maintains periodic inspection of production of listed equipment or materials and whose listing states either that the equipment or material meets appropriate standards or has been tested and found suitable for use in a specific manner.

NOTE: The means for identifying listed equipment may vary for each organization concerned with product evaluation, some of which do not recognize equipment as listed unless it is also labeled. The "authority having jurisdiction" should utilize the system employed by the listing organization to identify a listed product.

Protected Structures. Structures equipped with operational automatic sprinkler systems or Class I, II, or III wet standpipe or dry standpipe systems for fire department use.

Qualified Agency. Any individual, firm, corporation, or company that either in person or through a representative is regularly engaged in such work, is familiar with all precautions required, and has complied with all the requirements of the authority having jurisdiction.

Roofing Kettle. Any container in excess of 15 gal (56.8 L) capacity used for preheating tar, asphalt, pitch, or similar substances for waterproofing.

Shall. Indicates a mandatory requirement.

Should. Indicates a recommendation or that which is advised but not required.

Single-Ply Roofing Systems. Single-layer roof coverings made of plastic, synthetic rubber, or modified bitumen.

Structures. Includes but is not limited to buildings, piers, bridges, and underground installations.

Thermal Spraying. A group of welding or allied processes in which finely divided metallic or nonmetallic materials are deposited in a molten or semimolten condition to form a coating. The coating material shall be permitted to be in the form of powder, ceramic rod, wire, or molten materials.

Thermit Welding. A welding process that produces coalescence of metals by heating them with superheated liquid metal from a chemical reaction between a metal oxide and aluminum, with or without the application of pressure. Filler metal, where used, is obtained from the liquid metal.

Torch-Applied Roof Systems. Bituminous roofing systems using membranes that are adhered by heating with a torch and melting asphalt back coating instead of mopping hot asphalt for adhesion.

Underground Structures. Structures located in an underground tunnel, shaft, chamber, passageway, or cut and covered excavation.

Chapter 2 Temporary Construction, Equipment, and Storage

2-1 Temporary Offices and Sheds.

2-1.1* Separation distances between buildings under construction and construction-related structures, such as temporary offices, trailers, sheds, and other facilities for the storage of tools and materials having combustible construction or contents, shall be according to Table 2-1.1.

Table 2-1.1 Separation Distances

Temporary Structure Exposing Wall Length, ft (m)	Minumum Separation Distance, ft (m)
20 (6)	30 (9)
30 (9)	35 (11)
40 (12)	40 (12)
50 (15)	45 (14)
60 (18)	50 (15)
More than 60 (18)	60 (18)

NOTE 1: If the separation distance between temporary structures is less than the minimum separation distance, then the exposing wall length shall be considered the sum of individual exposing wall lengths of the temporary structure.
NOTE 2: A 75 percent reduction in separation distances can be applied if automatic sprinkler protection is provided in the exposing structure.
NOTE 3: The separation distances apply to single-level structures only. For multilevel unsprinklered structures this table does not apply. A level, as applied for this table, is 12 ft (1.2 m).

2-1.2* Detachment between temporary structures, adequate temporary fixed fire protection systems, and portable equipment shall be provided as required by the authority having jurisdiction.

2-1.3 Only safely installed approved heating devices shall be used in temporary offices and sheds. Ample clearance shall be provided around stoves and heaters and all chimney and vent connectors to prevent ignition of adjacent combustible materials as per NFPA 211, *Standard for Chimneys, Fireplaces, Vents, and Solid Fuel-Burning Appliances* (connectors and solid fuel); NFPA 54, *National Fuel Gas Code* (fuel gas devices); and NFPA 31, *Standard for the Installation of Oil-Burning Equipment* (liquid fuel devices). Where temporary heating devices are used, see Section 3-2.

2-2 Temporary Enclosures.

2-2.1 Only noncombustible panels or flame-resistant tarpaulins or approved materials of equivalent fire-retardant characteristics shall be used. Any other fabrics or plastic films used shall be certified as conforming to the requirements of the Large-Scale Test contained in NFPA 701, *Standard Methods of Fire Tests for Flame-Resistant Textiles and Films.*

2-2.2 Where used to enclose structures, forming equipment, and similar items, the enclosing material shall be fastened securely or guarded by construction so it cannot be blown by the wind against heaters or other sources of ignition.

2-2.3 For temporary enclosures there shall be a minimum of one fire extinguisher suitable for all classes of fires that are expected inside the enclosure. Fire extinguishers shall be located so that travel distance to a fire extinguisher does not exceed 50 ft (15 m).

2-3 Equipment.

2-3.1 Internal combustion engines and associated equipment, such as air compressors, hoists, derricks, pumps, and similar devices, shall be so located that the exhausts discharge well away from combustible materials. Where the exhausts are piped to outside the structure under construction, alteration, or demolition, a clearance of at least 9 in. (230 mm) shall be maintained between such piping and combustible material. See NFPA 37, *Standard for the Installation and Use of Stationary Combustion Engines and Gas Turbines.*

2-3.2 Internal combustion engines and associated equipment shall be shut down and allowed to cool sufficiently prior to refueling. (*See 5-6.4.*)

2-3.3 Service areas for equipment shall not be located within structures under construction, alteration, or demolition.

2-3.4 Fuel for internal combustion engines shall not be stored within structures under construction, alteration, or demolition, except as allowed in Section 3-5.

Chapter 3 Processes and Hazards

3-1 Hot Work Operations.

3-1.1* A permit system shall be used for hot work operations on the job site under the supervision of the fire prevention program manager (*see 5-1.1*). A permit shall not be issued until (1) it has been determined that hot work can be safely conducted at the desired location, (2) combustibles have been moved away or covered by an approved tarpaulin (3) the atmosphere is nonflammable, and (4) a fire watch (with dedicated extinguisher) is posted for the duration of the work and for 30 minutes thereafter (60 minutes for torch-applied roofing operations; see 7-1-3.11) to see that sparks or drops of hot metal do not start fires. All cracks or openings in floors shall be safely covered or closed.

3-1.2 All gas-operated cutting and welding equipment and operations shall be in accordance with applicable sections of NFPA 51, *Standard for the Design and Installation of Oxygen-Fuel Gas Systems for Welding, Cutting, and Allied Processes*, and NFPA 51B, *Standard for Fire Prevention in Use of Cutting and Welding Processes.*

3-1.3 Thermit Welding.

3-1.3.1* In Thermit welding the mold shall be thoroughly dried before the charge is ignited and provided with a cover.

3-1.3.2* Bulk storage of Thermit welding materials shall be maintained in a detached shed at least 50 ft (15 m) from main buildings. The shed shall be maintained dry, posted as a "No Smoking" area, and kept locked.

3-1.3.3 Containers for the starting material shall be tightly closed immediately after each use.

3-1.3.4 The molds shall not be removed until at least 10 to 12 minutes after the weld is made or after sufficient cooling has taken place.

3-1.3.5 There shall be no smoking in areas where Thermit welding material is being used.

3-2 Temporary Heating Equipment.

3-2.1 Temporary heating equipment shall be listed and shall be installed, used, and maintained according to the manufacturer's instructions.

3-2.2 Chimney or vent connectors, where required from direct-fired heaters, shall be maintained at least 18 in. (457 mm) from combustibles and shall be installed in accordance with NFPA 211, *Standard for Chimneys, Fireplaces, Vents, and Solid Fuel-Burning Appliances.*

3-2.3 Oil-fired heaters shall comply in design and installation features with NFPA 31, *Standard for the Installation of Oil-Burning Equipment.*

3-2.4 Fuel supplies for liquefied petroleum gas-fired heaters shall comply with NFPA 58, *Standard for the Storage and Handling of Liquefied Petroleum Gases*, and NFPA 54, *National Fuel Gas Code.*

3-2.5* Refueling operations shall be conducted in an approved manner.

3-2.6 Heating devices shall be situated so that they are secured and shall otherwise be installed in accordance with their listing, including clearance to combustible material, equipment, or construction.

3-2.7* Temporary heating equipment, where utilized, shall be monitored for safe operation and maintained by properly trained personnel.

3-3 Smoking.

3-3.1* Smoking shall be prohibited at or in the vicinity of hazardous operations or combustible/flammable materials. "No Smoking" signs shall be posted in these areas.

3-3.2 Smoking shall be permitted only in designated areas. Where smoking is permitted, safe receptacles for smoking materials shall be provided.

3-4 Waste Disposal.

3-4.1* Accumulations of combustible waste material, dust, and debris shall be removed from the structure and its immediate vicinity at the end of each work shift or more frequently as necessary for safe operations.

3-4.2 Rubbish shall not be burned on the premises without first obtaining a permit from the authority having jurisdiction.

3-4.3 Materials susceptible to spontaneous ignition, such as oily rags, shall be stored in a listed disposal container.

3-5 Flammable and Combustible Liquids, and Flammable Gases.

3-5.1 Storage.

3-5.1.1 Storage of flammable and combustible liquids shall be in accordance with NFPA 30, *Flammable and Combustible Liquids Code*, except as modified by this section.

3-5.1.2* Storage of Class I and II liquids shall not exceed 60 gal (227 L) within 50 ft (15 m) of the structure.

3-5.1.3 Storage areas shall be kept free of weeds, debris, and combustible materials not necessary to the storage.

3-5.1.4 Open flames and smoking shall not be permitted in flammable and combustible liquids storage areas. Such storage areas shall be appropriately posted as "No Smoking" areas.

3-5.2 Handling of Flammable and Combustible Liquids at Point of Final Use.

3-5.2.1 Class I and II liquids shall be kept in approved safety containers.

3-5.2.2 Means shall be provided to dispose of leakage and spills promptly and safely.

3-5.2.3* Class I liquids shall only be dispensed where there are no open flames or other sources of ignition within the possible path of vapor travel.

3-5.3 Storage and Handling of Combustible and Flammable Gases.

3-5.3.1 Storage and handling of combustible and flammable gases shall be in accordance with NFPA 54, *National Fuel Gas Code*, and NFPA 58, *Standard for the Storage and Handling of Liquefied Petroleum Gases*.

3-5.3.2 Open flames and smoking shall not be permitted in flammable gas storage areas.

3-6 Explosive Materials.

3-6.1 The storage, handling, and use of explosive materials shall be in accordance with NFPA 495, *Explosive Materials Code*.

3-6.2 All blasting operations shall be under the direct supervision of someone legally licensed to use explosives and in possession of required permits.

Chapter 4 Utilities

4-1 Electrical.

4-1.1 All construction-operation electrical wiring and equipment for light, heat, or power purposes shall be in accordance with pertinent provisions of NFPA 70, *National Electrical Code®*.

4-1.2 Temporary Wiring.

4-1.2.1 Branch Circuits. All branch circuits shall originate in an approved power outlet or panelboard. Conductors shall be permitted within multiconductor cord or cable assemblies or as open conductors. All conductors shall be protected by overcurrent devices at their rated ampacity. Runs of open conductors shall be located where the conductors will not be subject to physical damage, and the conductors shall be fastened at intervals not exceeding 10 ft (3 m). Each branch circuit that supplies receptacles or fixed equipment shall contain a separate equipment grounding conductor when run as open conductors.

4-1.2.2 Lighting.

4-1.2.2.1 Temporary lights shall be equipped with guards to prevent accidental contact with the bulb, except that guards shall not be required when construction of the reflector is such that the bulb is deeply recessed.

4-1.2.2.2 Temporary lighting fixtures, such as quartz, that operate at temperatures capable of igniting ordinary combustibles shall be securely fastened so that the possibility of their coming in contact with such materials is precluded.

4-1.2.2.3 Temporary lights shall be equipped with heavy-duty electric cords with connections and insulation maintained in safe condition. Temporary lights shall not be suspended by their electric cords unless cords and lights are designed for this means of suspension. Splices shall have insulation equal to that of the cable.

4-1.2.3 Removal. Temporary wiring shall be removed immediately upon completion of construction or purpose for which the wiring was installed.

Chapter 5 Fire Protection

5-1 Owner's Responsibility for Fire Protection.

5-1.1* The owner shall designate a person to be responsible for the fire prevention program and to ensure that it is carried out to completion of the project. This Fire Prevention Program Manager shall have the authority to enforce the provisions of this and other applicable fire protection standards.

5-1.2 Where guard service is provided, the manager shall be responsible for the guard service.

5-1.3 Prefire Plans.

5-1.3.1 Where there is public fire protection or a private fire brigade, the manager shall be responsible for prefire plans being developed with the fire agencies. These plans shall be updated as necessary.

5-1.3.2* The prefire plan shall include provisions for on-site visits by the fire agency.

5-1.4 The manager shall be responsible to ensure that proper training has been provided for the use of protection equipment.

5-1.5 The manager shall be responsible for the presence of adequate numbers and types of fire protection devices and appliances and for their proper maintenance.

5-1.6 The manager shall be responsible for supervising the permit system for hot work operations. (*See Section 3-1.*)

5-1.7 A weekly self-inspection program shall be implemented.

5-1.8* Impairments to the fire protection systems or fire alarm, detection, or communications systems shall be authorized only by the Fire Prevention Program Manager.

5-1.8.1 Temporary protective coverings used on fire protection devices during renovations, such as painting, shall be removed promptly when work has been completed in the area.

5-2 Site Security.

5-2.1* Guard service shall be provided where required by the authority having jurisdiction.

5-2.2* Where guard service is provided, the guard(s) shall be trained in (1) notification procedures to call the fire department and management personnel, (2) knowledge of fire protection equipment, and (3) familiarization with fire hazards. Guards shall be informed of any special status of emergency equipment or hazards.

5-2.3* Security fences shall be provided where required by the authority having jurisdiction.

5-2.4* Entrances (doors and windows) to the structure under construction, alteration, or demolition shall be secured where required by the authority having jurisdiction.

5-3* Fire Alarm Reporting. There shall be a readily available public fire alarm box near the premises, telephone service to the responding fire department, or equivalent facilities. Instructions shall be issued to notify the fire department immediately in case of fire. When telephone service is employed, the local fire department number and site address shall be conspicuously posted near each telephone.

5-4 Access for Fire Fighting.

5-4.1 A suitable location at the site shall be designated as a command post and provided with plans, emergency information, keys, communication, and equipment, as needed. The person in charge of fire protection shall respond to the location command post whenever fire occurs.

5-4.2 Where access to or within a structure or an area is unduly difficult because of secured openings or where immediate access is necessary for life saving or fire fighting purposes, the authority having jurisdiction shall be permitted to require a key box to be installed in an accessible location. The key box shall be an approved type and shall contain keys to gain necessary access as required by the authority having jurisdiction.

5-4.3 Every building shall be accessible to fire department apparatus by way of access roadways with an all-weather driving surface of not less than 20 ft (6 m) of unobstructed width, to withstand the live loads of fire apparatus and having a minimum of 13 ft 6 in. (4 m) of vertical clearance. Dead-end fire department access roads in excess of 150 ft (46 m) in length shall be provided with approved provisions for the turning around of fire department apparatus.

Exception: The requirements of this section may be modified when, in the opinion of the fire department, fire fighting or rescue operations would not be impaired.

5-4.4 The required width of access roadways shall not be obstructed in any manner, including parking of vehicles. "No Parking" signs or other appropriate notice, or both, prohibiting obstruction shall be permitted to be required and shall be maintained.

5-4.5 The access roadway shall be extended to within 150 ft (46 m) of all portions of the exterior walls of the first story of any building. Where the access roadway cannot be provided, an approved fire protection system or systems shall be provided as required and approved by the authority having jurisdiction.

5-4.6 Where a bridge is required to be used as access, it shall be constructed and maintained using design live loading sufficient to carry the imposed loads of the fire apparatus.

5-4.7 Access for use of heavy fire fighting equipment shall be provided to the immediate job site at the start of the project and maintained until completion.

5-4.8 In all buildings over one story in height, at least one stairway shall be provided in usable condition at all times, and shall meet the requirements of 5-2.2 of NFPA *101®, Life Safety Code®*. This stairway shall be extended upward as each floor is installed in new construction and maintained for each floor remaining during demolition. The stairway shall be lighted. During construction the stairway shall be enclosed if the building exterior walls are in place.

5-4.9 Where hoists and elevators provide the only efficient means of transporting hose and other cumbersome fire fighting equipment to upper floors, they shall be available to the fire department whenever necessary.

5-4.10 Free access from the street to fire hydrants and to outside connections for standpipes, sprinklers, or other fire extinguishing equipment, whether permanent or temporary, shall be provided and maintained at all times. Protective pedestrian walkways shall not be so constructed as to impede access to hydrants. No material or construction shall interfere with access to hydrants, siamese connections, or fire extinguishing equipment.

5-4.11* Free access to permanent, temporary, or portable first-aid fire equipment shall be maintained at all times.

5-5 Standpipes. In all new buildings in which standpipes are required or where existing in buildings being altered or demolished, such standpipes shall be maintained in conformity with the progress of building activity in such a manner that they are always ready for use.

5-6* First-Aid Fire Fighting Equipment.

5-6.1 The suitability, distribution, and maintenance of extinguishers shall be in accordance with NFPA 10, *Standard for Portable Fire Extinguishers.*

5-6.2 Wherever a toolhouse, storeroom, or other shanty is located in or adjacent to the building under construction or demolition, or a room or space within that building is used for storage, dressing room, or workshop, at least one approved extinguisher shall be provided and maintained in an accessible location.

Exception: This requirement may be waived if structures do not exceed 150 ft² (14 m²) floor area or are equipped with automatic sprinklers or other approved protection.

5-6.3 At least one approved fire extinguisher shall also be provided in plain sight on each floor at each usable stairway as soon as combustible material accumulates.

5-6.4 Suitable fire extinguishers shall be provided on self-propelled equipment.

Chapter 6 Safeguarding Construction and Alteration Operations

6-1 General. The provisions of Chapters 1 through 5 shall be followed, as applicable, for all construction, in addition to the specific requirements of this chapter.

6-2* Scaffolding, Shoring, and Forms.

6-2.1 Accumulations of unnecessary combustible forms or form lumber shall be prohibited. Combustible forms or form lumber shall be brought into the structure only when needed. Combustible forms or form lumber shall be removed from the structure as soon as stripping is complete. Those portions of the structure where combustible forms are present shall not be used for the storage of other combustible building materials.

6-2.2* During forming and stripping operations, portable fire extinguishers or charged hose lines shall be provided to protect adequately the additional combustible loading.

6-3 Construction Material and Equipment Storage.

6-3.1 Temporary storage of equipment to be installed, combustible construction materials, or combustible packing materials shall not be permitted in unprotected structures under construction or alteration unless authorized by the authority having jurisdiction.

6-3.2* Storage shall not be permitted in protected structures until protection is in service.

6-3.3 Yard storage of equipment to be installed or combustible construction materials shall not be stored closer than 30 ft (9 m) from the structure under construction or alteration. (*See 2-1.1.*)

6-4 Permanent Heating Equipment. The permanent heating equipment for a new building shall be installed and put into operation as soon as practical.

6-5 Utilities.

6-5.1 The provisions of Chapter 4 shall apply in addition to the specific requirements of this section.

6-5.2 Gas.

6-5.2.1 Installation. Installation of gas piping for construction purposes, or modifications to existing gas piping, gas utilization equipment, or accessories shall be performed only by a qualified agency. All such work shall be in accordance with NFPA 54, *National Fuel Gas Code.*

6-5.2.2 Modifications. All modifications to existing gas piping systems shall normally be performed with the gas turned off.

Exception: Hot taps may be made if they are installed by trained and experienced crew utilizing equipment specifically designed for such purpose.

6-6* Fire Cutoffs. Fire walls and exit stairways, if required for the completed building, shall be given construction priority for installation. Fire doors with approved closing devices and hardware shall be installed as soon as is practical and preferably before combustible material is introduced. Fire doors, after installation in accordance with NFPA 80, *Standard for Fire Doors and Fire Windows,* shall not be obstructed from closing.

6-7 Fire Protection During Construction.

6-7.1 The provisions of Chapter 5 shall apply in addition to the specific requirements of this section.

6-7.2 Water Supply.

6-7.2.1* Water supply for fire protection, either temporary or permanent, shall be made available as soon as combustible material accumulates. There shall be no delay in the installation of fire protection equipment. (*See A-6-2.2.*)

6-7.2.2 Where underground water mains and hydrants are to be provided, they shall be installed, completed, and in service prior to construction work.

6-7.3 Sprinkler Protection.

6-7.3.1* If automatic sprinkler protection is to be provided, the installation shall be placed in service as soon as possible. Details of installation shall be in accordance with NFPA 13, *Standard for the Installation of Sprinkler Systems.*

6-7.3.2 Where sprinklers are required for safety to life, the building shall not be occupied until the sprinkler installation has been entirely completed and tested such that the protection is not susceptible to frequent impairment attributable to testing and corrections.

Exception: This provision shall not preclude the occupancy of the lower floors of a building, even though the upper floors may be in various stages of construction or protection, provided the following conditions are satisfied:

(a) The sprinkler protection of the lower occupied floors is completed and tested in accordance with the above criteria;

(b) The sprinkler protection of the upper floors will be supplied by entirely separate systems and separate control valves such that its absence or incompleteness will in no way impair the sprinkler protection of the occupied lower floors.

6-7.3.3 Operation of sprinkler control valves shall be permitted only by properly authorized personnel and shall be accompanied by notification of duly designated parties. When the sprinkler protection is being regularly turned off and on to facilitate connection of newly completed segments, the sprinkler control valves shall be checked at the end of each work period to ascertain that protection is in service.

6-7.4 Standpipes.

6-7.4.1 General.

6-7.4.1.1* Pipe size, hose valves, hose, water supply, and other details for new construction shall be in accordance with NFPA 14, *Standard for the Installation of Standpipe and Hose Systems*.

6-7.4.1.2 On permanent Type II and III standpipes, hose and nozzles shall be provided and made ready for use as soon as water supply is available to the standpipe.

Exception: In combined systems where occupant hose will not be required, temporary hose and nozzles shall be provided during construction.*

6-7.4.2 Standpipe Installations in Buildings Under Construction. When required by the authority having jurisdiction, in buildings under construction, a standpipe system, either temporary or permanent in nature, shall be installed in accordance with the following.

6-7.4.2.1 The standpipes shall be provided with conspicuously marked and readily accessible fire department connections on the outside of the building at the street level and shall have at least one standard hose outlet at each floor.

6-7.4.2.2 Pipe sizes, hose valves, hose, water supply, and other details for new construction shall be in accordance with this standard.

6-7.4.2.3 Standpipes shall be securely supported and restrained at each alternate floor.

6-7.4.2.4* At each floor level there shall be provided at least one approved hose valve for attaching fire department hose. Valves shall be kept closed at all times and guarded against mechanical injury.

6-7.4.2.5 Hose valve(s) shall have external threads having the NH standard thread, for the valve size specified, as addressed in NFPA 1963, *Standard for Screw Threads and Gaskets for Fire Hose Connections*.

Exception: Where local fire department connections do not conform to NFPA 1963, the authority having jurisdiction shall designate the connection to be used.

6-7.4.2.6* Standpipes shall be extended up with each floor and securely capped at the top. Top hose outlets shall, at all times, be not more than one floor below the highest forms, staging, and similar combustibles.

6-7.4.2.7 Temporary standpipes shall remain in service until the permanent standpipe installation is complete.

Chapter 7 Safeguarding Roofing Operations

7-1 Roofing Operations.

7-1.1 General. All roofing operations involving heat sources and hot processes shall be conducted by a qualified agency.

7-1.2 Asphalt and Tar Kettles.

7-1.2.1 Asphalt and tar kettles shall be located in a safe place outside of the building or on a noncombustible roof at a point so as to avoid danger of ignition of combustible material below.

7-1.2.2 A lid that can be closed by means of gravity shall be provided on all roofing kettles. The tops and covers of all kettles shall be close fitting and constructed of steel having a thickness of not less than 0.075 in. (2 mm) (No. 14 manufacturer's standard gauge).

7-1.2.3* Used roofing mops and rags shall be cleaned of excessive asphalt and stored away from the building and combustible materials. Discarded roofing mops and rags shall not be in contact with combustibles.

7-1.2.4 Kettles shall be constantly attended when in operation.

7-1.3* Single-Ply and Torch-Applied Roofing Systems.

7-1.3.1* Single-ply and torch-applied roofing systems shall be installed using extreme caution. Torches or hot-air guns used to secure roofing membranes shall be used in accordance with manufacturer's recommendations. In order to prevent smoking or ignition of roofing membranes, they shall not be overheated.

7-1.3.2* Caution shall be used when working around roof openings, penetrations, or flashings. The flame of the torch shall not come in direct contact with wood nailers, cant strips, or metal flashing. Small torches shall be used to heat the underside of the membrane away from these areas before securement. Hot trowels shall be used to feather seams at laps and flashings. The torch shall not be used in areas where the flame impingement cannot be fully viewed. Open flames shall not be left unattended.

7-1.3.3 The torch flame shall not be applied to a combustible substrate for the membrane. Base ply shall be used to cover wood deck, combustible insulation (such as foam plastic, kraft-faced glass fiber, or wood fiber), small crevices, cant strips, plastic fastener plates, or any other com-

bustible surface. Base ply shall be permitted to consist of either glass fiber felts or minimum 40-lb (18-kg) organic felts. Torch flames shall not come in contact with exposed plastic roofing cement.

7-1.3.4 Installation of torch-applied roofing and, in some cases, single-ply roofing systems is hot work and shall comply with Section 3-1, except where otherwise noted.

7-1.3.5* Protective clothing and personal protective equipment shall be worn by installers.

7-1.3.6 Proper equipment shall be used to heat roofing membranes. Torches shall be equipped with a pilot adjustment, flame height adjustment, a minimum of 25 ft (8 m) to a maximum of 50 ft (15 m) of listed hose, pressure gauge, and regulator. A spark igniter shall be used. Torch trolleys and multiple torch head machines shall be equipped with listed safety valves.

7-1.3.7* Safety caps shall be attached to all fuel gas cylinders and installed on the valves whenever cylinders are not in use. The fuel gas cylinder shall be adequately sized for the torch used. If frost build-up occurs on fuel gas cylinders and the rate of vapor withdrawal is no longer adequate for operating conditions, the cylinder shall not be placed on its side or heated with the torch flame. The hose shall be disconnected and a larger cylinder used.

7-1.3.8* Equipment shall be thoroughly inspected and repaired or replaced as needed prior to use.

7-1.3.9 Fuel gas cylinders shall not be hoisted by their valves. Straps placed around the cylinders shall be utilized.

7-1.3.10 Carts used to transport fuel gas cylinders shall be stable. Tall, narrow, standing cylinders shall be strapped or chained against walls or in proper carts.

7-1.3.11* A fire watch shall be conducted for at least one hour after torches have been extinguished.

7-1.4 Fire Extinguishers for Roofing Operations.

7-1.4.1* There shall be at least one portable fire extinguisher having a rating of not less than 20-B within 30 ft (9 m) horizontal travel distance of every roofing kettle at all times while such kettle is in operation.

7-1.4.2* There shall be at least one multipurpose 2-A:20-B:C portable fire extinguisher on the roof being covered or repaired, or other fire protection as determined by the authority having jurisdiction.

7-1.4.3 There shall be at least one multipurpose 2-A:20-B:C portable fire extinguisher within 20 ft (6 m) horizontal travel distance of torch-applied roofing equipment.

7-1.5 Fuel for Roofing Operations.

7-1.5.1 Fuel containers, burners, and related appurtenances of roofing equipment in which liquefied petroleum gas is used for heating shall comply with all the applicable requirements of NFPA 58, *Standard for the Storage and Handling of Liquefied Petroleum Gases*.

7-1.5.2 Fuel containers shall be located at least 10 ft (3 m) from the burner flame or at least 2 ft (0.6 m) therefrom when properly insulated from heat or flame.

Exception: Hand-held fuel containers with maximum 1-lb (453-g) capacity.

7-1.5.3 Solid fuel or Class I liquids shall not be used as fuel for roofing kettles.

Chapter 8 Safeguarding Demolition Operations

8-1 General. The provisions of Chapters 1 through 5 shall be followed, as applicable, for all demolition operations, in addition to the specific requirements of this chapter.

8-2 Special Precautions.

8-2.1 Special precautions shall be taken when demolition work is done in areas where floors are soaked with oil or other flammable liquid, if dust accumulations are present, or where combustible insulation is present in floors, walls, or ceilings/roofs where hot work is being done. In these situations, charged hose lines of adequate number and size shall be provided.

8-2.2* Flammable and combustible liquids shall be drained from tanks and machinery reservoirs in a safe manner and removed from the building immediately. Particular attention shall be paid to removal of residue and sludge accumulations if hot work operations are involved.

8-3 Temporary Heating Equipment. In cold weather demolition operations, building heat shall be maintained to permit sprinklers, hose, and extinguishers to be operable in areas not in the process of demolition. The minimum temperature at extremities of such areas with wet sprinkler systems shall be 40°F (4°C).

8-4* Smoking. Smoking shall be prohibited throughout demolition areas.

8-5* Demolition Using Explosives. If explosives are used in demolition work (implosion), hose lines [at least two 1½-in. (38-mm) or one 2½-in. (64-mm)] shall be provided in the immediate vicinity of the demolition site during actual detonation. These lines shall be of sufficient length to be capable of extinguishing any small fire anywhere on the demolition site after detonation.

8-6 Utilities.

8-6.1 Electrical. Electric service shall be reduced to a minimum and identified to leave no uncertainty as to which circuits are energized.

8-6.2 Gas. Prior to demolition, gas supplies shall be turned off and capped at a point outside the building. Gas lines within the building shall be purged after capping unless exempted by the authority having jurisdiction.

8-7* Fire Cutoffs. Vertical and horizontal cutoffs shall be retained until razing operations necessitate their removal, as judged by the authority having jurisdiction. Fire doors shall be closed at the end of each working day.

8-8 Fire Protection During Demolition.

8-8.1 The provisions of Chapter 5 shall apply in addition to the specific requirements of this section.

8-8.2* When a building is equipped with sprinklers, the sprinkler protection shall be retained in service as long as the condition requiring sprinklers continues to exist.

8-8.3 Operation of sprinkler control valves shall be permitted only by properly authorized personnel and shall be accompanied by notification of designated parties. When the sprinkler protection is being regularly turned off and on to facilitate removal and capping of segments, the sprinkler control valves shall be checked at the end of each work shift to ascertain that protection is in service.

8-8.4 Standpipes shall be maintained in conformity with the progress of demolition activity in such a manner that they are always ready for fire department use.

8-8.5* Fire extinguishing equipment shall be available subject to the authority having jurisdiction.

Chapter 9 Safeguarding Underground Operations

9-1* General.

9-1.1* The provisions of Chapters 1 through 8 shall be followed, as applicable, for all operations in underground structures, in addition to the specific requirements of this chapter.

9-1.2 Drainage systems shall be properly designed and installed to remove water from sprinkler discharge or fire hose streams.

9-1.3 Fire safety for existing, operating fixed guideway underground transportation systems undergoing alteration or renovation shall be in accordance with NFPA 130, *Standard for Fixed Guideway Transit Systems*.

9-1.4 Means of egress for existing, operating underground structures shall be in accordance with NFPA *101*, *Life Safety Code*.

9-1.5 At each aboveground entrance, underground operations shall have a check-in/check-out system that provides an accurate record of each person underground.

9-1.6 Completed or unused sections of the underground facility shall be barricaded and made off limits. Consideration shall be given to compartmentation through the installation of fire barriers to limit the extent and severity of the fire and to provide areas of refuge for occupants.

9-1.7 Fire safety inspections shall be conducted at regular and frequent intervals. (*See 5-1.1.*)

9-1.8 Open flames and fires shall be prohibited in all underground operations except as prescribed for cutting, welding, and hot work operations.

9-1.9* The carrying of matches, lighters, or other flame producing smoking materials shall be prohibited in all underground operations where fire or explosion hazards exist.

9-1.10 Listed less hazardous hydraulic fluids shall be used in underground machinery and equipment unless the machinery and equipment are protected by an approved fire suppression system or by approved multipurpose fire extinguishers rated at least 4A:40BC.

9-1.11 Water line outlets located at shaft stations shall have at least one standard fitting with outlet threads compatible with equipment of the local fire department. Additional water supply lines shall be permitted to be required by the authority having jurisdiction due to increased combustible loading.

9-1.12 Fire protection extinguishing equipment (either automatic or manual) applicable to the hazard and approved by the authority having jurisdiction shall be provided at the head, tail, drive, and take-up pulleys of belt conveyors and at intervals along belt conveyor lines not to exceed 300 ft (91 m).

9-1.13 Wherever self-propelled equipment is used underground, a fire suppression system or a fire extinguisher rated at least 4A:40BC shall be on the equipment.

9-2 Special Precautions.

9-2.1 Welding, cutting, and burning operations shall be in accordance with NFPA 51B, *Standard for Fire Prevention in Use of Cutting and Welding Processes*. A suitable fire extinguisher or other fire control device shall be ready for instant use in any location where welding is done.

9-2.2 Acetylene, liquefied petroleum gas (LPG), and methylacetylene propadiene stabilized gas (MPS) shall be permitted to be used underground only for welding, cutting, and hot work and only if the quality of air is within permissible limits as set forth in the ACGIH *Threshold Limit Values and Biological Exposure Indices for 1992-1993*.

9-2.3 A limited number of underground construction operations involve the use of compressed air to avoid flooding. The use of compressed air often increases the percentage of oxygen in the working areas and therefore increases the risk of fire and explosion. Compressed air operations require special precautions that are beyond the scope of this publication. However, a good understanding of strict compliance with the fire hazards and safety and health requirements of the regulatory authorities having jurisdiction is necessary to ensure a fire safe working environment.

9-3 Emergency Procedures and Systems.

9-3.1* A written fire prevention, fire suppression, and emergency evacuation plan shall be developed with special attention being given to rescue and smoke venting procedures, to the means of ingress/egress, and to training and orientation of employees and visitors.

9-3.2 Audible alarm and emergency lighting for safe evacuation shall be required.

9-3.3 Underground operations shall have disaster and evacuation drills for each shift at least once at the start of underground operations and every six months or more frequently as appropriate. A record of such drills shall be maintained.

9-4 Underground Equipment and Storage Requirements.

9-4.1* Class I flammable liquids shall not be taken, stored, or used underground, nor within 100 ft (30 m) of a tunnel portal or shaft opening.

9-4.2 Class II and III liquids shall be transported and stored in approved closed containers, safety cans, or tanks. Quantities shall be limited to those necessary for one day's operation.

9-4.3 Lubricating oils, greases, and rope dressings taken underground shall be in closed and reclosable metal containers that shall not permit the contents to leak out or spill.

9-4.4 Oil, grease, and diesel fuel stored underground shall be kept in tightly sealed containers in fire-resistant areas at least 100 ft (30 m) from shafts and inclines. Storage areas shall be positioned or diked so that the contents of ruptured or overturned containers shall not flow from the storage area.

9-4.5 The quantity of combustible materials to be used underground shall be kept to a minimum. Advance planning shall provide for the use of materials having the most favorable combination of high ignition points, low rates of combustion, and low emissions of smoke and harmful gases.

9-4.6 Areas within 25 ft (8 m) of major electrical installations and unburied tanks for storage of combustible liquids shall be free of transient combustible materials.

9-4.7 Fan houses, fan bulkheads for main and booster fans, and air ducts connecting main fans to underground openings shall be constructed of noncombustible materials.

9-4.8 No combustible structure shall be erected and no combustible materials shall be stored within 100 ft (30 m) of an access shaft, shaft hoist, or other entry.

9-4.9 Metal cans with self-closing lids shall be provided and used to store combustible waste and debris and shall be removed to the surface daily.

9-4.10 Where combustible or flammable materials are stored underground, suitable fire extinguishers shall be installed so travel distance from any one point in the area does not exceed 50 ft (15 m) on a horizontal plane.

9-5 Electrical.

9-5.1 Electrical cords and plugs shall be heavy duty and suitable for use in damp locations. (*See NFPA 70, National Electrical Code.*)

9-5.2 Conductors shall be so located or guarded as to protect them from physical damage. Multiconductor portable cable shall be permitted to supply mobile equipment. An equipment grounding conductor shall be run with circuit conductors inside the metal raceway or inside the multiconductor cable jacket. The equipment grounding conductor shall be permitted to be insulated or bare.

9-5.3 Oil-filled transformers shall not be used underground unless they are located in a fire-resistant enclosure suitably vented to the outside and surrounded by a dike to retain the contents of the transformers in event of rupture.

9-5.4 Bare terminals of transformers, switches, motor controllers, and other equipment shall be enclosed to prevent accidental contact with energized parts. Enclosures for use in tunnels shall be raintight, rainproof, or watertight (*see NFPA 70, National Electrical Code, for definitions*) as required by the environmental conditions.

9-5.5 Special attention shall be paid to maintaining clear access and adequate workspace around electrical equipment. (*See NFPA 70E, Standard for Electrical Safety Requirements for Employee Workplaces.*) Good housekeeping shall be maintained to avoid fire hazards.

9-5.6 All nonenergized metal parts of electric equipment and metal raceways and cable sheaths shall be effectively grounded and bonded to all metal pipes and rails at the portal and at intervals not exceeding 1000 ft (300 m) throughout the tunnel.

Chapter 10 Referenced Publications

10-1 The following documents or portions thereof are referenced within this standard and shall be considered part of the requirements of this document. The edition indicated for each reference is the current edition as of the date of the NFPA issuance of this document.

10-1.1 NFPA Publications. National Fire Protection Association, 1 Batterymarch Park, P.O. Box 9101, Quincy, MA 02269-9101.

NFPA 10, *Standard for Portable Fire Extinguishers*, 1990 edition.

NFPA 13, *Standard for the Installation of Sprinkler Systems*, 1991 edition.

NFPA 14, *Standard for the Installation of Standpipe and Hose Systems*, 1993 edition.

NFPA 30, *Flammable and Combustible Liquids Code*, 1993 edition.

NFPA 31, *Standard for the Installation of Oil-Burning Equipment*, 1992 edition.

NFPA 37, *Standard for the Installation and Use of Stationary Combustion Engines and Gas Turbines*, 1990 edition.

NFPA 51, *Standard for the Design and Installation of Oxygen-Fuel Gas Systems for Welding, Cutting, and Allied Processes*, 1992 edition.

NFPA 51B, *Standard for Fire Prevention in Use of Cutting and Welding Processes*, 1989 edition.

NFPA 54, *National Fuel Gas Code*, 1992 edition.

NFPA 58, *Standard for the Storage and Handling of Liquefied Petroleum Gases*, 1992 edition.

NFPA 70, *National Electrical Code*, 1993 edition.

NFPA 70E, *Standard for Electrical Safety Requirements for Employee Workplaces*, 1988 edition.

NFPA 80, *Standard for Fire Doors and Fire Windows*, 1992 edition.

NFPA *101, Life Safety Code*, 1991 edition.

NFPA 130, *Standard for Fixed Guideway Transit Systems*, 1993 edition.

NFPA 211, *Standard for Chimneys, Fireplaces, Vents, and Solid Fuel-Burning Appliances*, 1992 edition.

NFPA 495, *Explosive Materials Code*, 1992 edition.

NFPA 701, *Standard Methods of Fire Tests for Flame-Resistant Textiles and Films*, 1989 edition.

NFPA 1963, *Standard for Screw Threads and Gaskets for Fire Hose Connections*, 1993 edition.

10-1.2 ACGIH Publication. American Conference of Governmental Industrial Hygienists, 6500 Glenway Avenue, Cincinnati, OH 45211.

ACGIH *Threshold Limit Values and Biological Exposure Indices for 1992-1993*.

Appendix A Explanatory Material

This Appendix is not a part of the requirements of this NFPA document, but is included for information purposes only.

A-2-1.1 Separation distances less than those shown in Table 2-1.1 may be used if the construction is noncombustible and the combustible loading is limited. For multilevel unsprinklered structures the authority having jurisdiction should be consulted for separation distances.

A-2-1.2 Where located 30 ft (9 m) or more from the structure and constructed of combustible materials, it is desirable to subdivide temporary support buildings into small detached units to minimize fire loss. Large construction support complexes should be protected with adequate fire protection, e.g., automatic sprinklers, yard hydrants, hose, and extinguishers, as required by the authority having jurisdiction.

A-3-1.1 For a sample permit and procedure, see NFPA 51B, *Standard for Fire Prevention in Use of Cutting and Welding Processes*. Additional fire watch should be provided during welding or cutting operations where sparks or molten metal may drop several floors.

If welding operations have been conducted during the previous working period, the oncoming watchman (*see 5-2.1*) should be alerted to check the location where welding was done as part of his/her regular rounds. Where watch service is not provided, use of gas-operated welding or cutting equipment should be discontinued a minimum of one hour before quitting time.

Where practical, work should be moved to a safe location to be welded.

Torches should not be used to cut holes in walls, floors, ceilings, or roofs containing combustible insulation, framing, sheathing, or finish material.

If the structure has a combustible floor, the floor should be wet down or covered with damp sand or sheet metal before and after welding or cutting operations are conducted. Adequate precautions must be taken so that wetting down will not introduce a personnel safety hazard.

A-3-1.3.1 When the charge for Thermit welding has been ignited, the operator should stand several steps away [at least 10 ft (3 m)] and wear goggles. Burns may occur from the metal splashings, by upsetting the crucible, by breaking the mold, or by allowing the molten metal to come in contact with moisture in the mold, on the floor, or on the ground.

A-3-1.3.2 Where storage near the point of use is necessary, it should be kept at least 10 ft (3 m) away and limited to one day's supply. A listed flammable liquid cabinet should be used. The area should be kept dry and the cabinet should be locked.

It has been reported that moisture may cause ignition. Ferric oxide and powdered aluminum can be used in a metal cylinder as an incendiary bomb, which creates increased concern for keeping storage areas locked.

A-3-2.5 This may necessitate removal of the heater prior to refueling. The appliance should also be allowed to cool prior to refueling.

A-3-2.7 Misuse of temporary heating devices has resulted in numerous fires and millions of dollars in property loss. Temporary heating equipment, while operating, should be visually inspected every hour to ensure that combustibles have not blown or fallen over near the temporary heating device. During windy periods it may be necessary to reduce the interval between inspections. Any object near the temporary heating device that is hot to the touch should be moved, or the temporary heating device relocated. The visual inspection should also ensure that the appliance is operating properly. Any appliance that is not operating properly should be turned off until repairs have been made to the appliance.

A-3-3.1 Areas where smoking should be prohibited include but are not limited to temporary holding areas for combustible construction materials, storage areas, and areas where oil, gasoline, propane, or flammable material are stored or used.

A-3-4.1 If a chute is employed for removal of debris, it should be erected on the outside of the building. The chute should be of noncombustible construction and the main artery of the chute should be as straight as possible so as to avoid accumulations or clogging within the chute.

Failure to remove scrap and trash accumulations provides the fuel for the rapid expansion of a fire that might otherwise be contained to a small area. These accumulations also provide a convenient fuel source for malicious fires.

A-3-5.1.2 The reference to "structure" is intended to apply to those structures under construction, alteration, or demolition and not to temporary structures on the construction site. Additionally, existing properly protected storage within 50 ft (15 m) of the structure or inside an existing structure under alteration is not intended to be regulated by this provision.

A-3-5.2.3 The vapors given off by flammable liquids generally have vapor densities greater than that of air. Therefore, these vapors will tend to collect in low spots and travel at floor level. Being invisible, these vapors are difficult to detect without the aid of proper instruments designed specifically for that purpose.

Proper ventilation is therefore important in the prevention of accidental ignition of these vapors. Proper ventilation can be accomplished by either natural or mechanical means.

A-5-1.1 Make one person responsible for the protection of property from fire. This person should see that the proper procedures for controlling fire hazards are set up and should have full authority to enforce them.

The person should be appointed by the owner. Where an entirely new structure is being constructed, the owner should see that specifications for new buildings contain a clause stating that the "contractor will take all reasonable precautions against fire in accordance with good fire protection engineering practice."

Responsibility for loss prevention rests with the owner. However, loss prevention recommendations are normally accomplished by the contractor. To ensure that recommendations are carried out promptly, the owner's assistance may be needed.

Fire prevention education should be a topic at contractors' safety meetings (tail-gate talks) at least once a month. Topics that may be discussed include maintaining clear access to fire fighting equipment, reinforcing cutting and welding procedures, flammable liquids use and storage, use of first-aid fire fighting equipment, roofing operations, and precautions for the use of temporary heating equipment.

All fires should be investigated by the manager, and needed fire prevention improvements that are identified by the investigation should be communicated to all employees as soon as possible.

A-5-1.3.2 Large-scale construction sites change rapidly as construction progresses. The prefire plan should be flexible to allow for different stages of construction. Critical stages that should be considered include access, installation of water mains and fire hydrants, framing/exterior shell, roofing, covering of interior partitions, installation of fixed fire protection, concrete form work, and installation of building systems.

Since construction projects do change, the local fire department should be encouraged to visit the site on a regular basis. Prefire plan visits should be scheduled by the manager at least semi-annually and when there have been major revisions of the fire prevention plan. Since municipal fire departments work rotating shifts, a series of prefire plan visits may be necessary to allow all fire fighters who would respond an opportunity to visit the site. In rural areas and smaller cities the local fire department may be a volunteer organization or have only a small career fire fighter crew on duty during the daytime. It may be necessary for the manager to schedule the prefire plan visit during the evening hours to meet the needs of the local fire department.

A-5-1.8 See NFPA 72, *National Fire Alarm Code*, for impairment notification.

A-5-2.1 Due to the growing threat of arson, guard service should be provided on major projects even when not required by the authority having jurisdiction. The requirements for guard service should also be based on but not limited to the hazards at the site, the size of the risk, the difficulty of fire fighting, the exposure risk, and the physical security of the site.

A-5-2.2 It is recommended that areas in buildings should be patrolled at all times when construction, alteration, and demolition operations are not in progress by a competent guard registered on an approved clock from stations covering all parts of the building in accordance with NFPA 601, *Standard on Guard Service in Fire Loss Prevention*. Guards' rounds should include all parts of the buildings and outside areas where there is hazardous equipment or materials. Rounds should be conducted every half hour for two hours after suspension of work for the day and every hour thereafter during night and off days and shall include tours of all accessible work areas. (*See NFPA 601, Standard on Guard Service in Fire Loss Prevention, Chapter 6.*)

A-5-2.3 The requirements for security fencing should be based on but not limited to the hazards at the site, the size of the risk, the difficulty of fire fighting, the exposure risk, and the presence of guard service.

A-5-2.4 Securing the openings (doors and windows) to the structure, where possible, would reduce the chance of entry by unauthorized persons. This would reduce the chance of arson or accidental fires. It could, in some instances, eliminate the need for guard service or security fencing. It will also help prevent freezing or wind damage to fire protection equipment and prevent combustible material from being blown against heating devices and igniting.

A-5-3 In large projects and/or tall structures, it is advisable to have an audible device for an evacuation signal in case of fire or other emergency.

A-5-4.11 Clear and unobstructed access should be maintained to all first-aid fire fighting equipment. Fire fighting equipment should also be clearly visible from surrounding areas. If visibility to first-aid fire fighting equipment may be obstructed, signs conforming to NFPA 170, *Standard for Firesafety Symbols*, should be installed to indicate the position of the fire fighting equipment.

A-5-6 Portable fire extinguishers, water pails, small hose lines, and 1½-in. (38-mm) standpipe hose are considered first-aid fire fighting equipment. To be effective, first-aid fire fighting equipment must be used in the incipient stage of a fire.

A-6-2 Steel scaffolding or approved fire-retardant lumber and planking should be used on both the outside and inside of the structure. Construction materials (e.g., forms, shoring, bracing, temporary stairways, platforms, tool boxes, plan boxes, solvents, paints, tarpaulins, and similar items) should be noncombustible, fire retardant, "safety" solvent, or high flash point, as the case may require. A concerted effort should be made to attain as high a level of noncombustibility of materials as possible. (*See also NFPA 703, Standard for Fire Retardant Impregnated Wood and Fire Retardant Coatings for Building Materials.*)

A-6-2.2 The authority having jurisdiction should be contacted regarding the adequacy of water supplies for hose lines.

A-6-3.2 Accepted good practice provides sprinklered areas for the storage of interior finish materials and building mechanical equipment, much of which may be received in

combustible packaging and which cannot be stored outside because of absence of exterior space, weather, or security. Even when construction combustibles are not a factor, sprinkler protection should be available for unanticipated early delivery of combustible contents planned for the permanent occupancy. It is not unusual, when needed, to temporarily plug the extremity of a partially installed sprinkler system so that a portion may be placed in automatic service.

A-6-6 See NFPA 80, *Standard for Fire Doors and Fire Windows*.

A-6-7.2.1 No minimum water supply is specified due to the wide range of construction types, sites, and sizes. However, unless combustibles are essentially nonexistent in the completed structure and occupancy, a minimum of 500 gpm (1893 L/min) should be provided. In most instances the required supply will be higher, and authorities having jurisdiction should be consulted.

A-6-7.3.1 With good scheduling and contracting, it is possible for the sprinkler installation to follow the building construction progressively and closely. This is frequently done in multiple-story buildings to facilitate protection on the lower floors before the upper floors have been built.

A-6-7.4.1.1 Threaded plugs should be inserted in fire department hose connections, and they should be properly guarded against physical damage.

A-6-7.4.1.2 Exception The intent of this provision is to allow the permanent standpipes to be used as temporary standpipes during construction.

A-6-7.4.2.4 At the highest hose outlet, there should be maintained a substantial box, preferably of metal, in which should be kept a sufficient amount of hose to reach all parts of the floor, appropriate nozzles, spanner wrenches, and hose straps.

A-6-7.4.2.6 Supply of fire hose and nozzles should be ordered in advance so they will be available as soon as standpipes are ready. Hose lines should be connected in areas where construction is in progress.

A-7-1.2.3 Many flammable and combustible liquids, including roofing asphalts, combine readily with the oxygen in air and produce heat. When these liquids are present on rags and mops used in roofing operations, the heat can concentrate inside the mass faster than it can be dissipated and result in spontaneous combustion.

Fires in mops can be prevented by "spinning" or cleaning excessive asphalt out of the mop or rag after its work period is finished.

A-7-1.3 For additional information see the ARMA publication, *Torch-Applied Roofing, Do's and Don'ts* and Factory Mutual Technical Advisory Bulletin 1-29, *Safeguarding Torch-Applied Roof Installations*.

A-7-1.3.1 Torch-applied roofing may be a potentially hazardous construction process, and extreme caution should be exercised during installation. The exposed outer surface of the membrane coil should be heated until a slight sheen develops. The compound should not be overheated. A slight smoke vapor can be seen when the compound is overheated. The flame from a hand-held torch should be constantly moved from side to side. If a mobile heating apparatus is used, it should be kept in constant motion while operating.

Some roof membranes, such as polyvinyl chloride (PVC) or chloro-sulfonated polyethylene (CSPE or hypalon), may require heating or the use of solvents in order to form lap joints or to secure the membrane.

A-7-1.3.2 Roof openings/vents and crevices should be covered with a stable, noncombustible cover to prevent ignition of building contents.

Extreme caution should be used near penetrations such as exhaust vents. Flames could ignite grease accumulations from kitchen vents and lint accumulations from laundry vents. Such accumulations should be cleaned before roofing work is started.

Air conditioning units and ventilating fans should be shut down before torch work is done in that area.

A torch stand should be used to direct the flame upward when momentarily not in use. The cylinder valve should be closed to burn off propane in the line before shutting off the torch head. The gas supply should be shut off whenever a propane odor is detected.

Torches should not be used near gas lines or electrical wires.

A-7-1.3.5 Protective clothing should include acceptable fabrics, long-sleeve shirt, long pants, gloves, and eye protection. The safe handling of hand torches and hot trowels necessitates proper protective clothing and personal protective equipment.

A-7-1.3.7 Liquid fuel gas cylinders may be of either the vapor withdrawal or liquid withdrawal type. With the vapor withdrawal type, vapor is drawn off from the torch head. Vapor withdrawal cylinders are equipped with female cylinder valves. Liquid withdrawal cylinders transfer the liquid, via a dipstick, from the cylinder to the torch head where it is vaporized. Liquid withdrawal cylinders have male cylinder valves, which may be equipped with adapters.

Frost build-up occurs only with vapor withdrawal cylinders. This can be as a result of the cylinder being undersized for the torch or air temperatures being low. When vapor is drawn off more quickly than it is replaced, heat is absorbed and frost build-up occurs on the outside of the cylinder. Vapor pressure then further declines. Consequently, liquid withdrawal cylinders are preferred. However, if vapor withdrawal cylinders are used, 40- or 100-lb (18.2- or 45.5-kg) cylinders should be used with larger torches (such as those used on the field of the roof) or when temperatures are low [below 20°F (-7°C)].

A-7-1.3.8 Fuel gas cylinders should be inspected for dents. If dents larger than a quarter are found, the cylinder should be replaced. Torch and cylinder connectors should be visually inspected and checked for leaks with a soap and water solution. An open flame should not be used to test for leaks.

Leaky equipment should not be used. Regulator adjustments and pressure gauges should be checked to ensure that they are operable. The vent on the regulator should be checked to ensure that it is not blocked. If an unstable flame occurs (roars loudly and tends to blow itself out), the equipment should be repaired or replaced immediately.

A-7-1.3.11 All roof areas worked on should be checked for hot spots and signs of smoldering. The inside of the building should also be inspected for signs of fire or smoke. Particular attention should be paid to cants, flashings, and areas around penetrations such as vent pipes, air vents, and skylights. Where available, infrared scanners should be used to detect hot spots. All fires should be reported to the fire department even if extinguished. Smoldering may continue after extinguishment, may take place for hours before flaming begins, and may take place in areas unsuspected by the layman. (*Also see A-3-1.1.*)

A-7-1.4.1 Additional information regarding the safe use and operation of roofing kettles can be found in NFPA 1, *Fire Prevention Code*, Section 3-12.

A-7-1.4.2 For large roof areas additional protection, such as charged hose lines or additional extinguishers, may be advisable.

A-8-2.2 Tanks and piping formerly containing flammable liquids are likely to contain flammable vapors and should be removed prior to demolition of the building. If this is not feasible, these hazards should be placarded or otherwise identified for careful removal. Purging with inert materials should be done as early as possible in the demolition operation in order to minimize the possibility of explosion. Remaining residue or sludge may constitute a fire or explosion hazard. For guidance on draining and inerting tanks see NFPA 327, *Standard Procedures for Cleaning or Safeguarding Small Tanks and Containers Without Entry*, and NFPA 30, *Flammable and Combustible Liquids Code*.

A-8-4 Areas where smoking should be prohibited include but are not limited to temporary holding areas for combustible construction materials, storage areas, and areas where oil, gasoline, propane, or flammable material are stored or used.

A-8-5 If buildings are demolished by explosives, work should be done only by experienced personnel with procedures approved by the authority having jurisdiction.

A-8-7 In situations where adjacent structures will remain, demolition should be started immediately adjacent to the remaining structures, thereby creating a space separation between the remaining structures and the remaining demolition work.

Vertical open shafts in buildings under demolition have been a major factor in the rapid spread of fire throughout the building. Outside chutes should be used where possible so that floor-to-floor integrity can be maintained.

A-8-8.2 The existing sprinklers should be retained in service as long as is reasonable by cutting off and capping the system at the floor or area being razed. Modification of the sprinkler systems to permit alterations or additional demolition should be done under direction of the authority having jurisdiction and should be expedited so automatic protection may be restored as quickly as possible.

A-8-8.5 During demolition operations, charged hose lines supplied by hydrants or sprinkler-riser adapters should be available.

A-9-1 The following publications may be consulted for additional information on underground operations and related subjects:

ANSI A10.16, *American National Standard Safety Requirements for Construction of Tunnels, Shafts and Caissons*, 1988 edition.

ACGIH *Threshold Limit Values and Biological Exposure Indices for 1992-1993*.

CFR, Title 29, Part 1926, Subpart S—*Tunnels and Shafts, Caissons, Cofferdams and Compressed Air*.

CFR, Title 30, Part 57—*Safety and Health Standards, Underground Metal and Non-metal Mines*.

CFR, Title 30, Part 75—*Mandatory Safety Standards, Underground Coal Mines*.

NFPA *Fire Protection Handbook*, 17th edition.

NFPA 121, *Standard on Fire Protection for Self-Propelled and Mobile Surface Mining Equipment*, 1990 edition.

NFPA 122, *Standard for the Storage of Flammable and Combustible Liquids Within Underground Metal and Nonmetal Mines (Other than Coal)*, 1990 edition.

A-9-1.1 Underground structures and construction activities present unique fire protection problems in that fires can quickly create temperatures and smoke levels that are intolerable to workers and fire fighters. Due to the unusual circumstances, the complexity and variety of activities regarding underground operations, fire prevention, fire suppression, and emergency evacuation plans should be reviewed with responding fire departments and medical facilities. It is further recommended that fire fighting personnel be given periodic tours of the underground work areas.

A-9-1.9 If an underground location is classified as gassy by the regulatory authorities, then additional fire protection and equipment may be needed. For example, continuous monitoring for flammable gas, explosionproof electrical equipment, and other related requirements may be necessary. It is recommended that contact be made with the authority having jurisdiction over the project to determine specific safety and fire prevention needs.

A-9-3.1 An underground emergency evacuation plan should be developed, and the first and foremost consideration of this plan should be the prompt and safe removal of all persons underground. This plan should include, as a minimum: emergency communications and alarm system; clear, concise, and uncomplicated emergency instructions; location of means of egress from the underground work areas; availability and location of self-rescuer air breathing units and first-aid supplies; emergency ventilation methods; and location of any refuge stations.

A-9-4.1 The use of hazardous materials, liquids, or chemicals underground should be minimized and eliminated when feasible. Strict controls including fire-resistant storage areas vented to the outside are recommended.

Appendix B Referenced Publications

B-1 The following documents or portions thereof are referenced within this standard for informational purposes only and thus should not be considered part of the requirements of this document. The edition indicated for each reference is the current edition as of the date of the NFPA issuance of this document.

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

NFPA 1, *Fire Prevention Code*, 1992 edition.

NFPA 30, *Flammable and Combustible Liquids Code*, 1993 edition.

NFPA 51B, *Standard for Fire Prevention in Use of Cutting and Welding Processes*, 1989 edition.

NFPA 72, *National Fire Alarm Code*, 1993 edition.

NFPA 80, *Standard for Fire Doors and Fire Windows*, 1992 edition.

NFPA 121, *Standard on Fire Protection for Self-Propelled and Mobile Surface Mining Equipment*, 1990 edition.

NFPA 122, *Standard for the Storage of Flammable and Combustible Liquids Within Underground Metal and Nonmetal Mines (Other than Coal)*, 1990 edition.

NFPA 170, *Standard for Firesafety Symbols*, 1991 edition.

NFPA 327, *Standard Procedures for Cleaning or Safeguarding Small Tanks and Containers Without Entry*, 1993 edition.

NFPA 601, *Standard on Guard Service in Fire Loss Prevention*, 1992 edition.

NFPA 703, *Standard for Fire Retardant Impregnated Wood and Fire Retardant Coatings for Building Materials*, 1992 edition.

Fire Protection Handbook, 17th edition.

B-1.2 Other Publications.

B-1.2.1 ACGIH Publication. American Conference of Governmental Industrial Hygienists, 6500 Glenway Avenue, Cincinnati, OH 45211.

ACGIH *Threshold Limit Values and Biological Exposure Indices for 1992-1993*.

B-1.2.2 ANSI Publication. American National Standards Institute, 1430 Broadway, New York, NY 10018.

ANSI A10.16, *American National Standard Safety Requirements for Construction of Tunnels, Shafts and Caissons*, 1988 edition.

B-1.2.3 ARMA Publication. Asphalt Roofing Manufacturer's Association, 6288 Montrose Road, Rockville, MD 20852.

Torch-Applied Roofing, Do's and Don'ts, 1986 edition.

B-1.2.4 Factory Mutual Research Corp. Publication. Factory Mutual Research Corp., 1151 Boston-Providence Tpke., Norwood, MA 02062.

Safeguarding Torch-Applied Roof Installations, 1988 edition.

B-1.2.5 U.S. Government Publications. U.S. Government Printing Office, Washington, DC 20402.

CFR, Title 29, Part 1926—*Safety and Health Regulations for Construction, Subpart S—Tunnels and Shafts, Caissons, Cofferdams and Compressed Air.*

CFR, Title 30, Part 57—*Safety and Health Standards, Underground Metal and Non-metal Mines.*

CFR, Title 30, Part 75—*Mandatory Safety Standards, Underground Coal Mines.*

Index