NFPA 241

Standard for Safeguarding Construction, Alteration, and Demolition Operations

2000 Edition

NFPA, 1 Batterymarch Park, PO Box 9101, Quincy, MA 02269-9101
An International Codes and Standards Organization

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NFPA 241

Standard for

Safeguarding Construction, Alteration, and Demolition Operations

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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 World Fire Safety Congress and Exposition™ held May 14–17, 2000, in Denver, CO. It was issued by the Standards Council on July 20, 2000, with an effective date of August 18, 2000, and supersedes all previous editions.

This edition of NFPA 241 was approved as an American National Standard on August 18, 2000.

Origin and Development of NFPA 241

Work on the subject of construction, alteration, and demolition operations began in 1930 when the NFPA Committee on Construction Operations developed the *Recommended Good Practice Requirements for Building Construction Operations*. This text was adopted by the NFPA, 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. Complete revisions were adopted by the NFPA in 1968 and 1973. An editorial revision was approved in 1975 that brought the standard into conformance with the NFPA *Manual of Style*. The standard was substantively reconfirmed in 1980.

The 1986 edition represented a complete rewrite. That rewrite was the result of a comprehensive review by the Technical Committee on Construction and Demolition. When the document was reconfirmed 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 included mandatory references with which various provisions of the standard were required to comply. 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 in this edition.

The 1989 edition included a complete rewrite of the section on roofing operations and greatly expanded the associated appendix items to address torch-applied roofing in additional detail. A new chapter on underground operations was added.

In the 1993 edition, extensive editing by the committee was undertaken to clarify and update the standard.

In the 1996 edition, the committee revised and reorganized Chapter 9.

The 2000 edition changes consist of reformatting the entire document and clarification of requirements for hotwork and torch-applied roofing.

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This list represents the membership at the time the Committee was balloted on the final text of this edition. Since that time, changes in the membership may have occurred. A key to classifications is found at the back of the document.

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

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Standard for

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

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. Where one or more complete paragraph(s) has been deleted, the deletion is indicated by a bullet between the paragraphs that remain.

Information on referenced publications can be found in Chapter 2 and Appendix B.

Chapter 1 Administration

1.1* Scope. This standard shall apply to structures in the course of construction, alteration, or demolition, including those in underground locations.

1.2 Purpose. This standard is intended to prescribe minimum safeguards for construction, alteration, and demolition operations in order to provide reasonable safety to life and property from fire during such operations.

1.3 Application.

1.3.1* This standard provides measures for preventing or minimizing fire damage during construction, alteration, and demolition operations.

1.3.2* The public fire department and other fire protection authorities also shall be consulted for guidance.

1.3.3 Alteration activities shall be permitted to require the use of both the demolition and construction activity requirements, as applicable.

1.3.4 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 if the building is entirely under the jurisdiction of the contractor.

1.4 Equivalency. Nothing in this standard is 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. Technical documentation shall be submitted to the authority having jurisdiction to demonstrate equivalency. The system, method, or device shall be approved for the intended purpose by the authority having jurisdiction.

Chapter 2 Referenced Publications

2.1 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 B.

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

NFPA 10, *Standard for Portable Fire Extinguishers*, 1998 edition.

NFPA 13, *Standard for the Installation of Sprinkler Systems*, 1999 edition.

NFPA 14, *Standard for the Installation of Standpipe, Private Hydrant, and Hose Systems*, 2000 edition.

NFPA 30, *Flammable and Combustible Liquids Code*, 2000 edition.

NFPA 31, *Standard for the Installation of Oil-Burning Equipment*, 1997 edition.

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

NFPA 51B, *Standard for Fire Prevention During Welding, Cutting, and Other Hot Work*, 1999 edition.

NFPA 54, *National Fuel Gas Code*, 1999 edition.

NFPA 58, *Liquefied Petroleum Gas Code*, 1995 edition.

NFPA 70, *National Electrical Code®*, 1999 edition.

NFPA 70E, *Standard for Electrical Safety Requirements for Employee Workplaces*, 2000 edition.

NFPA 80, *Standard for Fire Doors and Fire Windows*, 1999 edition.

NFPA *101®, Life Safety Code®*, 2000 edition.

NFPA 130, *Standard for Fixed Guideway Transit and Passenger Rail Systems*, 2000 edition.

NFPA 211, *Standard for Chimneys, Fireplaces, Vents, and Solid Fuel-Burning Appliances*, 2000 edition.

NFPA 495, *Explosive Materials Code*, 1996 edition.

NFPA 701, *Standard Methods of Fire Tests for Flame Propagation of Textiles and Films*, 1999 edition.

NFPA 1963, *Standard for Fire Hose Connections*, 1998 edition.

2.1.2 Other Publications.

2.1.2.1 ACGIH Publication. American Conference of Governmental Industrial Hygienists, 6500 Glenway Avenue, Bldg. D-7, Cincinnati, OH 45211.

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

Chapter 3 Definitions

3.1 General. For the purpose of this standard, the following terms shall be defined as provided in this section.

3.2 NFPA Official Definitions.

3.2.1* Approved. Acceptable to the authority having jurisdiction.

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

3.2.3* Listed. Equipment, materials, or services included in a list published by an organization that is acceptable to the authority having jurisdiction and concerned with evaluation of products or services, that maintains periodic inspection of production of listed equipment or materials or periodic evaluation of services, and whose listing states that either the equipment, material, or service meets appropriate designated standards or has been tested and found suitable for a specified purpose.

3.2.4 Shall. Indicates a mandatory requirement.

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

3.3 General Definitions.

3.3.1 Hot Work. Any work involving burning, welding, or similar operations that is capable of initiating fires or explosions, including cutting, welding, thermit welding, brazing, soldering, grinding, thermal spraying, thawing pipe, torch applied roofing, or any other similar activity.

3.3.2 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.

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

3.3.4 Roofing System.

3.3.4.1 Single-Ply Roofing System. A single-layer roof covering made of plastic, synthetic rubber, or modified bitumen.

3.3.4.2 Torch-Applied Roofing System. A bituminous roofing system using membranes that are adhered by heating with a torch and melting an asphalt backcoating instead of mopping hot asphalt for adhesion.

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

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

3.3.5.2 Underground Structure. A structure located in an underground tunnel, a shaft, a chamber, or a passageway; or cut and covered excavation.

3.3.6 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 a powder, a ceramic rod, a wire, or molten materials.

3.3.7 Thermit Welding. A welding process that produces coalescence of metals by heating them with superheated liquid metal resulting 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.

3.3.8 Tunnel. An underground structure with a design length over 75 ft (22.86 m) and a 6-ft (1.83-m) diameter.

Chapter 4 Temporary Construction, Equipment, and Storage

4.1 Temporary Offices and Sheds.

4.1.1* 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 in accordance with Table 4.1.1.

Table 4.1.1 Separation Distances

Temporary Structure Exposing Wall Length		Minimum Separation Distance	
ft	m	ft	m
20	6	30	9
30	9	35	11
40	12	40	12
50	15	45	14
60	18	50	15
>60	>18	60	18

Notes:
1. Where the separation distance between temporary structures is less than the minimum separation distance, then the exposing wall length shall be considered to be the sum of the individual exposing wall lengths of the temporary structure.
2. A 75-percent reduction in separation distances shall be permitted to be applied, provided automatic sprinkler protection is used in the exposing structure.
3. The separation distances apply to single-level structures only. This table does not apply to multilevel, unsprinklered structures. A level, where applying this table, is 12 ft (3.65 m).

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

4.1.3 Only safely installed approved heating devices shall be used in temporary offices and sheds.

4.1.4 Clearance shall be provided around stoves, heaters, and all chimney and vent connectors to prevent ignition of adjacent combustible materials in accordance with NFPA 31, *Standard for the Installation of Oil-Burning Equipment* (liquid fuel devices); NFPA 54, *National Fuel Gas Code* (fuel gas devices); and NFPA 211, *Standard for Chimneys, Fireplaces, Vents, and Solid Fuel-Burning Appliances* (connectors and solid fuel). *(Where temporary heating devices are used, see Section 5.2.)*

4.2 Temporary Enclosures.

4.2.1 Only noncombustible panels, flame-resistant tarpaulins, or approved materials of equivalent fire-retardant characteristics shall be used.

4.2.2 Any other fabrics or plastic films used shall be certified as conforming to the requirements of Test Method #2 contained in NFPA 701, *Standard Methods of Fire Tests for Flame Propagation of Textiles and Films.*

4.2.3 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.

4.2.4 Fire Extinguishers.

4.2.4.1 Temporary enclosures shall be equipped with a minimum of one fire extinguisher suitable for all classes of fires that are expected inside the enclosure.

4.2.4.2 Fire extinguishers shall be located so that travel distance to a fire extinguisher does not exceed 50 ft (15 m).

4.3 Equipment.

4.3.1* Internal combustion engines and associated equipment, such as air compressors, hoists, derricks, pumps, and similar devices, shall be located so that the exhausts discharge well away from combustible materials.

4.3.2 Where the exhausts are piped 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.

4.3.3 Internal combustion engines and associated equipment shall be shut down and allowed to cool sufficiently prior to refueling.

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

4.3.5 Fuel for internal combustion engines shall not be stored within structures under construction, alteration, or demolition.

Exception: Where permitted by Section 5.5.

Chapter 5 Processes and Hazards

5.1 Hot Work.

5.1.1* Responsibility for hot work operations and fire prevention precautions, including permits and fire watches, shall be in accordance with NFPA 51B, *Standard for Fire Prevention During Welding, Cutting, and Other Hot Work.*

5.1.2 Gas operated cutting and welding equipment using multiple oxygen and fuel gas cylinders shall be in accordance with NFPA 51, *Standard for the Design and Installation of Oxygen-Fuel Gas Systems for Welding, Cutting, and Allied Processes.*

5.1.3 Fire Watch.

5.1.3.1 Fire watches shall be assigned no other duties.

5.1.3.2 A fire watch shall be posted for the duration of the work and for 60 minutes thereafter for torch-applied roofing operations *(see 9.1.3.9).*

5.1.4 Thermit Welding.

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

5.1.4.2* Bulk storage of Thermit welding materials shall be maintained in a detached shed at least 50 ft (15 m) from the main buildings.

5.1.4.3 Storage sheds shall be maintained dry, posted as a "no smoking" area, and kept locked.

5.1.4.4 Containers for the starting material shall be closed tightly immediately after each use.

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

5.1.4.6 Smoking shall not be permitted in areas where Thermit welding material is being used.

5.2 Temporary Heating Equipment.

5.2.1 Temporary heating equipment shall be listed and shall be installed, used, and maintained in accordance with the manufacturer's instructions.

5.2.2 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.*

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

5.2.4 Fuel supplies for liquefied petroleum gas-fired heaters shall comply with NFPA 54, *National Fuel Gas Code,* and NFPA 58, *Liquefied Petroleum Gas Code.*

5.2.5* Refueling operations shall be conducted in an approved manner.

5.2.6 Heating devices shall be situated so that they are secured.

5.2.7 Heating devices shall be installed in accordance with their listing, including clearance to combustible material, equipment, or construction.

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

5.3 Smoking.

5.3.1* 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.

5.3.2 Smoking shall be permitted only in designated areas.

5.3.3 Where smoking is permitted, safe receptacles for smoking materials shall be provided.

5.4 Waste Disposal.

5.4.1* 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.

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

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

5.4.4* When a trash chute is used, an approved safety plan shall be submitted to the authority having jurisdiction.

5.5 Flammable and Combustible Liquids and Flammable Gases.

5.5.1 Storage.

5.5.1.1 Storage of flammable and combustible liquids shall be in accordance with NFPA 30, *Flammable and Combustible Liquids Code*.

Exception: Where modified by this section.

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

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

5.5.1.4 Open flames and smoking shall not be permitted in flammable and combustible liquids storage areas.

5.5.1.5 Such storage areas shall be appropriately posted as "no smoking" areas.

5.5.2 Handling of Flammable and Combustible Liquids at Point of Final Use.

5.5.2.1 Class I and Class II liquids shall be kept in approved safety containers.

5.5.2.2 Means shall be provided to dispose of leakage and spills promptly and safely.

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

5.5.3 Storage and Handling of Combustible and Flammable Gases.

5.5.3.1 Storage and handling of combustible and flammable gases shall be in accordance with NFPA 54, *National Fuel Gas Code*, and NFPA 58, *Liquefied Petroleum Gas Code*.

5.5.3.2 Open flames and smoking shall not be permitted in flammable gas storage areas.

5.6 Explosive Materials.

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

5.6.2 All blasting operations shall be under the direct supervision of an individual who is legally licensed to use explosives and who possesses the required permits.

Chapter 6 Utilities

6.1 Electrical.

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

6.1.2 Temporary Wiring.

6.1.2.1 Branch Circuits. All branch circuits shall originate in an approved power outlet or panelboard.

6.1.2.2 Conductors shall be permitted within multiconductor cord or cable assemblies or as open conductors.

6.1.2.3 All conductors shall be protected by overcurrent devices rated for the ampacity of the conductors.

6.1.2.4 Runs of open conductors shall be located where the conductors are not subject to physical damage, and the conductors shall be fastened at intervals not exceeding 10 ft (3 m).

6.1.2.5 Each branch circuit that supplies receptacles or fixed equipment shall contain a separate equipment grounding conductor where run as an open conductor.

6.1.3 Lighting.

6.1.3.1 Temporary lights shall be equipped with guards to prevent accidental contact with the bulb.

Exception: Guards shall not be required where construction of the reflector is such that the bulb is deeply recessed.

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

6.1.3.3 Temporary lights shall be equipped with heavy-duty electrical cords with connections and insulation maintained in safe condition.

6.1.3.4 Temporary lights shall not be suspended by their electrical cords.

Exception: Temporary lights shall be permitted to be suspended by their electrical cords where the cords and lights have been designed for that purpose.

6.1.3.5 Splices shall have insulation equivalent to that of the cable.

6.1.3.6 Temporary wiring shall be removed immediately upon the completion of the construction or purpose for which the wiring was installed.

Chapter 7 Fire Protection

7.1 Fire Safety Program. An overall construction or demolition fire safety program shall be developed; essential items to be emphasized include the following:

(1) Good housekeeping
(2) On-site security
(3) Installation of new fire protection systems as construction progresses
(4) Preservation of existing systems during demolition
(5) Organization and training of an on-site fire brigade
(6) Development of a prefire plan with the local fire department
(7) Rapid communication
(8) Consideration of special hazards resulting from previous occupancies
(9) Protection of existing structures and equipment from exposure fires resulting from construction, alteration, and demolition operations

7.2 Owner's Responsibility for Fire Protection.

7.2.1* The owner shall designate a person who shall be responsible for the fire prevention program and who shall ensure that it is carried out to completion.

7.2.1.1 This fire prevention program manager shall have the authority to enforce the provisions of this and other applicable fire protection standards.

7.2.1.2 The fire prevention program manager shall have knowledge of the applicable fire protection standards, available fire protection systems, and fire inspection procedures.

7.2.1.3 Inspection records shall be available for review by the authority having jurisdiction.

7.2.2 Where guard service is provided, the manager shall be responsible for the guard service.

7.2.3* Prefire Plans.

7.2.3.1 Where there is public fire protection or a private fire brigade, the manager shall be responsible for the development of prefire plans in conjunction with the fire agencies.

7.2.3.2 Prefire plans shall be updated as necessary.

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

7.2.4 Program Manager Responsibilities.

7.2.4.1 The manager shall be responsible for ensuring that proper training in the use of protection equipment has been provided.

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

7.2.4.3 The manager shall be responsible for supervising the permit system for hot work operations. *(See Section 5.1.)*

7.2.4.4 A weekly self-inspection program shall be implemented with records maintained and made available.

7.2.4.5* Impairments to the fire protection systems or fire alarm, detection, or communications systems shall be authorized only by the fire prevention program manager.

7.2.4.6 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.

7.2.5 Site Security.

7.2.5.1* Guard service shall be provided where required by the authority having jurisdiction.

7.2.5.2* Where guard service is provided, the guard(s) shall be trained in the following:

(1) Notification procedures that include calling the fire department and management personnel
(2) Knowledge of fire protection equipment
(3) Familiarization with fire hazards
(4) Use of construction elevators

7.2.5.3 Guards shall be informed of any special status of emergency equipment or hazards.

7.2.5.4* Security fences shall be provided where required by the authority having jurisdiction.

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

7.3 Installation, Testing, and Maintenance. Where fire alarm, detection, or protection systems are required, they shall be installed, maintained, and tested in accordance with the appropriate NFPA standards. *(See Chapter 2.)*

7.4* Fire Alarm Reporting.

7.4.1 There shall be a readily available public fire alarm box near the premises, telephone service to the responding fire department, or equivalent facilities.

7.4.2 Instructions shall be issued for the immediate notification of the fire department in the case of a fire. Where telephone service is employed, the local fire department number and site address shall be conspicuously posted near each telephone.

7.5 Access for Fire Fighting.

7.5.1 A suitable location at the site shall be designated as a command post and provided with plans, emergency information, keys, communications, and equipment, as needed.

7.5.2 The person in charge of fire protection shall respond to the location command post whenever fire occurs.

7.5.3 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.

7.5.4 The key box shall be an approved type and shall contain keys to gain access as required by the authority having jurisdiction.

7.5.5 Access Roadways.

7.5.5.1 Every building shall be accessible by fire department apparatus by means of roadways having an all-weather driving surface of not less than 20 ft (6 m) of unobstructed width, having the ability to withstand the live loads of fire apparatus, and having a minimum of 13 ft 6 in. (4 m) of vertical clearance.

7.5.5.2 Dead-end fire department access roads in excess of 150 ft (46 m) in length shall be provided with approved provisions for turning around fire department apparatus.

Exception: The requirements of 7.5.5 shall be permitted to be modified where, in the opinion of the fire department, fire-fighting or rescue operations would not be impaired by such modification.

7.5.5.3 The required width of access roadways shall not be obstructed in any manner, including obstruction by parked vehicles.

7.5.5.4 "No parking" signs or other appropriate notices, or both, prohibiting obstruction shall be permitted to be required and shall be maintained.

7.5.5.5 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.

7.5.5.6 Where an access roadway cannot be provided, an approved fire protection system or systems shall be provided as required and approved by the authority having jurisdiction.

7.5.5.7 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.

7.5.5.8 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.

7.5.6 Stairs.

7.5.6.1 In all buildings over one story in height, at least one stairway shall be provided that is in usable condition at all times and that meets the requirements of NFPA *101®*, *Life Safety Code®*.

7.5.6.2 This stairway shall be extended upward as each floor is installed in new construction and maintained for each floor still remaining during demolition.

7.5.6.3 The stairway shall be lighted.

7.5.6.4 During construction, the stairway shall be enclosed where the building exterior walls are in place.

7.5.7 Hoists and Elevators. 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.

7.5.8 Hydrants.

7.5.8.1 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.

7.5.8.2 Protective pedestrian walkways shall not be constructed so that they impede access to hydrants.

7.5.8.3 No material or construction shall interfere with access to hydrants, siamese connections, or fire extinguishing equipment.

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

7.7* First-Aid Fire-Fighting Equipment.

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

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

Exception: This requirement shall be permitted to be waived where the structure does not exceed 150 ft² (14 m²) in floor area or is equipped with automatic sprinklers or other approved protection.

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

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

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

7.8 Means of Egress. The means of egress shall be provided in accordance with 4.6.10 of NFPA *101, Life Safety Code.*

Chapter 8 Safeguarding Construction and Alteration Operations

8.1 General. In addition to the specific requirements of this chapter, the provisions of Chapter 1 and Chapters 3 through 7 shall be followed, as applicable, for all construction.

8.2* Scaffolding, Shoring, and Forms.

8.2.1 Accumulations of unnecessary combustible forms or form lumber shall be prohibited.

8.2.2 Combustible forms or form lumber shall be brought into the structure only when needed.

8.2.3 Combustible forms or form lumber shall be removed from the structure as soon as stripping is complete.

8.2.4 Those portions of the structure where combustible forms are present shall not be used for the storage of other combustible building materials.

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

8.3 Construction Material and Equipment Storage.

8.3.1 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.

Exception: Where authorized by the authority having jurisdiction.

8.3.2* Storage shall not be permitted in protected structures until protection is in service.

8.3.3 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 4.1.1.)*

8.4 Permanent Heating Equipment. The permanent heating equipment for a new building shall be installed and put into operation as soon as practicable.

8.5 Utilities.

8.5.1 General. The provisions of Chapter 6 shall apply in addition to the specific requirements of this section.

8.5.2 Gas.

8.5.2.1 The 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.

8.5.2.2 All such work shall be in accordance with NFPA 54, *National Fuel Gas Code.*

8.5.2.3 All modifications to existing gas piping systems normally shall be performed with the gas turned off.

Exception: Hot taps shall be permitted to be made, provided they are installed by a trained and experienced crew utilizing equipment specifically designed for such purpose.

8.6 Building Separation Walls.

8.6.1 Fire Cutoffs.

8.6.1.1 Fire walls and exit stairways, where required for the completed building, shall be given construction priority for installation.

8.6.1.2 Fire doors with approved closing devices and hardware shall be installed as soon as is practicable and preferably before combustible material is introduced.

8.6.1.3 Fire doors, after installation in accordance with NFPA 80, *Standard for Fire Doors and Fire Windows*, shall not be obstructed from closing.

8.6.2 Temporary Separation Walls.

8.6.2.1 Protection shall be provided to separate an occupied portion of the structure from a portion of the structure undergoing alteration, construction, or demolition operations when such operations are considered as having a higher level of hazard than the occupied portion of the building.

8.6.2.2 Walls shall have at least a 1-hour fire resistance rating.

8.6.2.3 Opening protectives shall have at least a 45-minute fire protection rating.

8.6.2.4* Nonrated walls and opening protectives shall be permitted when an approved automatic sprinkler system is installed.

8.7 Fire Protection During Construction.

8.7.1 General. The provisions of Chapter 7 shall apply in addition to the specific requirements of this section.

8.7.2 Water Supply.

8.7.2.1* A water supply for fire protection, either temporary or permanent, shall be made available as soon as combustible material accumulates.

8.7.2.2 There shall be no delay in the installation of fire protection equipment. *(See A.8.2.5.)*

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

8.7.3 Sprinkler Protection.

8.7.3.1* If automatic sprinkler protection is to be provided, the installation shall be placed in service as soon as practicable.

8.7.3.2 The details of installation shall be in accordance with NFPA 13, *Standard for the Installation of Sprinkler Systems*.

8.7.3.3 Where sprinklers are required for safety to life, the building shall not be occupied until the sprinkler installation has been entirely completed and tested so that the protection is not susceptible to frequent impairment caused by testing and correction.

Exception: This provision shall not prohibit occupancy of the lower floors of a building, even where the upper floors are 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 8.7.3.3;

(b) The sprinkler protection of the upper floors is supplied by entirely separate systems and separate control valves so that the absence or incompleteness of protection in no way impairs the sprinkler protection of the occupied lower floors.

8.7.3.4 The operation of sprinkler control valves shall be permitted only by properly authorized personnel and shall be accompanied by the notification of duly designated parties.

8.7.3.5 Where the sprinkler protection is 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 shift to ascertain that protection is in service.

8.7.4 Standpipes.

8.7.4.1 General.

8.7.4.1.1* The 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, Private Hydrant, and Hose Systems*.

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

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

8.7.4.2 Standpipe Installations in Buildings Under Construction. Where 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 8.7.4.2.1 through 8.7.4.2.9.

8.7.4.2.1 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.

8.7.4.2.2 The pipe sizes, hose valves, hose, water supply, and other details for new construction shall be in accordance with this standard.

8.7.4.2.3 The standpipes shall be securely supported and restrained at each alternate floor.

8.7.4.2.4* At each floor level, at least one approved hose valve for attaching fire department hose shall be provided.

8.7.4.2.5 Valves shall be kept closed at all times and guarded against mechanical injury.

8.7.4.2.6 A hose valve(s) shall have NH standard external threads for the valve size specified in accordance with NFPA 1963, *Standard 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.

8.7.4.2.7* The standpipes shall be extended up with each floor and shall be securely capped at the top.

8.7.4.2.8 Top hose outlets shall be not more than one floor below the highest forms, staging, and similar combustibles at all times.

8.7.4.2.9 Temporary standpipes shall remain in service until the permanent standpipe installation is complete.

Chapter 9 Safeguarding Roofing Operations

9.1 Roofing Operations.

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

9.1.2 Asphalt and Tar Kettles.

9.1.2.1* Asphalt and tar kettles and associated LP-Gas cylinders shall be located in a safe place outside of the building at a point that avoids the danger of ignition of combustible material.

9.1.2.2 Asphalt and tar kettles shall not be located on roofs.

9.1.2.3 A lid that can be closed by means of gravity shall be provided on all roofing kettles.

9.1.2.4 The tops and covers of all kettles shall be close-fitting and constructed of steel having a thickness of not less than No. 14 manufacturer's standard gauge [0.075 in. (2 mm)].

9.1.2.5* Used roofing mops and rags shall be cleaned of excessive asphalt and stored away from the building and combustible materials.

9.1.2.6 Discarded roofing mops and rags shall not be in contact with combustibles.

9.1.2.7 Kettles shall be constantly attended when in operation by a minimum of one employee knowledgeable of the operations and hazards. The employee shall be within 25 ft (7.6 m) of the kettle and have the kettle within sight.

9.1.2.8 Roofing kettles shall not block exits, means of egress, gates, roadways, or entrances. In no case shall kettles be closer than 10 ft (3 m) from exits or means of egress.

9.1.3* Single-Ply and Torch-Applied Roofing Systems.

9.1.3.1* General.

9.1.3.1.1 Single-ply and torch-applied roofing systems shall be installed using extreme caution.

9.1.3.1.2 Torches or hot-air guns used to secure roofing membranes shall be used in accordance with the manufacturer's recommendations.

9.1.3.1.3 In order to prevent smoking or ignition of roofing membranes, they shall not be overheated.

9.1.3.2* Openings, Penetrations and Flashings.

9.1.3.2.1 Caution shall be used where working near roof openings, penetrations, or flashings.

9.1.3.2.2 The flame of the torch shall not come in direct contact with wood nailers, cant strips, or metal flashing.

9.1.3.2.3 Small torches shall be used to heat the underside of the membrane at a distance from these areas before securement.

9.1.3.2.4 Hot trowels shall be used to feather seams at laps and flashings.

9.1.3.2.5 The torch shall not be used in areas where the flame impingement cannot be fully viewed.

9.1.3.2.6 Open flames shall not be left unattended.

9.1.3.3 Flame Contact Protection.

9.1.3.3.1 The torch flame shall not be applied to a combustible substrate for the membrane.

9.1.3.3.2 Base ply shall be used to cover wooden decks, combustible insulation (such as foam plastic, kraft-faced glass fiber, or wood fiber), small crevices, cant strips, plastic fastener plates, or any other combustible surface.

9.1.3.3.3 Base ply shall be permitted to consist of either glass fiber felts or minimum 40-lb (18-kg) organic felts.

9.1.3.3.4 Torch flames shall not come in contact with exposed plastic roofing cement.

9.1.3.4 Installation. The installation of torch-applied roofing and, in some cases, single-ply roofing systems is hot work and shall comply with Section 5.1, except where otherwise noted.

9.1.3.5* Personal Protection. Protective clothing and personal protective equipment shall be worn by installers.

9.1.3.6 Equipment.

9.1.3.6.1 Proper equipment shall be used to heat roofing membranes.

9.1.3.6.2 Torches shall be equipped with a pilot adjustment, a flame height adjustment, a minimum of 25 ft (8 m) to a maximum of 50 ft (15 m) of listed hose, a pressure gauge, and a regulator.

9.1.3.6.3 A spark igniter shall be used.

9.1.3.6.4 Torch trolleys and multiple torch head machines shall be equipped with listed safety valves.

9.1.3.7* Equipment Inspection. Equipment shall be inspected thoroughly and repaired or replaced as needed prior to use.

9.1.3.8* Fuel Gas Cylinders.

9.1.3.8.1 Fuel gas cylinders shall not be hoisted by their valves.

9.1.3.8.2 Straps placed around the cylinders shall be utilized.

9.1.3.8.3 Carts used to transport fuel gas cylinders shall be stable.

9.1.3.8.4 Safety caps shall be attached to all fuel gas cylinders and installed on the valves whenever cylinders are not in use.

9.1.3.8.5 The fuel gas cylinder shall be sized for the torch used.

9.1.3.8.6 If frost buildup 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.

9.1.3.8.7 The hose shall be disconnected and a larger cylinder used.

9.1.3.9* Fire Watch. A fire watch shall be conducted for at least 1 hour after torches have been extinguished.

9.1.4 Fire Extinguishers for Roofing Operations.

9.1.4.1* There shall be at least one portable fire extinguisher having a rating of not less than 20-B no closer than 5 ft (1.5 m) and no more than 25 ft (7.6 m) of horizontal travel distance from every kettle at all times while such kettle is in operation.

9.1.4.2 Fire extinguishers shall be located in an accessible, visible, or identified location.

9.1.4.3* 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 shall be provided as determined by the authority having jurisdiction.

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

9.1.4.5 All kettle operators and torch applied roof installers shall be trained in the use of fire extinguishers.

9.1.5 Fuel for Roofing Operations.

9.1.5.1 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, *Liquefied Petroleum Gas Code*.

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

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

9.1.5.3 Solid fuel or Class I liquids shall not be used as fuel for roofing kettles.

9.1.5.4 LP-Gas cylinders shall be secured to prevent accidental tip over.

9.1.5.5 Where in the opinion of the authority having jurisdiction, there is danger of physical damage to the fuel containers, protection shall be provided.

Chapter 10 Safeguarding Demolition Operations

10.1 General. In addition to the specific requirements of this chapter, the provisions of Chapter 1 and Chapters 3 through 7 shall be followed, as applicable, for all demolition operations.

10.2 Special Precautions.

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

10.2.2* 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 the removal of residue and sludge accumulations if hot work operations are involved.

10.3 Temporary Heating Equipment.

10.3.1 During cold-weather demolition operations, building heat shall be maintained to allow the operation of sprinklers, hose, and extinguishers in areas not in the process of demolition.

10.3.2 The minimum temperature at the extremities of such areas equipped with wet sprinkler systems shall be 40°F (4°C).

10.4* Smoking. Smoking shall be prohibited throughout the demolition areas.

10.5* Demolition Using Explosives.

10.5.1 If explosives are used in demolition work (implosion), hose lines [at least two of $1^1/_2$ in. (38 mm) or one of $2^1/_2$ in. (64 mm)] shall be provided in the immediate vicinity of the demolition site during the actual detonation.

10.5.2 These lines shall be of sufficient length to be capable of extinguishing any small fire anywhere on the demolition site after detonation.

10.6 Utilities.

10.6.1 Electrical Service. Electrical service shall be reduced to a minimum, and the identity of energized circuits shall be ensured to avoid any uncertainty.

10.6.2 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.

Exception: Gas lines shall not be required to be purged where permitted by the authority having jurisdiction.

10.7* Fire Cutoffs.

10.7.1 Vertical and horizontal cutoffs shall be retained until razing operations necessitate their removal as permitted by the authority having jurisdiction.

10.7.2 Fire doors shall be closed at the end of each working day.

10.8 Fire Protection During Demolition.

10.8.1 General. The provisions of Chapter 7 shall apply in addition to the specific requirements of this section.

10.8.2* System Operation. Where a building is equipped with sprinklers, the sprinkler protection shall be retained in service as long as the condition requiring the use of sprinklers exists.

10.8.3 Sprinkler Control Valves.

10.8.3.1 The operation of sprinkler control valves shall be permitted only by properly authorized personnel and shall be accompanied by the notification of designated parties.

10.8.3.2 Where the sprinkler protection is 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.

10.8.4 Standpipes. 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.

10.8.5* Fire Exit. Fire extinguishing equipment shall be available subject to the authority having jurisdiction.

Chapter 11 Safeguarding Underground Operations

11.1* General.

11.1.1* In addition to the specific requirements of this chapter, the provisions of Chapter 1 and Chapters 3 through 10 shall be followed for all underground operations.

Exception: Where modified by this chapter.

11.1.2 Drainage systems shall be properly designed and installed to remove water from sprinkler discharge and fire hose streams.

11.1.3 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 and Passenger Rail Systems*.

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

11.1.5 Security.

11.1.5.1 At each aboveground entrance, underground operations shall have a check-in/check-out system, supervised by a qualified individual at all times, that provides an accurate record of each person who is underground.

11.1.5.2 The location of the check-in/check-out system shall be within 25 ft (8 m) of the entrance and shall be easily identified.

11.1.6 Completed or unused sections of the underground facility shall be barricaded, properly marked, and made off limits.

11.1.7 Compartmentation by means of the installation of fire and smoke barriers shall be at intervals that limit the extent and severity of the fire and that provide areas of refuge for occupants.

11.1.8 Water Supply.

11.1.8.1 A fire protection water supply system shall be provided in accordance with 8.7.2.1.

11.1.8.2 A standard fitting with outlet threads compatible with the equipment of the local fire department shall be provided so that travel distance does not exceed 150 ft (46 m).

11.2 Emergency Procedures.

11.2.1* Evacuation Plans.

11.2.1.1 A written fire prevention, fire suppression, and emergency evacuation plan shall be developed, maintained, and kept current.

11.2.1.2 The authority having jurisdiction shall be provided with a copy of the current plan for its review and shall have the opportunity to comment on the plan.

11.2.1.3 Special attention shall be given to rescue and smoke-venting procedures, to means of ingress/egress, and to training and orientation of employees and visitors.

11.2.2 All personnel, including visitors, shall be trained in emergency and evacuation procedures and informed of the hazards prior to going underground.

11.2.3 Drills.

11.2.3.1 Underground operations shall conduct disaster and evacuation drills for each shift at least once at the start of underground operations and every 6 months, or more frequently as appropriate.

11.2.3.2 A record of such drills shall be maintained.

11.3 Fire Detection, Protection, and Communications Systems.

11.3.1* Fire Detection and Protection Systems.

11.3.1.1 Fire protection extinguishing equipment applicable to the hazard shall be provided at the head, tail, drive, and take-up pulley areas of belt conveyors and at intervals along belt conveyor lines that shall not exceed 300 ft (91 m).

11.3.1.2 Belt conveyors installed in underground locations shall meet the following minimum requirements:

(1) Conveyor belting shall be approved.
(2) Entrances in which belt conveyors are installed shall be kept free of accumulations such as muck, debris, and combustibles.
(3) All belt conveyors shall be equipped with an approved slippage switch system designed to shut down the belt when sliding friction develops between the drive pulley(s) and the belt. The slippage switch system shall be tested weekly. On each new installation, the slippage switch system shall be tested before the conveyor is used.
(4) All conveyor belt systems shall be equipped with approved interlock systems that shut down belt conveyors when any conveyor in the system stops or reduces its normal speed or upon activation of any required fire protection system.
(5) Fixed combustible materials such as posts, cribbing, and roof supports shall be either guarded from contact by the belt using metal or located at a distance of at least $^1/_2$ the width of the belt from any idler or pulley. An alternate method for minimizing potential frictional ignition is the use of alignment switches at intervals sufficient to prevent the belt from contacting such materials. Guarding for machinery in the drive area and at other points along the belt shall be of noncombustible material.
(6) New installations of belt conveyors shall utilize a structure that does not provide a deck between the upper and lower strands of the belt.

Exception: Belts that carry the load of the belt on a low-friction metal deck without rollers.

11.3.1.3 Suitable fire extinguishers shall be installed so that travel distance from any one point in a tunnel does not exceed 300 ft (91 m) on a horizontal plane.

11.3.1.4 Audible and visible alarm and emergency lighting for safe evacuation shall be required.

11.3.2 Fire Communications Systems.

11.3.2.1 Two means of communications with the surface shall be available at all times from all areas of the underground facility.

11.3.2.2 All communications systems shall be tested weekly.

11.4 Electrical.

11.4.1* Electrical cords and plugs shall be heavy duty and suitable for use in damp locations.

11.4.2 Conductors.

11.4.2.1 Conductors shall be located or guarded so as to be protected from physical damage. Multiconductor portable cable shall be permitted to supply mobile equipment.

11.4.2.2 An equipment grounding conductor shall be run with circuit conductors inside the metal raceway or inside the multiconductor cable jacket.

11.4.2.3 The equipment grounding conductor shall be permitted to be insulated or bare.

11.4.3 Oil-filled transformers shall not be used underground.

Exception: Where located in a fire-resistant enclosure suitably vented to the outside and surrounded by a dike to retain the contents of the transformers in the event of rupture.

11.4.4 Enclosures.

11.4.4.1 Bare terminals of transformers, switches, motor controllers, and other equipment shall be enclosed to prevent accidental contact with energized parts.

11.4.4.2 Enclosures for use in tunnels shall be raintight, rainproof, or watertight as defined in NFPA 70, *National Electrical Code*, where necessitated by the environmental conditions.

11.4.5 Special attention shall be given to maintaining clear access and adequate work space around electrical equipment in accordance with NFPA 70E, *Standard for Electrical Safety Requirements for Employee Workplaces*. Proper housekeeping shall be maintained to avoid fire hazards.

11.4.6 All nonenergized metal parts of electrical 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.

11.5 Hazardous Operations and Procedures.

11.5.1 Hot work operations shall be in accordance with NFPA 51B, *Standard for Fire Prevention During Welding, Cutting, and Other Hot Work*.

11.5.2 A suitable fire extinguisher or other fire control device shall be ready for instant use in any location where hot work is performed.

11.5.3 Acetylene, liquefied petroleum gas (LPG), liquefied oxygen (LOX), 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 permitted limits in accordance with the ACGIH *Threshold Limit Values and Biological Exposure Indices for 1992–1993*.

11.5.4 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.

11.5.5 Flammable and Combustible Liquids.

11.5.5.1* Class I flammable liquids shall not be taken, stored, or used underground or within 100 ft (30 m) of a tunnel portal or shaft opening.

11.5.5.2 Class II and Class III liquids shall be transported and stored in approved closed containers, safety cans, or tanks.

11.5.5.3 Quantities shall be limited to those necessary for one work shift.

11.5.5.4 Lubricating oils, greases, and rope dressings taken underground shall be in closed and reclosable approved containers that do not allow the contents to leak or spill.

11.5.5.5 Oil, grease, and diesel fuel stored underground shall be kept in tightly sealed containers in fire-resistant areas located at least 100 ft (30 m) from shafts and inclines.

11.5.5.6 Storage areas shall be positioned or diked so that the contents of ruptured or overturned containers cannot flow from the storage area.

11.5.5.7 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.

11.6 Storage.

11.6.1 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.

11.6.2 Metal containers with self-closing lids shall be provided and used to store combustible waste and debris and shall be removed and taken to the surface daily.

11.7 Equipment.

11.7.1 Less hazardous hydraulic fluids that are listed shall be used in underground machinery and equipment.

Exception: Where the machinery and equipment are protected by an approved fire suppression system or by approved multipurpose fire extinguishers rated at least 4-A:40-B:C.

11.7.2 Wherever self-propelled equipment is used underground, a fire suppression system or a fire extinguisher rated at least 4-A:40-B:C shall be provided on the equipment.

11.7.3* Ventilation.

11.7.3.1 Where single-entry shafts/tunnel ventilation systems are used, they shall be reversible from a location outside and in close proximity to the shaft/tunnel.

11.7.3.2 The ventilation system shall be sufficient for the number of personnel and equipment underground.

11.7.3.3 Air-sampling logs shall be maintained. Air tests shall be conducted before or after each shift.

11.7.3.4 Air-sampling logs shall be available to the authority having jurisdiction.

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

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.1.1 General requirements applying to construction and demolition are contained in Chapter 1 and Chapters 3 through 7; specific requirements for construction and alteration activities are found in Chapter 8; those requirements specific to roofing operations are covered in Chapter 9; those requirements specific to demolition activities are covered in Chapter 10; and specific requirements for activities in underground locations are contained in Chapter 11.

A.1.3.1 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.

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.

A.1.3.2 The unique and dangerous situations confronting fire fighters during such operations demand that a complete exchange of pertinent information be established and continued during the life of the project.

A.3.2.1 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.3.2.2 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.3.2.3 Listed. The means for identifying listed equipment may vary for each organization concerned with product evaluation; some organizations 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.

A.4.1.1 Separation distances less than those shown in Table 4.1.1 can be used, provided 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.4.1.2 Where located 30 ft (9 m) or more from the structure and constructed of combustible materials, it is recommended that temporary support buildings be divided 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.4.3.1 See NFPA 37, *Standard for the Installation and Use of Stationary Combustion Engines and Gas Turbines.*

A.5.1.1 For a sample permit and procedure, see NFPA 51B, *Standard for Fire Prevention During Welding, Cutting, and Other Hot Work.* Additional fire watches should be provided during welding or cutting operations where sparks or molten metal could drop several floors.

If welding operations have been conducted during a work shift, the guard for the following work shift *(see 7.2.5.1)* should be alerted to check the location where welding was performed as part of his/her regular rounds. Where watch service is not provided, the use of gas-operated welding or cutting equipment should be discontinued for a minimum of 1 hour before the end of the work shift.

Where practicable, 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 should be taken so that wetting down does not introduce a personnel safety hazard.

A.5.1.4.1 When the charge for Thermit welding has been ignited, the operator should stand several steps away [at least 10 ft (3 m)] and should wear goggles. Burns can occur from metal splashings, by upsetting the crucible, by breaking the mold, or by allowing the molten metal to come into contact with moisture in the mold, on the floor, or on the ground.

A.5.1.4.2 Where storage near the point of use is necessary, it should be kept at least 10 ft (3 m) away from that point and limited to a supply necessary for one workday. 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 can 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.5.2.5 This can necessitate the removal of the heater prior to refueling. The appliance also should be allowed to cool prior to refueling.

A.5.2.8 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 might 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 should be relocated. The visual inspection also should ensure that the appliance is operating properly. Any appliance that is not operating properly should be turned off until repairs have been made.

A.5.3.1 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 is stored or used.

A.5.4.1 Failure to remove scrap and trash accumulations provides fuel for the rapid expansion of a fire that might otherwise be confined to a small area. These accumulations also provide a convenient fuel source for malicious fires.

A.5.4.4 An approved safety plan should include the following:

(1) A fire watch should be in accordance with Section 5.1.
(2) Adequate fire protection should include sprinklers, hose, extinguishers, or barriers as needed for the particular hazard present including the construction of the chute.
(3) Protection of openings in exterior walls and protection of combustible exterior building surfaces should be adjacent to the chute.
(4) At the end of each work day, provisions should be made to assure that exposure fires are minimized. *(See 5.4.1.)*
(5) Trash chutes used in the interior of a building should be of noncombustible construction.
(6) The main artery of the chute should be as straight as practical to avoid accumulations or clogging within the chute.

A.5.5.1.2 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.5.5.2.3 The vapors given off by flammable liquids generally have vapor densities greater than those of air. Therefore, these vapors 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 the 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.7.2.1 One person should be made responsible for the protection of property from fire. This person should ensure that the proper procedures for controlling fire hazards are established and should have full authority to enforce them.

The responsible person should be appointed by the owner. Where an entirely new structure is being constructed, the owner should ensure 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."

The responsibility for loss prevention is the owner's. However, loss prevention recommendations normally are accomplished by the contractor. To ensure that recommendations are carried out promptly, the owner's assistance might be needed.

Fire prevention education should be a topic at contractor safety meetings ("tailgate talks") at least once a month. Topics that could 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 necessary fire prevention improvements that are identified by the investigation should be communicated to all employees as soon as possible.

A.7.2.3 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, installation of building systems, and construction safety hazards.

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 semiannually and when there have been major revisions to the fire prevention plan. Since municipal fire departments work rotating shifts, a series of prefire plan visits might be necessary to allow all responding fire fighters an opportunity to visit the site. In rural areas and smaller cities, the local fire department might be a volunteer organization or might have only a small career fire fighter crew on duty during the day. It might 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.7.2.4.5 See NFPA *101®*, *Life Safety Code®*, for impairments to fire protection systems or fire alarm, detection, or communication systems where required by that code. In addition, see NFPA 72, *National Fire Alarm Code®*, for impairments resulting to fire alarm equipment, and NFPA 25, *Standard for the Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems*, for impairments resulting to water-based fire protection equipment.

A.7.2.5.1 Due to the growing threat of arson, guard service should be provided on major projects even where not required by the authority having jurisdiction. The requirements for guard service also should be based on, but should not be limited to, the hazards at the site, the size of the risk, the difficulty of the fire-fighting situation, the exposure risk, and the physical security of the site.

A.7.2.5.2 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 security tour supervision system (watch clock) with stations covering all parts of the building in accordance with NFPA 601, *Standard for Security Services in Fire Loss Prevention.* Guard rounds should include all parts of the buildings and outside areas where hazardous equipment or materials are located. Rounds should be conducted every $^1/_2$ hour for 2 hours after suspension of work for the day and every hour thereafter during the night and nonworking days and shall include tours of all accessible work areas. *(See NFPA 601, Chapter 6.)*

A.7.2.5.4 The requirements for security fencing should be based on, but should not be limited to, the hazards at the site, the size of the risk, the difficulty of the fire-fighting situation, the exposure risk, and the presence of guard service.

A.7.2.5.5 Securing the openings (doors and windows) to the structure, where possible, reduces the chance of entry by unauthorized persons. This, in turn, reduces the chance of arson or accidental fires. It could, in some instances, eliminate the need for guard service or security fencing. It also helps prevent freezing or wind damage to fire protection equipment and prevents combustible material from being blown against heating devices and igniting.

A.7.4 In large projects or tall structures, or both, the use of an audible device for an evacuation signal in case of fire or other emergency is recommended.

A.7.7 Portable fire extinguishers, water pails, small hose lines, and $1^1/_2$-in. (38-mm) standpipe hose are considered first aid

fire-fighting equipment. To be effective, first aid fire-fighting equipment should be used in the incipient stage of a fire.

A.7.7.1 A suitable number and type of spare fire extinguishers should be provided on site for immediate replacement of discharged fire extinguishers.

A.7.7.5 Clear and unobstructed access to all first aid fire-fighting equipment should be maintained. Fire-fighting equipment also should be clearly visible from surrounding areas. If visibility to first aid fire-fighting equipment is obstructed, signs in accordance with NFPA 170, *Standard for Fire Safety Symbols*, should be installed to indicate the position of the fire-fighting equipment.

A.8.2 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 of the noncombustible, fire-retardant, safety solvent, or high flash point type, as the case necessitates. 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.8.2.5 The authority having jurisdiction should be contacted regarding the adequacy of water supplies for hose lines.

A.8.3.2 Accepted good practice provides sprinklered areas for the storage of interior finish materials and building mechanical equipment, much of which could be received in combustible packaging and which cannot be stored outside due to the absence of exterior space, weather, or security. Even where construction combustibles are not a factor, sprinkler protection should be available for unanticipated early delivery of combustible contents to be used for the permanent occupancy. Where necessary, it is not unusual to plug the extremity of a partially installed sprinkler system temporarily so that a portion can be placed in automatic service.

A.8.6.2.4 Construction tarps would not be considered appropriate barriers or opening protectives.

A.8.7.2.1 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 is greater, and authorities having jurisdiction should be consulted.

A.8.7.3.1 With proper scheduling and contracting, it is possible for the sprinkler installation to follow the building construction closely as it progresses. This is frequently done in multiple-story buildings to facilitate protection on the lower floors before the upper floors have been built.

A.8.7.4.1.1 Threaded plugs should be inserted in fire department hose connections, and they should be guarded properly against physical damage.

A.8.7.4.1.2 Exception The intent of this exception is to permit the permanent standpipes to be used as temporary standpipes during construction.

A.8.7.4.2.4 A substantial box, preferably of metal, in which a sufficient amount of hose to reach all parts of the floor, appropriate nozzles, spanner wrenches, and hose straps are kept should be maintained at the highest hose outlet.

A.8.7.4.2.7 A supply of fire hose and nozzles should be ordered in advance so that it is available as soon as the standpipes are ready. Hose lines should be connected in areas where construction is in progress.

A.9.1.2.1 Roofing kettles and all integral working parts should be in good working condition and should be maintained free of excessive residue.

A.9.1.2.5 Many flammable and combustible liquids, including roofing asphalts, combine readily with the oxygen in air and produce heat. Where 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 can 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.9.1.3 For additional information, see the ARMA publication, *Torch-Applied Roofing, Dos and Don'ts*, and the Factory Mutual Data Sheet 1–33, *Safeguarding Torch-Applied Roof Installations*.

A.9.1.3.1 Torch-applied roofing can 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 moved from side to side constantly. If a mobile heating apparatus is used, it should be kept in constant motion while in operation.

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

A.9.1.3.2 Roof openings/vents and crevices should be covered with a stable, noncombustible cover to prevent the 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 begun.

Areas equipped with air conditioning units and ventilating fans should be shut down before torch work is performed.

A torch stand should be used to direct the flame upward while momentarily suspending the use of the flame. 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.9.1.3.5 Protective clothing should include acceptable fabrics, a long-sleeve shirt, long pants, gloves, and eye protection. The safe handling of hand torches and hot trowels necessitates the use of proper protective clothing and personal protective equipment.

A.9.1.3.7 Liquid fuel gas cylinders can be of either the vapor withdrawal or liquid withdrawal type. The vapor withdrawal type draws vapor off the torch head. Vapor withdrawal cylinders are equipped with female cylinder valves. Liquid withdrawal cylinders transfer the liquid, via a dipstick, from the