

NFPA[®]

241

Standard for
Safeguarding Construction,
Alteration, and Demolition
Operations

2022



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NFPA® 241

Standard for

Safeguarding Construction, Alteration, and Demolition Operations

2022 Edition

This edition of NFPA 241, *Standard for Safeguarding Construction, Alteration, and Demolition Operations*, was prepared by the Technical Committee on Construction and Demolition. It was issued by the Standards Council on March 18, 2021, with an effective date of April 8, 2021, and supersedes all previous editions.

This document has been amended by one or more Tentative Interim Amendments (TIAs) and/or Errata. See “Codes & Standards” at www.nfpa.org for more information.

This edition of NFPA 241 was approved as an American National Standard on April 8, 2021.

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 document, *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.

When the document was reconfirmed in 1980, it came under the Technical Committee on Building Construction. The 1986 edition represented a complete rewrite, the result of a comprehensive review by the committee. 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 codes and standards were referenced in a mandatory fashion.

The 1986 edition also 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 were 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.

Revisions to the 1993, 1996, and the 2000 editions mainly consisted of reformatting and clarifications.

The 2004 edition changes mainly consisted of the elimination of exceptions and the reversal of units of measurement for compliance with the *Manual of Style for NFPA Technical Committee Documents*.

Revisions for the 2009 edition included a requirement for a 2-hour fire watch following torch-applied roofing operations and new provisions for exterior trash chutes.

Changes in the 2013 edition included additional requirements for temporary heating equipment, an expansion of items needed in a construction or demolition fire safety program, and an updating of references related to underground air quality.

The 2019 edition included not only a number of clarifications but an introduction of new requirements. A special provision was added to the application section that allows the authority having jurisdiction to implement portions of the standard as appropriate. Recognizing that temporary heating equipment and cooking equipment continue near the top of the list for ignition sources in the construction environment, new provisions were added to reinforce the need to secure such equipment to prevent it from being displaced. A new requirement was added to ensure that electrical service disconnecting means are readily accessible and clearly labeled as such. A reference to NFPA 56 was added with regard to cleaning and purging of fuel gas piping during both the installation and removal process of such systems. A requirement for guard services is now specifically mandated for a building using combustible construction that is more than 40 feet above grade. A new section was added to Chapter 11 that deals with standpipe installation in tunnels under construction to coordinate with the requirements of NFPA 502. Finally, a new chapter dealing with tall timber structures was included in this edition. This was in anticipation of codes in the United States and other countries that will expand the use of heavy timber construction beyond the traditional height limits of six stories.

The 2022 edition provides substantial changes as a result of a comprehensive review by the committee. These changes include new material on a variety of construction, alteration, and demolition operation topics, as well as a detailed reorganization of the standard. Chapter 4, General Requirements, has grouped existing and new content into one chapter for ease of use to the reader. Several sections in Chapter 4 have significant revisions, including requirements concerning both the Fire Prevention Program, as well as the Fire Prevention Program Manager. These revisions have been added after careful review of recent fire events over the past several years. Chapter 8, *Safeguarding Construction and Alteration Operations*, provides new references to NFPA 909 and NFPA 914 to specifically address historic structures and cultural resource properties. A new Chapter 13, *Safeguarding Construction Operations for Large Wood Structures*, provides requirements for large wood frame structures for the first time within NFPA 241. Finally, updates to other chapters, Annex A, referenced publications, and informational references provide further requirements and guidance for the protection of buildings during construction, alteration, and demolition.

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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.

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

A reference in brackets [] following a section or paragraph indicates material that has been extracted from another NFPA document. Extracted text may be edited for consistency and style and may include the revision of internal paragraph references and other references as appropriate. Requests for interpretations or revisions of extracted text shall be sent to the technical committee responsible for the source document.

Information on referenced and extracted publications can be found in Chapter 2 and Annex 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.

1.5 Units and Formulas.

1.5.1 SI Units. Metric units of measurement in this standard are in accordance with the modernized metric system known as the International System of Units (SI).

1.5.2 Primary Values. The SI value for a measurement and the inch-pound value given in parentheses shall each be acceptable for use as primary units for satisfying the requirements of this standard.

1.6 Enforcement.

1.6.1 This standard shall be administered and enforced by the authority having jurisdiction (AHJ) designated by the governing authority.

1.6.2 The AHJ shall determine whether the provisions of this standard have been met.

1.6.3* The AHJ shall be permitted to accept partial requirements of this standard.

Chapter 2 Referenced Publications

2.1 General. The documents or portions thereof listed in this chapter are referenced within this standard and shall be considered part of the requirements of this document.

2.2 NFPA Publications. National Fire Protection Association, 1 Batterymarch Park, Quincy, MA 02169-7471.

NFPA 1, *Fire Code*, 2021 edition.

NFPA 10, *Standard for Portable Fire Extinguishers*, 2022 edition.

NFPA 13, *Standard for the Installation of Sprinkler Systems*, 2022 edition.

NFPA 14, *Standard for the Installation of Standpipe and Hose Systems*, 2019 edition.

NFPA 20, *Standard for the Installation of Stationary Pumps for Fire Protection*, 2022 edition.

NFPA 24, *Standard for the Installation of Private Fire Service Mains and Their Appurtenances*, 2022 edition.

NFPA 25, *Standard for the Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems*, 2020 edition.

NFPA 30, *Flammable and Combustible Liquids Code*, 2021 edition.

NFPA 31, *Standard for the Installation of Oil-Burning Equipment*, 2020 edition.

NFPA 51, *Standard for the Design and Installation of Oxygen-Fuel Gas Systems for Welding, Cutting, and Allied Processes*, 2018 edition.

NFPA 51B, *Standard for Fire Prevention During Welding, Cutting, and Other Hot Work*, 2019 edition.

NFPA 54, *National Fuel Gas Code*, 2021 edition.

NFPA 55, *Compressed Gases and Cryogenic Fluids Code*, 2020 edition.

NFPA 56, *Standard for Fire and Explosion Prevention During Cleaning and Purging of Flammable Gas Piping Systems*, 2020 edition.

NFPA 58, *Liquefied Petroleum Gas Code*, 2020 edition.

NFPA 70®, *National Electrical Code®*, 2020 edition.

NFPA 70E®, *Standard for Electrical Safety in the Workplace®*, 2021 edition.

NFPA 72®, *National Fire Alarm and Signaling Code®*, 2022 edition.

NFPA 80, *Standard for Fire Doors and Other Opening Protectives*, 2022 edition.

NFPA 101®, *Life Safety Code®*, 2021 edition.

NFPA 130, *Standard for Fixed Guideway Transit and Passenger Rail Systems*, 2020 edition.

NFPA 211, *Standard for Chimneys, Fireplaces, Vents, and Solid Fuel-Burning Appliances*, 2019 edition.

NFPA 259, *Standard Test Method for Potential Heat of Building Materials*, 2018 edition.

NFPA 495, *Explosive Materials Code*, 2018 edition.

NFPA 701, *Standard Methods of Fire Tests for Flame Propagation of Textiles and Films*, 2019 edition.

NFPA 704, *Standard System for the Identification of the Hazards of Materials for Emergency Response*, 2022 edition.

NFPA 909, *Code for the Protection of Cultural Resource Properties—Museums, Libraries, and Places of Worship*, 2021 edition.

NFPA 914, *Code for the Protection of Historic Structures*, 2019 edition.

NFPA 1006, *Standard for Technical Rescue Personnel Professional Qualifications*, 2021 edition.

NFPA 1620, *Standard for Pre-Incident Planning*, 2020 edition.

NFPA 1670, *Standard on Operations and Training for Technical Search and Rescue Incidents*, 2017 edition.

NFPA 1963, *Standard for Fire Hose Connections*, 2019 edition.

NFPA 5000®, *Building Construction and Safety Code®*, 2021 edition.

2.3 Other Publications.

2.3.1 ASTM Publications. ASTM International, 100 Barr Harbor Drive, P.O. Box C700, West Conshohocken, PA 19428-2959.

ASTM E84, *Standard Test Method for Surface Burning Characteristics of Building Materials*, 2019a.

ASTM E136, *Standard Test Method for Assessing Combustibility of Materials Using a Vertical Tube Furnace at 750°C*, 2019a.

ASTM E2652, *Standard Test Method for Assessing Combustibility of Materials Using a Tube Furnace with a Cone-shaped Airflow Stabilizer at 750°C*, 2018.

ASTM E2965, *Standard Test Method for Determination of Low Levels of Heat Release Rate for Materials and Products Using an Oxygen Consumption Calorimeter*, 2017.

2.3.2 FM Approvals. FM Approvals, 1151 Boston-Providence Turnpike, P.O. Box 9102, Norwood, MA 02062.

ANSI/FM 4950, *Welding Pads, Welding Blankets and Welding Curtains for Hot Work Operations*, July 2014.

2.3.3 UL Publications. Underwriters Laboratories Inc., 333 Pfingsten Road, Northbrook, IL 60062-2096.

UL 723, *Test for Surface Burning Characteristics of Building Materials*, 2018.

2.3.4 Other Publications.

Merriam-Webster's Collegiate Dictionary, 11th edition, Merriam-Webster, Inc., Springfield, MA, 2003.

2.4 References for Extracts in Mandatory Sections.

NFPA 51B, *Standard for Fire Prevention During Welding, Cutting, and Other Hot Work*, 2019 edition.

NFPA 58, *Liquefied Petroleum Gas Code*, 2020 edition.

NFPA 287, *Standard Test Methods for Measurement of Flammability of Materials in Cleanrooms Using a Fire Propagation Apparatus (FPA)*, 2017 edition.

NFPA 600, *Standard on Facility Fire Brigades*, 2020 edition.

NFPA 5000®, *Building Construction and Safety Code®*, 2021 edition.

Chapter 3 Definitions

3.1 General. The definitions contained in this chapter shall apply to the terms used in this standard. Where terms are not defined in this chapter or within another chapter, they shall be defined using their ordinarily accepted meanings within the context in which they are used. *Merriam-Webster's Collegiate Dictionary*, 11th edition, shall be the source for the ordinarily accepted meaning.

3.2 NFPA Official Definitions.

3.2.1* Approved. Acceptable to the authority having jurisdiction.

3.2.2* Authority Having Jurisdiction (AHJ). An organization, office, or individual responsible for enforcing the requirements of a code or standard, or 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.

3.2.6 Standard. An NFPA Standard, the main text of which contains only mandatory provisions using the word “shall” to indicate requirements and that is in a form generally suitable for mandatory reference by another standard or code or for adoption into law. Nonmandatory provisions are not to be considered a part of the requirements of a standard and shall be located in an appendix, annex, footnote, informational note, or other means as permitted in the NFPA Manuals of Style. When used in a generic sense, such as in the phrase “standards development process” or “standards development activities,” the term “standards” includes all NFPA Standards, including Codes, Standards, Recommended Practices, and Guides.

3.3 General Definitions.

3.3.1 Critical Heat Flux (CHF). The minimum heat flux at or below which there is no ignition. [287, 2017]

3.3.2 Cross Laminated Timber (CLT). A prefabricated engineered wood product consisting of not less than three layers of solid-sawn or structural composite lumber where the adjacent layers are cross-laminated and bonded with structural adhesives to form a solid wood element. [5000, 2021]

3.3.3 Fabrics or Plastic Films. See 4.13.1.3.

3.3.4 Facility Fire Brigade. An organized group of employees at a facility who are knowledgeable, trained, and skilled in at least basic fire-fighting operations, and whose full-time occupation might be the provision of fire suppression and related activities for their employer. [600, 2020]

3.3.5 Fire Prevention Program Manager (FPPM). See Section 4.1.

3.3.6* High-Rise Building. A building where the floor of an occupiable story is greater than 23 m (75 ft) above the lowest level of fire department vehicle access. [5000, 2021]

3.3.7* Hot Work. Work involving burning, welding, or a similar operation that is capable of initiating fires or explosions. [51B, 2019]

3.3.8 Limited-Combustible Material. See 4.13.1.2.

3.3.9 Liquefied Petroleum Gas (LP-Gas). Any material having a vapor pressure not exceeding that allowed for commercial propane that is composed predominantly of the following hydrocarbons, either by themselves (except propylene) or as mixtures: propane, propylene, butane (normal butane or isobutane), and butylenes. [58, 2020]

3.3.10 Mass Timber. A category of framing styles typically characterized by the use of large solid wood panels used for walls, floors, and roof construction.

3.3.11* Modular Construction. A structure or sections of a building manufactured off-site and transported to the point of use for installation or connection, with or without other specified building components, for the purposes of constructing a finished building.

3.3.12 Noncombustible Material. See 4.13.1.1.

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

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

3.3.15 Roofing System.

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

3.3.15.2 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.

3.3.16* Structure. That which is built or constructed and limited to buildings and nonbuilding structures.

3.3.16.1 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.

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

3.3.17 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 can be in the form of a powder, a ceramic rod, a wire, or molten materials.

3.3.18 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.

Chapter 4 General Requirements

4.1 Owner's Responsibility for Fire Protection.

4.1.1 The owner shall designate a person responsible for the Fire Prevention Program.

4.1.1.1 This person shall ensure that the program is carried out to completion.

4.1.1.2 This person shall have alternate(s) acceptable to the AHJ.

4.1.1.3 This person's title shall be Fire Prevention Program Manager (FPPM).

4.1.2 The FPPM shall have the authority to enforce the provisions of this and other applicable fire protection standards.

4.1.3* The FPPM shall be a competent person with knowledge of the applicable fire protection codes and standards, available fire protection systems, and fire inspection procedures.

4.1.3.1 When temporary systems are utilized, the FPPM shall consult with the registered design professional in responsible charge.

4.1.4 The FPPM shall have the overall responsibility for safeguarding life and property from fire during construction, alteration, and demolition.

4.1.5 The FPPM, or designee, shall conduct daily inspections to identify deficiencies and hazards.

4.1.5.1 The FPPM shall ensure action is taken to correct any deficiencies or hazards without delay.

4.1.5.2 Inspection records shall be available for review by the AHJ.

4.1.6* The FPPM shall ensure fire prevention awareness and education is provided to personnel associated with that project in accordance with 4.2.2.

4.1.7* The FPPM shall be made aware of all fires in accordance with the fire safety plan.

4.1.8 This plan shall coordinate with other existing safety or action plans as required by other applicable codes and standards.

4.1.9 Where guard service is provided, the FPPM shall be responsible for the guard service.

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

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

4.1.12 The FPPM shall be responsible for supervising the permit system for hot work operations. (See Section 7.1.)

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

4.1.14* Impairments to the fire protection systems or fire alarm, detection, or communications systems shall be authorized only by the FPPM.

4.1.15 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.

4.1.16* Pre-incident Plans.

4.1.16.1 Where there is public fire protection or a private fire brigade, the FPPM shall be responsible for the development of pre-incident plans in conjunction with the fire agencies.

4.1.16.2 Pre-incident plans shall be updated as necessary.

4.1.16.3 The pre-incident plan shall include provisions for on-site visits by the fire agency.

4.1.17 Site Security.

4.1.17.1* Where required by the AHJ, buildings with combustible construction exposed during construction more than 12.19 m (40 ft) above grade plane shall be provided with guard service when there are no crews on-site.

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

- (1) Notification procedures that include calling the fire department and management personnel
- (2) Function and operation of fire protection equipment
- (3) Familiarization with fire hazards
- (4) Use of construction elevators, where provided

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

4.1.17.4* Security fences shall be provided where required by the AHJ.

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

4.1.17.6 Egress paths with exit doors available for egress shall remain unobstructed.

4.2 Fire Prevention Program.

4.2.1 An overall project-specific Fire Prevention Program shall be developed.

4.2.2 The following items shall be addressed in the Fire Prevention Program:

- (1) Development of a pre-incident plan in accordance with NFPA 1620
- (2) Emergency contacts
- (3) Site emergency communication procedures
- (4) Site personnel responsibilities during an incident
- (5) Signage for site address(es) and building identification acceptable to the AHJ
- (6) Site hot work operations
- (7) Fire protection systems, as follows:
 - (a) For construction operations, installation of new fire protection systems as construction progresses
 - (b) For alteration operations, preservation of existing fire protection systems during alteration
 - (c) For demolition operations, preservation of existing fire protection systems during demolition
 - (d) Procedure for the FPPM to notify the installing contractor when changes need to be made to previously installed temporary protection
- (8) Procedures for reporting specific emergency incident location to first responders
- (9) Emergency evacuation procedures for site personnel
- (10) Good housekeeping
- (11) Waste disposal
- (12) On-site security
- (13) Consideration of special hazards
- (14) Protection of existing structures and equipment from exposure fires
- (15) Documentation for applicable project fire-related inspections, tests, training, and drills, as required by this standard
- (16) A life safety plan that emphasizes the need to do all of the following:
 - (a) Alert personnel of emergencies
 - (b) Provide clear egress paths to safety
 - (c) Ensure lighting and markings are provided to enable safe personnel travel
- (17) Temporary utilities, as follows:
 - (a) Safety plan for gas supplies on site in accordance with NFPA 55 and NFPA 58
 - (b) Verification that direct-fired heaters used for drying and temporary heat do not discharge unsafe levels of carbon monoxide
 - (c) Periodic leak checks and condition checks for temporary piping and hoses used for distribution of fuels
 - (d) Periodic review and verification of temporary bonding and grounding of electrical systems

4.2.3* A fire department status board shall be provided in an approved location and documented in the Fire Prevention Program.

4.3* Fire Protection.

4.3.1 General. The provisions of Chapter 4 shall apply in addition to the specific requirements of this section.

4.3.1.1 Fire protection systems shall be supervised and monitored in accordance with Section 4.9.

4.3.2 Sprinkler Protection.

4.3.2.1* If automatic sprinkler protection is to be provided, the system(s) shall be placed temporarily in service in accordance with 4.3.2.2 through 4.3.2.9.

4.3.2.2* Measures used to place permanent fire protection systems temporarily in service during construction shall be as follows:

- (1) In conformance with the Fire Prevention Program
- (2) Evaluated based on the type and status of the system
- (3) Evaluated based on the conditions of the building construction

4.3.2.3* Systems temporarily placed in service during construction shall not be required to comply with NFPA standards.

4.3.2.4* The details of installation for systems temporarily placed in service during construction shall be in accordance with the Fire Prevention Program, including the following:

- (1) The placement of sprinklers in unfinished spaces including the following:
 - (a) The maximum deflector distance from the deck above
 - (b) The maximum sprinkler spacing before permanent walls are built
 - (c) The position of sprinklers relative to obstructions that will disrupt the discharge pattern
- (2) The design criteria for the temporary sprinkler protection including the following:
 - (a) The discharge density from the sprinklers based on classification of hazard during construction
 - (b) The remote area configuration before permanent walls are built
 - (c) The source and adequacy of the automatic water supply including hose allowance
- (3) The protection of sprinklers and piping including the following:
 - (a) To include or not include protection of sprinklers through the use of protective caps and straps or other means
 - (b) The permissible use of exposed nonmetallic piping
 - (c) The protection of water-filled pipes during the freezing season
- (4) The point in time during construction in which temporary fire protection systems are required
- (5) The procedure for the FPPM to notify the installing contractor when changes need to be made to previously installed temporary protection

4.3.2.5 Where sprinklers are required, 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, unless otherwise permitted by 4.3.2.6.

4.3.2.6 The provision of 4.3.2.5 shall not prohibit occupancy of completed floors of a building, even where other floors are in various stages of construction or protection, provided that both of the following conditions are satisfied:

- (1) The sprinkler protection of the occupied floors has been completed and tested in accordance with 4.3.2.5.
- (2) The sprinkler protection of the floors remaining under construction 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 floors.

4.3.2.7 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.

4.3.2.8 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.

4.3.2.9 Fire protection system control valves shall be identified and posted with signs that indicate whether they can be used to place systems in service in an emergency.

4.3.3 Fire Pumps.

4.3.3.1 General. The installation of fire pumps temporarily placed in service during construction shall be in accordance with 4.3.3.2 or 4.3.3.3 and the Fire Prevention Program.

4.3.3.2 Permanent Fire Pumps. Where a permanent fire pump will be used for temporary fire protection, the installation shall include the following:

- (1) Adequately sized water service installed, flushed, and tested per NFPA 24
- (2) Any required backflow prevention
- (3) Electrical wiring associated with the fire pump and jockey pump completed per NFPA 70 and NFPA 20
- (4) Utility meter installed and electrical power turned on to fire pump and jockey pump
- (5) Minimum 4.4°C (40°F) permanent and reliable heat source in pump room
- (6) All required fire alarms associated with the fire pump complete, tested, and in service (local and remote), including tamper switches, fire pump running, fire pump power failure, and power phase reversal, per NFPA 72 or applicable fire alarm code
- (7) Inertia base installed and cured
- (8) Enclosure in accordance with the Fire Prevention Program

4.3.3.3 Temporary Pumps. Where a temporary pump will be used for temporary fire protection, the installation shall include the following:

- (1) Adequately sized water service
- (2) Any required backflow prevention
- (3) Necessary electrical wiring to power the pump
- (4) Electrical power turned on to the pump
- (5) All required fire alarms in accordance with the Fire Prevention Program
- (6) Where required by the Fire Prevention Program, a room enclosure
- (7) Where required by the Fire Prevention Program, minimum 4.4°C (40°F) permanent and reliable heat source in the room enclosure

4.4 Means of Egress. The means of egress shall be provided in accordance with 4.6.10 of NFPA 101.

4.5* Notification and Emergency Reporting.

4.5.1 Fires shall be immediately reported to the appropriate emergency services organization in accordance with the Fire Prevention Program.

4.5.2 A method to contact the emergency services organization shall be available.

4.5.3 The emergency services organization contact information and site address shall be conspicuously posted in approved locations.

4.6 Fire Alarm Systems. Where a fire alarm system is installed in a building under alteration, the system shall comply with *NFPA 72*.

4.7 Standpipes.

4.7.1 General

4.7.1.1* The pipe size, hose valves, hose, water supply, and other details for new construction shall be in accordance with *NFPA 14* or the Fire Prevention Program.

4.7.1.2 On permanent Class II and Class III standpipes with a Class II connection, hose and nozzles shall be provided and made ready for use as soon as the water supply is available to the standpipe.

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

4.7.2 Standpipe Installations in Buildings Under Construction.

4.7.2.1* In buildings under construction that require a standpipe system, a standpipe system, either temporary or permanent, shall be installed in accordance with 4.7.2 and the Fire Prevention Program.

4.7.2.1.1* Standpipes shall be installed when the progress of construction reaches 12.2 m (40 ft) in height above the lowest level of fire department vehicle access.

4.7.2.1.2* As construction progresses, standpipes shall be extended to within one floor of the highest point of construction having secured decking or flooring.

4.7.2.1.3* Standpipes shall be tested for integrity in accordance with the Fire Prevention Program as new segments or portions are added.

4.7.2.1.4 The number and location of temporary standpipes shall be in accordance with the Fire Prevention Program.

4.7.2.2 Readily accessible standpipe fire department connections shall be provided on the outside of the building at street level.

4.7.2.2.1 Standpipes shall be conspicuously identified in accordance with 4.7.5.

4.7.2.3 When temporary standpipes are provided, the sizing, location of hose valves, water supply, if provided, and other requirements shall be in accordance with the Fire Prevention Program.

4.7.2.4 The standpipe shall be supported in accordance with *NFPA 14* or the Fire Prevention Program.

4.7.2.5 Standpipes shall be provided with fire department hose connections in accordance with 4.7.2.5.1 through 4.7.2.5.3.

4.7.2.5.1 Hose connections shall be provided at accessible locations.

4.7.2.5.2 At least one approved hose connection shall be provided at each floor level in the exit stairway.

4.7.2.5.3 Where required by the AHJ, one approved hose connection shall be provided on each intermediate landing of the exit stairway.

4.7.2.6 Hose valves shall be kept closed at all times and hose threads guarded against mechanical damage.

4.7.2.7 Hose valves shall have National Hose Standard (NHS) external threads for the valve size specified in accordance with *NFPA 1963* unless modified by 4.7.2.8.

4.7.2.8 Where local fire department connections do not conform to *NFPA 1963*, the AHJ shall designate the connection to be used.

4.7.2.9 The standpipes shall be extended up with each floor and shall be securely capped at the top to maintain integrity.

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

4.7.2.11 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.

4.7.3 Fire department connections shall be located in an area accessible to the fire department, unobstructed by fences or other enclosures.

4.7.4 Standpipe systems shall be supervised and monitored in accordance with Section 4.9.

4.7.5 Fire Department Connection Identification.

4.7.5.1 Fire department connections shall be identified by approved signs.

4.7.5.2 A light shall be provided above the fire department connection(s) to identify the location.

4.7.5.3 The light required by 4.7.5.2 shall be of a color approved by the AHJ.

4.8 Hydrants.

4.8.1 Unobstructed access to fire hydrants and to outside connections for standpipes, sprinklers, or other fire protection equipment, whether permanent or temporary, shall be provided and maintained at all times.

4.8.2 No material or construction activities shall interfere with access to fire protection features or equipment.

4.9 Fire Detection and Alarms.

4.9.1 If fire detection, supervision, off-site monitoring, or building notification are required, the installation shall be placed in service in accordance with the Fire Prevention Program.

4.9.2 The use of temporary measures to place fire detection, supervision, monitoring, or alarms in service shall be as follows:

- (1) In accordance with the Fire Prevention Program
- (2) Evaluated based on the hazard and the scope of the temporary measures

4.9.3 Fire detection, supervision, monitoring, and alarms placed in service shall comply with *NFPA 72* in accordance with the Fire Prevention Program.

4.10* First-Aid Fire-Fighting Equipment.

4.10.1* The suitability, distribution, and maintenance of extinguishers shall be in accordance with *NFPA 10*.

4.10.2 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, unless otherwise permitted by 4.10.3.

4.10.3 The requirement of 4.10.2 shall be permitted to be waived where the structure does not exceed 14 m² (150 ft²) in floor area or is equipped with automatic sprinklers or other approved protection.

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

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

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

4.11* Temporary Protection During Construction, Alteration, or Demolition. During construction, alteration, or demolition, the use of temporary fire sprinkler protection approved by the AHJ shall be permitted as supplemental protection.

4.12 Access for Fire Fighting.

4.12.1 Command Post.

4.12.1.1 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.

4.12.1.2 Command posts and their contents shall be approved by the AHJ.

4.12.1.3 Command posts and their contents shall be maintained to be readily available at all times.

4.12.1.4 The FPPM or their alternate shall be available to respond to the location command post whenever fire occurs.

4.12.2 Key Box.

4.12.2.1 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 AHJ shall be permitted to require a key box to be installed in an accessible location.

4.12.2.2 The key box shall be an approved type and shall contain keys to gain access as required by the AHJ.

4.12.3 Access Roadways.

4.12.3.1 Every building shall be accessible by fire department apparatus by means of roadways having an all-weather driving surface of not less than 6.1 m (20 ft) of unobstructed width, having the ability to withstand the live loads of fire apparatus, and having a minimum of 4.1 m (13 ft 6 in.) of vertical clearance.

4.12.3.2 Access for use of fire department apparatus shall be provided to the immediate job site at the start of the project and maintained until completion.

4.12.3.3 Dead-end fire department access roads in excess of 46 m (150 ft) in length shall be provided with approved provisions for turning around fire department apparatus unless otherwise permitted by 4.12.3.4.

4.12.3.4 The requirements of 4.12.3.1 through 4.12.3.3 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.

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

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

4.12.3.7 The access roadway shall be extended to within 46 m (150 ft) of all portions of the exterior walls of the first story of any building.

4.12.3.8 Where an access roadway cannot be provided, an approved fire protection system or systems shall be provided as required and approved by the AHJ.

4.12.3.9 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.

4.12.3.10 Fire department access roadways shall not be used as staging or storage areas for modular construction.

4.12.4 Stairs.

4.12.4.1 Not less than one half of the required exit stairs in the constructed areas shall be available for egress and fire department access at all times.

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

4.12.4.3 The stairway shall be lighted.

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

4.12.4.5 All exit stairs shall be provided with stair identification signs to include the floor level, stair designation, and exit path direction as required to provide for safe egress.

4.12.5 Hoists and Elevators.

4.12.5.1 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.

4.12.5.2 Coordination shall be established to ensure that the fire department is trained in hoist or elevator use when operators are not available.

4.12.5.3 Every opening into a hoistway or shaftway shall be clearly identified and protected against inadvertent entry.

4.12.5.4 Identification acceptable to the AHJ shall be readily visible from the car indicating each floor level.

4.13 Construction Materials for Enclosures and Fire Separation.

4.13.1 Where required by this standard, construction materials shall meet the requirements of 4.13.1.1, 4.13.1.2, or 4.13.1.3, as applicable.

4.13.1.1* **Noncombustible Material.** A material that complies with any of the following shall be considered a noncombustible material:

- (1)* The material that, in the form in which it is used, and under the conditions anticipated, will not ignite, burn, support combustion, or release flammable vapors when subjected to fire or heat.
- (2) The material is reported as passing ASTM E136, *Standard Test Method for Assessing Combustibility of Materials Using a Vertical Tube Furnace at 750°C*.
- (3) The material is reported as complying with the pass/fail criteria of ASTM E136 when tested in accordance with the test method and procedure in ASTM E2652, *Standard Test Method for Assessing Combustibility of Materials Using a Tube Furnace with a Cone-shaped Airflow Stabilizer, at 750°C*.

[5000:7.1.4.1.1]

4.13.1.2* **Limited-Combustible Material.** A material shall be considered a limited-combustible material when one of the following is met:

- (1) The conditions of 4.13.1.2.1 and 4.13.1.2.2, and the conditions of either 4.13.1.2.3 or 4.13.1.2.4 shall be met.
- (2) The conditions of 4.13.1.2.5 shall be met.

[5000:7.1.4.2]

4.13.1.2.1 The material does not comply with the requirements for a noncombustible material in accordance with 4.13.1.1. [5000:7.1.4.2.1]

4.13.1.2.2 The material, in the form in which it is used, exhibits a potential heat value not exceeding 3500 Btu/lb (8141 kJ/kg) when tested in accordance with NFPA 259. [5000:7.1.4.2.2]

4.13.1.2.3 The material shall have a structural base of noncombustible material with a surfacing not exceeding a thickness of $\frac{1}{8}$ in. (3.2 mm) where the surfacing exhibits a flame spread index not greater than 50 when tested in accordance with ASTM E84, *Standard Test Method for Surface Burning Characteristics of Building Materials*, or UL 723, *Test for Surface Burning Characteristics of Building Materials*. [5000:7.1.4.2.3]

4.13.1.2.4 The material shall be composed of materials that in the form and thickness used neither exhibit a flame spread index greater than 25 nor exhibit evidence of continued progressive combustion when tested in accordance with ASTM E84 or UL 723 and are of such composition that all surfaces that would be exposed by cutting through the material on any plane would neither exhibit a flame spread index greater than 25 nor exhibit evidence of continued progressive combustion when tested in accordance with ASTM E84 or UL 723. [5000:7.1.4.2.4]

4.13.1.2.5 Materials shall be considered limited-combustible materials where tested in accordance with ASTM E2965, *Standard Test Method for Determination of Low Levels of Heat Release Rate for Materials and Products Using an Oxygen Consumption Calorimeter*, at an incident heat flux of 75 kW/m² for a 20-minute exposure, and both the following conditions are met:

- (1) The peak heat release rate shall not exceed 150 kW/m² for longer than 10 seconds.
- (2) The total heat released shall not exceed 8 MJ/m². [5000:7.1.4.2.5]

4.13.1.3 **Fabrics or Plastic Films.** Fabrics or plastic films shall meet the requirements of Test Method 2 in NFPA 701.

4.13.1.4* **Fire walls, fire barriers, smoke barriers, rated floor assemblies, exit stairways, and fire stop systems, where required for the completed building, shall be given construction priority for installation.**

4.13.1.5 Fire doors with approved closing devices and hardware shall be installed as soon as practical.

4.13.1.6 Fire doors, after installation in accordance with NFPA 80 shall not be obstructed from closing.

4.13.2 Fire-Resistance-Rated Doors and Opening Protectives.

4.13.2.1 Prior to installation, fire-resistance-rated doors and opening protectives shall be stored where they will not be subject to inclement weather or physical or mechanical damage.

4.13.2.2 Rated door assemblies and rated opening protectives, where required for the completed building, shall be given construction priority for installation.

4.13.2.3 Rated door assemblies, once installed, shall not be obstructed and shall be able to close and latch.

4.13.2.4 A visual inspection of opening protectives shall be performed and documented as part of the weekly self-inspection program required by 4.1.13.

4.13.2.5 Any installation that has been damaged shall be repaired or replaced without delay.

4.13.3 Renovations and Alterations.

4.13.3.1 Opening protectives used in renovation, alteration, or demolition operations shall not be altered or obstructed.

4.13.3.2 Opening protectives shall remain in place during renovation, alteration, and demolition operations until they are no longer needed or required.

4.13.3.3 Opening protectives and systems used in vertical and horizontal means of egress shall remain until they are no longer needed.

4.13.4 Temporary Construction Barriers.

4.13.4.1 Barriers 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 have a higher level of hazard than the occupied portion of the building.

4.13.4.1.1 Barriers shall have at least a 1-hour fire resistance rating.

4.13.4.1.2 Opening protectives shall have at least a 45-minute fire resistance rating.

4.13.4.2 Barriers in buildings protected throughout with approved, automatic sprinkler systems that are not impaired in accordance with NFPA 25 shall be permitted to be noncombustible material, limited-combustible material, or fabric or plastic films meeting the requirements of 4.13.1.

4.13.4.3* In conjunction with the Fire Prevention Program, as an alternative to 4.13.4.1 and 4.13.4.2, a risk assessment shall be permitted to be performed to determine the required protective measures between an occupied portion of the structure and the portion of the structure undergoing alteration, construction, or demolition operations.

4.13.4.4 Barriers when erected shall not interfere with the operation of any fire and life safety system or devices.

4.14 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.)

4.15 Fire Protection Markings.

4.15.1 While under construction, alteration, or demolition, buildings shall have approved address numbers placed in a position to be plainly legible and visible from the street or road fronting the property.

4.15.2 Address numbers shall contrast with their background.

4.15.3 Address numbers shall be Arabic numerals or alphabet letters.

4.15.4* While under construction, alteration, or demolition, buildings shall have an approved fire fighter safety building marking system (FFSBMS) sign.

4.15.5 The FFSBMS sign shall provide basic building and structure information for fire fighters responding to the building or structure.

4.15.6 The approved FFSBMS sign shall be in a position to be plainly legible and visible from the street, road, or other means fronting the property or as approved by the AHJ.

Chapter 5 Temporary Construction, Equipment, and Storage

5.1 Application. For the purposes of Chapter 5, the term *temporary* shall be defined as the duration of the construction project.

5.2* Temporary Offices and Sheds.

5.2.1* Separation distances between buildings with combustible construction or contents that are un-sprinklered and construction-related structures, such as temporary offices, trailers, sheds, modular construction, and other facilities for the storage of tools and materials, shall be in accordance with Table 5.2.1, except as modified by 5.2.1.1.

5.2.1.1* As an alternative to 5.2.1 and Table 5.2.1, separation distances as accepted by the AHJ shall be permitted to be used.

5.2.2* Detachment between temporary structures, adequate temporary fixed fire protection systems, and portable equipment shall be provided as required by the AHJ.

5.2.3 Only approved heating devices installed in accordance with the manufacturer's specifications shall be used in temporary offices and sheds.

5.2.4 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 (liquid fuel devices); NFPA 54 (fuel gas devices); and NFPA 211 (connectors and solid fuel).

Table 5.2.1 Separation Distances

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

Notes:

(1) Where the separation distance between temporary structures is less than the minimum separation distance, then the exposing wall length is considered to be the sum of the individual exposing wall lengths of the temporary structures.

(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, un-sprinklered structures. A level, where applying this table, is 3.6 m (12 ft).

5.2.5 Temporary heating devices shall be in accordance with Section 7.3.

5.3 Temporary Enclosures.

5.3.1 Construction materials shall be noncombustible material, limited-combustible material, or plastic films that meet the requirements of 4.13.1.

5.3.2 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.

5.3.3 Fire Extinguishers.

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

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

5.4 Equipment.

5.4.1* 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.

5.4.2 Where the exhausts are piped outside the structure under construction, alteration, or demolition, a clearance of at least 230 mm (9 in.) shall be maintained between such piping and combustible material.

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

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

5.4.5 Fuel for internal combustion engines shall not be stored within structures under construction, alteration, or demolition, unless otherwise permitted in Section 7.8.

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*.

6.1.1.1 Electrical devices shall be maintained in a safe condition.

6.1.1.2 Extension cords shall be maintained free from damage.

6.1.1.3 Damaged equipment and cords shall be removed from service until rendered safe.

6.1.1.4 During construction or demolition activities, all temporary and permanent service equipment disconnecting means shall be readily accessible to emergency service personnel and shall be labeled as to which equipment is controlled by such disconnects.

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 3 m (10 ft).

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 unless the 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 unless such 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 and lights shall be removed immediately upon the completion of the construction or purpose for which the wiring and lights were installed.

6.1.3.7 Emergency Lighting.

6.1.3.7.1 Emergency lighting for egress shall be permitted to be provided by natural light during periods of work from first light until dusk.

6.1.3.7.2 Areas shielded from natural light shall require that each worker have personal lighting to provide illumination for the expected duration of passage to natural light.

6.1.3.7.3 Temporary lighting, supplemented by personal lighting, shall be provided at all other times.

6.2 Fuel Gas.

6.2.1 Fuel gas piping shall be properly cleaned and purged prior to it being commissioned or decommissioned in accordance with *NFPA 56*.

6.2.2 Fuel gas shall not be utilized for the cleaning of piping under any circumstance.

6.3 Water Supply.

6.3.1* A water supply for fire protection, either temporary or permanent, shall be made available as soon as significant combustible material is present.

6.3.2 There shall be no delay in the installation of fire protection equipment. (*See A.7.7.5.*)

6.3.3* Where underground water mains and hydrants are to be provided, they shall be installed, completed, and in service prior to commencing construction work on any structure.

6.3.4 Water mains, fire hydrants, and all appurtenances shall not be impaired once placed in service.

6.3.5 In the event underground water main sectional valves or individual fire hydrant control valves are impaired, the AHJ shall be notified in accordance with *NFPA 25*.

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

6.5 Natural Gas.

6.5.1 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.

6.5.2 All such work shall be in accordance with *NFPA 54*.

6.5.3 All modifications to existing gas piping systems shall be performed with the gas turned off, unless otherwise permitted by 6.5.4.

6.5.4 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.

Chapter 7 Processes and Hazards

7.1 Hot Work.

7.1.1* Responsibility for hot work operations and fire prevention precautions, including permits and fire watches, shall be in accordance with NFPA 51B except as modified in Chapter 10.

7.1.2 Gas-operated cutting and welding equipment using multiple oxygen and fuel gas cylinders shall be in accordance with NFPA 51.

7.1.3 Where hot work will be conducted and it is not practical to remove combustibles in the area, the combustibles shall be covered with welding pads, blankets, or curtains tested in accordance with ANSI/FM 4950, *Evaluating Welding Pads, Welding Blankets and Welding Curtains for Hot Work Operations*, for at least a 10.7 m (35 ft) radius of the operation.

7.1.4 Fire Watch.

7.1.4.1 Fire watches shall be assigned no other duties.

7.1.4.2 A fire watch shall be posted for the duration of the work and for 2 hours thereafter for torch-applied roofing operations (*see 10.3.9*).

7.2 Thermit Welding.

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

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

7.2.3 Storage sheds shall be maintained dry, posted as a "No Smoking" area, and kept locked.

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

7.2.5 The molds shall not be removed until sufficient cooling has taken place in accordance with the manufacturer's published instructions.

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

7.3* Heating and Cooling Equipment Used During Construction, Alteration, or Demolition.

7.3.1 Heating and cooling equipment shall be listed.

7.3.2* Heating and cooling equipment shall be installed in accordance with its listing, including clearance to combustible material, equipment, or construction.

7.3.3 Heating and cooling equipment shall be installed, used, and maintained in accordance with the manufacturer's instructions, except as otherwise provided in 7.3.4.

7.3.4 Where instructions, as addressed in 7.3.3, are not available, heating and cooling equipment shall be used in accordance with recognized safe practices.

7.3.5 Heating and cooling equipment shall be designed, placed, or and used in such a manner that it is secured against overturning, overheating, displacement, or electrical heaters with tip-over protection.

7.3.6 Only personnel familiar with the operation of the heating and cooling equipment shall be allowed to operate such devices.

7.3.7* The area where heating and cooling equipment is utilized shall be inspected not less than daily for safe conditions.

7.3.8 Heating and cooling equipment and devices determined to be damaged or unsafe shall not be used.

7.3.9 Heating equipment using exposed radiant heating wires shall not be used.

7.3.10 Electric wiring shall comply with other sections in this standard and with NFPA 70.

7.3.11 Chimney or vent connectors, where required from direct-fired heaters, shall be maintained at least 460 mm (18 in.) from combustibles and shall be installed in accordance with NFPA 211 or with the manufacturer's written instructions.

7.3.12 Oil-fired heaters shall comply in design and installation features with NFPA 31.

7.3.13 Fuel supplies for LP-Gas-fired heaters shall comply with other sections in this standard and with NFPA 58.

7.3.14 Fuel supplies for natural gas-fired heaters shall comply with other sections in this standard and with NFPA 54.

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

7.3.16 Areas where equipment is utilizing fossil fuel or wood shall be provided with carbon monoxide detection in accordance with NFPA 72.

7.4 Smoking.

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

7.4.2 Smoking shall be permitted only in designated areas.

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

7.5 Waste Disposal.

7.5.1* 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.

7.5.2 Rubbish shall not be burned on the premises without first obtaining a permit from the AHJ.

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

7.5.4 Trash chutes, where provided, shall comply with 7.5.4.1 through 7.5.4.6.

7.5.4.1 A trash chute safety plan shall be submitted to and approved by the AHJ.

7.5.4.2 Trash chutes located on the exterior of a building shall be constructed of noncombustible or limited-combustible material that meets the requirements of 4.13.1, or protected in accordance with 7.5.4.3 through 7.5.4.6 if of combustible construction.

7.5.4.3* The interior of combustible trash chutes shall be provided with not less than one temporary automatic sprinkler within a recess near the top of the chute.

7.5.4.4 The temporary sprinkler required by 7.5.4.3 shall be protected by the recess as well as a listed sprinkler guard.

7.5.4.5 The temporary sprinkler required by 7.5.4.3 shall be connected to any available water supply with a listed fire hose, or a flexible, commercial rubber hose, with a diameter of not less than 19 mm (¾ in.) and a listed flexible connector.

7.5.4.6 The temporary sprinkler required by 7.5.4.3 shall be protected against freezing where required by the AHJ.

7.6 Construction Material and Equipment Storage.

7.6.1* Temporary storage of equipment to be installed, or excessive combustible construction or packing materials, shall not be permitted in unprotected structures under construction or alteration unless authorized by the AHJ.

7.6.2* In structures required to be protected, combustible storage shall not be permitted until an approved level of protection is provided.

7.6.3 Yard storage of equipment to be installed or combustible construction materials shall not be stored closer than 9 m (30 ft) from the structure under construction or alteration. (See 5.2.1.)

7.7* Scaffolding, Shoring, and Forms.

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

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

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

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

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

7.8 Flammable and Combustible Liquids and Flammable Gases.

7.8.1 Storage.

7.8.1.1 Storage of flammable and combustible liquids shall be in accordance with NFPA 30 unless otherwise modified by this section.

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

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

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

7.8.1.5 Such storage areas shall be appropriately posted as "No Smoking" areas.

7.8.1.6 Storage areas shall be appropriately posted with markings in accordance with NFPA 704.

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

7.8.2.1 Handling of flammable and combustible liquids shall be in accordance with NFPA 30 except as modified by 7.8.2.2 through 7.8.2.4.

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

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

7.8.2.4* 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.

7.8.3 Storage and Handling of Combustible and Flammable Gases.

7.8.3.1 Storage and handling of combustible and flammable gases shall be in accordance with NFPA 54 and NFPA 58.

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

7.9 Explosive Materials.

7.9.1 The storage, handling, and use of explosive materials shall be in accordance with NFPA 495.

7.9.2 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.

7.10 Cooking.

7.10.1 Cooking equipment shall be placed and used in such a manner so that it is secured against overturning or displacement.

7.10.2 Cooking shall only be performed in approved cooking areas that are designated by approved signs, which state the following:

**DESIGNATED COOKING AREA — COOKING OUTSIDE
THIS AREA IS PROHIBITED**

7.10.3 Cooking outside of approved cooking areas shall be prohibited.

7.10.4 Mobile cooking operations shall comply with NFPA 1.

7.10.5 Mobile cooking operations shall comply with applicable sections of this standard for site access and separation distances for heat sources and combustibles.

7.10.6 Cooking operations shall be documented in the Fire Prevention Program.

7.11 Asbestos.

7.11.1 The removal of asbestos and other hazardous material shall be done in accordance with 7.11.1 through 7.11.5.

7.11.2 The AHJ and the fire department shall be notified prior to the removal operations.

7.11.3 Signs shall be posted at the entrance, exit and exit access door, decontamination areas, and waste disposal areas.

7.11.4 The signs shall state that the material is being removed from the area and state any health hazards, contact informa-

tion, and any personal protective equipment (PPE) requirements.

7.11.5 Signs shall have a reflective surface, and lettering shall be a minimum of 50.8 mm (2 in.) in height.

Chapter 8 Safeguarding Construction and Alteration Operations

8.1 General. In addition to the specific requirements in other chapters, the provisions of Sections 8.2, 8.3, and 8.4 shall be followed for all construction and alteration operations.

8.2 Cultural Resource Properties. Construction and alteration operations within cultural resource properties shall be performed in accordance with other chapters of this standard and NFPA 909.

8.3 Historic Structures. Construction and alteration operations within historic structures shall be performed in accordance with other chapters of this standard and NFPA 914.

8.4 Impairments. Impairments shall be in accordance with Chapter 4.

Chapter 9 Safeguarding Demolition Operations

9.1 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.

9.2 Special Precautions.

9.2.1 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.

9.2.2* 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.

9.3 Heating and Cooling Equipment.

9.3.1 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.

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

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

9.5* Demolition Using Explosives. Demolition of buildings by use of explosives shall be performed by a qualified agency following approved procedures.

9.6 Utilities.

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

9.6.2 Gas.

9.6.2.1 Prior to demolition, gas supplies shall be turned off and capped at a point outside the building.

9.6.2.2 Gas lines within the building shall be purged after capping unless otherwise permitted by the AHJ.

9.7* Fire Cutoffs.

9.7.1 Vertical and horizontal cutoffs shall be retained until razing operations necessitate their removal as permitted by the AHJ.

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

9.8 Fire Protection During Demolition.

9.8.1 General. The provisions of Chapter 4 shall apply in addition to the specific requirements of this section.

9.8.2* 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.

9.8.3 Sprinkler Control Valves.

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

9.8.3.2 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.

9.8.4 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.

9.8.5* Fire Protection. Approved fire protection shall be provided.

Chapter 10 Safeguarding Roofing Operations

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

10.2 Asphalt and Tar Kettles.

10.2.1* 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.

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

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

10.2.4 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 [2 mm (0.075 in.)].

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

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

10.2.7 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 7.6 m (25 ft) of the kettle and have the kettle within sight.

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

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

10.3.1* General.

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

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

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

10.3.1.4* Personnel applying torch-applied roofing shall be qualified.

10.3.2* Openings, Penetrations, and Flashings.

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

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

10.3.2.3 Small torches shall be used to heat the underside of the membrane at a safe distance from openings, penetrations, and flashing before securing.

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

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

10.3.2.6 Open flames shall not be left unattended.

10.3.3 Flame Contact Protection.

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

10.3.3.2 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.

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

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

10.3.4 Installation.

10.3.4.1 The installation of torch-applied roofing and, in some cases, single-ply roofing systems is hot work and shall comply with Section 7.1, except where otherwise noted.

10.3.4.2* Torch-applied roofing shall be exempt from the requirements of 7.1.3, commonly referred to as the "35-foot rule," of NFPA 51B.

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

10.3.6 Equipment.

10.3.6.1 Proper equipment shall be used to heat roofing membranes.

10.3.6.2 Torches shall be equipped with a pilot adjustment, a flame height adjustment, a minimum of 7.6 m (25 ft) to a maximum of 15 m (50 ft) of listed hose, a pressure gauge, and a regulator.

10.3.6.3 A spark igniter shall be used.

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

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

10.3.8* Fuel Gas Cylinders.

10.3.8.1 Valves. Fuel gas cylinders shall not be hoisted by their valves.

10.3.8.2 Straps. Straps placed around the cylinders shall be utilized.

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

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

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

10.3.8.6 Frost Buildup.

10.3.8.6.1 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.

10.3.8.6.2 If frost buildup occurs on fuel gas cylinders and the rate of vapor withdrawal is no longer adequate for operating conditions, the hose shall be disconnected and a cylinder with greater propane volume shall be used.

10.3.9* Fire Watch. A fire watch shall be conducted for at least 2 hours after torches have been extinguished.

10.4 Fire Extinguishers for Roofing Operations.

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

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

10.4.3* 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 AHJ.

10.4.4 There shall be at least one multipurpose 2-A:20-B:C portable fire extinguisher within 6.1 m (20 ft) of horizontal travel distance from torch-applied roofing equipment.

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

10.5 Fuel for Roofing Operations.

10.5.1 Fuel containers, burners, and related appurtenances of roofing equipment in which LP-Gas is used for heating shall comply with all the applicable requirements of NFPA 58.

10.5.2 Fuel containers having capacities greater than 0.45 kg (1 lb) shall be located at least 3 m (10 ft) from the burner flame or at least 0.6 m (2 ft) therefrom where properly insulated from heat or flame.

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

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

10.5.5 Fuel containers shall be protected against physical damage as approved.

Chapter 11 Safeguarding Underground Operations

11.1* General.

11.1.1* Modifications. In addition to the specific requirements of this chapter, the provisions of Chapter 1 and Chapters 3 through 9 shall apply to all underground operations unless otherwise modified by this chapter.

11.1.2 Tunnels. The tunnels covered by this standard shall be underground structures with a design length greater than 23 m (75 ft) and a diameter greater than 1.8 m (6 ft).

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

11.1.4 Fire Safety. Fire safety for existing, operating, fixed guideway underground transportation systems undergoing alteration or renovation shall be in accordance with NFPA 130.

11.1.5 Means of Egress. Means of egress for existing, operating, underground structures shall be in accordance with the adopted building codes or NFPA 101.

11.1.6 Security.

11.1.6.1 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.

11.1.6.2 The location of the check-in/check-out system shall be within 7.6 m (25 ft) of the entrance and shall be easily identified.

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

11.1.7 Compartmentation. 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 6.3.1.

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 46 m (150 ft).

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 AHJ 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 91 m (300 ft).

11.3.1.2 Belt conveyors installed in underground locations, other than belts that carry the load of the belt on a low-friction metal deck without rollers, shall meet all of the following 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, and both of the following shall apply:
 - (a) The slippage switch system shall be tested weekly.
 - (b) 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 of the following occurs:
 - (a) Any conveyor in the system stops or reduces its normal speed.
 - (b) Any required fire protection system is activated.
- (5) Fixed combustible materials such as posts, cribbing, and roof supports shall be protected against frictional ignition by one of the following methods:
 - (a) The material shall be guarded from contact by the belt using metal.

- (b) The material shall be located at a distance of at least $\frac{1}{2}$ the width of the belt from any idler or pulley.
 - (c) Alignment switches shall be provided at intervals sufficient to prevent the belt from contacting such materials.
- (6) Guarding, if provided, for machinery in the drive area and at other points along the belt shall be of noncombustible material.
- (7) New installations of belt conveyors shall utilize a structure that does not provide a deck between the upper and lower strands of the belt.

11.3.1.3 Suitable fire extinguishers shall be installed so that travel distance from any one point in a tunnel does not exceed 91 m (300ft) 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 only be used underground 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, rain-proof, or watertight as defined in *NFPA 70* 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*. 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 300 m (1000 ft) throughout the tunnel.

11.5 Hazardous Operations and Procedures.

11.5.1 Hot work operations shall be in accordance with NFPA 51B.

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, LP-Gas, liquefied oxygen (LOX), and methylacetylene propadiene stabilized gas (MPS) shall be permitted to be used underground where both of the following conditions are met:

- (1) The material is used only for welding, cutting, and hot work.
- (2)* The quality of air is within approved limits.

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 30 m (100 ft) 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 30 m (100 ft) 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 7.6 m (25 ft) 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 30 m (100 ft) 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 unless 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 AHJ.

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.

11.8* Standpipe Installations in Tunnels Under Construction. Where required by the AHJ, a Class I, II, or III standpipe system shall be installed and tested in tunnels under construction in accordance with 11.8.1 through 11.8.6, NFPA 14, and NFPA 25.

11.8.1 A standpipe system shall be installed before the tunnel has exceeded a length of 61 m (200 ft) beyond any access shaft or portal.

11.8.1.1 The standpipe system shall be extended as work progresses so that a hose valve connection is available within 61 m (200 ft) of the most remote portion of the tunnel or tunnel heading.

11.8.2 Standpipe and hose valves shall be securely supported and the system shall be securely capped at the end.

11.8.3 Threaded connections for hose valves and fire department connections shall be of the size and type required by the responding fire department.

11.8.4 Standpipe hose valves shall be spaced at not greater than 61 m (200 ft) intervals, and be positioned in the tunnel and kept clear to ensure ready access from the walking surface.

11.8.5 Standpipe system water supply and fire department connection(s) shall be provided at a location(s) adjacent to the tunnel construction access point and shall be readily accessible to fire department apparatus.

11.8.6 Temporary standpipe systems shall remain in service until the permanent standpipe system is complete.

11.8.7 Underground Operations.

11.8.7.1* Where required, an underground rescue plan shall be developed and addressed in the Fire Prevention Program in accordance with 4.2.2.

11.8.7.1.1 Technical rescue professional qualifications regarding underground operations shall be in accordance with NFPA 1006.

11.8.7.1.2 Technical rescue regarding underground operations shall be in accordance NFPA 1670.

Chapter 12 Safeguarding Construction Operations for Tall Mass Timber Wood Structures

12.1* General. The provisions of Chapter 1, Chapters 3 through 8, and this chapter shall apply for all construction, as applicable.

12.2* Roofing Operations. The requirements of Chapter 10 shall apply for roofing operations, except that torch-applied roofing systems shall be prohibited.

12.3* Fire Exposure Analysis. Before construction begins, a study shall be conducted to ensure that the installation of passive and active fire protection features, combined with the separation provided between other structures on the same or adjacent lots, are adequate to allow safe egress and to prevent fire spread to the exposed structures.

12.3.1 The analysis shall be included with the construction documents submitted with the building permit and acceptable to the AHJ.

12.3.2 Construction shall comply with the requirements established by the fire exposure analysis.

12.4 Wood Structural Panels. Wood structural panels shall be designed, manufactured, and identified in accordance with Chapter 35 of *NFPA 5000*.

12.4.1* Structural wood members that are required to receive passive fire protection shall have the protection installed as required by the fire exposure analysis outlined in Section 12.3.

12.5 Site Security.

12.5.1* Guard service trained in accordance with 4.1.17.2 or other methods acceptable to the AHJ shall be required at all times that combustible construction has exceeded three stories and workers are not on the site.

12.5.2 Minimum 1.8 m (6 ft) high security fences shall be provided around the entire exterior of the construction site.

12.6 Water Mains, Standpipes, Hydrants, and Fire Department Connections.

12.6.1 Underground fire protection water mains and hydrants shall be installed in accordance with 6.3.3.

12.6.2 Each stairwell required for egress in the constructed areas of the structure shall be equipped with an operational standpipe during construction in accordance with Section 4.7.

12.6.3 The distance between the fire department connection and hydrant shall not exceed 30.5 m (100 ft).

12.7 Fire Protection Systems. Fire protection systems that are temporarily placed in service shall be in accordance with the Fire Prevention Program.

12.8* Hot Work. Fire watches shall remain in place for 2 hours after hot work is complete.

12.9 Temporary Heat.

12.9.1 The use of direct-fired heaters shall be prohibited inside the structure.

12.9.2 Heating shall be indirect fired or ducted heat from heaters located outside the structure or by permanent heating systems.

12.10 Temporary Lighting. The use of high-intensity lighting, such as quartz or metal halide, shall be prohibited during construction or alterations.

Chapter 13 Safeguarding Construction Operations for Large Wood Frame Structures

13.1* General.

13.1.1 The provisions of Chapter 1, Chapters 3 through 8, and this chapter shall apply for all construction, as applicable.

13.1.2 A large wood structure shall be considered all wood structures that meet one of the following:

- (1) Up to, and including, three stories and greater than 13,935 m² (150,000 ft²) aggregate total floor area
- (2) Over three stories, or over 12.2 m (40 ft) above the lowest level of fire department vehicular access, and greater than 4645.2 m² (50,000 ft²) aggregate total floor area

13.2 Roofing Operations.

13.2.1 The requirements of Chapter 10 shall apply for roofing operations except as specified in 13.2.2.

13.2.2 Torch-applied roofing systems shall be prohibited.

13.3 Fire Exposure Analysis. Before construction begins, a study shall be conducted to ensure that the installation of passive and active fire protection features, combined with the separation provided between other structures on the same or adjacent lots, or adjacent buildings under construction simultaneously, are adequate to allow safe egress and prevent fire spread to the exposed structures.

13.3.1 The analysis shall be included with the construction documents submitted with the building permit and acceptable to the AHJ.

13.3.2 Construction shall comply with the requirements established by the fire exposure analysis.

13.4* Site Security.

13.4.1 Guard service trained in accordance with 4.1.17.2 or other methods acceptable to the AHJ shall be required at all times.

13.4.2 Minimum 1.8 m (6 ft) high security fences shall be provided around the entire exterior of the construction site.

13.5 Water Mains, Standpipes, Hydrants, and Fire Department Connections.

13.5.1 Underground fire protection water mains and hydrants shall be installed in accordance with 6.3.3.

13.5.2 Where standpipes are required in the occupied building or by the Fire Prevention Program, the number of temporary standpipes to be provided shall be in accordance with the Fire Prevention Program.

13.5.3 The distance between the fire department connection and hydrant shall not exceed 30.5 m (100 ft).

13.6 Fire Protection Systems. Fire protection systems that are temporarily placed in service shall be in accordance with the Fire Prevention Program.

13.7* Hot Work. Fire watches shall remain in place for 2 hours after hot work is complete.

13.8 Temporary Heat.

13.8.1 The use of direct-fired heaters shall be prohibited inside the structure.

13.8.2 Heating shall be indirect-fired or ducted heat from heaters located outside the structure or by permanent heating systems.

13.9 Temporary Lighting. The use of high-intensity lighting, such as quartz or metal halide, shall be prohibited during construction or alterations.

Annex A Explanatory Material

Annex A is not a part of the requirements of this NFPA document but is included for informational purposes only. This annex 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 4; specific requirements for construction and alteration activities are found in Chapter 8; those requirements specific to roofing operations are covered in Chapter 10; those requirements specific to demolition activities are covered in Chapter 9; 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.1.6.3 Not all sections of this standard are intended to apply to every construction or alteration project. For example, it might not be reasonable to expect a complete fire safety program, including an on-site fire brigade or a pre-incident plan with the local fire department, for a minor project, such as adding a light fixture. However, some sections would be applicable to all projects, such as a first aid kit (*see 4.10.6*) or good housekeeping [*see 4.2.2(10)*]. This proposed exception allows the AHJ to make the determination on the applicability of the provisions of this standard.

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 installa-

tions, 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 (AHJ). The phrase “authority having jurisdiction,” or its acronym AHJ, 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.3.3.6 High-Rise Building. It is the intent of this definition that, in determining the level from which the highest occupiable floor is to be measured, the enforcing agency should exercise reasonable judgment, including consideration of overall accessibility to the building by fire department personnel and vehicular equipment. Where a building is situated on a sloping terrain and there is building access on more than one level, the enforcing agency might select the level that provides the most logical and adequate fire department access. [5000, 2021]

A.3.3.7 Hot Work. As applies to this standard, hot work includes cutting, welding, Thermit welding, brazing, soldering, grinding, thermal spraying, thawing pipe, torch-applied roofing, or any other similar activity.

A.3.3.11 Modular Construction. Modular construction is not intended to include manufactured homes as defined by 24 CFR 3280.2, “Manufactured Home Construction and Safety Standards: Definitions.”

A.3.3.13 Qualified Agency. Training should be conducted in accordance with manufacturers’ instructions or approved industry standards.

A.3.3.16 Structure. Structures include buildings, piers, bridges, and underground installations. Additional definitions of structures are provided in *NFPA 5000*.

A.4.1.3 The FPPM should be familiar with the provisions of this standard. Requirements could also include, but are not necessarily limited to, someone who has one of the following certifications:

- (1) Registered professional engineer in fire protection engineering
- (2) Certified fire protection specialist
- (3) Degree in fire safety, fire protection engineering, or fire protection engineering technology
- (4) Completion of other fire prevention training

The FPPM level of knowledge should be appropriate for the size and complexity of the project as follows:

- (1) For projects that are small and of limited complexity, the FPPM should demonstrate basic skills in fire hazard recognition and fire safety planning.
- (2) For projects that are moderate to large in size or complexity, the FPPM should demonstrate the knowledge in (1) as well as an understanding of the operation of fire protection equipment and the capability to develop advanced fire safety plans.

A.4.1.6 Training of construction personnel in fire safety hazards and fire prevention is critical to reducing fire risks. Training programs should be considered to address the following:

- (1) For new personnel assigned to the project
- (2) When activities create new fire hazards
- (3) On a monthly basis for long-term projects
- (4) When events/incidents identify changes to the program

A.4.1.7 Necessary fire prevention improvements that are identified by the investigation should be communicated to all employees as soon as possible.

A.4.1.14 See NFPA 101 for impairments to fire protection systems or fire alarm, detection, or communication systems where required by that code. In addition, see NFPA 72 for impairments resulting to fire alarm equipment, and NFPA 25 for impairments resulting to water-based fire protection equipment.

A.4.1.16 Large-scale construction sites change rapidly as construction progresses. The pre-incident 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. Pre-incident plan visits should be scheduled by the FPPM at least semiannually and when there have been major revisions to the Fire Prevention Program. Since municipal fire departments work rotating shifts, a series of pre-incident 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 FPPM to schedule the pre-incident plan visit during the evening hours to meet the needs of the local fire department.

A.4.1.17.1 Due to the growing threat of arson, guard service should be provided on major projects even where not required by the AHJ. 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.4.1.17.2 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. Guard rounds should include all parts of the buildings and outside areas where hazardous equipment or materials are located. Rounds should be conducted every ½ hour for 2 hours after suspension of work for the day and every hour thereafter during the night and nonworking days and should include tours of all accessible work areas.

A.4.1.17.4 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.4.1.17.5 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.4.2.3 The fire department status board, such as a white board or computer monitor, should include information such as a key contact phone number(s), temporary building conditions affecting site and floor access, fire protection systems, means of egress components, temporary access, hot work operations, and site hazard operations.

Approved locations would be readily accessible areas near the site entrance.

A.4.3 Protection required in this standard can be supplemented by other approved forms of protection. This could include, but is not limited to, the use of self-contained, remote-controlled, detection, notification, and suppression systems.

A.4.3.2.1 With proper scheduling, it is possible for the fire sprinkler installation to follow the building construction as it progresses. This is frequently done in multistory buildings to facilitate protection on the lower floors before the upper floors have been built. Temporary measures can be used to place permanent fire protection systems temporarily in service earlier during construction to provide temporary protection.

Temporary automatic sprinkler protection in accordance with this section can reduce the risk of an uncontrolled fire during construction, recognizing that the protection criteria specified in the Fire Prevention Program is not suitable for controlling all fire events that could occur on a construction site.

A.4.3.2.2 Examples of temporary measures could include building heat, manual systems with an emergency control valve, limited water supply, and alternative means to monitor systems.

A.4.3.2.3 Whereas the permanent fire protection systems are required to meet NFPA standards, systems placed in service temporarily during construction are subject to different and varying conditions than those used in full-scale fire tests to verify the installation criteria of sprinkler systems. Conditions that differentiate the permanent protection from the temporary protection include, but are not limited to, the lack of

finished ceilings, lack of finished walls, protective sprinkler caps being in place, obstructions present during construction, exposed wood construction, fuel loading of construction materials, and lack of heat.

A.4.3.2.4 The design criteria in NFPA 13, NFPA 13R, or NFPA 13D are intended for completed, occupied buildings and are derived through full-scale fire tests to determine the factors used in the design of the system, including the position and location of sprinklers to achieve both the proper response time for activation and adequate coverage of the hazard area through the proper distribution of water at a specified rate.

The response time is affected by the distance of the sprinkler below a building feature capable of collecting heat. Where a finished ceiling is not installed, the sprinklers are located in close proximity to the floor or roof deck above. Where a finished ceiling is anticipated, the sprinklers are located in close proximity to the finished ceiling and installed at that level. However, when sprinklers are installed and put in service before the finished ceiling is installed, the response time for the sprinklers to activate in a fire event is increased, and in some cases sprinklers near the fire might not activate at all until the fire is out of control. To compensate for the delayed activation time of sprinklers in the fire area, a larger remote area for hydraulic calculations needs to be considered because more sprinklers will activate due to the size of the fire.

To position the sprinklers temporarily in close proximity to the floor or roof deck above will in most cases result in inadequate coverage of the hazard area. Sprinkler spray patterns will be obstructed by ducts, piping, electrical wiring, and other mechanical and electrical systems installed at the same level as the sprinklers. Sprinklers could activate in a more timely fashion, but water might not reach the fire due to these obstructions.

Protective caps and straps are included on sprinklers to protect them from damage during shipping, handling, installation, and after installation until all construction activities are completed. NFPA 13, A.9.4.1.5.2, recommends:

Protective caps and straps can be removed from upright sprinklers, from sprinklers that are fitted with sprinkler guards, and from sprinklers that are not likely to be subject to damage due to construction activities or other events. In general, protective caps and straps should not be removed until construction activities or other events have progressed to the point where the sprinklers will not be subjected to conditions that could cause them to be damaged. Consideration should be given to leaving the protective caps and straps in place where other construction work is expected to take place, adjacent to the sprinklers following their installation, until that activity is complete. Protective caps and straps on sidewall and pendent sprinklers, for example, should be left in place pending installation of the wall and ceiling systems and then removed as finish escutcheons are being installed. In retrofit applications, with minimal follow-on trade construction activity, and with upright sprinklers, it would be reasonable to remove the caps and straps immediately following the installation on the sprinkler piping.

The benefit of the use of protective caps should be weighed against the potential for damage of exposed sprinklers used for temporary protection during construction.

For temporary protection, nonmetallic piping can sometimes remain exposed prior to the installation of a protective membrane.

The Fire Prevention Program should provide direction as to when the systems can provide such temporary interim protection.

A.4.5 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.4.7.1.1 Threaded plugs should be inserted in fire department hose connections, and they should be guarded properly against physical damage.

A.4.7.1.3 The intent of this provision is to permit the permanent standpipes to be used as temporary standpipes during construction.

A.4.7.2.1 It is acceptable to use the permanent standpipes and associated piping for the temporary standpipes required during construction. If the permanent standpipe or standpipes are going to be used during construction, it is assumed that they will conform to NFPA 14 requirements. Sometimes the AHJ might require a separate temporary standpipe that in some situations could be connected to a small water supply. This temporary standpipe might or might not be sized to NFPA 14 requirements. The location of this standpipe or standpipes, location of hose valves, and any water supply should be detailed in the Fire Prevention Program.

A.4.7.2.1.1 Consideration should be given to install the standpipes as the building progresses from grade. From a project management standpoint, if the standpipe installation is commenced in the early stages of the project, there will be fewer delays when the building reaches 12.2 m (40 ft) in height.

A.4.7.2.1.2 Where required by the AHJ or the Fire Prevention Program, the following should be located at the highest hose outlet of the temporary standpipe:

- (1) A box, preferably metal, large enough to accommodate all of the required items
- (2) Sufficient hose to be able to reach all portions of the floor or protection area of the standpipe
- (3) Appropriate nozzle(s)
- (4) Spanner wrench(s)
- (5) Hose strap(s)
- (6) Hose reel(s)

A.4.7.2.1.3 As construction progresses, the temporary standpipe system should remain intact and be ready for use. As new floors or sections are added, there should be some verification that the system remains ready for pressurization and use. This could be done with a visual inspection or with a pressure test with water or air if located in freezing conditions. It is not the intent to require a 2-hour hydrostatic test each time a piece of pipe is added to the system.

A.4.10 Portable fire extinguishers, water pails, small hose lines, and 38 mm (1.5 in.) 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.4.10.1 A suitable number and type of spare fire extinguishers should be provided on site for immediate replacement of discharged fire extinguishers.

A.4.10.6 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 should be installed to indicate the position of the fire-fighting equipment.

A.4.11 During construction, alternation, and demolition, there are many hazardous conditions, such as cutting, welding, grinding, and combustible or hazardous product storage that can be made safer by installing a temporary fire sprinkler system. Given that such protection will be supplemental to any other protection that would be required, there is no harm in allowing this additional safety feature on a temporary basis if the design and installation is considered acceptable by the AHJ.

A.4.12.3.5 Construction vehicles, support vehicles, and passenger vehicles should not interfere with emergency response.

A.4.13.1.1 The provisions of 4.13.1.1 do not require inherently noncombustible materials to be tested to be classified as noncombustible materials. [5000:A.7.1.4.1]

A.4.13.1.1(1) Examples of such materials include steel, concrete, masonry, and glass. [5000:A.7.1.4.1.1(1)]

A.4.13.1.2 Material subject to increase in combustibility or flame spread index beyond the limits herein established through the effects of age, moisture, or other atmospheric condition is considered combustible. (See NFPA 259 and NFPA 220.) [5000:A.7.1.4.2]

A.4.13.1.4 In many buildings where combustible framing is used, fire-rated or non-fire-rated walls or wall sheathing will often eventually be installed between adjacent sections of the building. For example, gypsum sheathing is frequently used on wall studs to separate adjacent apartment or condominium units. Interior gypsum is usually paper-faced and cannot be installed until the building is enclosed. Moisture-resistant gypsum board is often used on exterior walls, is usually glass-faced or unfaced, and can be temporarily exposed to weather. In some cases, installing a layer of gypsum board on both sides of the same studs might hamper mechanical, electrical, and plumbing installations. Installing one layer of moisture-resistant gypsum board on one side of wall studs at certain intervals will provide some temporary passive protection. That in conjunction with manual fire-fighting efforts can help limit horizontal fire spread. While this installation detail might not be justified between every unit, providing it between multiple units could help limit fire spread during some of the construction process.

A.4.13.4.3 The risk assessment should consider but is not limited to construction activities, hazards associated with the activity, active and passive systems already in place, feasibility of adding additional passive and active protection, duration of activity, other applicable items that impact protection, and any requirements of the AHJ.

A.4.15.4 See Annex C of NFPA 1 for further details.

A.5.2 Prior to placing temporary structures on site, the location of the following items should be prioritized:

- (1) Egress

- (2) Fire separation
- (3) Gas and electrical utilities
- (4) Proximity to property lines
- (5) Distance to property lines, roads, railroad crossings, easements, overhead utility lines, and transformers
- (6) Combustible awnings
- (7) Temporary restroom facilities

The type of construction materials necessary for elevated platforms, stairs, and ramps should be considered prior to determining separation distances.

The type of glazing used in unprotected window openings should be considered prior to locating temporary buildings. When annealed glass is proposed on a building under construction, the separation distance should be comparable to that needed for combustible construction. When tempered glass is proposed on a building under construction, lesser separation distances can be accepted.

The construction types and flame spread index (FSI) of exterior walls of temporary buildings should meet codes and standards acceptable to the AHJ. Noncombustible construction for temporary buildings with noncombustible contents, or fire-resistant construction for temporary buildings with combustible contents, will allow for reduced separation distances. Loggias that connect temporary buildings should be of limited combustible or noncombustible construction in accordance with NFPA 220.

A.5.2.1 Separation distances less than those shown in Table 5.2.1 can be used, provided the construction is noncombustible and the combustible loading is limited. For multilevel unsprinklered structures, the AHJ should be consulted for separation distances.

The following example illustrates the use of Note (1) to Table 5.2.1:

In Figure A.5.2.1, construction trailers 1 and 2 (CT1 and CT2) are both combustible and present a fire exposure to the main building, which is under construction. The east wall of CT1 and the west wall of CT2 are both 6 m (20 ft) long, are spaced only 3 m (10 ft) apart, and present a fire exposure to each other. According to Table 5.2.1, the separation distance between them should be a minimum of 9 m (30 ft) to prevent fire spread from one to the other. Consequently, in accordance with Note (1) to Table 5.2.1, the south walls of both CT1 and CT2 should be considered a fire exposure to the main building and their lengths should be added to determine the minimum separation distance, S_{min} . Since both walls are 9 m (30 ft) long, the exposing wall length should be taken as 18 m (60 ft), and S_{min} equals 15 m (50 ft).

A.5.2.1.1 NFPA 80A is a recognized approach for determining exposure separation distances.

Alternatively, a performance-based analysis that considers radiant heat exposure and verifies that the separation distance will result in an incident heat flux from the source exposure that will not exceed the critical heat flux of the exposed exterior wall sheathing, as determined using the *SFPE Handbook of Fire Protection Engineering*, can be used.

A.5.2.2 Where located 9 m (30 ft) 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

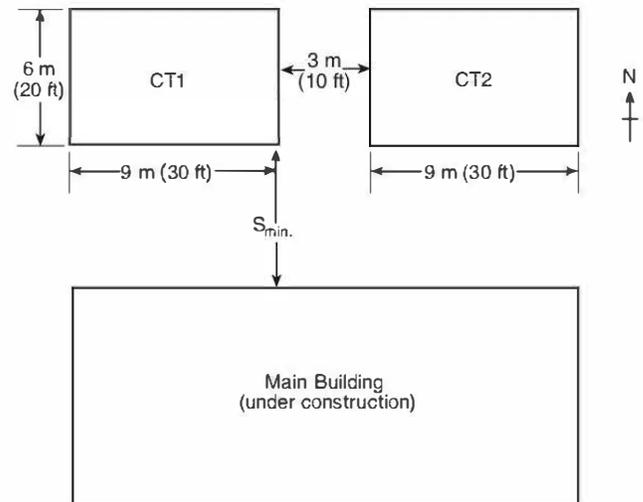


FIGURE A.5.2.1 Example of Application of Note (1) to Table 5.2.1.

support complexes should be protected with adequate fire protection (e.g., automatic sprinklers, yard hydrants, hose, and extinguishers) as required by the AHJ.

A.5.4.1 See NFPA 37.

A.6.3.1 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 1893 L/min (500 gpm) should be provided. In most instances, the required supply is greater, and authorities having jurisdiction should be consulted.

A.6.3.3 It is not intended to prohibit the construction of noncombustible structure foundation elements, such as foundations and footings, prior to the completion of underground water mains and hydrants.

A.7.1.1 For a sample permit and procedure, see NFPA 51B. 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 4.1.17.1*) should be alerted to check the location where welding was performed as part of his or 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.7.2.1 When the charge for Thermit welding has been ignited, the operator should stand several steps away [at least 3 m (10 ft)] 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.7.2.2 Where storage near the point of use is necessary, it should be kept at least 3 m (10 ft) 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.7.3 This section is not intended to include existing fixed building heating and cooling equipment.

A.7.3.2 Examples of relevant test standards include, but are not limited to, UL 647, *Unvented Kerosene-Fired Room Heaters and Portable Heaters*, and UL 1278, *Movable and Wall- or Ceiling-Hung Electric Room Heaters*.

A.7.3.7 Misuse of temporary heating equipment 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 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.7.3.15 This might necessitate the removal of the heater prior to refueling. The appliance also should be allowed to cool prior to refueling.

A.7.4.1 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 materials are stored or used.

A.7.5.1 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. Open-topped dumpsters containing combustible materials should be emptied or moved to at least 11 m (35 ft) from combustible structures at the end of each work shift.

A.7.5.4.3 The temporary sprinkler or sprinklers are not required to comply with NFPA 13. Where trash chutes have a length exceeding 11 m (36 ft), intermittent levels of sprinkler protection should be provided at intervals not exceeding 11 m (36 ft). The use of fire retardant coatings can be substituted for sprinkler protection provided that the coating is compatible with the substrate, abrasion resistant, and approved by the AHJ.

A.7.6.1 Some combustible construction materials, such as wood framing members, are usually staged on the floor under construction. As currently written, this requirement makes it very difficult to follow normal framing procedures. Reasonable

amounts of combustible construction materials are allowed in the area where they are being installed.

A.7.6.2 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.7.7 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 the definition of the term "fire-retardant-treated wood" in NFPA 5000.)

A.7.7.5 The AHJ should be contacted regarding the adequacy of water supplies for hose lines.

A.7.8.1.2 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 15 m (50 ft) of the structure or inside an existing structure under alteration is not intended to be regulated by this provision.

A.7.8.2.4 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.9.2.2 Tanks and piping formerly containing flammable liquids are likely to contain flammable vapors and should be removed prior to the demolition of a 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 practicable in the demolition operation in order to minimize the possibility of explosion. Remaining residue or sludge could constitute a fire or explosion hazard. Guidance on draining and inerting tanks can be found in NFPA 30 and NFPA 326.

A.9.4 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 is stored or used.

A.9.5 If explosives are used in demolition work (e.g., implosions), hose lines should be available on-site. The number and position of hose lines should be determined by the AHJ. The hose lines should be of sufficient length and number to be capable of extinguishing any small fire anywhere on the demolition site after detonation.

A.9.7 In situations where adjacent structures are to remain standing, demolition should be started immediately adjacent to the structures to be left standing, thereby creating a space separation between the structures that will remain through the balance of the demolition work.

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

A.9.8.2 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 allow alterations or additional demolition should be done under the direction of the AHJ and should be expedited so that automatic protection can be restored as quickly as possible.

A.9.8.5 During demolition operations, a means of fire protection should be provided. This is best provided by charged hose lines supplied by hydrants or sprinkler-riser adapters.

A.10.2.1 Roofing kettles and all integral working parts should be in good working condition and should be maintained free of excessive residue.

A.10.2.5 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.10.3 For additional information, see FM Data Sheet 1-33, *Safeguarding Torch-Applied Roof Installations*.

A.10.3.1 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.10.3.1.4 One example of demonstrating qualifications could be through the Certified Roofing Torch Applicator program (CERTA) administered through the National Roofing Contractors' Association (NRCA).

A.10.3.2 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.10.3.4.2 While there are a number of important safety requirements in NFPA 51B, it is impractical to apply the “35-foot rule” to torch-applied roofing because the roof cover itself is combustible and such a requirement would prohibit the use of such systems. Requirements in this standard for torch-applied roofing provide safe alternatives to the “35-foot rule.”

A.10.3.5 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.10.3.7 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 cylinder to the torch head, where it is vaporized. Liquid withdrawal cylinders have male cylinder valves, which can come equipped with adapters.

Frost buildup occurs only with vapor withdrawal cylinders. This can be the result of a cylinder that is undersized for the torch or air temperatures that are low. When vapor is drawn off more quickly than it is replaced, heat is absorbed and frost buildup occurs on the outside of the cylinder. Vapor pressure then further declines. Consequently, liquid withdrawal cylinders are recommended. However, where vapor withdrawal cylinders are used, 18 kg (40 lb) or 45 kg (100 lb) cylinders should be used with larger torches (such as those used on the field of the roof) or where temperatures are low [below -7°C (20°F)].

A.10.3.8 Fuel gas cylinders should be inspected for dents. If dents larger than 25 mm (1 in.) in diameter are found, the cylinder should be replaced. Torch and cylinder connectors should be inspected visually 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 (e.g., roars loudly and tends to blow itself out), the equipment should be repaired or replaced immediately.

A.10.3.9 All roof areas under repair should be checked for hot spots and signs of smoldering. The inside of the building also should be inspected for signs of fire or smoke. Particular attention should be paid to eaves, 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 when extinguished. Smoldering can continue after extinguishment,

can occur for hours before flaming begins, and can occur in areas unsuspected by laypersons. (Also see A. 7.1.1.)

A.10.4.1 Additional information regarding the safe use and operation of roofing kettles can be found in NFPA 1 Section 16.8.

A.10.4.3 For large roof areas, additional protection, such as charged hose lines or additional extinguishers, is recommended.

A.11.1 In addition to NFPA 120 and NFPA 122, the following publications should be consulted for additional information on underground operations and related subjects:

- (1) *Threshold Limit Values and Biological Exposure Indices*
- (2) ANSI/ASSP A10.16, *Safety Requirements for Tunnels, Shafts, and Caissons*
- (3) 29 CFR 1926, "Safety and Health Regulations for Construction," Subpart S, "Tunnels and Shafts, Caissons, Cofferdams and Compressed Air"
- (4) 30 CFR 57, "Safety and Health Standards — Underground Metal and Nonmetal Mines"
- (5) 30 CFR 75, "Mandatory Safety Standards — Underground Coal Mines"
- (6) NFPA *Fire Protection Handbook*

A.11.1.1 Underground structures and construction activities present unique fire protection problems, because 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.11.2.1 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, the following:

- (1) Emergency communications and alarm system
- (2) Clear, concise, and uncomplicated emergency instructions
- (3) Location of means of egress from the underground work areas
- (4) Availability and location of self-rescuer air breathing units and first aid supplies
- (5) Emergency ventilation methods
- (6) Location of any refuge stations

A.11.3.1 If an underground location is classified as gassy by the regulatory authorities, additional fire protection and equipment might be needed. For example, continuous monitoring for flammable gas, explosionproof electrical equipment, and other related requirements could be necessary. The AHJ over the project should be consulted to determine specific safety and fire prevention needs.

A.11.4.1 See NFPA 70.

A.11.5.3(2) One source of information on air quality is the ACGIH publication *Threshold Limit Values and Biological Exposure Indices*.

A.11.5.5.1 The use of hazardous materials, liquids, or chemicals underground should be minimized and eliminated where feasible. Strict controls including fire-resistant storage areas vented to the outside should be used.

A.11.7.3 For ventilation requirements, see 29 CFR 1926.800, Subpart S.

A.11.8 Where a permanent standpipe system is not required or is required but not yet completed, a temporary standpipe system can be used to meet the intent of Section 11.8.

A.11.8.7.1 Table A.11.8.7.1 provides crosswalk guidance of other NFPA standards in relation to NFPA 241 for underground facilities.

A.12.1 This includes buildings that are Type IV construction (see 7.2.5 of NFA 5000), including, but not limited to, laminated timber (LT) panels and heavy (solid) timber. Portions of such buildings might include fire-resistive or noncombustible construction for primary structural elements.

Laminated timber is a prefabricated engineered wood product consisting of not less than 3 layers of solid-sawn or structural composite lumber where the adjacent layers are cross-laminated and bonded with structural adhesives, nails, or wood dowels to form a solid wood element.

A.12.2 While guidance on the use of torch-applied roofing systems does exist, such systems have resulted in fires that destroyed at least two tall timber buildings before they were occupied.

A.12.3 Due to the size of such structures and the potentially large concentration of combustible construction materials on-site before protection is installed, an exposure fire could justify an RDP analysis. This analysis could consider fire exposure from the maximum number of stories that would not yet have passive or active fire protection installed, the separation distance to exposed structures, and the critical heat flux (CHF) that would cause ignition or cause windows to fail on the exposed structures. As the building under construction might not yet be enclosed enough to protect fire-resistant sheathing or fire-resistive coatings from rain or moisture, consideration could be given to the use of passive protection products that are moisture resistant or exterior grade.

The number of stories that are either not yet sprinklered or do not have fire-resistive sheathing installed on the exterior side of the exposing wall(s) should not exceed four.

Egress could be considered adequate if all the fire-resistive stairways and all their opening protectives and related hardware required for the constructed portions of the structure are installed.

A.12.4.1 For additional guidance, see *Understanding the Mass Timber Code Proposals: A Guide for Building Officials*.

A.12.5.1 Where video surveillance is intended to serve as an alternative method to watch service, all areas of the construction site should be visible.

A.12.8 Hot work should be avoided until all fire protection systems are installed.

A.13.1 This chapter applies to large wood frame structures classified as NFPA Type V construction in accordance with NFPA 5000.

Table A.II.8.7.1 Crosswalk Guidance of NFPA Standards for Underground Facilities

NFPA 241, 2022 edition	NFPA 120, 2020 edition	NFPA 122, 2020 edition	NFPA 502, 2020 edition	NFPA 520, 2016 edition	NFPA 1006, 2021 edition	NFPA 1670, 2017 edition
11.1.2 Tunnels	9.3.6	NA	Ch 7	NA	Ch 15	Ch 14
11.1.3 Drainage	NA	NA	7.12	4.1.4.3.3	NA	NA
11.1.4 Fire Safety	4.2, 4.3	Ch 5, Ch 6, Ch 7, Ch 11	Ch 7	Ch 6	NA	NA
11.1.5 Means of Egress	9.3.6-9.3.6.2	5.1.9(5)	7.16	Ch 5	Ch 12, Ch 14, Ch 15	11.3.3(6), 14.3.3(6)
11.1.6 Security	NA	NA	NA	NA	NA	NA
11.1.7 Compartmentation	NA	5.1.9(6)	7.3, 7.16.6.4	4.2	NA	NA
11.1.8 Water Supply	4.3.1	6.2.3, 6.2.4, 11.3.3	7.8	6.4	NA	NA
11.2 Emergency Procedures	4.3.4.6.2, 11.1	Ch 5	4.4.2, 13.3	7.1	Ch 12, Ch 14, Ch 15	4.1.12
11.3 Fire Detection, Protection, and Communications Systems	4.3.2, 4.3.2.2.7, 4.3.3	Ch 6	4.5, 7.4, 7.5	Ch 6, 5.8.2.6	Ch 12, Ch 14, Ch 15	13.3.3(21), 14.4.2.4
11.4 Electrical	4.3.3.2.1.1	9.4.2.1	Ch 12	4.4	NA	NA
11.5 Hazardous Operations and Procedures	Ch 7	Ch 4	Ch 7	Ch 7	Ch 12, Ch 14, Ch 15	4.1.12
11.6 Storage	4.2.8, 4.2.9, Ch 7	4.8, Ch 9, Ch 10	7.12.6.1, 7.12.7.1	4.1.3	NA	NA
11.7 Equipment	4.3.3.2.1, 4.3.4.5	Ch 6	13.3(11)	4.1.3.3, 4.2.7, 4.4.3	Ch 12, Ch 14, Ch 15	4.4
11.7.3 Ventilation	4.3.1.1.4, 7.6.1.4, 7.6.5.2.13	5.1.9(9), 10.1.4	7.11	5.8.4, 7.1.2(4)	Ch 12, Ch 14, Ch 15	A.14.3.3(1)
11.8 Standpipes	NA	6.2	7.8	6.3	NA	NA

NA: Not applicable.

A.13.4 See A.12.3.

A.13.7 Hot work should be avoided until all fire protection systems are installed.

Annex B Informational References

B.1 Referenced Publications. The following documents or portions thereof listed in this annex are referenced within the informational sections of this standard and are not part of the requirements of this document unless also listed in Chapter 2 for other reasons.

B.1.1 NFPA Publications. National Fire Protection Association, 1 Batterymarch Park, Quincy, MA 02169-7471.

NFPA 1, *Fire Code*, 2021 edition.

NFPA 13, *Standard for the Installation of Sprinkler Systems*, 2022 edition.

NFPA 13B, *Standard for the Installation of Sprinkler Systems in One- and Two-Family Dwellings and Manufactured Homes*, 2022 edition.

NFPA 13R, *Standard for the Installation of Sprinkler Systems in Low-Rise Residential Occupancies*, 2022 edition.

NFPA 14, *Standard for the Installation of Standpipe and Hose Systems*, 2019 edition.

NFPA 25, *Standard for the Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems*, 2020 edition.

NFPA 30, *Flammable and Combustible Liquids Code*, 2021 edition.

NFPA 37, *Standard for the Installation and Use of Stationary Combustion Engines and Gas Turbines*, 2021 edition.

NFPA 51B, *Standard for Fire Prevention During Welding, Cutting, and Other Hot Work*, 2019 edition.

NFPA 70®, *National Electrical Code®*, 2020 edition.

NFPA 72®, *National Fire Alarm and Signaling Code®*, 2022 edition.

NFPA 80A, *Recommended Practice for Protection of Buildings from Exterior Fire Exposures*, 2022 edition.

NFPA 101®, *Life Safety Code®*, 2021 edition.

NFPA 120, *Standard for Fire Prevention and Control in Coal Mines*, 2020 edition.

NFPA 122, *Standard for Fire Prevention and Control in Metal/Nonmetal Mining and Metal Mineral Processing Facilities*, 2020 edition.

NFPA 170, *Standard for Fire Safety and Emergency Symbols*, 2021 edition.

NFPA 220, *Standard on Types of Building Construction*, 2021 edition.

NFPA 259, *Standard Test Method for Potential Heat of Building Materials*, 2018 edition.

NFPA 326, *Standard for the Safeguarding of Tanks and Containers for Entry, Cleaning, or Repair*, 2020 edition.

NFPA 502, *Standard for Road Tunnels, Bridges, and Other Limited Access Highways*, 2020 edition.

NFPA 520, *Standard on Subterranean Spaces*, 2016 edition.

NFPA 601, *Standard for Security Services in Fire Loss Prevention*, 2020 edition.

NFPA 1006, *Standard for Technical Rescue Personnel Professional Qualifications*, 2021 edition.

NFPA 1670, *Standard on Operations and Training for Technical Search and Rescue Incidents*, 2017 edition.

NFPA 5000®, *Building Construction and Safety Code®*, 2021 edition.

Fire Protection Handbook, 20th edition, 2008.

B.1.2 Other Publications.

B.1.2.1 ACGIH Publications. American Conference of Governmental Industrial Hygienists, 1330 Kemper Meadow Drive, Cincinnati, OH 45240-1634.

Threshold Limit Values and Biological Exposure Indices, 2019.

B.1.2.2 ASSP Publications. American Society of Safety Professionals, 520 N. Northwest Highway, Park Ridge, IL 60068.

ANSI/ASSP A10.16, *Safety Requirements for Tunnels, Shafts, and Caissons*, 2009, reaffirmed 2016.

B.1.2.3 FM Publications. FM Global, 1151 Boston-Providence Turnpike, P.O. Box 9102, Norwood, MA 02062.

FM Data Sheet 1-33, *Safeguarding Torch-Applied Roof Installations*, 2017.

B.1.2.4 MTCC Publications. Mass Timber Code Coalition, <https://www.facebook.com/pg/buildtallbuildsafe/about/>.

Understanding the Mass Timber Code Proposals: A Guide for Building Officials, 2018.

B.1.2.5 NRCA Publications. National Roofing Contractors Association, 10255 W. Higgins Road, Suite 600, Rosemont, IL 60018-5607.

Certified Roofing Torch Applicator (CERTA) program, <https://nrca.net/education/certa>.

B.1.2.6 SFPE Publications. Society of Fire Protection Engineers, 9711 Washingtonian Blvd, Suite 380, Gaithersburg, MD 20878.

SFPE Handbook of Fire Protection Engineering, 2016.

B.1.2.7 UL Publications. Underwriters Laboratories Inc., 333 Pfingsten Road, Northbrook, IL 60062-2096.

UL 647, *Unvented Kerosene-Fired Room Heaters and Portable Heaters*, 1993, revised 2010.

UL 1278, *Movable and Wall- or Ceiling-Hung Electric Room Heaters*, 2014, revised 2020.

B.1.2.8 US Government Publications. US Government Publishing Office, 732 North Capitol Street, NW, Washington, DC 20401-0001.

Title 24, Code of Federal Regulations, Part 3280.2, "Definitions."

Title 29, Code of Federal Regulations, Part 1926, "Safety and Health Regulations for Construction," Subpart S, "Tunnels and Shafts, Caissons, Cofferdams and Compressed Air."

Title 30, Code of Federal Regulations, Part 57, "Safety and Health Standards — Underground Metal and Nonmetal Mines."

Title 30, Code of Federal Regulations, Part 75, "Mandatory Safety Standards — Underground Coal Mines."

B.2 Informational References. The following documents or portions thereof are listed here as informational resources only. They are not part of the requirements of this document.

B.2.1 AWC Publications. American Wood Council, 222 Catocin Circle SE, Suite 201, Leesburg, VA 20175.

Basic Fire Precautions During Construction of Large Buildings, 2015.

Fire Department's Role in the Prevention and Suppression of Fires During Construction of Large Buildings, 2015.

Hot Work During Construction of Large Buildings, 2015.

B.2.2 Ministry of Municipal Affairs and Housing Publications. Ministry of Municipal Affairs, 17th floor, 777 Bay Street, Toronto, Ontario, Canada M5G 2E5.

Fire Safety During Construction for Five and Six Storey Wood Buildings in Ontario: A Best Practice Guideline, May 2016.

B.2.3 NIST Publications. National Institute of Standards and Technology, 100 Bureau Drive, Stop 1070, Gaithersburg, MD 20899-1070.

NIST GCR 98-751, "Window Breakage Induced by Exterior Fires," June 1998.

B.2.4 Other Publications.

Armstrong, Monty, "The Role of the Fire Inspector for Heavy Timber Construction of Buildings Using Cross Laminated Timber," NFPA 2015 Conference and Expo.

B.3 References for Extracts in Informational Sections.

NFPA 13, *Standard for the Installation of Sprinkler Systems*, 2022 edition.

NFPA 5000®, *Building Construction and Safety Code®*, 2021 edition.

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