

NFPA® 120

Standard for Fire Prevention and Control in Coal Mines

2023 Edition



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An International Codes and Standards Organization

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NFPA® 120

Standard for

Fire Prevention and Control in Coal Mines

2023 Edition

This edition of NFPA 120, *Standard for Fire Prevention and Control in Coal Mines*, was prepared by the Technical Committee on Mining Facilities. It was issued by the Standards Council on November 29, 2022, with an effective date of December 19, 2022, 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 120 was approved as an American National Standard on December 19, 2022.

Origin and Development of NFPA 120

In 1977, with the formation of the Mining Committee, this standard, NFPA 120, formerly NFPA 653, was reassigned to the Committee on Mining Facilities. The change in numerical identity of the standard was in keeping with the numbering sequence assigned to the Mining Committee for other documents under development. NFPA 120 represents a complete revision of the former NFPA 653 and also includes changes in style in accordance with the *NFPA Manual of Style*.

The 1971 edition of NFPA 653, *Coal Preparation Plants*, was the same as the 1959 edition and was adopted at the NFPA 1971 Annual Meeting. The 1959 edition of NFPA 653 was prepared by the NFPA Committee on Dust Explosion Hazards and was adopted at the 1958 Annual Meeting with an amendment adopted in 1959.

The 1994 edition of NFPA 120 included a variety of technical and editorial updates. Previous editions not already mentioned include the versions issued in 1984 and 1988.

The 1999 edition addressed the need for emergency lighting, expanded the types of portable fire extinguishers used, and expanded and clarified the types of fire suppression equipment used. The water supply requirements were also clarified.

The 2004 edition applied the *NFPA Manual of Style* to the document. It also incorporated all the appropriate sections of NFPA 121 and NFPA 123, which was done in an effort to consolidate common requirements.

For the 2010 edition, the technical committee revised the fire prevention and fire protection provisions for coal mines by requiring the use of means to manage the spontaneous combustion potential of the coal being mined, as well as adding an inspection plan for carbon monoxide detection systems. The fire prevention practices for coal mines were improved by referencing the inspection and maintenance practices of fire suppression systems in the corresponding NFPA fire suppression standard. The committee provided improved fire protection for transformers by referencing *NFPA 70®*, *National Electrical Code®*, and adding NFPA 850, *Recommended Practice for Fire Protection for Electric Generating Plants and High Voltage Direct Current Converter Stations*, as an annex reference. Similarly, the standard was revised to make it consistent with fire protection industry practices and the updated provisions in NFPA 122, *Standard for Fire Prevention and Control in Metal/Nonmetal Mining and Metal Mineral Processing Facilities*.

For the 2014 edition, the technical committee rewrote the sprinkler requirements in a more coherent manner and provided additional guidance for underground sprinkler systems. In addition, the committee established a common definition and a protection scheme for self-propelled, mobile, and portable equipment.

For the 2020 edition, the technical committee added new fire safety material to Chapter 6 related to the use of spiral concentrators in coal processing facilities. Direction was also provided regarding best practices for welding and cutting operations within the vicinity of spiral concentrators.

In the 2023 edition, the technical committee has added new ventilation requirements in Chapter 4 to reduce combustible gas concentrations in mines. Several new requirements for conveyors have been added in Chapter 9 for fire detection in reclaim tunnels, the location of monitoring equipment, and cleaning conveyor systems to mitigate combustible dust buildup, as well as egress and secondary escape requirements in belowgrade reclaim conveyor areas. Additionally, changes were made throughout the document to the terms *flammable and combustible liquid* to align with the *ignitable (flammable and combustible) liquid* terminology updated in NFPA 30.

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Committee Scope: This Committee shall have primary responsibility for documents on safeguarding life and property against fire, explosion, and related hazards associated with underground and surface coal and metal and nonmetal mining facilities and equipment.

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Standard for

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2023 Edition

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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.

1.1.1* This standard shall cover minimum requirements for reducing loss of life and property from fire and explosion in the following:

- (1) Underground bituminous coal mines
- (2) Coal preparation plants designed to prepare coal for shipment
- (3) Surface building and facilities associated with coal mining and preparation
- (4) Surface coal and lignite mines

1.1.2 This standard shall not apply to the following:

- (1) Ignitable (flammable and combustible) liquids produced in underground coal mines
- (2) Other equipment and processes, such as coal pulverizers, used to condition coal for firing in boilers at power-generating plants or gasification plants or for utilization in certain special processes

1.2 Purpose. This standard shall be intended for the use and guidance of those charged with designing, constructing, purchasing, testing, installing, examining, approving, operating, or maintaining fire prevention, fire protection, or firefighting equipment in underground bituminous coal mines, coal preparation plants, and surface mining equipment and processes.

1.3* Application.

1.3.1 This standard shall be based on the current state of the art, and application to existing installations shall not be mandatory. Nevertheless, operating mines are urged to adopt those features of this standard that are considered applicable and reasonable for existing installations.

1.3.2 At times it will be necessary for those responsible for the storage of ignitable (flammable and combustible) liquids and the use of diesel-powered equipment within underground bituminous coal mines to consult an experienced fire protection specialist, and it shall be permitted.

1.3.3 Only those skilled in fire protection shall be considered competent to design and supervise the installation of mine fire protection systems.

1.3.4 Coal preparation plants shall be designed by experienced persons familiar with fire and explosion hazards in coal-processing plants.

1.3.5 At times it will be necessary for those charged with purchasing, testing, approving, and maintaining fire protection equipment for self-propelled and surface mining equipment to consult an experienced fire protection specialist.

1.4 Retroactivity. The provisions of this standard reflect a consensus of what is necessary to provide an acceptable degree of protection from the hazards addressed in this standard at the time the standard was issued.

1.4.1 Unless otherwise specified, the provisions of this standard shall not apply to facilities, equipment, structures, or installations that existed or were approved for construction or installation prior to the effective date of the standard. Where specified, the provisions of this standard shall be retroactive.

1.4.2 In those cases where the authority having jurisdiction determines that the existing situation presents an unacceptable degree of risk, the authority having jurisdiction shall be permitted to apply retroactively any portions of this standard deemed appropriate.

1.4.3 The retroactive requirements of this standard shall be permitted to be modified if their application clearly would be impractical in the judgment of the authority having jurisdiction, and only where it is clearly evident that a reasonable degree of safety is provided.

1.4.4 Operators are urged to avail themselves of any information that will prevent dust dispersions, eliminate sources of ignition, or otherwise reduce fire and explosion hazards by improving conditions in their plants.

1.5 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.

1.5.1 Technical documentation shall be submitted to the authority having jurisdiction to demonstrate equivalency.

1.5.2 The system, method, or device shall be approved for the intended purpose by the authority having jurisdiction.

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

NFPA 11, *Standard for Low-, Medium-, and High-Expansion Foam*, 2021 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 17, *Standard for Dry Chemical Extinguishing Systems*, 2021 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*, 2023 edition.

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

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

NFPA 55, *Compressed Gases and Cryogenic Fluids Code*, 2023 edition.

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

NFPA 68, *Standard on Explosion Protection by Deflagration Venting*, 2023 edition.

NFPA 69, *Standard on Explosion Prevention Systems*, 2019 edition.

NFPA 70®, *National Electrical Code®*, 2023 edition.

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

NFPA 85, *Boiler and Combustion Systems Hazards Code*, 2023 edition.

NFPA 91, *Standard for Exhaust Systems for Air Conveying of Vapors, Gases, Mists, and Particulate Solids*, 2020 edition.

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

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

NFPA 780, *Standard for the Installation of Lightning Protection Systems*, 2023 edition.

NFPA 1142, *Standard on Water Supplies for Suburban and Rural Firefighting*, 2022 edition.

NFPA 1961, *Standard on Fire Hose*, 2020 edition.

NFPA 1962, *Standard for the Care, Use, Inspection, Service Testing, and Replacement of Fire Hose, Couplings, Nozzles, and Fire Hose Appliances*, 2018 edition.

NFPA 2001, *Standard on Clean Agent Fire Extinguishing Systems*, 2022 edition.

2.3 Other Publications.

▲ **2.3.1 API Publications.** American Petroleum Institute, 200 Massachusetts Avenue, NW, Suite 1100, Washington, DC 20001.

API STD 2000, *Venting Atmospheric and Low-Pressure Storage Tanks*, 2014 edition.

2.3.2 ASME Publications. American Society of Mechanical Engineers, Two Park Avenue, New York, NY 10016-5990.

Boiler and Pressure Vessel Code, 2019.

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

ASTM D5/D5M, *Standard Test Method for Penetration of Bituminous Materials*, 2020.

ASTM D323, *Standard Test Method for Vapor Pressure of Petroleum Products (Reid Method)*, 2020a.

ASTM D4359, *Standard Test Method for Determining Whether a Material is a Liquid or a Solid*, 1990, reapproved 2019.

ASTM E72, *Standard Methods of Conducting Strength Tests of Panels for Building Construction*, 2015.

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

ASTM E162, *Standard Test Method for Surface Flammability of Materials Using a Radiant Heat Energy Source*, 2016.

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

2.3.4 NETA Publications. InterNational Electrical Testing Association, 3050 Old Centre Avenue, Suite 101, Portage, MI 49024.

ANSI/NETA MTS, *Standard for Maintenance Testing Specifications for Electrical Power Distribution Equipment and Systems*, 2019.

2.3.5 National Technical Information Service. National Technical Information Service, National Technical Reports Library, 5301 Shawnee Road, Alexandria, VA 22312.

“Schedule 2G,” March 1968.

■ **2.3.6 US Government Publications.** US Government Publishing Office, 732 North Capitol Street, NW, Washington, DC 20401-0001.

Title 30, Code of Federal Regulations, Part 75.351(i), “Atmospheric Monitoring Systems.”

Title 30, Code of Federal Regulations, Part 75.1502, “Mine Emergency Evacuation and Firefighting Program of Instruction.”

2.3.7 USDA Forest Service Publications. US Department of Agriculture, US Forest Service, 1400 Independence Avenue, SW, Washington, DC 20250-1111.

Specification 5100-186(d), *Fire Hose, Cotton-Synthetic, Lined, Woven Jacket, 1-inch and 1½-inch Hose*, 2006.

2.3.8 Other Publications.

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

2.4 References for Extracts in Mandatory Sections.

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

NFPA 17, *Standard for Dry Chemical Extinguishing Systems*, 2021 edition.

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

NFPA 52, *Vehicular Natural Gas Fuel Systems Code*, 2019 edition.

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

NFPA 99, *Health Care Facilities Code*, 2021 edition.

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

NFPA 122, *Standard for Fire Prevention and Control in Metal/Nonmetal Mining and Metal Mineral Processing Facilities*, 2023 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 Labeled. Equipment or materials to which has been attached a label, symbol, or other identifying mark of an organization that is acceptable to the authority having jurisdiction and concerned with product evaluation, that maintains periodic inspection of production of labeled equipment or materials, and by whose labeling the manufacturer indicates compliance with appropriate standards or performance in a specified manner.

3.2.4* 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.

3.2.5 Shall. Indicates a mandatory requirement.

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

3.2.7 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 phrases

“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 Adequate Ventilation. Air volume and velocity that is sufficient to dilute, render harmless, and carry away flammable or explosive concentrations of dusts and vapors.

3.3.2 Atmospheric Tank. A storage tank that has been designed to operate at pressures from 760 mm Hg through 812 mm Hg (atmospheric through 1.0 psig) measured at the top of the tank.

3.3.3 Boiling Point. The temperature at which the vapor pressure of a liquid equals the surrounding atmospheric pressure. [30, 2021]

3.3.4 Closed Container. A container as herein defined, so sealed by means of a lid or other device that neither liquid nor vapor will escape from it at ordinary temperatures. [30, 2021]

3.3.5 Coal Preparation. The separation, crushing, screening, washing, drying, storage, and loadout of coal to make ready for market.

3.3.6 Combustible. Capable of undergoing combustion.

Δ 3.3.7 Combustible Liquid. Any liquid that has a closed-cup flash point at or above 37.8°C (100°F), as determined by the test procedures and apparatus set forth in Section 4.4 of NFPA 30. Combustible liquids are classified according to Section 4.3 of NFPA 30.

3.3.8 Combustible Liquid Storage Area — Fixed. An area used for storage of Class II and Class III combustible liquids that is infrequently moved, and where the aggregate quantity present shall not exceed 18,925 L (5000 gal). Handling of liquids incidental to transfer can take place within a storage area.

3.3.9 Combustible Liquid Storage Area — Mobile. Self-propelled or mobile equipment fitted with suitable containers or tanks and other related fixtures used for the storage, transport, and dispensing of Class II and Class III combustible liquids. The aggregate quantity of combustible liquid carried on such equipment does not exceed 3785 L (1000 gal).

3.3.10 Combustible Liquid Storage Area — Portable. An area used for storage of Class II and Class III combustible liquids that is periodically moved, and where the aggregate quantity present does not exceed 3785 L (1000 gal). Handling of liquids incidental to transfer can take place within a storage area.

3.3.11 Combustion. A chemical process of oxidation that occurs at a rate fast enough to produce heat and usually light in the form of either a glow or flame. [5000, 2021]

Δ 3.3.12 Container. Any vessel of 450 L (119 gal) or less capacity used for transporting or storing liquids.

3.3.13 Diesel-Powered Equipment. Any device powered by a diesel engine. [122, 2023]

3.3.14 Dry Pipe Sprinkler System. A sprinkler system employing automatic sprinklers that are attached to a piping system containing air or nitrogen under pressure, the release of which (as from the opening of a sprinkler) permits the water pressure to open a valve known as a dry pipe valve, and the water then

flows into the piping system and out the opened sprinklers. [13, 2022]

3.3.15 Emergency Egress. An egress from a compartment or work station in emergencies when the normal egress is unusable.

3.3.16 Equipment Operator. The authorized person who starts, controls, or stops mining equipment.

3.3.17 Fire Detector. An automatic device designed to detect the presence of fire and initiate action. [122, 2023]

3.3.18 Fire-Resistant Construction. Masonry walls or equivalent having at least a 1-hour fire rating, including compressible materials having an equivalent fire resistance capability.

3.3.19 Fire-Resistant Enclosure. An enclosure that is constructed of fire-resistant construction.

3.3.20 Fire Risk Assessment. The evaluation of the relative danger of the start and spread of fire; the generation of smoke, gases, or toxic fumes; and the possibility of explosion or other occurrence endangering the lives and safety of personnel or causing significant damage to property. [122, 2023]

3.3.21 Fixed Fire-Suppression System. An engineered or pre-engineered total flooding or local application system consisting of a fixed supply of extinguishing agent permanently connected for fixed agent distribution to fixed nozzles that are arranged to discharge an extinguishing agent into an enclosure (total flooding), directly onto a hazard (local application), or a combination of both; or an automatic sprinkler system. [122, 2023]

3.3.21.1 Engineered Systems. Engineered systems are those systems requiring individual calculation and design to determine the flow rates, nozzle pressures, pipe size, area, or volume protected by each nozzle, quantity of suppression agent, number and types of nozzles and their placement in a specific system.

3.3.21.2 Pre-Engineered Systems. Those systems having predetermined flow rates, nozzle pressures, and quantities of extinguishing agent and having specific pipe size, maximum and minimum pipe lengths, flexible-hose specifications, number of fittings, and number and types of nozzles. [17, 2021]

▲ **3.3.22 Flammable Liquid.** Any liquid that has a closed-cup flash point below 37.8°C (100°F), as determined by the test procedures and apparatus set forth in Section 4.4 of NFPA 30, and a Reid vapor pressure that does not exceed an absolute pressure of 276 kPa (40 psi) at 37.8°C (100°F), as determined by ASTM D323, *Standard Test Method for Vapor Pressure of Petroleum Products (Reid Method)*. Flammable liquids are classified according to Section 4.3 of NFPA 30.

3.3.23 Flammable Liquid Storage Area. Area used for storage of Class I liquids.

3.3.24 Flash Point. The minimum temperature of a liquid at which sufficient vapor is given off to form an ignitable mixture with the air, near the surface of the liquid or within the vessel used, as determined by the appropriate test procedure and apparatus specified in Section 4.4 of NFPA 30. [30, 2021]

3.3.25 Hand Hose Line System. A hose and nozzle assembly connected by fixed piping or connected directly to a supply of extinguishing agent. [122, 2023]

3.3.26 Hydrant. A valved hose connection.

3.3.27 Important Structures. A structure that is considered not expendable in an exposure fire.

3.3.28 Inby. A mining term that means in the direction of the face of the mine or further into the mine.

3.3.29 Intrinsically Safe. As applied to equipment and wiring, equipment and wiring that are incapable of releasing sufficient electrical energy under normal or abnormal conditions to cause ignition of a specific hazardous atmospheric mixture. [99, 2021]

3.3.30 Liquid. Any material that (1) has a fluidity greater than that of 300 penetration asphalt when tested in accordance with ASTM D5/D5M, *Standard Test Method for Penetration of Bituminous Materials*, or (2) is a viscous substance for which a specific melting point cannot be determined but that is determined to be a liquid in accordance ASTM D4359, *Standard Test Method for Determining Whether a Material is a Liquid or a Solid*. [30, 2021]

3.3.31 Low Pressure Tank. A storage tank designed to withstand an internal pressure above 3.5 kPa (0.5 psig) but not more than 102.4 kPa (15 psig).

3.3.32 Mine Operator. Any owner, lessee, or other person who operates, controls, or supervises a mine. [122, 2023]

3.3.33* Mobile Equipment. Wheeled, skid-mounted, track-mounted, or rail-mounted equipment capable of moving or being moved.

3.3.34 Noncombustible Material. See 4.2.14.

3.3.35 Normal Operation. The regular performance of those functions for which a machine or accessory is designed.

3.3.36 Operating Area. An area where mining of coal is taking place or area where construction is underway.

3.3.37 Outby. A mining term that means in the direction away from the face of the mine or toward the outside of the mine; opposite of inby.

3.3.38 Permissible Equipment. A completely assembled machine or accessory for which formal approval has been issued, allowing operation in a potentially explosive methane and air-mixture environment.

3.3.39 Pipeline System. An arrangement of piping, valves, connections, and allied equipment installed in a mine for the purpose of transporting, transferring, or dispensing ignitable (flammable or combustible) liquids. [122, 2023]

3.3.40 Portable Extinguisher. An extinguisher of the hand-held or wheeled type that is capable of being carried or moved about, or a transportable system consisting of a hose reel or rack, hose, and discharge nozzle assembly connected to a supply of suppressant.

3.3.41 Portable Tank. Any vessel having a liquid capacity over 230 L (60 gal) intended for storing liquids and not intended for fixed installation. [30, 2021]

3.3.42 Pressure Vessel. A container or other component designed in accordance with the ASME *Boiler and Pressure Vessel Code*. [52, 2019]

3.3.43 Rock Dust. Crushed limestone applied on surfaces in mines to make coal dust incombustible in the event of a gas explosion.

3.3.44 Safety Can. A listed container of not more than 20 L (5.3 gal) capacity having a screen or strainer in each fill and pour opening and having a spring-closing lid and spout cover designed to safely relieve internal pressure when exposed to fire. [30, 2021]

3.3.45 Self-Closing Doors. Doors that, when opened and released, return to the closed position. [80, 2022]

3.3.46 Self-Propelled Equipment. Any unit that contains a motive power train as an integral part of the unit.

3.3.47 Suitable. That which is appropriate and has the qualities or qualifications to meet a given purpose, occasion, condition, function, or circumstance. [122, 2023]

3.3.48 Tank. A closed vessel having a liquid capacity in excess of 227 L (60 gal). [122, 2023]

3.3.49 Task Trained. Instructed in the safety and health aspects and safe work procedures of the task prior to performing such tasks.

3.3.50 Unattended. Any machine or device that is not regularly operated by a miner or not in direct line of sight of a miner that is assigned within 152.4 m (500 ft) of the equipment during each production shift.

Chapter 4 Underground Mining Operations

4.1 General. This chapter shall cover minimum requirements for reducing loss of life and property from fire in underground coal mines.

4.2* Fire Prevention. Precautions shall be taken to prevent the ignition of flammable vapors and combustible materials.

4.2.1 Smoking materials, matches, and lighters shall not be allowed underground.

4.2.2 Rock Dusting. Rock dust shall be provided on the ribs, ceiling, and floor of the mine from the mine entry to the working face in all areas of the mine that are active (not sealed).

4.2.2.1 Rock dust shall be maintained at a concentration of 80 percent.

4.2.3 Cutting and Welding. Cutting and welding and compressed gas usage shall be in accordance with Section 7.1.

4.2.4 Housekeeping.

4.2.4.1 Maintenance and operating practices shall prevent the accidental release of ignitable (flammable or combustible) liquids.

4.2.4.2 A cleanup plan shall be established, implemented, and monitored to prevent the accumulation of loose coal and other combustible materials.

4.2.4.3 Where ignitable (flammable or combustible) liquids are used or handled, means shall be provided to dispose of leakage or spills.

4.2.4.4 Waste receptacles shall be provided for combustible refuse.

4.2.4.5 Routes designated for access to fire protection equipment shall be kept clear of obstructions.

4.2.5 Underground Maintenance Shops.

4.2.5.1* Underground maintenance shops that are intended for use longer than 6 months shall be enclosed structures of fire-resistant construction, including floor, roof, roof supports, doors, and door frames, or shall be protected with an automatic sprinkler fire suppression system in accordance with 4.3.3.3.

4.2.5.2 The shop area shall be ventilated directly to a return airway.

4.2.6* Belt Conveyors. Belt conveyors installed in underground coal mines shall, as a minimum, meet all the requirements of Section 9.4 of this standard.

4.2.7 Hydraulic Fluids.

4.2.7.1 Fire-resistant hydraulic fluid shall be approved by the authority having jurisdiction.

4.2.7.2 Unattended hydraulic equipment shall employ fire-resistant hydraulic fluid and be protected by an automatic fire suppression system.

4.2.7.3 Where fire-resistant fluids are required, samples of in-use fire-resistant fluids of the invert emulsion type shall be collected quarterly.

4.2.7.3.1 Samples of the in-use fire-resistant fluids shall be tested individually to determine if the water content will make the fluid fire resistant.

4.2.7.3.2 When a sample of the in-use fire-resistant fluids indicates that the water content is insufficient for the fluid to be fire resistant, the fluid shall be replaced or water shall be added to restore the fire resistance of the fluid.

4.2.7.3.3 When water is added to the hydraulic system of any machine, a sample shall be taken and analyzed within 24 hours.

4.2.8 Flammable Liquids Storage and Use. The storage and use of flammable liquids underground shall conform to Section 7.5.

4.2.9 Combustible Liquids Storage and Use. The storage and use of combustible liquids underground shall conform to Section 7.6.

4.2.10 Methane Control. Methane within the coal mine shall be reduced to not more than 1 percent on the intake air and 2 percent on the return air.

4.2.10.1 Methane monitors shall be provided on equipment used to cut coal from the face.

4.2.10.1.1 The methane monitors shall alarm at 1 percent concentration and be interlocked to shut down the machine at a 2 percent concentration of methane.

4.2.11* Spontaneous Combustion.

4.2.11.1 Mine operators shall determine the spontaneous combustion potential of the coal being mined.

4.2.11.2* Mines with a high spontaneous combustion potential shall take means to minimize the spontaneous combustion risk.

4.2.12 Liquid-Filled Transformers.

4.2.12.1* Transformers with mineral oil or other combustible coolants shall not be installed underground.

4.2.12.2 An oil analysis, including dissolved gas, shall be conducted on combustible oil-filled transformers that are located on the surface based on the manufacturer's recommendations or on ANSI/NETA MTS, *Standard for Maintenance Testing Specifications for Electrical Power Distribution Equipment and Systems*, whichever is more stringent.

4.2.13* Thermographic Scanning. Thermographic scanning shall be performed on surface switchgear and motor starters supplying the underground electrical system on an annual basis.

N 4.2.14* Noncombustible Material. A material that complies with any of the following shall be considered a noncombustible material:

- (1)* A 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) A material that is reported as passing ASTM E136, *Standard Test Method for Assessing Combustibility of Materials Using a Vertical Tube Furnace at 750°C*
- (3) A material that 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* [101:4.6.13]

4.3* Fire Protection.

4.3.1 Water Supply for Mine Fire Protection.

4.3.1.1 General Requirements.

4.3.1.1.1* Water distribution lines shall extend from the surface to each operating area.

4.3.1.1.2 Water distribution lines from a suitable underground supply of water shall be permitted to replace the surface distribution lines if sufficient quantity is available and power for the pump(s) will not be affected or interrupted during a fire.

4.3.1.1.3 The operator shall choose the entry in which the water line is located, and it shall be protected by the choice of location.

4.3.1.1.4 Water flow and ventilation airflow shall be in the same direction unless provision is made to ensure the availability of firefighting water on the upwind side of a fire in the entry containing the water line.

4.3.1.1.5 Where applicable, water lines shall be protected against freezing.

4.3.1.1.6 Water lines that are 50 mm (2 in.) or larger in diameter shall be joined with flanges, mechanical grooved fittings, threaded fittings, or other fittings.

4.3.1.1.7 At least every third joint shall be capable of allowing limited motion and emergency rearrangement.

4.3.1.1.8 Pipe and fittings shall be of metal construction and designed to withstand the anticipated water pressure.

4.3.1.1.9* Water lines shall be equipped with shutoff valves at intervals not exceeding 1524 m (5000 ft).

4.3.1.1.10 A shutoff valve shall be provided in each branch line at the point where it is coupled to the main water line.

4.3.1.1.10.1 Shutoff valves for fire protection shall be sealed, locked, or supervised in the open position.

4.3.1.2 Water Demand.

4.3.1.2.1* All coal mine water systems shall be capable of simultaneously supplying three hose streams, each with a flow rate of at least 190 L/min (50 gpm), and a nozzle pressure of at least a gauge pressure of 345 kPa (50 psi) for a total of 570 L/min (150 gpm), applied through the maximum expected lay of hose.

4.3.1.2.2* The mine water system shall be capable of supplying the required hose stream water demand continuously for 24 hours or the sprinkler water demand continuously for 2 hours, whichever is the greater supply.

4.3.1.3 Hydrants.

4.3.1.3.1* The mine operator shall choose the entry in which hydrants are to be located, except for belt conveyor entries where hydrants shall be located in the same entry as the belt, locate personnel doors, and provide fire hose that reaches parallel entries where risk of fires exists.

4.3.1.3.2* Hydrants that supply water to a fire hose shall be provided on the water line at intervals not exceeding 91.4 m (300 ft) for belt conveyors and 152.4 m (500 ft) for haulage tracks.

4.3.1.3.3 Hydrants shall be located in the belt entry and accessible.

4.3.1.3.3.1 If staggered crosscuts are used, hydrant locations and crosscuts with personnel doors shall be located to provide a route for laying a fire hose to parallel entries.

4.3.1.3.3.2 At least one hydrant shall be located upwind of the area protected by an automatic sprinkler system.

4.3.1.4 Maintenance. The water supply system shall be maintained operable.

4.3.2* Protective Signaling Fire Detection Systems.

4.3.2.1 General Requirements.

4.3.2.1.1* The design and installation of all fire detection systems shall be approved for the intended use.

4.3.2.1.2 Fire detectors and related signaling system components used to initiate an audible or visual alarm, automatic activation of a fire suppression system, or equipment shutdown shall be listed or approved for the intended use.

4.3.2.1.3* Signaling system input, alarm, and releasing circuits shall be supervised.

4.3.2.1.3.1 The presence of a fault, alarm, or release shall initiate a signal in the protected area and remotely in a constantly attended location.

4.3.2.1.3.2 The signal specified in 4.3.2.1.3.1 shall indicate which condition has occurred.

4.3.2.1.3.3 A trouble signal shall not be required when the main power supply is intentionally shut off during periods of mine inactivity.

4.3.2.1.4* All components of protective signaling systems used in by the last open crosscut or in return air shall be classified as permissible or intrinsically safe.

4.3.2.2 Selection and Application.

4.3.2.2.1* Carbon monoxide (CO) detectors or the equivalent shall be installed along all belt conveyors and at all unattended automatic belt heads (where mine cars are loaded automatically).

4.3.2.2.2* Compartment sizes and contours, airflow patterns, obstructions, and other characteristics of the protected area shall determine the placement, type, sensitivity, and, where applicable, number of detectors.

4.3.2.2.3 The fire alarm shall identify a fire within each belt flight (segment).

4.3.2.2.4 Fire detection systems shall be installed so as to minimize the possibility of damage from roof falls and from the moving belt and its load.

4.3.2.2.5 The voltage of automatic fire alarm systems shall not exceed 120 volts.

4.3.2.2.6 The system shall be designed to provide an alarm up to 4 hours after the source of power to the belt is shut off.

4.3.2.2.7 An audible and visual alarm shall be provided either at the location of the belt or at a constantly attended location that has a telephone or equivalent communication with those miners who might be endangered.

4.3.2.2.8 The alarm system shall be equipped with a “trouble” signal to indicate open circuits, shorts, ground faults, or any other defects.

4.3.2.2.9 The alarm system shall include a manual reset feature.

4.3.2.2.10* Electrical equipment buildings and rooms on the surface that are critical to underground operations shall be provided with a smoke detection system.

4.3.2.2.10.1 The smoke detection system shall report to a constantly attended location.

4.3.2.2.10.2 Fire alarm systems shall be installed in accordance with *NFPA 72*.

4.3.2.3 Inspection, Maintenance, and Testing.

4.3.2.3.1 Fire detection systems and associated equipment shall be tested after installation according to the manufacturer’s or designer’s instruction manual.

4.3.2.3.2 The detection system shall be inspected visually weekly.

4.3.2.3.3 Carbon monoxide detection systems shall be visually inspected daily, functionally tested weekly, and calibrated monthly, not to exceed 31 days between calibrations.

4.3.2.3.4 Fire detection systems installed in surface structures shall be inspected in accordance with *NFPA 72*.

4.3.3 Fire Protection Systems.

4.3.3.1 General Requirements.

4.3.3.1.1 Mining equipment requiring a fixed fire protection system shall be protected by a system with the capacity to suppress the largest anticipated fires in the protected areas and shall meet the following criteria:

- (1) They shall be listed or approved for the purpose.
- (2) They shall be located or guarded so as to be protected against physical damage.
- (3)* They shall be actuated either automatically, manually, or both.
- (4)* They shall be provided with an agent distribution hose or pipe secured and protected against damage, including abrasion and corrosion, and shall be flame resistant.
- (5) They shall be provided with discharge nozzle blowoff caps or other devices or materials to prevent the entrance of moisture, dirt, or other material into the piping. The discharge nozzle protective device shall blow off, blow out, or open upon agent discharge.
- (6)* Water-based systems shall not be required to have nozzle blowoff caps as long as the nozzles are kept free of blockage at all times.
- (7) The fire protection system shall be installed so that system actuation causes shutdown of the protected equipment.
- (8) Discharge nozzles or sprinklers shall not be covered with any material that will reduce the effectiveness of the system.

4.3.3.1.2 Automatically actuated systems other than water-based sprinkler systems shall have a manual actuator capable of being activated from the operator’s compartment or other accessible location.

4.3.3.1.3 Unless otherwise noted in this standard, fire protection systems shall be installed and operate in accordance with the applicable NFPA standard.

4.3.3.1.3.1 Pre-engineered systems shall be designed, installed, and tested in accordance with the fire suppression system manufacturer’s listed installation and maintenance manual.

4.3.3.1.4* Where the nature of a coal mine does not allow the NFPA standards to be followed, systems that provide equivalent protection shall be approved by the authority having jurisdiction.

4.3.3.2 Applications.

4.3.3.2.1* Equipment and Facilities.

4.3.3.2.1.1 Equipment and facilities shall be protected in accordance with the following requirements:

- (1)* Drive areas of belt conveyors shall be protected in accordance with 9.4.6.
- (2) **Ignitable (flammable and combustible)** liquid storage areas shall be protected in either of the following fashions:
 - (a) Automatic water-based fixed fire protection systems installed for the protection of Class I or Class II liquid storage areas shall be of the Class B foam-water type.
 - (b) Fixed diesel or other Class II combustible liquid storage areas shall be protected with a dry chemical system or a system that provides equivalent protection according to the authority having jurisdiction.

- (3) Unattended hydraulic equipment shall use fire-resistant hydraulic fluid.
- (4) Unattended electrical equipment such as enclosed electric motors, controls, transformers, rectifiers, battery chargers, and other equipment that does not have a hydraulic system shall be protected by an approved automatic fire protection system.

(A) Unattended electrical equipment located on noncombustible material and spaced at least 0.61 m (2 ft) from coal or other combustible material shall not be required to be protected with an automatic fire suppression system.

(B) Unattended electrical equipment located on noncombustible material and separated from coal or other combustible material by a fire-resistive layer or wall shall not be required to be protected with an automatic fire suppression system.

4.3.3.2.1.2 Sprinkler systems used to protect the equipment and facilities listed in 4.3.3.2.1.1 shall satisfy the requirements of 4.3.3.3 through 4.3.3.5.4.

4.3.3.2.1.3 Dry or wet chemical systems used to protect the equipment and facilities listed in 4.3.3.2.1.1 shall satisfy the requirements for self-propelled equipment in 4.3.3.6.1.

4.3.3.2.2* Air Compressors. Air compressors with motors that exceed 5 horsepower shall be protected by an approved automatic fire protection system interlocked to shut down the power to the compressor and by one of the following:

- (1) A person in constant attendance, within the line of sight of the compressor, and equipped with a portable fire extinguisher
- (2) Containment within an enclosure that is constructed of noncombustible materials, ventilated to prevent overheating of the compressor, and designed to provide containment of any possible fire involving the compressor

4.3.3.3 Sprinkler System Requirements.

4.3.3.3.1* Water Supply. The water supply shall have enough pressure and flow to provide sprinkler coverage as the sprinkler design is intended.

4.3.3.3.1.1 An approved strainer with a flush-out connection and a manual shutoff valve shall be provided at the point of the sprinkler system connection to the main water line.

4.3.3.3.1.2 An indicating, full-flow, slow-opening water control valve shall be located at the tap of the water line supplying the sprinkler system.

4.3.3.3.1.3 When the sprinkler system is put into operation, the slow-opening valve specified in 4.3.3.3.1.2 shall be sealed or locked in the open position, or be provided with a supervisory alarm.

4.3.3.3.1.4 A pressure gauge shall be provided at the point of connection.

4.3.3.3.1.5 The water line from the water main to the sprinkler system shall be metallic.

4.3.3.3.1.6 The water line from the water main to the sprinkler system of a belt drive shall be flexible metal or reinforced nonmetal if excessive vibration could reduce the reliability of the sprinkler system.

4.3.3.3.1.7 Fittings and piping shall have a rated pressure higher than the anticipated maximum pressure on the system.

4.3.3.3.2 General Installation Requirements.

4.3.3.3.2.1* Piping in sprinkler systems shall comply with NFPA 13.

4.3.3.3.2.2 Nonmetallic pipe shall not be used downstream of the sprinkler control valve unless investigated and approved for this purpose.

4.3.3.3.2.3 Hangers supporting sprinkler piping shall be metallic.

4.3.3.3.2.4 At least one hanger shall be attached to each length of pipe.

4.3.3.3.2.5* Sprinklers shall be standard orifice pendent, upright, or sidewall-type automatic sprinklers.

4.3.3.3.2.6* For sprinkler systems installed to protect the equipment and facilities indicated in 4.3.3.2.1.1(2) through 4.3.3.2.1.1(4), 4.3.3.2.1.1(A), and 4.3.3.2.1.1(B), sprinklers shall be spaced no more than 3.66 m (12 ft) apart, and the protection of any one sprinkler shall not exceed 9.3 m² (100 ft²).

4.3.3.3.2.7* Sprinklers shall be located so that the discharge will not be obstructed.

4.3.3.3.2.8 Sprinkler deflectors shall be located at a distance below the roof of not less than 25.4 mm (1 in.) nor greater than 508 mm (20 in.).

4.3.3.3.2.9 Roof cavities containing combustible material such as wood or coal in the area to be protected shall be protected by installation of upright sprinklers within the cavity at the top of riser pipes so that the deflectors are within 508 mm (20 in.) of the roof.

4.3.3.3.2.10 Wet-pipe sprinkler systems shall not be used where chance of freezing exists.

4.3.3.3.2.11 Provisions shall be made to drain all parts of the system.

4.3.3.3.2.12 Drain connections shall be sized as shown in Table 4.3.3.3.2.12.

4.3.3.3.2.13 Trapped piping sections shall be equipped with auxiliary drains or otherwise arranged to facilitate draining.

4.3.3.3.3 General Alarm Requirements for Sprinkler Systems.

4.3.3.3.3.1 A waterflow switch or alarm valve capable of detecting the flow through one opened sprinkler shall be installed in the piping feeding the sprinklers.

(A) An inspector's test connection shall be provided at the end of the most remote line of the sprinkler system.

(B) The inspector's test connection shall simulate the operation of a single sprinkler for sprinkler systems other than belt drive systems.

Table 4.3.3.3.2.12 Sizes of Drain Connections

Riser or Main Size	Size of Drain Connection
Up to 2 in.	¾ in. or larger
2½ in. to 3½ in.	1¼ in. or larger
4 in. and larger	2 in. only

For SI units, 1 in. = 25.4 mm.

(C) In addition to 4.3.3.3.1(B), the inspector's test connection for belt drive systems shall simulate a minimum of eight sprinklers activating at the same time.

4.3.3.3.3.2 The alarm device shall be connected to an alarm system that will alarm at a constantly attended location. The alarm device shall provide a local audible and visual alarm.

4.3.3.3.3.3 The alarm system shall identify the sprinkler system involved.

4.3.3.3.3.4 In dry-pipe automatic sprinkler systems, the alarm system shall be actuated by a pressure switch associated with the trim on the dry-pipe device.

4.3.3.3.3.5 A paddle-type water flow switch shall be installed in wet systems only.

4.3.3.3.4 Antifreeze System. Where danger of freezing exists, sprinkler systems filled with antifreeze solution shall be permitted and shall meet the requirements of 7.6.2 and 7.6.3 of NFPA 13.

4.3.3.3.5* Dry-Pipe System. Where danger of freezing exists, a dry-pipe sprinkler system shall be permitted and shall meet the requirements of 4.3.3.3.5.1 through 4.3.3.3.5.7.

4.3.3.3.5.1 The dry-pipe valve and its accessories shall be installed in a separate area and shall be protected against freezing and mechanical injury.

4.3.3.3.5.2 If the separate area described in 4.3.3.3.5.1 is ventilated with return air, all electrical components shall be permissible or intrinsically safe.

4.3.3.3.5.3 Water pressure shall be regulated not to exceed the maximum pressure specified by the manufacturer of the dry-pipe valve.

4.3.3.3.5.4 The dry-pipe valve shall be installed in accordance with the manufacturer's instructions.

4.3.3.3.5.5 Mechanical grooved couplings, including gaskets used on dry-pipe systems, shall be listed for dry-pipe service.

4.3.3.3.5.6 Operation of the dry-pipe system and supervision of the system, including pressure of the air supply, shall be signaled to an attended location. Signaling to an attended location shall be permitted to utilize alarm systems serving fire detection equipment.

4.3.3.3.5.7 The system air supply shall be provided from a reliable source such as a dedicated compressor and shall be equipped with an air maintenance device.

4.3.3.3.5.8 Sprinklers shall be installed in the upright position on a dry-pipe system or be listed dry type or horizontal sidewall sprinklers installed according to the listing for dry-pipe systems.

4.3.3.3.6 Protection of Specific Hazards.

4.3.3.3.6.1* Automatic water-based fixed fire protection systems installed for the protection of Class I or Class II liquid storage areas shall be of the foam-water type.

4.3.3.3.6.2* Where the requirements of 9.4.6 dealing with underground belt drives are satisfied by installing automatic sprinkler systems, such systems shall comply with the requirements of 4.3.3.3.1.2 and 4.3.3.3.1.3.

4.3.3.4 Automatic Sprinkler System Acceptance Testing.

4.3.3.4.1 Flushing of Water-Line Connections.

4.3.3.4.1.1 Water-line connections and lead-in connections shall be flushed at the maximum flow rate available before connection is made to the sprinkler piping in order to remove foreign material.

4.3.3.4.1.2 Flushing shall be continued until the water is clear.

4.3.3.4.2 Flow Testing of Sprinkler Systems.

4.3.3.4.2.1 Wet-pipe closed automatic sprinkler systems shall be flow-tested by operating flow through at least one sprinkler for non-belt drive areas and at least eight sprinklers for belt drive areas.

4.3.3.4.2.2 If the system contains fewer than eight sprinklers, all sprinklers or an inspector's test simulating all sprinklers shall be flow-tested as specified in 4.3.3.4.2.1.

4.3.3.4.2.3 With a water flow and pressure that is present under normal mine operating conditions, if the residual pressure measured downstream of the opened sprinklers is 70 kPa (10 psi) or greater for belt drive systems and 140 kPa (20 psi) for all other systems, the system shall be considered acceptable.

4.3.3.4.2.4 Closed sprinkler systems installed to protect areas where the water discharge could damage the area or its contents shall not be required to be tested by operating flow through opened sprinklers.

4.3.3.4.2.5 Where the condition(s) in 4.3.3.4.2.4 exist, the alternative test of operating flow through a 51 mm (2 in.) valve test connection shall be permitted to be used.

4.3.3.4.2.6 Portable sprinkler systems that are dismantled and reinstalled in new areas shall be flow-tested following the initial installation.

4.3.3.4.3 Tests of Dry-Pipe Sprinkler Systems.

4.3.3.4.3.1 Where there is no risk of freezing, new dry-pipe systems shall be flow-tested and hydrostatically tested in accordance with NFPA 13.

4.3.3.4.3.2 A dry-pipe valve shall be tested according to the manufacturer's recommendations.

4.3.3.4.3.3* Where there is risk of freezing in dry-pipe systems, an air pressure of 276 kPa (40 psi) shall be pumped up and allowed to stand 24 hours, and all leaks that allow a loss of pressure over 10.3 kPa (1½ psi) during the 24 hours shall be stopped.

4.3.3.5 Inspection, Maintenance, and Testing.

4.3.3.5.1 All fire suppression systems shall be tested after installation in accordance with the appropriate NFPA standard.

4.3.3.5.2 If an applicable NFPA standard does not exist, then a fire suppression system shall be tested in accordance with the manufacturer's or designer's instruction manual.

4.3.3.5.3 Testing shall not require the discharge of suppressant unless there is no other satisfactory manner in which the reliability and integrity of the system can be verified.

4.3.3.5.4* All persons who inspect, test, operate, or maintain fire suppression systems shall be trained.

4.3.3.5.5 Sprinkler System Maintenance.

4.3.3.5.5.1 All sprinkler systems shall be maintained in accordance with the manufacturer's requirements or in accordance with NFPA 25.

4.3.3.5.5.2* As a minimum, all closed-head sprinkler systems, except antifreeze systems, shall be flushed annually by operating flow through the end of the line drain(s) for the system to remove any silt buildup.

(A) If pendent sprinklers are used on wet-type sprinkler systems, the end sprinkler on each line shall be removed and examined annually to check for silt buildup.

(B) If silt buildup is found, all sprinklers on the line shall be removed, the line flushed, and new sprinklers installed.

4.3.3.5.5.3* As a minimum, deluge sprinklers and deluge water-spray systems shall be flow-tested on a monthly basis.

4.3.3.5.5.4 The strainer shall be flushed on a weekly basis, at a minimum.

4.3.3.5.6 Antifreeze Systems.

(A) Each year at the onset of freezing weather, a small amount of antifreeze shall be drawn from the drain valve and the test valve(s) and tested with a hydrometer to ensure that the solution is suitable for the lowest temperature expected.

(B) If the test described in 4.3.3.5.6(A) shows that the solution is not suitable, the solution shall be replaced.

4.3.3.6 Fire Suppression for Self-Propelled Equipment.

4.3.3.6.1* Fire suppression systems consisting of an agent container and a network of agent distribution hose or pipe with discharge nozzles attached shall be used to protect self-propelled equipment and shall comply with the following:

- (1) The system shall suppress any potential fire on the equipment it is intended to protect.
- (2) The fire suppression system shall be approved for the purpose, and the components shall be located or guarded to protect against damage.
- (3) Fire suppression systems shall be actuated automatically, manually, or both.
- (4) Automatically actuated systems designed to incorporate manual actuation shall be equipped with one or more such devices accessible for actuation and shall be maintained in operable condition.
- (5) Discharge nozzles shall be provided with blow-off caps or other devices to prevent the entrance of moisture or other environmental materials into the piping.
- (6) The protective device shall blow off, blow out, or open upon agent discharge.
- (7) The electrical components of systems installed on equipment that might be operated in the last open crosscut or in return air shall be permissible.
- (8) A standby source of power shall be provided if electrical power is the only means of actuation.
- (9) All fire suppression equipment and systems shall be tested after installation in accordance with the manufacturer's or designer's recommendations.
- (10) Testing shall not require the discharge of agent unless there is no other feasible way to evaluate the system.
- (11)* An owner's or operations manual shall be provided for all fire suppression systems.

(12)* Fire suppression systems shall be inspected and maintained in accordance with the appropriate NFPA standard.

4.3.3.6.2* Fire suppression systems shall be provided for protection of attended, electrically powered, self-propelled equipment such as cutting machines, continuous miners, shearers, roof and coal drills, loaders, shuttle cars, scoops, and locomotives that use hydraulic fluid, unless fire-resistant hydraulic fluid is used.

4.3.3.6.3 Cutting machines, continuous miners, shearers, and other machines that supply water through a hose for dust control during mining shall be permitted to use this water source for fire protection, provided a diversion valve is at or outby the operator's station to permit quick and convenient diversion of water to the fire suppression nozzles.

4.3.4 Manual Firefighting.

4.3.4.1 Portable Fire Extinguishers.

4.3.4.1.1 General Requirements.

4.3.4.1.1.1* Portable fire extinguishers used in underground coal mines shall be listed, multipurpose (ABC) dry chemical types having a minimum nominal capacity of 4.6 kg (10 lb) of extinguishing agent, and shall meet the requirements of NFPA 10.

4.3.4.1.1.2 Portable extinguishers shall be kept in their designated places.

4.3.4.1.1.3 Extinguishers shall be located where they will be accessible in the event of fire.

4.3.4.1.1.4 In areas where visual obstruction cannot be completely avoided, visible markings shall be provided to indicate the location.

4.3.4.1.1.5 Extinguishers subject to dislodgment shall be installed in brackets specifically designed for this problem.

4.3.4.1.1.6 Extinguishers shall be protected from physical damage.

4.3.4.1.1.7 Damaged extinguishers shall be repaired, replaced, or removed from service.

4.3.4.1.1.8 At least one hand-portable fire extinguisher having a nominal capacity of 9.1 kg (20 lb) with a minimum rating of 10-A:60-B:C shall be located outside of, but not more than 3.0 m (10 ft) from, the opening into each flammable and combustible storage area and maintenance shop.

4.3.4.1.1.9 The installation of manual or automatic fire suppression systems shall not waive the requirement of 4.3.4.1.1.8.

4.3.4.1.1.10 Where portable fire extinguishers are provided within flammable and combustible storage areas, travel distance to a portable extinguisher shall not exceed 12.2 m (40 ft).

4.3.4.1.2 Selection and Application.

4.3.4.1.2.1 Multipurpose (ABC) dry chemical extinguishers shall be provided for protection of the following:

- (1) Ventilation doors on trolley wire-supplied track haulage-ways
- (2) Pumps and pump rooms

- (3) Conveyor belt drives
- (4) Belt head loading equipment
- (5) Air compressors
- (6) Electrical equipment such as transformers, load centers, rectifiers, circuit breakers, generators, and starters
- (7) Rotary dump areas
- (8) Battery-charging areas
- (9) Intervals of 23 m (75 ft) along a longwall face unless washdown hose is present
- (10) Ignitable (flammable and combustible) liquid storage areas
- (11) Mobile equipment used for the storage, transport, and dispensing of combustible liquids
- (12) Electric- or diesel-powered mobile equipment
- (13) Self-propelled equipment

4.3.4.1.2.2 The installation of an automatic or manually operated fire suppression system shall not eliminate the requirement for a portable fire extinguisher.

4.3.4.1.2.3* At least one multipurpose (ABC) dry chemical extinguisher having a nominal capacity of 13.6 kg (30 lb) or greater of agent or two multipurpose (ABC) dry chemical extinguishers having a nominal capacity of 9.1 kg (20 lb) or greater of agent each shall be provided in each working section of a mine, including the headgate of a longwall face.

4.3.4.1.3 Inspection and Maintenance.

4.3.4.1.3.1 Portable fire extinguishers shall be inspected, maintained, and recharged as specified in Chapter 7 of NFPA 10 and shall include the requirements of 4.3.4.1.3.2 through 4.3.4.1.3.9.

4.3.4.1.3.2* Visual Inspection.

(A) Portable fire extinguishers shall be inspected visually at least monthly.

(B) The visual inspection shall confirm the following:

- (1) The extinguisher is in its designated place.
- (2) The tamper seals are intact.
- (3) The extinguisher gauge is in the operable range (if extinguisher is stored pressure type).
- (4) There is no obvious physical damage or condition to prevent operation.

4.3.4.1.3.3 Extinguishers shall be subjected to a thorough maintenance examination at least once every 12 months.

4.3.4.1.3.4 Maintenance procedures shall include a thorough examination of the extinguisher, including mechanical parts, extinguishing agent, and the means of expulsion.

4.3.4.1.3.5 Any detected troubles or impairments shall be corrected or replaced immediately by competent personnel.

4.3.4.1.3.6 Each extinguisher shall have a durable tag or label securely attached on which the date of the maintenance services shall be recorded.

4.3.4.1.3.7 All extinguishers shall be recharged after any discharge.

4.3.4.1.3.8 All extinguishers shall be recharged as deemed necessary through inspection and maintenance.

4.3.4.1.3.9 Portable extinguishers shall be hydrostatically tested at intervals not exceeding those specified in Chapter 8 of NFPA 10.

4.3.4.2 Hand Hose Line Systems.

4.3.4.2.1 Selection and Application.

4.3.4.2.1.1* Fire hose for use in underground coal mines shall be a minimum of 38 mm (1½ in.) in diameter, single or multiple jacket, and of a type suitable for coal mine use.

4.3.4.2.1.2 The hose shall meet the minimum applicable standards of NFPA 1961.

4.3.4.2.1.3 Hose lines employing natural fibers shall not be used in underground coal mines.

4.3.4.2.1.4* Fire hose, including couplings, shall be rated for the maximum line pressure that can exist on the mine water system, or there shall be provision for limiting the line pressure to the working pressure of the hose.

4.3.4.2.1.5 Nozzle flow pressure shall be adjusted to provide hose control.

4.3.4.2.1.6* Couplings for fire hose used in underground coal mines shall have straight, iron pipe threads or National Standard Thread.

4.3.4.2.1.7 Where hose or hose-connected equipment is brought in from outside the mine, compatible adapters shall be available.

4.3.4.2.1.8 Hose nozzles shall be capable of delivering a straight stream and a spray discharge.

4.3.4.2.1.9* Fire hose shall be stored in caches, and caches shall contain hose to reach all areas covered by the hydrants that the cache will serve.

4.3.4.2.1.10 Each cache shall contain at least one hose nozzle and one hose wrench.

4.3.4.2.1.11* Caches of fire hose shall be provided at strategic underground locations as follows:

- (1) At each intersection with an active submain
- (2) At the mouth of each panel
- (3) At and on the intake side of each conveyor belt drive
- (4) At the entrance to each shop and storage area as defined in 4.2.5, 4.2.8, and 4.2.9
- (5) In each operating area
- (6) At intervals not to exceed 1524 m (5000 ft) along the main haul route or travelway

4.3.4.2.1.12 Hand hose line systems, if used, shall be installed in accordance with NFPA 14 and shall be a minimum of either 38 mm (1½ in.) lined or 25.4 mm (1 in.) hard rubber.

4.3.4.2.1.13 Hand hose lines that are designated for firefighting and that have the capability to be used in Class I or Class II liquid storage areas shall be equipped to discharge a foam-water solution and shall be in accordance with the applicable sections of NFPA 11.

4.3.4.2.2* Maintenance. Caches of fire hose shall be checked at least every 6 months to ensure that the inventory of hose, nozzles, wrenches, and adapters is complete, and the following requirements shall apply:

- (1) At least one length of hose from each cache shall be pressure-tested annually in accordance with NFPA 1962.
- (2) The tested hose shall be tagged and dated so that a different length of hose is tested each year.

- (3) If any length of hose fails the pressure test, all lengths of hose in the cache shall be tested.
- (4) Hose lines that fail the test shall be replaced.

4.3.4.3 Portable Foam-Generating Devices.

4.3.4.3.1 General Requirements.

4.3.4.3.1.1 Portable foam generators, fire hose, foam concentrate, and emergency firefighting materials in accordance with 4.3.4.5 shall be accessible within 60 minutes of fire notification.

4.3.4.3.1.2 Portable foam-generating devices and associated equipment shall be listed or approved for that purpose.

4.3.4.3.2 High-Expansion Foam.

4.3.4.3.2.1 Where high-expansion foam is used, provision shall be made to supply uncontaminated air for foam making.

4.3.4.3.2.2 The foam system shall be tested with the water supply to determine the quality of the foam-making capabilities.

4.3.4.3.3 Maintenance.

4.3.4.3.3.1 At least annually, a thorough maintenance examination of the foam-generating devices and associated equipment, including foam concentrate, shall be made by the mine operator.

4.3.4.3.3.2 Operation of foam-generating equipment during training sessions conducted at least annually shall satisfy the maintenance examination requirement.

4.3.4.4 Rock Dust.

4.3.4.4.1 At least 109 kg (240 lb) of bagged, dry rock dust shall be stored upwind and kept available for firefighting at or near the following areas:

- (1) Maintenance and shop areas
- (2) Combustible liquid storage area
- (3) Working section
- (4) Belt drive area
- (5) Belt-head loading area
- (6) Ventilation doors on trolley wire-supplied track haulage-ways

4.3.4.4.2 Where it is impractical to store for fire extinguishment purposes, rock dust shall be permitted to be replaced with an additional portable extinguisher having a nominal capacity of 4.5 kg (10 lb) of multipurpose (ABC) dry chemical extinguishing agent.

4.3.4.5 Emergency Materials.

4.3.4.5.1 Emergency materials for fighting mine fires shall be near the shaft bottom or other entrance to the mine.

4.3.4.5.2 If the shaft bottom or other entrance to the mine is more than 3.2 km (2 mi) from a working section, additional caches of emergency materials shall be located within 3.2 km (2 mi) of the working section.

4.3.4.5.3 Emergency materials shall include fire hose and necessary adapters, multiple hydrants, wrenches and nozzles, brattice boards and cloth, wood posts, cap pieces, wood wedges, spad guns and spads, or other specialized equipment for installing line brattice, nails, bags of sealant or cement, saws, hammers, axes, shovels, and picks.

4.3.4.5.4 Caches of emergency materials shall be checked at least every 6 months to ensure that the inventory of materials is complete.

4.3.4.6* Training.

4.3.4.6.1 All miners shall be instructed annually in fire prevention and firefighting techniques.

4.3.4.6.2 All employees shall be instructed in emergency evacuation procedures.

4.3.4.6.3 All persons who inspect, test, operate, or maintain fire suppression systems shall be trained in the functions they are to perform.

N 4.4 Ventilation.

N 4.4.1 **Ventilation Plan.** The mine shall have a written ventilation plan.

N 4.4.1.1 The plan shall have the following features:

- (1) Direction and quantity of principal air flows.
- (2) Locations of seals used to isolate abandoned workings.
- (3) Locations of areas withdrawn from the ventilation system.
- (4) Locations of all main, booster, and auxiliary fans.
- (5) Locations of air regulators and stoppings and ventilation doors.
- (6) Locations of airway crossover devices such as overcasts and undercasts.
- (7) Locations of known oil or gas wells.
- (8) Locations of known underground mine openings adjacent to the mine.
- (9) Locations of permanent underground shops, combustible liquid storage, battery charging stations, and explosive storage. Permanent locations are those intended to exist for one year or more.
- (10) Mine fan data for all active fans.
- (11) Diagrams, descriptions, or sketches showing how ventilation is accomplished in each typical working place, including the approximate quantity of air provided.

N 4.4.1.2 The ventilation plan shall be updated on an annual basis.

N 4.4.2 **Ventilation Doors.** Ventilation doors shall be made of noncombustible material.

N 4.4.2.1 Ventilation doors shall be self-closing.

N 4.4.2.2 Ventilation doors shall be provided with a sign identifying the door as a ventilation door.

N 4.4.3 **Unventilated Areas.** Unventilated areas shall be sealed or barricaded and posted against entry.

N 4.4.3.1 Seals shall be provided with the means for checking the quality of air behind the seal.

N 4.4.3.2 A means to prevent a water head from developing unless the seal is designed to impound water shall be provided.

N 4.4.4 Air Quantity.

N 4.4.4.1 In bituminous and lignite mines the quantity of air shall be at least 5097 m³/hr (3000 cfm) reaching each working face where coal is being cut, mined, drilled for blasting, or loaded.

- N 4.4.4.1.1** When a greater quantity is necessary to dilute, render harmless, and carry away flammable, explosive, noxious, and harmful gases, dusts, smoke, and fumes, this quantity shall be specified in the approved ventilation plan.
- N 4.4.4.1.2** A minimum air quantity shall be required to be specified in the approved ventilation plan for other working places or working faces.
- N 4.4.4.1.3** The quantity of air reaching the working face shall be determined at or near the face end of the line curtain, ventilation tubing, or other ventilation control device.
- N 4.4.4.1.4** If the curtain, tubing, or device extends beyond the last row of permanent roof supports, the quantity of air reaching the working face shall be determined behind the line curtain or in the ventilation tubing at or near the last row of permanent supports.
- N 4.4.4.2** In bituminous and lignite mines, the quantity of air reaching the last open crosscut of each set of entries or rooms on each working section and the quantity of air reaching the intake end of a pillar line shall be at least 15,281 m³/hr (9000 cfm) unless a greater quantity is required to be specified in the approved ventilation plan.
- N 4.4.4.2.1** This minimum shall apply to sections which are not operating but are capable of producing coal by simply energizing the equipment on the section.
- N 4.4.4.3** In longwall and shortwall mining systems the quantity of air shall be at least 50,970 m³/hr (30,000 cfm) reaching the working face of each longwall unless the operator demonstrates that a lesser air quantity will maintain continual compliance with applicable methane and respirable dust standards.
- N 4.4.4.3.1** This lesser quantity shall be specified in the approved ventilation plan.
- N 4.4.4.3.2** A quantity greater than 50,970 m³/hr (30,000 cfm) shall be required to be specified in the approved ventilation plan.
- N 4.4.4.4** The velocity of air that will be provided to control methane and respirable dust shall be in accordance with applicable standards on each longwall or shortwall.
- N 4.4.4.4.1** The locations where these velocities will be provided shall be specified in the approved ventilation plan.
- N 4.4.4.4.2** The locations specified shall be at least 15.2 m (50 ft) but no more than 30.5 m (100 ft) from the headgate and tailgate, respectively.
- N 4.4.4.5** Ventilation shall be maintained during installation and removal of mechanized mining equipment.
- N 4.4.4.5.1** The approved ventilation plan shall specify the minimum quantity of air, the locations where this quantity will be provided, and the ventilation controls required.
- N 4.4.4.6** In anthracite mines, the quantity of air shall be as follows:
- (1) At least 2548.5 m³/hr (1500 cfm) shall reach each working face.
 - (2) At least 8495.1 m³/hr (5000 cfm) shall pass through the last open crosscut in each set of entries or rooms and at the intake end of any pillar line unless a greater quantity is required to be specified in the approved ventilation plan.
 - (3) When robbing areas where air currents cannot be controlled and air measurements cannot be obtained, the air shall have perceptible movement.
 - (4) The minimum ventilating air quantity for an individual unit of diesel-powered equipment being operated shall be at least that specified on the approval plate for that equipment.
- N 4.4.4.7 Mean Entry Air Velocity.** In exhausting face ventilation systems, the mean entry air velocity shall be at least 18.3 m (60 ft/m) reaching each working face where coal is being cut, mined, drilled for blasting, or loaded, and to any other working places as required in the approved ventilation plan.
- N 4.4.4.7.1** A lower mean entry air velocity shall be approved in the ventilation plan if the lower velocity will maintain methane and respirable dust concentrations in accordance with the applicable levels.
- N 4.4.4.7.2** Mean entry air velocity shall be determined at or near the inby end of the line curtain, ventilation tubing, or other face ventilation control device.
- N 4.4.4.8 Air Courses and Trolley Haulage Systems.**
- N 4.4.4.8.1** Where trolley haulage systems are maintained and where trolley wires or trolley feeder wires are installed, the authority having jurisdiction shall require enough entries or rooms as intake air courses to limit the velocity of air currents in the haulageways to minimize the hazards of fires and dust explosions in the haulageways.
- N 4.4.4.8.2** Unless the authority having jurisdiction approves a higher velocity, the velocity of the air current in the trolley haulage entries shall be limited to not more than 1.27 m/s (250 ft/m).
- N 4.4.4.8.2.1** A higher air velocity shall be required to limit the methane content in these haulage entries or elsewhere in the mine to less than 1.0 percent and provide an adequate supply of oxygen.
- N 4.4.5 Face Ventilation Control Devices.**
- N 4.4.5.1** Brattice cloth, ventilation tubing, and other face ventilation control devices shall be made of approved fire-resistant material.
- N 4.4.5.2** Ventilation control devices shall be used to provide ventilation to dilute, render harmless, and carry away flammable, explosive, noxious, and harmful gases, dusts, smoke, and fumes from the following locations:
- (1) To each working face from which coal is being cut, mined, drilled for blasting, or loaded
 - (2) To any other working places as required by the approved ventilation plan
- N 4.4.5.3** Ventilation control devices shall be installed at a distance no greater than 3 m (10 ft) from the area of deepest penetration to which any portion of the face has been advanced unless an alternative distance is specified and approved in the ventilation plan.
- N 4.4.5.3.1** Alternative distances specified shall be capable of maintaining concentrations of respirable dust, methane, and other harmful gases, in accordance with the levels specified in the applicable sections of this chapter.

N 4.4.5.4 When the line brattice or any other face ventilation control device is damaged to an extent that ventilation of the working face is inadequate, production activities in the working place shall cease until necessary repairs are made and adequate ventilation is restored.

N 4.4.6 Auxiliary Fans and Tubing.

N 4.4.6.1 When auxiliary fans and tubing are used for face ventilation, each auxiliary fan shall be in accordance with the following:

- (1) Permissible, if the fan is electrically operated
- (2) Maintained in proper operating condition
- (3) Deenergized or shut off when no one is present on the working section
- (4) Located and operated to avoid recirculation of air

N 4.4.6.2 If a deficiency exists in any auxiliary fan system, the deficiency shall be corrected or the auxiliary fan shall be deenergized immediately.

N 4.4.6.3 If the air passing through an auxiliary fan or tubing contains 1.0 percent or more methane, power to electrical equipment in the working place and to the auxiliary fan shall be deenergized until the methane concentration is reduced to less than 1.0 percent.

N 4.4.6.4 If the air passing through an auxiliary fan or tubing contains 1.0 percent or more methane, other mechanized equipment in the working place shall be shut off until the methane concentration is reduced to less than 1.0 percent.

N 4.4.6.5 When an auxiliary fan is stopped the following shall apply:

- (1) Line brattice or other face ventilation control devices shall be used to maintain ventilation to affected faces.
- (2) Electrical equipment in the affected working places shall be disconnected at the power source, and other mechanized equipment shall be shut off until ventilation to the working place is restored.

N 4.4.7 Working Sections and Working Places.

N 4.4.7.1 Each working section and each area where mechanized mining equipment is being installed or removed shall be ventilated by a separate split of intake air directed by overcasts, undercasts, or other permanent ventilation controls.

N 4.4.7.2* When two or more sets of mining equipment are simultaneously engaged in cutting, mining, or loading coal or rock from working places within the same working section, each set of mining equipment shall be on a separate split of intake air.

N 4.4.7.3* Air that has passed through any area that has not had a preshift inspection or through an area where second mining has been done shall not be used to ventilate any working place.

N 4.4.7.4 Air that has passed by any opening of any unsealed area that has not had a preshift ventilation inspection shall not be used to ventilate any working place.

N 4.4.8 Ventilation Controls.

N 4.4.8.1 Permanent stoppings or other permanent ventilation control devices shall be built and maintained as follows:

- (1) Between intake and return air courses, except temporary controls, stoppings or controls shall be permitted to be used in rooms that are 182.9 m (600 ft) or less from the

centerline of the entry from which the room was developed, including where continuous face haulage systems are used in such rooms.

- (2) Unless otherwise approved in the ventilation plan, the stoppings or controls in 4.4.8.1(1) shall be maintained to and including the third connecting crosscut outby the working face.
- (3) Stoppings and controls shall separate belt conveyor haulageways from return air courses.
- (4) To separate belt conveyor haulageways from intake air courses when the air in the intake air courses is used to provide air to active working places, the following shall be permitted:
 - (a) Temporary ventilation controls shall be permitted to be used in rooms that are 182.9 m (600 ft) or less from the centerline of the entry from which the rooms were developed, including where continuous face haulage systems are used in such rooms.
 - (b) Where continuous face haulage systems are used, permanent stoppings or other permanent ventilation control devices shall be built and maintained to the outby most point of travel of the dolly or 182.9 m (600 ft) from the point of deepest penetration in the conveyor belt entry, whichever distance is closer to the point of deepest penetration, to separate the continuous haulage entry from the intake entries.
- (5) Stoppings and controls shall separate the primary escape-way from belt and trolley haulage entries.
- (6) In return air courses, stoppings and controls shall direct air into adjacent worked-out areas.

N 4.4.8.2 Personnel doors shall comply with all the following:

- (1) Be constructed of noncombustible material
- (2) Be of sufficient strength to serve their intended purpose of maintaining separation and permitting travel between air courses
- (3) Be installed as follows in permanent stoppings:
 - (a) The distance between personnel doors shall be no more than 91.4 m (300 ft) in seam heights below 121.9 cm (48 in.) and 182.9 m (600 ft) in seam heights 121.9 cm (48 in.) or higher.
 - (b) The location of all personnel doors in stoppings along escapeways shall be clearly marked so that the doors can be easily identified by anyone traveling in the escapeway.
 - (c) Personnel doors shall be installed in the entries on either side of the doors.

N 4.4.8.2.1 When not in use, personnel doors shall be closed.

N 4.4.8.3 Doors, other than personnel doors, that are used in lieu of permanent stoppings or to control ventilation within an air course shall be as follows:

- (1) Made of noncombustible material or coated on all accessible surfaces with flame-retardant materials having a flame-spread index of 25 or less, as tested under ASTM E162, *Standard Test Method for Surface Flammability of Materials Using a Radiant Heat Energy Source*
- (2) Of sufficient strength to serve their intended purpose of maintaining separation and permitting travel between or within air courses or entries
- (3) Installed in pairs to form an airlock

- N 4.4.8.3.1** Where an airlock is used, one side of the airlock shall remain closed.
- N 4.4.8.3.2** When not in use, both sides of an airlock shall be closed.
- N 4.4.8.4** Except as provided in paragraphs 4.4.8.4.2, 4.4.8.4.3 and 4.4.8.4.4 of this section all overcasts, undercasts, shaft partitions, permanent stoppings, and regulators shall be constructed in accordance with the following:
- (1) A traditionally accepted method
 - (2) Of materials that have been demonstrated, using the following tests, to perform adequately or in a method and of materials that have been tested and shown to have a minimum strength equal to or greater than the traditionally accepted in-mine controls:
 - (a) Tests shall be permitted to be performed under ASTM E72, *Standard Methods of Conducting Strength Tests of Panels for Building Construction* (Section 12—Transverse Load—Specimen Vertical, load, only).
 - (b) The operator shall be permitted to conduct comparative in-mine tests.
 - (c) In-mine tests shall be designed to demonstrate the comparative strength of the proposed construction and a traditionally accepted in-mine control.
- N 4.4.8.4.1*** All overcasts, undercasts, shaft partitions, permanent stoppings, and regulators shall be constructed of noncombustible material.
- N 4.4.8.4.2** In anthracite mines, permanent stoppings shall be permitted to be constructed of overlapping layers of hardwood mine boards if the stoppings are a minimum 51 mm (2 in.) thick.
- N 4.4.8.4.3** When timbers are used to create permanent stoppings in heaving or caving areas, the stoppings shall be coated on all accessible surfaces with a flame-retardant material having a flame spread index of 25 or less, as tested under ASTM E162, *Standard Test Method for Surface Flammability of Materials Using a Radiant Heat Energy Source*.
- N 4.4.8.4.4** In anthracite mines, doors and regulators shall be permitted to be constructed of overlapping layers of hardwood boards if the doors, door frames, and regulators are a minimum 51 mm (2 in.) thick.
- N 4.4.8.5** When sealants are applied to ventilation controls, the sealant shall have a flame-spread index of 25 or less under ASTM E162, *Standard Test Method for Surface Flammability of Materials Using a Radiant Heat Energy Source*.
- N 4.4.8.6** Before mining is discontinued in an entry or room that is advanced more than 6.1 m (20 ft) from the inby rib, a crosscut shall be made or line brattice shall be installed and maintained to provide adequate ventilation.
- N 4.4.8.6.1** When conditions such as methane liberation warrant a distance less than 6.1 m (20 ft), the approved ventilation plan shall specify the following:
- (1) The location of such rooms or entries
 - (2) The maximum distance they will be developed before a crosscut is made or line brattice is installed
- N 4.4.8.7** All ventilation controls, including seals, shall be maintained to serve the purpose for which they were built.
- N 4.4.9 Worked-Out Areas and Areas Where Pillars Are Being Recovered.**
- N 4.4.9.1** Worked-out areas where no pillars have been recovered shall be one of the following:
- (1) Ventilated so that methane-air mixtures and other gases, dusts, and fumes from throughout the worked-out areas are continuously diluted and routed into a return air course, or to the surface of the mine
 - (2) Sealed
- N 4.4.9.2** During pillar recovery a bleeder system shall be used to control the air passing through the area and to continuously dilute and move methane-air mixtures and other gases, dusts, and fumes from the worked-out area away from active workings and into a return air course or to the surface of the mine.
- N 4.4.9.2.1** After pillar recovery, a bleeder system shall be maintained to provide ventilation to the worked-out area, or the area shall be sealed.
- N 4.4.9.3** The approved ventilation plan shall specify the following:
- (1) The design and use of bleeder systems
 - (2) The means to determine the effectiveness of bleeder systems
 - (3) The means for adequately maintaining bleeder entries free of obstructions such as roof falls and standing water
 - (4) The location of ventilating devices such as regulators, stoppings, and bleeder connectors used to control air movement through the worked-out area
- N 4.4.9.4** If the bleeder system used does not continuously dilute and move methane-air mixtures and other gases, dusts, and fumes away from worked out areas into a return air course or to the surface of the mine, or it cannot be determined by examinations or evaluations that the bleeder system is working effectively, the worked out area shall be sealed.
- N 4.4.9.5** Each mining system shall be designed so that each worked-out area can be sealed.
- N 4.4.9.5.1** The approved ventilation plan shall specify the location and the sequence of construction of proposed seals.
- N 4.4.9.6** In place of the requirements of paragraphs 4.4.9.1 and 4.4.9.2, for mines with a demonstrated history of spontaneous combustion or that are located in a coal seam determined to be susceptible to spontaneous combustion, the approved ventilation plan shall specify the following:
- (1) Measures to detect methane, carbon monoxide, and oxygen concentrations during and after pillar recovery, and in worked-out areas where no pillars have been recovered, to determine if the areas must be ventilated or sealed
 - (2) Actions that will be taken to protect miners from the hazards of spontaneous combustion
 - (3) If a bleeder system will not be used, the methods that will be used to control spontaneous combustion, accumulations of methane-air mixtures, and other gases, dusts, and fumes in the worked-out area
- N 4.4.10 Construction of Seals.**
- N 4.4.10.1 Seal Strengths.** Seals shall be constructed and maintained in accordance with 4.4.10.1.1 through 4.4.10.1.3.1.

N 4.4.10.1.1 Seals shall be constructed and maintained to withstand at least a 3.4 kPa (50 psi) overpressure when the atmosphere in the sealed area is monitored and maintained inert and designed using a pressure-time curve with an instantaneous overpressure of at least 3.4 kPa (50 psi).

N 4.4.10.1.1.1 A minimum overpressure of at least 3.4 kPa (50 psi) shall be maintained for at least four seconds then released instantaneously.

N 4.4.10.1.1.2 Seals constructed to separate the active longwall panel from the longwall panel previously mined shall be designed using a pressure-time curve with a rate of pressure rise of at least 3.4 kPa (50 psi) in 0.1 second.

N 4.4.10.1.1.3 A minimum overpressure of at least 3.4 kPa (50 psi) shall be maintained.

N 4.4.10.1.2 Seals shall be constructed and maintained to withstand overpressures of at least 82.7 kPa (120 psi) if the atmosphere in the sealed area is not monitored, is not maintained inert, the conditions in 4.4.10.1.3 of this section are not present, and the seal is designed using a pressure-time curve with an instantaneous overpressure of at least 82.7 kPa (120 psi).

N 4.4.10.1.2.1 A minimum overpressure of 82.7 kPa (120 psi) shall be maintained for at least four seconds then released instantaneously.

N 4.4.10.1.2.2 Seals constructed to separate the active longwall panel from the longwall panel previously mined shall be designed using a pressure-time curve with a rate of pressure rise of 82.7 kPa (120 psi) in 0.25 second.

N 4.4.10.1.2.3 A minimum overpressure of 82.7 kPa (120 psi) shall be maintained.

N 4.4.10.1.3 Seals shall be constructed and maintained to withstand overpressures greater than 82.7 kPa (120 psi) if the following apply:

- (1) The area is not monitored.
- (2) The area is not maintained inert.
- (3) The atmosphere in the sealed area is likely to contain homogeneous mixtures of methane between 4.5 percent and 17.0 percent and oxygen exceeding 17.0 percent throughout the entire area.
- (4) Pressure piling could result in overpressures greater than 82.7 kPa (120 psi) in the area to be sealed.
- (5) Other conditions are encountered, such as the likelihood of a detonation in the area to be sealed.

N 4.4.10.1.3.1 Where the conditions in paragraphs 4.4.10.1.3(1) through 4.4.10.1.3(5) of this section are encountered, the mine operator shall revise the ventilation plan to address the potential hazards.

N 4.4.10.1.3.2 The ventilation plan specified in 4.4.10.1.3.1 shall include seal strengths sufficient to address such conditions.

N 4.4.10.2 Engineering Design of Seals. Engineering design of seals shall accomplish the following:

- (1) Design addresses gas sampling pipes, water drainage systems, methods to reduce air leakage, pressure-time curve, fire-resistance characteristics, flame-spread index, entry size, engineering design and analysis, elasticity of design, material properties, construction specifications,

quality control, design references, and other information related to seal construction.

- (2) A professional engineer ensures the design of the seal is in accordance with current, prudent engineering practices and is applicable to conditions in an underground coal mine.
- (3) Design includes a summary of the installation procedures related to seal construction.

N 4.4.10.3 Seal Installation.

N 4.4.10.3.1 A professional engineer shall conduct or have oversight of seal installation and certify that the provisions in the approved seal design specified in this section have been addressed and are applicable to conditions at the mine.

N 4.4.10.3.2 The mine map shall be verified by a professional engineer or a professional land surveyor of the area to be sealed and proposed seal locations that include the deepest points of penetration prior to sealing.

N 4.4.10.3.3 Specific mine site information shall include the following:

- (1) Type of seal
- (2) Safety precautions taken prior to seal achieving design strength
- (3) Methods to address site-specific conditions that could affect the strength and applicability of the seal, including set-back distances
- (4) Site preparation
- (5) Sequence of seal installations
- (6) Projected date of completion of each set of seals
- (7) Supplemental roof support inby and outby each seal
- (8) Water flow estimation and dimensions of the water drainage system through the seals
- (9) Methods to ventilate the outby face of seals once completed
- (10) Methods and materials used to maintain each type of seal
- (11) Methods to address shafts and boreholes in the sealed area
- (12) Assessment of potential for overpressures greater than 82.7 kPa (120 psi) in sealed area
- (13) Additional sampling locations

N 4.4.10.4 Seal Construction.

N 4.4.10.4.1 Prior to sealing, the mine operator shall do the following:

- (1) Remove insulated cables, batteries, and other potential electric ignition sources from the area to be sealed when constructing seals unless it is not safe to do so. If ignition sources cannot safely be removed, seals must be constructed to at least 82.7 kPa (120 psi).
- (2) Remove metallic objects through or across seals.
- (3) Breach or remove all stoppings in the first crosscut inby the seals immediately prior to sealing the area.

N 4.4.10.4.2* Hot work with an arc or flame shall be prohibited within 45.7 m (150 ft) of a seal.

N 4.4.10.4.3 One nonmetallic sampling pipe shall be installed in each seal that shall extend into the center of the first connecting crosscut inby the seal.

- N 4.4.10.4.3.1** If an open crosscut does not exist, the sampling pipe shall extend one-half of the distance of the open entry in by the seal.
- N 4.4.10.4.3.2** Each sampling pipe shall be equipped with a shut-off valve and appropriate fittings for taking gas samples.
- N 4.4.10.4.3.3** The sampling pipes shall be labeled to indicate the location of the sampling point when more than one sampling pipe is installed through a seal.
- N 4.4.10.4.3.4** If a new seal is constructed to replace or reinforce an existing seal with a sampling pipe, the sampling pipe in the existing seal shall extend through the new seal.
- N 4.4.10.4.3.5** An additional sampling pipe shall be installed through each new seal to sample the area between seals, as specified in the approved ventilation plan.
- N 4.4.10.4.4** The seal at the lowest elevation shall have a corrosion-resistant, nonmetallic water drainage system.
- N 4.4.10.4.4.1** Seals shall not impound water or slurry.
- N 4.4.10.4.4.2** Water or slurry shall not accumulate within the sealed area to any depth that can adversely affect a seal.
- N 4.4.11 Sampling and Monitoring Requirements.**
- N 4.4.11.1** Sealed areas shall be monitored, whether ingassing or outgassing, for methane and oxygen concentrations and the direction of leakage.
- N 4.4.11.2** Each sampling pipe and approved sampling location shall be sampled at least every 24 hours.
- N 4.4.11.2.1** Atmospheres with seals of 82.7 kPa (120 psi) or greater shall be sampled until the design strength is reached for every seal used to seal the area.
- N 4.4.11.2.2*** Atmospheres with seals less than 82.7 kPa (120 psi) shall be monitored for methane and oxygen concentrations and maintained inert.
- N 4.4.11.3** The mine operator shall evaluate the atmosphere in the sealed area to determine whether sampling through the sampling pipes in seals and approved locations provides appropriate sampling locations of the sealed area.
- N 4.4.11.3.1** The mine operator shall make the evaluation immediately after the minimum 14-day required sampling if the mine ventilation system is reconfigured, if changes occur that adversely affect the sealed area, or if the authority having jurisdiction requests an evaluation.
- N 4.4.11.3.2** When the results of the evaluations indicate the need for additional sampling locations, the mine operator shall provide them.
- N 4.4.11.3.3** The authority having jurisdiction shall be permitted to require additional sampling locations and frequencies.
- N 4.4.11.4** Mine operators with an approved ventilation plan addressing spontaneous combustion in accordance with 4.4.9.6 shall sample the sealed atmosphere in accordance with the ventilation plan.
- N 4.4.11.5** The authority having jurisdiction shall be permitted to approve, in the ventilation plan, the use of a continuous monitoring system in lieu of monitoring provisions in this section.
- N 4.4.11.6** Except as provided in 4.4.11.9, the atmosphere in the sealed area shall be considered inert when the oxygen concentration is less than 10.0 percent or the methane concentration is less than 3.0 percent or greater than 20.0 percent.
- N 4.4.11.7** Immediate action shall be taken by the mine operator to restore an inert sealed atmosphere behind seals with strengths less than 82.7 kPa (120 psi).
- N 4.4.11.7.1** Until the atmosphere in the sealed area is restored to an inert condition, the sealed atmosphere shall be monitored at each sampling pipe and approved location at least once every 24 hours.
- N 4.4.11.8** Except as provided in 4.4.11.9, when a sample is taken from the sealed atmosphere with seals of less than 82.7 kPa (120 psi) and the sample indicates that the oxygen concentration is 10 percent or greater and methane is between 4.5 percent and 17 percent, the mine operator shall immediately perform the following:
- (1) Take an additional sample
 - (2) Notify the authority having jurisdiction
- N 4.4.11.8.1** When the additional sample indicates that the oxygen concentration is 10 percent or greater and methane is between 4.5 percent and 17 percent, persons shall be withdrawn from the affected area, which is the entire mine or other affected area identified by the operator and approved by the authority having jurisdiction in the ventilation plan.
- N 4.4.11.8.2** The operator shall be permitted to identify areas in the ventilation plan to be approved by the authority having jurisdiction where persons can be exempted from withdrawal.
- N 4.4.11.8.2.1** The operator's request shall address the location of seals in relation to the following:
- (1) Areas where persons work and travel in the mine
 - (2) Escapeways and potential for damage to the escapeways
 - (3) Ventilation systems and controls in areas where persons work or travel and where ventilation is used for escapeways
- N 4.4.11.8.2.2** The operator's request shall also address the gas concentration of other sampling locations in the sealed area and other required information.
- N 4.4.11.8.2.3** Before miners reenter the mine, the mine operator shall have a ventilation plan revision approved by the authority having jurisdiction specifying the actions to be taken.
- N 4.4.11.9** In sealed areas with a demonstrated history of carbon dioxide or sealed areas where inert gases have been injected, the operator shall be permitted to request that the authority having jurisdiction approve in the ventilation plan an alternative method to determine whether the sealed atmosphere is inert and when miners have to be withdrawn.
- N 4.4.11.9.1** The mine operator shall address the following in the ventilation plan:
- (1) Specific levels of methane, carbon dioxide, nitrogen, and oxygen
 - (2) Sampling methods and equipment used
 - (3) Methods to evaluate these concentrations underground at the seal

N 4.4.12 Methane Monitors.

N 4.4.12.1 MSHA-approved methane monitors shall be installed on all face-cutting machines, continuous miners, longwall face equipment, loading machines, and other mechanized equipment used to extract or load coal within the working place.

N 4.4.12.1.1 The sensing device for methane monitors on longwall-shearing machines shall be installed at the return air end of the longwall face.

N 4.4.12.1.2 An additional sensing device shall be installed on the longwall-shearing machine, downwind and as close to the cutting head as practicable.

N 4.4.12.1.3 An alternative location or locations for the sensing device required on the longwall-shearing machine shall be permitted in the ventilation plan.

N 4.4.12.1.4 The sensing devices of methane monitors shall be installed as close to the working face as practicable.

N 4.4.12.1.5 Methane monitors shall be maintained in permissible and proper operating condition.

N 4.4.12.1.6 Methane monitors shall be calibrated with a known air-methane mixture at least once every 31 days.

N 4.4.12.1.6.1 To ensure that methane monitors are properly maintained and calibrated, the operator shall comply with the following:

- (1) Use persons properly trained in the maintenance, calibration, and permissibility of methane monitors to calibrate and maintain the devices
- (2) Maintain a record of all calibration tests of methane monitors
- (3) Retain the record of calibration tests for 1 year from the date of the test

N 4.4.12.1.6.2 Records shall be maintained in a secure book that is not susceptible to alteration or electronically in a computer system to be secure and not susceptible to alteration.

N 4.4.12.1.6.3 Records shall be retained at a surface location at the mine and made available for inspection by the authority having jurisdiction.

N 4.4.12.2 When the methane concentration at any methane monitor reaches 1.0 percent, the monitor shall give a warning signal.

N 4.4.12.2.1 The warning signal device of the methane monitor shall be visible to a person who can deenergize electric equipment or shut down diesel-powered equipment on which the monitor is mounted.

N 4.4.12.3 The methane monitor shall automatically deenergize electric equipment or shut down diesel-powered equipment on which it is mounted when any of the following occur:

- (1) The methane concentration at any methane monitor reaches 2.0 percent.
- (2) The monitor is not operating properly.

N 4.4.13 Belt Air Course Ventilation.

N 4.4.13.1 The belt air course shall not be used as a return air course.

N 4.4.13.2 The belt air course shall not be used to provide air to working sections or to areas where mechanized mining equipment is being installed or removed.

N 4.4.13.2.1 The belt air course shall be separated with permanent ventilation controls from return air courses and from other intake air courses.

N 4.4.13.2.2 Air velocities shall be compatible with all fire detection systems and fire suppression systems used in the belt entry.

N 4.4.13.3 Air from a belt air course shall be permitted to be used to ventilate a working section or an area where mechanized mining equipment is being installed or removed, provided the following additional requirements are met:

- (1) The belt entry shall be equipped with an atmospheric monitoring system (AMS) that is installed, operated, examined, and maintained as specified in 4.4.14.
- (2) All miners shall be trained annually in the basic operating principles of the AMS, including the actions required in the event of activation of any AMS alert or alarm signal.
- (3) This training shall be conducted prior to working underground in a mine that uses belt air to ventilate working sections or areas where mechanized mining equipment is installed or removed.
- (4) This training shall be conducted as part of a miner's new miner training, experienced miner training, or annual refresher training.

N 4.4.13.4 The primary escapeway shall be monitored for carbon monoxide or smoke.

N 4.4.13.5 The area of the mine with a belt air course shall be developed with three or more entries.

N 4.4.13.6 No more than 50 percent of the total intake air, delivered to the working section or to areas where mechanized mining equipment is being installed or removed, shall be permitted to be supplied from the belt air course.

N 4.4.13.6.1 The locations for measuring these air quantities shall be approved in the mine ventilation plan.

N 4.4.13.7 Additional intake air shall be permitted to be added to the belt air course through a point-feed regulator.

N 4.4.13.7.1 The location and use of point-feed regulators shall be approved in the mine ventilation plan.

N 4.4.13.7.2 If the air through the point-feed regulator enters a belt air course that is used to ventilate a working section or an area where mechanized mining equipment is being installed or removed, the following conditions shall be met:

- (1) The air current that will pass through the point-feed regulator shall be monitored for carbon monoxide or smoke at a point within 15.2 m (50 ft) upwind of the point-feed regulator.
- (2) The air in the belt air course shall be monitored for carbon monoxide or smoke upwind of the point-feed regulator.
- (3) The sensor monitoring for carbon monoxide or smoke upwind of the point-feed regulator shall be in the belt air course within 15.2 m (50 ft) of the mixing point where air flowing through the point-feed regulator mixes with the belt air.

- (4) The point-feed regulator shall be provided with a means to close the regulator from the intake air course without requiring a person to enter the crosscut where the point-feed regulator is located.
- (5) The point-feed regulator shall also be provided with a means to close the regulator from a location in the belt air course immediately upwind of the crosscut containing the point-feed regulator.
- (6) A minimum air velocity of 1.52 m/s (300 ft/m) shall be maintained through the point-feed regulator.
- (7) The location(s) and use of a point-feed regulator(s) shall be approved in the mine ventilation plan and shown on the mine ventilation map.
- (8) An AMS shall be installed, operated, examined, and maintained as specified in 4.4.14.

N 4.4.14 Atmospheric Monitoring Systems (AMS).

N 4.4.14.1 AMS Operation. Whenever personnel are underground the AMS shall be operating.

N 4.4.14.2 A designated AMS operator shall be on duty at a location on the surface of the mine where audible and visual signals from the AMS can be seen or heard and the AMS operator can promptly respond to these signals.

N 4.4.14.3 Designated Surface Location and AMS Operator. When an AMS is used to comply with other provisions of this standard, the following requirements shall apply:

- (1) The mine operator shall designate a surface location at the mine where signals from the AMS will be received and two-way voice communication is maintained with each working section, with areas where mechanized mining equipment is being installed or removed, and with other areas designated in the approved emergency evacuation and firefighting program of instruction.
- (2) The mine operator shall designate an AMS operator to monitor and promptly respond to all AMS signals.

N 4.4.14.3.1 A map or schematic shall be provided at the designated surface location that shows the locations and type of AMS sensor at each location and the intended air flow direction at these locations.

N 4.4.14.3.1.1 The map or schematic shall be updated within 24 hours of any change in this information.

N 4.4.14.3.2 The names of the designated AMS operators and other appropriate personnel, including the designated person responsible for initiating an emergency mine evacuation and the method to contact these persons, shall be provided at the designated surface location.

N 4.4.14.4 Minimum Operating Requirements. AMSs used to comply with other provisions of this standard shall automatically provide the following:

- (1) Visual and audible signals at the designated surface location for any interruption of circuit continuity and any electrical malfunction of the system
- (2) Visual and audible alert signals at the designated surface location when the carbon monoxide concentration is 5 ppm above ambient levels or methane concentration at any sensor reaches the alert level of 1 percent
- (3) Visual and audible signals at the designated surface location distinguishable from alert signals when the carbon monoxide, smoke, or methane concentration at any sensor reaches the alarm level of 10 ppm above ambient

carbon monoxide, smoke optical density of 0.022 per meter, or 1.5 percent methane concentration

- (4) Visual and audible signals at all affected working sections and at all affected areas where mechanized mining equipment is being installed or removed when the carbon monoxide, smoke, or methane concentration at any sensor reaches the alarm level as specified in 30 CFR 75.351(i), "Atmospheric Monitoring Systems"
- (5) Visual and audible signals at other locations as specified in 30 CFR 75.1502, "Mine Emergency Evacuation and Firefighting Program of Instruction," when the carbon monoxide, smoke, or methane concentration at any sensor reaches the alarm level of 10 ppm above ambient carbon monoxide, smoke optical density of 0.022 per meter, or 1.5 percent methane concentration
- (6) The operational status of all sensors at the designated surface location
- (7) Visual and audible alarm signals at the designated surface location, at all affected working sections, and at all affected areas where mechanized mining equipment is being installed or removed when the carbon monoxide level at any two consecutive sensors alert at the same time

N 4.4.14.4.1 The signals in 4.4.14.4(1) through 4.4.14.4(3) and 4.4.14.4(7) shall be of sufficient magnitude to be seen or heard by the AMS operator.

N 4.4.14.4.2 The signals in 4.4.14.4(4), 4.4.14.4(5), and 4.4.14.4(7) shall be of sufficient magnitude to be seen or heard by miners working at these locations.

N 4.4.14.4.3 Methane alarms shall be distinguishable from other signals.

N 4.4.14.5 Location and Installation of AMS Sensors.

N 4.4.14.5.1 All AMS sensors shall be located such that measurements are representative of the mine atmosphere in these locations.

N 4.4.14.5.2 Carbon monoxide or smoke sensors shall be installed near the center in the upper third of the entry, in a location that does not expose personnel working on the system to unsafe conditions.

N 4.4.14.5.2.1 Sensors shall not be located in abnormally high areas or in other locations where air flow patterns do not permit products of combustion to be carried to the sensors.

N 4.4.14.5.3 Methane sensors shall be installed near the center of the entry, at least 305 mm (12 in.) from the roof, ribs, and floor, in a location that would not expose personnel working on the system to unsafe conditions.

N 4.4.14.5.4 Location of Sensors — Belt Air Course. In addition to the requirements of 4.4.14.5.1 thru 4.4.14.5.3, any AMS used to monitor belt air courses shall have sensors to monitor for carbon monoxide or smoke at the following locations:

- (1)* At or near the working section belt tailpiece in the air stream ventilating the belt entry
- (2) Upwind, a distance no greater than 15.2 m (50 ft) from the point where the belt air course is combined with another air course or splits into multiple air courses
- (3)* At intervals not to exceed 304.8 m (1000 ft) along each belt entry in areas where air velocities are maintained at 15.2 m (50 ft/m) or higher

- (4)* Not more than 30.5 m (100 ft) downwind of each belt drive unit, each tailpiece transfer point, and each belt take-up
- (5) At other locations in any entry that is part of the belt air course as required and specified in the mine ventilation plan

N 4.4.14.5.5 Locations of Sensors — the Primary Escapeway.

When used to monitor the primary escapeway, carbon monoxide or smoke sensors shall be located in the primary escapeway within 152.4 m (500 ft) of the working section and areas where mechanized mining equipment is being installed or removed.

N 4.4.14.5.5.1 In addition, another sensor shall be located within 152.4 m (500 ft) in by the beginning of the panel.

N 4.4.14.5.5.2 The point-feed sensor shall be permitted to be used as the sensor at the beginning of the panel if it is located within 152.4 m (500 ft) in by the beginning of the panel.

N 4.4.14.5.6 Location of Sensors — Return Air Splits. If used to monitor return air splits, a methane sensor shall be installed in the return air split between the last working place, longwall or shortwall face ventilated by that air split, and the junction of the return air split with another air split, seal, or worked-out area.

N 4.4.14.5.6.1 If used to monitor a return air split, the methane sensors shall be installed at the following locations:

- (1) In the return air course opposite the section loading point or, if exhausting auxiliary fan(s) are used, in the return air course no closer than 91.4 m (300 ft) downwind from the fan exhaust and at a point opposite or immediately outby the section loading point
- (2) Immediately upwind from the location where the return air split meets another air split or immediately upwind of the location where an air split is used to ventilate seals or worked-out areas

N 4.4.14.5.7 Location of Sensors — Electrical Installations.

When monitoring the intake air ventilating underground transformer stations, battery-charging stations, substations, rectifiers, or water pumps, at least one sensor shall be installed to monitor the mine atmosphere for carbon monoxide or smoke.

N 4.4.14.5.7.1 The sensor shall be located downwind.

N 4.4.14.5.7.2 The sensor shall be located not more than 15.2 m (50 ft) from the electrical installation being monitored.

N 4.4.14.6 Establishing Alert and Alarm Levels. An AMS shall initiate alert and alarm signals at the specified levels, as follows:

- (1) Alarm at 1.5 percent methane for split ventilation
- (2)* Alert at 5 ppm carbon monoxide above the ambient level and alarm at 10 ppm carbon monoxide above the ambient level when carbon monoxide sensors are used; and alarm at a smoke optical density of 0.022 per meter when smoke sensors are used
- (3) In the return split of air, alert at 1.0 percent methane and alarm at 1.5 percent methane

N 4.4.14.6.1 Establishing Carbon Monoxide Ambient Levels. Carbon monoxide ambient levels and the means to determine these levels shall be approved in the mine ventilation plan.

N 4.4.14.6.2 Installation and Maintenance. An AMS shall be installed and maintained by personnel trained in the installation and maintenance of the system.

N 4.4.14.6.3 Operating Condition Maintenance. The system shall be maintained in proper operating condition.

N 4.4.14.6.4 Sensors. Sensors used to monitor for carbon monoxide, methane, and smoke shall be either of a type listed and installed in accordance with the recommendations of a nationally recognized testing laboratory or approved by the authority having jurisdiction.

N 4.4.14.6.5 Time Delays. Where a demonstrated need exists, time delays shall be permitted to be incorporated in the AMS.

N 4.4.14.6.5.1 These time delays shall only be used to account for non-fire-related carbon monoxide alert and alarm sensor signals.

N 4.4.14.6.5.2 These time delays shall be limited to no more than 3 minutes.

N 4.4.14.6.5.3 The use and length of any time delays, or other techniques or methods that eliminate or reduce the need for time delays, shall be specified and approved in the mine ventilation plan.

N 4.4.14.6.6 Examination, Testing, and Calibration. At least once each shift when belts are operated as part of a production shift, sensors used to detect carbon monoxide or smoke in and alarms shall be visually examined.

N 4.4.14.6.6.1 At least once every seven days, alarms for AMS shall be functionally tested for proper operation.

N 4.4.14.6.6.2 At intervals not to exceed 31 days, the following shall be accomplished:

- (1) Each carbon monoxide sensor shall be calibrated in accordance with the manufacturer's calibration specifications.
- (2) Each smoke sensor shall be functionally tested in accordance with the manufacturer's calibration specifications.
- (3) Each methane sensor shall be calibrated in accordance with the manufacturer's calibration specifications.
- (4) If the alert or alarm signals will be activated during calibration of sensors, the AMS operator shall be notified prior to and upon completion of calibration.
- (5) The AMS operator shall notify miners on affected working sections, areas where mechanized mining equipment is being installed or removed, or other areas designated in the approved emergency evacuation and firefighting program of instruction when calibration will activate alarms and when calibration is completed.
- (6) Calibration shall be done with a known concentration of carbon monoxide in air sufficient to activate the alarm.

N 4.4.14.6.6.3 Recordkeeping. Where an AMS is used, individuals designated by the operator shall maintain records recording the time and location of the alarm, or the time and date of a malfunctioning alarm, by the end of the shift.

N 4.4.14.6.6.4 Retention Period. Records shall be retained for at least one year at a surface location at the mine and made available for inspection by the authority having jurisdiction.

N 4.4.14.6.6.5 Training. All AMS operators shall be trained annually in the proper operation of the AMS.

N (A) A record of the content of training, the person conducting the training, and the date the training was conducted shall be maintained at the mine for at least one year by the mine operator.

N (B) Where an AMS is used, a two-way voice communication system shall be installed in an entry that is separate from the entry in which the AMS is installed.

N 4.4.14.7 Actions in Response to AMS Malfunction, Alert, or Alarm Signals.

N 4.4.14.7.1 When a malfunction, alert, or alarm signal is received at the designated surface location, the sensor(s) that are activated shall be identified and the AMS operator shall promptly notify appropriate personnel.

N 4.4.14.7.2 Upon notification of a malfunction, alert, or alarm signal, appropriate personnel shall promptly initiate an investigation to determine the cause of the signal.

N 4.4.14.7.3 If any sensor indicates an alarm or if any two consecutive sensors indicate alert at the same time, the following procedures shall be followed unless the cause of the signal is known not to be a hazard to miners:

- (1) Appropriate personnel shall notify miners in affected working sections, in affected areas where mechanized mining equipment is being installed or removed, and at other locations specified in the emergency response plan.
- (2) All personnel in the affected areas, unless assigned other duties per the mine rescue plan, shall be withdrawn promptly to a safe location identified in the mine emergency evacuation and firefighting program of instruction.

N 4.4.14.7.4 If there is an alert or alarm signal from a methane sensor, an investigation shall be initiated to determine the cause of the signal, and the actions required under the mine rescue plan shall be taken.

N 4.4.14.7.5 If any fire detection components of the AMS malfunction or are inoperative, immediate action shall be taken to return the system to proper operation.

N 4.4.14.7.6 While the AMS component repairs are being made, operation of the belt shall be permitted to continue if the following conditions are met:

- (1) If one AMS sensor malfunctions or becomes inoperative, a trained person shall continuously monitor for carbon monoxide or smoke at the inoperative sensor.
- (2) If two or more adjacent AMS sensors malfunction or become inoperative, a trained person(s) shall patrol and continuously monitor for carbon monoxide or smoke so that the affected areas will be traveled each hour in their entirety, or a trained person shall be stationed to monitor at each inoperative sensor.
- (3) If the complete AMS malfunctions or becomes inoperative, trained persons shall patrol and continuously monitor for carbon monoxide or smoke so that the affected areas will be traveled each hour in their entirety.
- (4) The trained person(s) monitoring under this section shall have two-way voice communication capabilities with the AMS operator at intervals not to exceed 609.6 m (2000 ft) and report contaminant levels to the AMS operator at intervals not to exceed 60 minutes.
- (5) The trained person(s) monitoring under this section shall report immediately to the AMS operator any concentration of the contaminant that reaches either the alert or alarm level specified in 4.4.14.6, or the alternate alert and alarm levels specified in the mine ventilation plan, unless the source of the contaminant is known not to present a hazard.

(6) For those AMSs using sensors other than carbon monoxide sensors, an alternate detector and the alert and alarm levels associated with that detector shall be specified in the approved mine ventilation plan.

N 4.4.14.7.7 If the 0.25 m/s (50 ft/m) minimum air velocity is not maintained when required, immediate action shall be taken to return the ventilation system to proper operation.

N 4.4.14.7.7.1 While the ventilation system is being corrected, operation of the belt shall be permitted to continue only while a trained person(s) patrols and continuously monitors for carbon monoxide or smoke, so that the affected areas will be traveled each hour in their entirety.

N 4.4.15* Rock Dusting. All underground areas of a coal mine, except those areas in which the dust is too wet or too high in incombustible content to propagate an explosion, shall be rock dusted to within 12.2 m (40 ft) of all working faces unless such areas are inaccessible or unsafe to enter or unless the AHJ permits an exception upon his finding that such exception will not pose a hazard to the miners.

N 4.4.15.1 All crosscuts that are less than 12.2 m (40 ft) from a working face shall also be rock dusted.

N 4.4.15.2 Where rock dust is required to be applied, it shall be distributed upon the top, floor, and sides of all underground areas of a coal mine and maintained in such quantities that the incombustible content of the combined coal dust, rock dust, and other dust shall be not less than 80 percent.

N 4.4.15.2.1 Where methane is present in any ventilating current, the percent of incombustible content of such combined dusts shall be increased 0.4 per centum for each 0.1 percent of methane.

N 4.4.15.2.2 Moisture contained in the combined coal dust, rock dust, and other dusts shall be considered as a part of the incombustible content of such mixture.

N 4.4.15.3 Exemption of Anthracite Mines. Subsection 4.4.15 shall not apply to underground anthracite mines.

N 4.4.16 Gas Drainage for Reduction of Methane Before Mining. (Reserved)

Chapter 5 Surface Mining Operations

5.1 General. This chapter shall cover surface bituminous and subbituminous coal and lignite mining operations.

5.2* Fire Prevention. Risk reduction practices shall follow the principles of minimizing ignition sources and reducing exposure of combustible materials to ignition sources.

5.2.1 Housekeeping.

5.2.1.1 Spills, leaks, excess lubricants, and combustible materials such as oil-soaked wastes, rubbish, and accumulations of environmental debris shall not be allowed to accumulate in quantities that could create a fire hazard.

5.2.1.2 Approved metal receptacles shall be provided where oil-soaked wastes or rubbish are not immediately removed to a safe place for disposal.

5.2.1.3 The storage and handling of ignitable (flammable or combustible) liquids on or within equipment shall be in accordance with NFPA 30.

5.2.1.4 Access to fire protection equipment on mining equipment shall be kept clear of obstructions.

5.2.2 Inspection and Maintenance of Equipment. Hydraulic, coolant, lubrication and fuel lines, and electrical wiring shall be inspected and maintained in accordance with the manufacturers' recommendations.

5.2.3 Ignitable (Flammable and Combustible) Liquid Storage on Equipment and in Buildings. Ignitable (flammable and combustible) liquid storage and usage shall be in accordance with Sections 7.3 and 7.4.

5.2.4 Compressed Gas Storage and Usage. Compressed gas storage and usage shall be in accordance with Section 7.1.

5.3 Fire Protection.

5.3.1 Fire protection for the purposes of this standard shall be defined in the broad sense to include fire detection and fire suppression.

5.3.2* Fire suppression system types shall include dry chemical, wet chemical, gaseous, water mist, foam, and sprinkler.

5.3.3 Fire suppression systems and fire alarm systems shall be installed in accordance with applicable NFPA standards.

5.3.3.1 Fire suppression systems shall be tested and maintained in accordance with the appropriate NFPA standard.

5.3.3.2 Water Supplies. Fire suppression water supply shall be of sufficient quantity to extinguish the largest anticipated fire. This shall be accomplished with water trucks in pit areas or fire hydrants in coal processing areas.

5.3.4 Fire Extinguishers for Equipment.

5.3.4.1* A 9.1 kg (20 lb) ABC-type fire extinguisher shall be provided at intervals not to exceed 15.2 m (50 ft) travel distance, including the lower frame areas of draglines.

5.3.4.2 The fire-extinguishing agent applied by hand-portable extinguishers to hazards involving energized electrical equipment shall be nonconductive.

5.3.4.3 Portable extinguishers shall be maintained in accordance with NFPA 10 and kept in their designated places at all times.

5.3.4.4 Extinguishers shall be located on each vehicle and shall be accessible.

5.3.4.5 In areas where obstruction to visual observation cannot be completely avoided, visible markings shall be provided to indicate the location of the fire extinguishers.

5.3.4.6 Extinguishers installed under conditions where they can be subject to physical damage shall be guarded to protect against damage.

5.3.4.7 The installation of an automatic or manually operated fire suppression system shall not eliminate the portable fire extinguisher requirement.

5.3.4.8 Portable fire extinguishers shall be inspected, maintained, and recharged as specified in Chapter 7 of NFPA 10 and the following:

- (1) Portable fire extinguishers shall be inspected visually at least monthly.

- (2) The visual inspection shall ensure the following:

- (a) The extinguisher is in its designated place.
- (b) The tamper seals are intact.
- (c) The extinguisher gauge is in the operable range (if the extinguisher is the stored-pressure type).
- (d) There is no obvious physical damage or condition that will prevent proper operation.

- (3) Extinguishers found to be defective or deficient by visual inspection shall be replaced.

- (4) Extinguishers shall be subjected to a maintenance examination at least once every year.

- (5) Maintenance procedures shall include a thorough examination of the extinguishers, including mechanical parts, extinguishing agent, and expellant.

- (6) Any troubles or impairments shall be corrected.

- (7) All extinguishers shall be recharged after use in accordance with the manufacturer's recommendations.

- (8)* Each extinguisher shall have a permanent tag attached on which the inspection date shall be recorded.

5.3.4.9 Portable extinguishers shall be tested hydrostatically at intervals not exceeding those specified in Chapter 8 of NFPA 10.

5.3.5 Draglines, Electric Shovels, Highwall Miners, and Hydraulic/Electric Excavators.

5.3.5.1 Center Pin/Collector Ring Area.

5.3.5.1.1 An automatic fire suppression system shall be installed in the center pin/collector ring area of the dragline. If an electrical spark cannot communicate from the collector ring (e.g., a sealed ring) to the grease around the center pin, a fire suppression system is not required.

5.3.5.1.2 An automatic fire suppression system shall be installed in the ring gear area of shovels.

5.3.5.1.3 Suppression system alarms shall be transmitted to the operator's cab. An audible and visual alarm shall be provided.

5.3.5.1.4 A manual actuator shall be provided just outside the center pin/collector ring area.

5.3.5.2 Hydraulics.

5.3.5.2.1 An automatic fire suppression system shall be installed to protect the hydraulic pump(s), hydraulic control valves, associated lines and equipment in the hydraulic pump area, and other areas to which fires can propagate.

5.3.5.2.2* The system shall send audible and visual alarms to the operator's cab.

5.3.5.2.3 A manual actuator shall be located just outside the hydraulic compartment area.

5.3.5.3 Lube Oil Pumping and Storage.

5.3.5.3.1* Automatic lube oil systems that are located in a segregated room shall be provided with an automatic fire suppression system.

5.3.5.3.2 The system shall send an audible and visual alarm to the operator's cab.

5.3.5.3.3 A manual actuator shall be located just outside the lube oil room.

5.3.5.3.4 Lube oil rooms shall have automatic door closers or shall have the door interlocked to shut upon actuation of the fire suppression system.

5.3.5.4 Transformers.

5.3.5.4.1 Oil-filled transformers located in the tail section, enclosed rooms, or other inaccessible locations shall be provided with an automatic fire suppression system.

5.3.5.4.1.1 The system shall transmit an audible and visual alarm to the operator's cab.

5.3.5.4.1.2 A manual actuator shall be located just outside the transformer area.

5.3.5.4.2* Transformers located in areas other than those listed in 5.3.5.4.1 shall be protected with a Class BC, minimum 45.4 kg (100 lb), fire extinguisher.

5.3.5.4.3 Oil analysis, including dissolved gas, shall be conducted on combustible oil-filled transformers based upon manufacturer's recommendations or ANSI/NETA MTS, *Standard for Maintenance Testing Specifications for Electrical Power Distribution Equipment and Systems*, whichever is more stringent.

5.3.5.4.4 Thermographic scanning shall be performed on transformers at least annually.

5.3.5.5 Electrical Room or Cabinet.

5.3.5.5.1 Enclosed electrical rooms shall be protected with a total flooding gaseous extinguishing agent or equivalent fire suppression system.

5.3.5.5.1.1 The system shall be installed in accordance with NFPA 2001 or other applicable NFPA standards.

5.3.5.5.1.2 The system shall be actuated by a smoke, ultraviolet/infrared (UV/IR), or heat detector system and send an audible and visual alarm to the operator's cab.

5.3.5.5.1.3 The ventilation system shall be interlocked to the gaseous extinguishing system to shut down upon first detection.

5.3.5.5.1.4 The room shall be sealed to maintain the design gaseous extinguishing concentration.

5.3.5.5.1.5 Pre-discharge alarms shall be provided in rooms provided with automatic suppression systems.

5.3.5.5.2 Electrical rooms shall be maintained at a positive pressure to reduce the chances of dust entering the room.

5.3.5.5.3 Electrical cabinets shall be protected with a gaseous fire suppression system or equivalent fire protection system.

5.3.5.5.3.1 The system shall be installed in accordance with NFPA 2001 or other applicable NFPA standards.

5.3.5.5.3.2 The system shall be actuated by a smoke, UV/IR, or heat detector system and send an audible and visual alarm to the operator's cab.

5.3.5.5.4* Thermographic scanning shall be performed on the electrical switchgear and motor starters at least annually.

5.3.5.5.5 Diesel generators for highwall miners shall be provided with an automatic fire suppression system that includes an audible and visual alarm on the exterior of the generator enclosure.

5.3.5.6 Manual Extinguishing Equipment.

5.3.5.6.1 Minimum 45.4 kg (100 lb) A:B:C-type extinguishers shall be accessible to persons on the main deck of the dragline.

5.3.5.6.2 The location and number of extinguishers shall be determined by what is practical for the machine.

5.3.6 Hydraulic/Diesel Excavators.

5.3.6.1 An automatic fire suppression system shall be provided to protect the engine compartment, hydraulic pumps, and associated equipment.

5.3.6.1.1 For hydraulic systems above 567.8 L (150 gal) in the lines, a dual agent system shall be provided.

5.3.6.1.2 A manual actuator shall be located in the operator's cab and at the means of egress from the machine.

5.3.6.2 The machine shall be interlocked to shut down upon discharge of the extinguishing system.

5.3.6.3 A means shall be provided to automatically relieve the hydraulic pressure upon discharge of the extinguishing system.

5.3.6.4 Adequate fire resistance shielding shall be provided between the hydraulic hoses and the turbocharger and engine manifold to prevent hydraulic fluid from being sprayed on hot mechanical parts.

5.3.6.5 The fire detection electrical wiring within fire hazard areas, such as battery compartments, engine compartments, and so forth, shall be outfitted with a fire-resistant sleeve.

5.3.6.6* Fire-suppression system manual actuation lines shall not be routed near high heated surfaces and shall not be routed within fire hazard areas unless fitted with fire-resistant sleeves.

5.3.7 Mobile Equipment.

5.3.7.1 Fire Protection. Portable extinguishers installed on mobile mining equipment, including but not limited to mobile generators and compressors, shall have a minimum rating of 2-A:10-B:C and a nominal capacity of 2.3 kg (5 lb) of extinguishing agent.

5.3.8 Self-Propelled Equipment.

5.3.8.1 Portable Fire Extinguishers.

5.3.8.1.1* All self-propelled surface mining equipment, including but not limited to bulldozers, front-end loaders, haulage trucks, cranes, graders, scrapers, draglines, drills, shovels, and diesel and electrical equipment, shall be equipped with at least one listed portable, multipurpose (ABC), dry chemical extinguisher having a nominal capacity of 4.5 kg (10 lb) of agent or greater.

5.3.8.1.2 Portable extinguishers installed on small units of self-propelled mining equipment, including but not limited to miniature loaders and individual personnel transports, shall have a minimum rating of 2-A:10-B:C and a nominal capacity of 2.3 kg (5 lb) of extinguishing agent.

5.3.8.2 Fire Detection.

5.3.8.2.1 Fire detectors shall be permitted to be used to initiate audible or visual warning, automatic actuation of a fire suppression system, or equipment shutdown.

5.3.8.2.2 Fire detectors shall be tested and listed for the application.

5.3.8.2.2.1 If fire detectors are used with a pre-engineered fire suppression system then they shall be included in the fire suppression system listing.

5.3.8.2.3 Compartment sizes and contours, airflow patterns, obstructions, and other characteristics of the protected area shall determine the placement, type, sensitivity, durability, and, where applicable, number of detectors.

5.3.8.2.4 All fire detection systems and applicable equipment shall be tested after installation in accordance with *NFPA 72* and fire suppression systems standards.

5.3.8.2.4.1 It shall not be necessary for testing to require the discharge of any associated fire suppression system.

5.3.8.2.5* At least every 6 months, all fire detection systems, including alarms, shutdowns, and other associated equipment, shall be thoroughly examined and checked for proper operation in accordance with the manufacturer's recommendations.

5.3.8.2.5.1 Any equipment found deficient shall be repaired or replaced, and the system retested for operation in accordance with the manufacturer's instructions.

5.3.8.2.6 Between the maintenance examinations or tests, the detection system shall be inspected visually, in accordance with an approved schedule necessitated by conditions as determined by the mine operator.

5.3.8.3 Fixed Suppression Systems.

5.3.8.3.1 Haul trucks with a capacity of over 77 metric tons (85 tons) shall have a fixed fire suppression system protecting the engine compartment and hydraulic pump and other hazard areas.

5.3.8.3.2* Other large mining equipment such as but not limited to dozers, endloaders, drills, graders, and scrapers shall have a fixed fire suppression system protecting the engine compartment and hydraulic pump and other hazard areas.

5.3.8.3.3 Self-propelled equipment with a hydraulic system that exceeds 568 L (150 gal) in the lines shall be provided with a dual-agent fire suppression system.

5.3.8.3.4 Mining equipment requiring a fire suppression system shall be protected by a system to suppress potential fires in the protected areas and shall comply with the following:

- (1) The fire suppression system shall be listed or approved for the purpose.
- (2) Where installed, the equipment shall be located or guarded so as to be protected against physical damage.
- (3) Fire suppression systems shall be automatically actuated.
- (4)* Automatically actuated systems shall also have a manual actuator capable of being activated from the operator's compartment or other location.
- (5) Agent distribution hose or pipe shall be secured and protected against damage, including abrasion and corrosion.
- (6) Except for automatic sprinkler systems, discharge nozzles shall be protected against entrance of environmental debris, including moisture, dust, dirt, or insects, by blow-off caps or other similar devices or materials.
- (7) Except for automatic sprinkler systems, the nozzle cover shall open or blow off upon discharge of the system.

(8) The automatic fire suppression system shall be installed so that system actuation causes shutdown of the protected equipment.

(9) Up to a 30-second delay shall be included in the design of the interlock system for the operator to maintain control of the equipment.

5.3.8.3.5 A standby source of power shall be provided where electrical power is the only means of fire suppression system actuation.

5.3.8.3.6 All fire suppression equipment and systems shall be tested after installation in accordance with the manufacturer's or designer's recommendations.

5.3.8.3.6.1 Testing shall not require the discharge of suppressant unless there is no other manner in which the reliability and integrity of the system can be verified.

5.3.8.3.7 An installation-and-maintenance or owner's manual that describes system operation and maintenance requirements shall be provided for all fire suppression equipment.

5.3.8.3.8* In accordance with the manufacturers' or designers' recommended inspection and maintenance procedures and schedules, but not to exceed every 6 months, all fire suppression systems, including alarms, shutdowns, and other associated equipment, shall be thoroughly examined and checked for proper operation by trained and competent personnel.

5.3.8.3.8.1 Any equipment found deficient shall be repaired or replaced, and the system retested for proper operation.

5.3.8.3.8.2 Between regular maintenance examinations or tests, the system shall be inspected visually, in accordance with the manufacturer's or designer's recommended schedule.

5.3.8.3.8.3 Testing shall be in accordance with the applicable NFPA standards.

5.3.8.3.9 Fire suppression systems shall be maintained in operating condition at all times.

5.3.8.3.10 Use, impairment, and restoration of the system shall be reported to the mine operator.

5.3.8.3.11 All persons who can be expected to inspect, test, maintain, or operate a fire suppression system shall be trained to perform their intended tasks.

5.3.8.3.12 Where inadvertent discharge of the fire suppression system during servicing could result in injury to personnel, provisions shall be made to safeguard against accidental actuation of the system.

5.3.8.3.13 All operators, supervisors, and maintenance personnel of self-propelled and mobile equipment shall be trained in the use of fire suppression equipment.

Chapter 6 Coal Processing

6.1 General. This chapter covers coal preparation, crushing, screening, and drying.

6.1.1 Materials and Construction.

6.1.1.1 Coal mine surface buildings and structures, housing, and supporting coal-processing and coal-handling equipment shall be of noncombustible construction.

6.1.1.2 Dry coal screening, crushing, dry cleaning, and other operations producing coal dust shall be conducted in open structures to prevent the accumulation of dust concentration levels that can create explosion hazards.

6.1.1.2.1 Where open structures are impractical, enclosed buildings shall be provided with explosion venting in accordance with 6.2.3 and shall be located so as to minimize fire and explosion exposure to major buildings and equipment.

6.1.1.2.2 Location of the processes described in 6.1.1.2 in the main plant building shall be permitted, provided the dust-producing area is equipped with explosion venting in accordance with 6.2.3 and is separated from the remainder of the building by construction designed to withstand the pressure buildup from an explosion prior to pressure relief by means of explosion vents.

6.1.2 Coal Dust Control.

6.1.2.1 Dedusters.

6.1.2.1.1 All dedusting equipment shall be connected directly to a suction system capable of moving enough air to prevent the leakage of dust from the system.

6.1.2.1.2 The suction system shall discharge the dust-laden air by the shortest possible route to collectors outside the building.

6.1.2.2* Pneumatic Cleaners.

6.1.2.2.1 Dust-collecting systems with suction hoods at the cleaners, suction ducting that maintains at least a 20 m/sec (4000 ft/min) air velocity, and dust collectors having pressure release venting shall be installed.

6.1.2.2.2 Belt conveyor-type transfers and loading points associated with the cleaners shall be hooded similarly and connected to dust collectors.

6.1.3 Coal Storage. Coal storage facilities shall be in accordance with 9.5.2.

6.2 Fire and Explosion Prevention.

6.2.1 Electrical Classification of Hazard.

6.2.1.1 Plant areas of open construction where coal dust or any combustible gases liberated from the coal are dispersed to the open atmosphere shall be classified nonhazardous.

6.2.1.2 Plant areas isolated from the coal process, such as control rooms, electrical equipment rooms, or substations, that are provided with ventilation to prevent the accumulation of combustible gases or coal dust shall be classified nonhazardous.

6.2.1.3 Enclosed areas of processing plants where coal is wet to prevent particles from becoming airborne or where dry coal dust does not accumulate shall be classified nonhazardous.

6.2.1.4* Enclosed areas where the failure or malfunction of the ventilation would result in the accumulation of explosive concentrations of methane gas shall be designated as Class I, Division 2 locations in accordance with Article 500 of *NFPA 70*.

6.2.1.4.1* Electrical equipment approved as “permissible” by the Mine Safety and Health Administration (MSHA) shall be acceptable in locations classified Class I, Division 1.

6.2.1.5 Areas of a processing plant normally designated as Class I shall be permitted to be considered nonhazardous, provided the following conditions are met:

- (1) Ventilation to prevent an accumulation of an explosive or ignitable mixture of gases
- (2) Failsafe continuous methane monitoring designed to sound an alarm when the methane–air mixture reaches 20 percent of the lower explosive level (LEL) or 1 percent methane by volume
- (3) An interlock to stop the process equipment automatically when the methane–air mixture reaches 40 percent of the LEL or 2 percent methane by volume
- (4) An electrical system arranged so that when methane concentrations reach 40 percent of the LEL, all electrical circuits including control circuit conductors are de-energized
- (5) Any equipment that is needed to restore the plant to a methane–air mixture of less than 20 percent of the LEL or 1 percent methane by volume, such as lighting, ventilation, or sump pumps, installed in accordance with Class I, Division 1 requirements

6.2.1.6* Enclosed areas in which coal dust is not in suspension in explosive or ignitable quantities or in which coal dust might be present in explosive or ignitable quantities or might be in suspension in the air due to a malfunction shall be designated as Class II, Division 2 in accordance with Article 500 of *NFPA 70*.

6.2.1.7* The structure of a preparation plant shall be connected to a common electrical ground.

6.2.1.7.1 Any electrical equipment that is mounted on a concrete pad shall be grounded to the metal structure with a shunt.

6.2.1.7.2 Where the structure is nonmetallic, a separate grounding grid for equipment shall be provided.

6.2.1.8 Positive pressure shall be maintained in process control rooms to prevent the entry of fugitive dust.

6.2.1.9 Electrical Equipment Rooms. Positive pressure shall be maintained in electrical equipment rooms, such as switchgear rooms, motor control centers, and cable-spreading rooms, that have a potential for fugitive dust entry.

6.2.1.9.1 Thermographic scanning shall be performed on switchgear and motor starters on an annual basis.

6.2.1.10 Tools that are actuated by electrical power shall not be used in areas with explosive gases or dusts.

6.2.1.11 Transformers. Oil analysis, including dissolved gas, shall be conducted on combustible oil-filled transformers based upon manufacturer’s recommendations or ANSI/NETA MTS, *Standard for Maintenance Testing Specifications for Electrical Power Distribution Equipment and Systems*, whichever is more stringent.

6.2.1.12 A smoke detector system shall be provided in MCC rooms or other critical electrical rooms. The system shall be installed in accordance with *NFPA 72* and send an alarm to a constantly attended location.

6.2.2 Dust Collectors and Dust Removal Equipment.

6.2.2.1 Dust collectors or dust suppression systems using water-based sprays shall be used to reduce dust in suspension at coal transfer points.

6.2.2.2 Those areas in which combustible dust is or might be in suspension in the air continuously, intermittently, or periodically under normal operating conditions shall be provided with

a dust-collecting system or systems to collect such dust and prevent its discharge to the atmosphere.

6.2.2.2.1 All coal-handling equipment or machinery that produces dust shall be connected to a dust collector with ducts and hoods that are designed to provide suction volume and velocity to collect and transport all the dust produced.

6.2.2.2.2 Hoods, enclosures, and ducts shall be of noncombustible construction, designed and maintained in accordance with NFPA 91.

6.2.2.2.3 All dust collectors, other than those that are an integral part of dust-producing equipment, shall be located outside the working areas, preferably outside the building or in separate rooms that are vented to the outside.

6.2.2.3 When a plant or handling facility is planned, special consideration shall be given to the location of the dust-producing equipment with respect to the location of the dust collection devices to ensure that the connecting ducts will be as straight and as short as possible.

6.2.2.3.1* All dry dust collectors shall be of noncombustible construction, equipped with explosion doors or vents.

6.2.2.3.2 The entire dust-collecting system shall conform to NFPA 91.

6.2.2.4 In no case shall the design of the dust removal system be such that the dust is drawn through the fan before entering the collector. Fans shall be of noncombustible construction.

6.2.2.5* Ducts shall be designed to maintain a velocity of not less than 22.9 m/sec (4500 ft/min) to ensure the transport of both coarse and fine particles and to ensure re-entrainment if for any reason the particles should fall out before delivery to the dust collector (e.g., in the event of a power failure).

6.2.2.5.1 In bag-type dust collectors, the bags shall be constructed of antistatic, fire-resistant material and shall be provided with an electrical ground.

6.2.2.5.2 Dust collector hoppers shall be sloped at approximately 60 degrees to ensure material flow.

6.2.2.5.2.1 Zero-speed switches and high-level alarms shall be used to identify conditions that can lead to spontaneous combustion.

6.2.2.5.2.2 Hopper discharge valves or screw conveyors shall be provided to discharge the dust continually.

6.2.2.5.2.3 Hoppers shall not be used as storage bins.

6.2.2.5.3 Hood takeoffs shall have a minimum area of four times the area of the duct.

6.2.2.5.3.1 Ductwork also shall be supplied with blast gates and dampers for individual pickup volume adjustment.

6.2.3 Explosion Venting.

6.2.3.1* Explosion venting shall be provided in areas where coal dust might be present in explosive or ignitable quantities, such as in coal preparation plant buildings, and in sections of buildings housing screens, pneumatic coal-cleaning equipment, dryers, and other dust-producing machinery.

6.2.3.2 Ventilating hoods and exhaust ducts shall not be acceptable as explosion-venting devices unless they are

designed for a dual purpose and function to provide direct release of excess pressure to the outside.

6.2.3.3 Equipment vents or ducts used to direct the energy of an explosion in equipment to the outside of the building or a safe location shall be as short as possible and shall be designed to withstand the explosion pressure.

6.2.3.3.1 Vent closures, which might be necessary to permit proper functioning of equipment and to prevent the escape of dust during normal operation, shall be designed to open at the lowest possible increase in pressure or shall be of flexible or frangible materials that blow out or rupture to permit the release of explosion pressure.

6.2.4* Ignitable (Flammable and Combustible) Liquids and Liquefied Petroleum Gas. Ignitable (flammable and combustible) liquids and compressed gases shall be stored and used in accordance with Chapter 7.

6.2.5 Maintenance. The user shall have responsibility for establishing a maintenance program that ensures that equipment is in working order.

6.2.5.1 All coal-handling equipment and machinery shall be maintained in accordance with the manufacturers' recommendations.

6.2.6 Housekeeping. Provision shall be made for cleaning to prevent the accumulation of coal dust.

6.2.6.1 Combustible waste materials shall not be permitted to accumulate in locations where a fire or an explosion hazard can be created.

6.3* Preparation Plants and Crusher Buildings. This section shall apply to preparation plants, tipplers, crushers inside buildings, and crushers in belowgrade areas. Open air crushers do not pose a significant hazard and shall be excluded from the requirements of this section.

6.3.1 Building Construction.

6.3.1.1 Buildings and equipment shall be shaped, installed, or protected so as to minimize the surface area on which coal dust can accumulate.

6.3.1.2 Access for cleaning or washing down shall be provided.

6.3.1.3 Access platforms or walkways installed between floors shall be permitted to be open-grid construction to facilitate cleaning.

6.3.1.4 Walls or partitions isolating sections of the plant that contain dust-producing operations shall be constructed and installed to minimize the transmission of dust to adjacent areas.

6.3.1.5 To prevent the accumulation of dust on exposed wall or partition framing, metal siding or other equivalent material shall be installed on the side facing the dust-producing section.

6.3.1.6 Doors in the walls or partitions required by 6.3.1.4 shall be self-closing.

6.3.1.7 Drain systems shall be provided in areas where cleaning is accomplished by washing down.

6.3.1.8 Two remote means of egress shall be provided on each floor of the plant.

6.3.1.9 Emergency lighting shall be provided at the means of egress stairways in accordance with Section 7.9 of NFPA 101.

6.3.1.10* Emergency exit signs shall be provided at the means of egress stairways in accordance with Section 7.10 of NFPA 101.

6.3.1.11 If lightning protection is required, it shall be in accordance with NFPA 780.

6.3.1.12 Electrical Equipment. Transformers, switchgear, motor starters, and other electrical equipment shall be installed in accordance with NFPA 70.

6.3.1.12.1* Transformers located outside of the preparation plant shall be far enough away or provided with a fire barrier wall and containment or drainage to limit damage to the building if the transformer were on fire.

6.3.1.12.2* Combustible oil-filled transformers located inside the preparation plant shall be enclosed in a transformer vault constructed in accordance with NFPA 70.

6.3.1.12.3* Oil-filled transformers shall not be allowed on the roof of a preparation plant.

6.3.2 Fire Protection.

6.3.2.1 Portable Extinguishers.

6.3.2.1.1 Every building or room of a plant where combustible material is present or dry coal is processed or handled shall be provided with approved portable multipurpose fire extinguishers.

6.3.2.1.2 The number of approved portable extinguishers, their type, and their distribution shall be in accordance with NFPA 10 except that the smallest extinguisher shall have a nominal capacity of 9.1 kg (20 lb) of agent and a minimum rating of 10-A:60-B:C.

6.3.2.1.3 Extinguishers employing agents having a B:C rating shall be permitted to be used if the hazard is confined solely to electrical equipment.

6.3.2.2 Fixed Fire Protection Systems.

6.3.2.2.1* Where required by the authority having jurisdiction, fixed fire protection systems shall be provided and shall be designed in accordance with the appropriate NFPA standards, depending on the agent utilized.

6.3.2.2.1.1 Where a pre-engineered fire suppression system is used, it shall be designed and installed in accordance with the fire suppression system manufacturer's listed installation and maintenance manual.

6.3.2.2.2 Working plans for the fixed fire protection system shall be submitted for approval to the authority having jurisdiction.

6.3.2.2.3 Combustible hydraulic and lube oil systems that exceed 94.6 L (25 gal) and are located in below-grade areas shall be protected by an automatic fire suppression system.

6.3.2.3 Standpipe and Hose Systems.

6.3.2.3.1* Class III standpipe systems shall be provided in all coal preparation plants and crusher buildings in accordance with NFPA 14.

6.3.2.3.2 When automatic sprinkler systems are to be supplied through the standpipe system, hydraulic calculations shall be used to ensure that the piping and the water supply meet the hose and automatic sprinkler demands simultaneously.

6.3.2.3.3 Hose stations on or in conveyor galleries shall be provided with hoses that are of length equal to the distance between water supply connections.

6.3.2.3.4 Fire hose shall be provided in an accessible area in order to fight a fire involving spirals.

N 6.3.2.3.5* A means shall be provided to wash down conveyor systems within a structure to remove coal pieces and coal dust.

N 6.3.2.3.6 Vacuum systems, if used, shall be rated for Class II, Group F environments.

6.3.2.4 Water Supply.

6.3.2.4.1* Availability. An available supply of water shall be provided for fire protection systems and manual firefighting purposes.

6.3.2.4.2 Fire Mains. Where fire mains and hydrants are provided, the water supply system shall be installed and maintained in accordance with NFPA 24.

6.3.2.4.3 Other Water Supplies. Where public or private fire mains are not provided, alternative water supplies complying with NFPA 1142 shall be provided.

6.3.2.4.4* Capacity.

6.3.2.4.4.1 The water supply capacity shall be capable of providing the estimated water needed for firefighting purposes for a minimum duration of 2 hours.

6.3.2.4.4.2 Water pumps installed as part of a process water system and designed for the calculated flows and pressures required for firefighting shall be permitted to be used to supply fire mains.

6.3.2.5 Inspection and Maintenance of Fire Protection Equipment.

6.3.2.5.1 Portable extinguishers shall be maintained in accordance with NFPA 10.

6.3.2.5.1.1 Fire extinguishers shall be inspected on a 6-month basis.

6.3.2.5.2 Water-based fire protection systems shall be maintained in accordance with NFPA 25.

6.3.2.5.3 Any fire protection system, including sprinklers, installed in accordance with the requirements of this standard shall be maintained to provide assurance that the system will operate.

6.3.2.5.4 All persons who inspect, test, or maintain fixed fire protection systems shall be trained in accordance with the appropriate NFPA standards and the manufacturers' specifications.

6.3.2.6 Surveillance.

6.3.2.6.1 Periodic surveillance for fire hazards shall be conducted when the plant, or any part thereof, is not in operation or not constantly attended.

6.3.2.6.2 Frequency of surveillance shall be dependent on the type of coal product involved and its susceptibility to self-heating and other site conditions.

6.3.2.6.3* Smoke detectors shall be provided in electrical equipment rooms.

6.3.2.6.3.1 Fire alarm systems shall be installed in accordance with *NFPA 72*.

6.3.2.6.3.2 Audio and visual notification alarms shall be provided in the area, and the signal shall be transmitted to a constantly attended location.

6.4 Dryers.

6.4.1* General.

6.4.1.1 Thermal coal-drying systems shall be located at least 30.5 m (100 ft) from any underground coal mine opening.

6.4.1.2 Dryers that have been idle for more than 30 days or shut down because of a fire or any other emergency condition during normal operation shall be checked to ensure that there is no burning material within the system before being placed back in service.

6.4.2 Loss Prevention Design Features. Dryer heating units that are fired by pulverized coal shall be installed, operated, and maintained in accordance with *NFPA 85*.

6.4.2.1 Dryers of the direct-fired type shall be designed and operated so that combustion is complete as possible within the furnace/air heater before the gases of combustion come in direct contact with the coal drying in the drying chamber.

6.4.2.2 Dryers shall be designed and constructed to be dust-tight, with smooth surfaces to prevent the accumulation of coal.

6.4.2.3 Where coal can be exposed to excessive heat on normal or emergency shutdown, a bypass stack with an automatically controlled damper shall be installed to direct the products of combustion away from the coal.

6.4.2.4 Thermal dryer systems that have a hot gas inlet or plenum chambers where fly ash or coal siftings might accumulate shall be equipped with drop-out doors or ports to facilitate removal of these solids.

6.4.2.4.1 Where continuous means of removing drop-out solids are not provided, checking and manual clean-out shall be provided as conditions warrant.

6.4.2.5* All internal areas of thermal coal dryers where coal solids could possibly hang up or accumulate under any abnormal operating condition, such as in the drying chamber or dry cyclone collector, shall be equipped with explosion relief vents that open directly to the outside atmosphere.

6.4.2.5.1 These explosion relief vents shall be of the quantity, size, and location to operate in excess of the design normal pressure.

6.4.2.5.2 Explosion vents shall be checked or tested at least once each month, and records kept to verify these checks.

6.4.2.5.3 Explosion vents shall be directed away from personnel work areas and walkways.

6.4.2.6 During system operation, visual checks shall be made of all the mechanical components and equipment associated with the drying system as conditions warrant.

6.4.2.7* Indirect heat exchange-type dryers, such as thermal disk processors, shall be given special consideration in the design of fire protection for the dryer and dryer building.

6.4.3 Instrumentation and Control.

6.4.3.1 Instrumentation and control panels on thermal dryers shall be located in an area relatively free of moisture, vibration, dust, and noise.

6.4.3.2 The panel shall be located within the range and view of the supervising operator.

6.4.3.3 The operator control room shall be provided with windows or other means, such as video cameras, that give visual contact with the thermal drying system.

6.4.3.4 The panel shall include recording-type control instruments, monitoring indicators, alarms, and temperature limits set to maintain normal operation.

6.4.3.5 Audible and visual alarms shall be interlocked electrically to provide shutdown of the drier when temperatures are exceeded or other emergency malfunctions occur.

6.4.3.6 Control instruments shall be checked and serviced by a technician at least every 3 months.

6.4.3.7 Where pneumatic controls are used, instrument quality air shall be provided.

6.4.3.8 A schematic diagram showing the locations of thermocouples, pressure taps, and other controls shall be posted at the control panel.

6.4.3.9 Written procedures, including start-up, normal shutdown, and emergency shutdown procedures, shall be provided and posted at the control panel.

6.4.3.10 All main fans shall be inspected and shall have bearing temperature and vibration detectors.

6.4.3.11 Coal feed bins shall have low-level alarms.

6.4.4 Fire Protection for Drying Chambers. Drying chambers shall be protected by an automatic water spray system.

6.4.4.1 The automatic spray system shall include a manual control.

6.4.4.2 The source for the fire protection water shall be such that the required volume flow rate and pressure of clean (solid-free) water are available at all times and that the exposed piping is protected against freezing.

6.4.5* Explosion Venting.

6.4.5.1 Buildings shall be provided with explosion venting in accordance with *NFPA 69* and shall be located to minimize fire and explosion exposure to other buildings and equipment.

6.4.5.2 Cyclone collectors used with dryers shall be equipped with explosion vents equal in size to the cross-sectional area of the exhaust sleeve to supplement the venting area provided at the exhaust opening.

6.4.5.3 Dryers shall be designed and installed, if possible, with their explosion vents opening directly to the outside.

6.4.5.3.1 This venting shall be permitted to be accomplished by installation of the dryer along an outside wall of the building, directly under the roof, or by a portion of the dryer being extended through the roof.

6.4.5.3.2 If such locations are not practicable, ducts to the outside of the building shall be as short as possible and designed to withstand explosion pressure.

6.4.5.3.3 Access floors, platforms, walkways, and stairs on the thermal dryer structure shall be located so that personnel are not in the line of an explosion vent.

6.5 Conveyors. Conveyors shall be in accordance with Section 9.1.

6.6 Mobile Equipment. Mobile equipment used in coal processing areas shall conform to 5.3.8.

6.7 Spiral Concentrators.

6.7.1* In addition to the requirements of NFPA 51B, when welding or cutting operations are to occur directly above or within 10.5 m (35 ft) of a coal washing spiral concentrator, the following fire prevention measures shall be taken:

- (1) A hot work permit shall be created and approved by an individual designated by management to authorize cutting and welding operations before commencing welding or cutting work as described in 6.7.1.
- (2) The hot work permit shall, at a minimum, include the requirements for performing a risk assessment before work commences as well as the provisions contained in 7.1.2.5(1) through 7.1.2.5(5) of this standard.
- (3) The spirals and the surrounding area shall be washed down with water to remove the accumulation of as many coal fines as practical and to thoroughly wet residual coal fines remaining in the spirals and surrounding area within 10.5 m (35 ft).
- (4) Periodic wetting of spirals and the surrounding area shall continue as required by the authority having jurisdiction for the duration of welding and cutting activities.
- (5) A trained fire watch shall be posted within the visual vicinity of the spirals when hot work is in process.
- (6) A fire watch shall be maintained for a minimum of 1 hour following completion of all hot work.
- (7) The fire watch shall be guided by the provisions contained in 7.1.2.12 of this standard.
- (8) Fire extinguishers and fire hoses shall be available during hot work as prescribed in 7.1.2.5(3) and 7.1.2.5(4) of this standard.
- (9) Fire-resistant barriers shall be used where practical to isolate the spirals from hot material or debris.

6.7.2 Signage shall be permanently posted around spirals, prohibiting smoking or open flame and requiring approved hot work permits before commencing any welding or cutting tasks as described in 6.7.1.

Chapter 7 Storage and Use of Compressed Gases and **Ignitable (Flammable and Combustible) Liquids**

7.1* Compressed Gas Storage and Usage — Cutting and Welding.

7.1.1 Procedures and Maintenance of Equipment.

7.1.1.1 Cutting and welding shall be performed only by persons who have been task trained.

7.1.1.2 Personal protective equipment shall be worn by personnel during welding or flame cutting operations.

7.1.1.3 Before any cutting or welding is performed, prior approval shall be granted by management or its designated agent.

7.1.1.4 Compressed gas shall be used only for its intended purpose.

7.1.1.5 Compressed oxygen shall not be used to blow coal dust from clothing or machinery.

7.1.1.6 Manifolding of cylinders containing gases used for cutting and welding shall be permitted only in shops ventilated with sufficient quantity and velocity to dilute, render harmless, and clear away flammable or explosive concentrations of vapors.

7.1.1.7 When not in use, the compressed gas cylinder valve shall be closed.

7.1.1.8 Cutting and welding equipment shall be maintained in operating condition with all safeguards in place and functioning.

7.1.1.9 Flashback and backflow preventers shall be installed at the outlets of all pressure regulators and on the hose connections used in cutting, welding, brazing, and soldering torches.

7.1.2 Fire Prevention and Control.

7.1.2.1* Cutting or welding shall not be performed on or within containers or tanks that have stored combustible or flammable materials until such containers or tanks have been purged and cleaned or have been inerted.

7.1.2.2 Cutting or welding shall not be performed within 15.2 m (50 ft), measured horizontally, of explosives, blasting agents, or **ignitable (flammable or combustible)** liquid storage areas unless separated by a noncombustible barrier.

7.1.2.3 Electrical cutting and welding equipment shall be electrically grounded.

7.1.2.4 All machinery and operations producing combustible dust within range of welding sparks shall be shut down prior to the start of the welding or cutting operation and shall remain inoperative until a final inspection is completed.

7.1.2.5* Before cutting and welding operations are undertaken, the following precautions shall be observed:

- (1) The immediate area shall be cleaned and cleared of combustible material and, if underground, wetted down with water or coated with rock dust.
- (2) Open gear cases and combustible machine components located within 7.6 m (25 ft) of cutting or welding operations shall be covered with noncombustible material.
- (3) Fire-extinguishing equipment, including fully charged and operable multipurpose (ABC) dry chemical extinguishers, rock dust, or water hose, shall be within 7.6 m (25 ft) of the cutting or welding operation.
- (4) In the case of a portable fire extinguisher, a single unit having a nominal capacity of 9.1 kg (20 lb) with a minimum rating of 4-A:40-B:C shall be within 7.6 m (25 ft) of the cutting or welding operation.
- (5) Tests for methane gas (CH_4) shall be made before cutting or welding in any area where methane gas is likely to be present, and the following shall apply:
 - (a) Cutting or welding shall not be permitted to begin or continue unless the concentration of methane gas is less than 1 percent by volume.
 - (b) Methane concentration shall be continuously monitored during the cutting and welding operation.

- (6) Where cutting or welding is necessary in by the last open crosscut, a continuous fire watch shall be maintained.
- (7) Where in by equipment to be modified or repaired can be moved, it shall be moved out by the last open crosscut before cutting or welding.
- (8) Ventilation shall be established prior to and maintained during cutting or welding.
- (9) Ignitable (flammable and combustible) liquids shall not be dispensed within 15.2 m (50 ft) of cutting or welding operations.
- (10) Freshly painted surfaces shall be permitted to dry so that ignitable vapor is not present before cutting or welding.
- (11) When conducting cutting and welding operations inside buildings, in draglines, or underground, a permit shall be prepared and signed by the person performing the work and by an individual designated by management to authorize cutting and welding operations.

7.1.2.6 Combustibles posing a fire hazard shall be relocated or protected with a fire-retardant cover or fire-retardant barrier.

7.1.2.7 Where welding or cutting with an arc or a flame is performed where combustible materials are present and cannot be removed or protected from ignition sources, a fire watch shall be provided.

7.1.2.7.1 Where a fire watch is required, it shall be maintained for a minimum of 30 minutes after completion of cutting or welding operations to detect and extinguish smoldering combustibles.

7.1.2.7.2 The fire watch shall have fire-extinguishing equipment available and be trained in its use.

7.1.2.7.3 Fire watchers shall be familiar with the facilities and the procedures for sounding an alarm in the event of a fire.

7.1.2.8 Openings or cracks in walls, partitions, floor decks, or ducts shall be covered tightly with a noncombustible material to prevent the passage of sparks to adjacent areas.

7.1.2.9 Where welding is being performed on a metal wall, partition, ceiling, or roof, precautions shall be taken to prevent ignition of combustibles on the other side due to conduction or radiation.

7.1.2.10 In confined spaces, positive ventilation shall be established prior to start-up of cutting or welding operations.

7.1.2.11 Noncombustible barriers shall be installed below welding or cutting operations that are being performed in or over shafts, silos, and similar openings.

7.1.2.12 Inspection.

7.1.2.12.1 Inspection for sparks, smoldering material, and fire shall be made during cutting or welding.

7.1.2.12.2 After completion of the work, a search of the area, including the floors above and below, shall be made for fires and for development of smoldering fires.

7.1.3 Underground Transport. Compressed gas cylinders for cutting or welding shall be transported as follows:

- (1) The cylinders shall be disconnected from regulators.
- (2) The cylinders shall be protected with a metal cap or headband (fence-type metal protector around the valve stem).
- (3) The cylinders shall be secured by devices that will hold them in place during transit.

- (4) The cylinders shall be placed in electrically insulated, substantial containers designed to hold the cylinders during transit on a trolley wire haulage system.
- (5) The cylinders shall be labeled "empty" or "MT" if the gas has been expended.

7.1.4 Underground Storage. Compressed gas cylinders stored underground shall meet all the requirements of Section 7.1.

7.1.4.1* Compressed gas cylinders shall be clearly marked using the designations of the US Department of Transportation (DOT).

7.1.4.2 Compressed gas cylinders shall be placed in storage areas that shall be designated for the purpose, constructed of noncombustible material or rock-dusted, and free of trash and ignitable (flammable or combustible) liquids.

7.1.4.3 Compressed gas cylinders shall be stored and secured in an upright position or angled with the valve end elevated.

7.1.4.4 Compressed gas cylinders shall be protected against damage from the following:

- (1) Falling material
- (2) Contact with power lines and energized electrical machinery
- (3) Heat from cutting or welding operations

7.1.4.5 The valves of the compressed gas cylinder shall be closed and protected from physical damage when not in use.

7.1.4.5.1 Hoses from compressed gas shall have flash arresters on the regulator side and shall be drained after use.

7.1.4.6 Compressed gas cylinders shall not be stored or left unattended in by the last open crosscut.

7.1.4.7 Where located in other than underground shops, compressed gas cylinders not in use shall have the regulators removed, and the valves shall be protected by being covered with protective metal caps, by tank design, or by other approved equivalent protection.

7.1.4.8 Flammable compressed gas shall be segregated from oxygen by a fire-resistive barrier (e.g., steel plating or concrete blocks) or by a distance of 6.1 m (20 ft).

7.1.5 Surface Storage.

7.1.5.1 Storage of compressed gases on an excavating machine shall be limited to that used on a daily basis.

7.1.5.2 Acetylene, oxygen, and other compressed gas cylinders shall be kept in the upright position and secured against falling over.

7.1.5.3 A metal or caged barrier shall be provided above cylinders in storage if there is the potential for falling objects.

7.1.5.4 Flammable compressed gas shall be segregated from oxygen by a fire-resistive barrier (e.g., steel plating or concrete blocks) or by a distance of 6.1 m (20 ft).

7.1.5.5 Storage of flammable gases and oxygen shall be located outside buildings or in a room designed in accordance with NFPA 55.

7.1.5.6 All electrical equipment within an enclosed storage room containing flammable gases shall be Class I, Division 2, Group A, B, C, or D.

7.1.5.7 Outside storage areas shall be kept clear of dry vegetation and combustible materials for a minimum distance of 7.6 m (25 ft).

7.1.5.8 Storage areas shall be provided with physical protection from vehicle damage.

7.1.5.9* Compressed gas cylinders shall be clearly marked using the designations of the DOT.

7.1.5.10 Empty cylinders shall be clearly marked "Empty" or "MT" or stored in a separate area.

7.2 Liquid Propane Storage and Use. The storage, use, and handling of liquefied petroleum gases (LP-Gases), such as propane or butane, shall be in accordance with NFPA 58.

7.3 Ignitable (Flammable and Combustible) Liquid Storage Tanks on the Surface.

7.3.1* Design and Location of Storage Tanks.

7.3.1.1 Storage tanks shall be built, installed, and used in accordance with NFPA 30.

7.3.1.2* The tank shall be listed for its use.

7.3.1.3 Aboveground flammable liquids storage tanks shall be located a minimum of 15.2 m (50 ft) from important structures.

7.3.1.4 Aboveground combustible liquid storage tanks shall not be stored closer than 1.5 m (5 ft) from important structures.

7.3.1.5 Aboveground tanks shall not be located within 30.5 m (100 ft) of mine openings, fan installations, hoist houses, or any buildings connected to these operations.

7.3.1.6 The contents of the storage tank shall be identified by the designations given in NFPA 704.

7.3.2* Control of Spillage from Aboveground Tanks. Facilities shall be provided so that any accidental discharge will be prevented from endangering important facilities or adjoining property or from reaching waterways.

7.3.3 Normal and Emergency Venting.

Δ 7.3.3.1 Atmospheric storage tanks shall be vented in accordance with API STD 2000, *Venting Atmospheric and Low-Pressure Storage Tanks*.

7.3.3.2 As an alternative to 7.3.3.1, the normal vent shall be at least as large as the largest filling or withdrawal connection, but in no case shall it be less than 31.7 mm (1¼ in.) nominal diameter.

7.3.3.3 Aboveground tanks storing flammable liquids shall have the vent normally closed and be equipped with a flame arrester.

7.3.3.4* Emergency Relief.

7.3.3.4.1 Emergency relief shall be provided for all aboveground tanks storing material with a flash point less than 93.3°C (200°F).

7.3.3.4.2 The relief shall be in the form of a relief valve or a weak roof-to-shell seam.

7.3.3.5 Tanks containing material with a flash point greater than 93.3°C (200°F) that are located in the same diked area as liquids with lower flash points shall also conform to 7.3.3.4.

7.3.3.6* Vent piping shall be located so that the discharge is above the fill pipe opening and at least 3.7 m (12 ft) above the adjacent ground level.

7.3.4 Fuel Lines.

7.3.4.1 Fuel lines shall be equipped with valves to cut off fuel at the source.

7.3.4.2 Fuel lines with flexible piping shall be equipped with a fusible link activated automatic shutoff valve located at the point where the fuel line exits the storage tank.

7.3.5 Leakage and Overfill of Buried Tanks.

7.3.5.1 Buried tanks with flammable liquids shall have a leak detection program in effect.

7.3.5.2 Accurate inventory records of buried tanks with flammable liquids shall be maintained.

7.3.5.3 Buried tanks shall be equipped with an overfill alarm interlocked to shut off the feed when the tank is 95 percent full and to alarm at 90 percent.

7.3.6 Vehicle Barriers. Vehicle barriers shall be provided around aboveground stationary storage tanks or fuel pumps that are located in an area subject to vehicular traffic.

7.3.7 Control of Ignition Sources.

7.3.7.1 Signs warning against smoking or open flames shall be posted so they can be readily seen.

7.3.7.2 Storage tanks containing flammable liquids shall be grounded.

7.3.7.3 Tank trucks with flammable liquids shall be grounded by being electrically bonded to the fill pipe when storage tank filling operations are taking place.

7.3.7.4 Areas surrounding storage tanks shall be kept free of grass, weeds, underbrush, or other combustible material such as trash or leaves for at least 7.6 m (25 ft) in all directions.

7.3.8 Fire Extinguishers. Two fully charged and operable 9.1 kg (20 lb) extinguishers with minimum ratings of 4-A:40-B:C shall be provided within 9.1 m (30 ft) of the tank or pump.

7.4 Ignitable (Flammable and Combustible) Liquid Storage on Surface Equipment and in Buildings.

7.4.1 The storage, use, and handling of ignitable (flammable and combustible) liquids in surface buildings shall conform to NFPA 30 except Chapters 1, 2, 3, 4, and 15, and Section 18.5.

7.4.2 Ignitable (flammable and combustible) liquids on equipment, except in fuel tanks on vehicles, shall be stored and handled in accordance with NFPA 30.

7.4.3 Flammable liquids of a quantity greater than 94.6 L (25 gal) shall be stored in a flammable liquids cabinet.

7.4.4 All flammable aerosols shall be stored in a flammable liquids cabinet.

7.4.5* On equipment, combustible liquid storage in drums or totes shall not exceed a 1-day supply.

7.4.6 Upon request, the mine operator shall provide the authority having jurisdiction with information regarding the composition and flash point of the flammable and combustible materials.

7.4.7 Smoking and Open Flames.

7.4.7.1 Smoking and open flames shall be prohibited in areas or locations where fire or explosion hazards exist.

7.4.7.2 Signs warning against smoking and open flames shall be posted.

7.4.8 Vehicle Refueling.

7.4.8.1 Vehicles using liquid fuels shall be refueled only at locations designated for that purpose and from approved dispensing pumps and nozzles.

7.4.8.2 Engines, except diesel engines, shall be shut off during refueling.

7.5 Flammable Liquids Stored and Used Underground.

7.5.1 General.

7.5.1.1* Electrical equipment in flammable liquid storage areas shall be classified as one of the following:

- (1) Class I, Division 1 as specified in *NFPA 70*
- (2) "Permissible" electrical equipment

7.5.1.2 Flammable liquids in storage shall be kept in closed containers.

7.5.1.3 Flammable liquids shall be permitted to be used only where there are no open flames or other sources of ignition within the possible path of vapor travel in flammable concentrations.

7.5.1.4 Flammable liquid containers shall be returned to a flammable liquid storage area after use.

7.5.1.5 All aerosol cans shall be treated as containing flammable liquids unless otherwise specifically identified.

7.5.1.6 Individual aerosol cans that are used regularly in normal operations shall be permitted on mobile equipment or in tool cabinets and shall be protected from mechanical damage.

7.5.2 Flammable Liquid Containers.

7.5.2.1 Flammable paints shall be stored only in original containers or cans of not over 19 L (5 gal) capacity.

7.5.2.2 All other flammable liquids shall be transferred to a listed safety can prior to being transported underground.

7.5.2.3 Safety cans containing Class IA flammable liquids shall not exceed 7.6 L (2 gal) capacity.

7.5.2.4 All flammable liquid containers shall be labeled with the word "Flammable."

7.5.2.5 Flammable liquid containers shall be stored in a stable manner.

7.5.3 Flammable Liquid Storage Areas.

7.5.3.1 Flammable liquids shall be stored in one of the following:

- (1) Listed or approved noncombustible storage cabinets

- (2) Cabinets meeting the requirements specified in Section 9.5 of NFPA 30
- (3) An enclosure of fire-resistive construction

7.5.3.2 In operating areas, containers of flammable liquids and aerosol cans shall be stored at least 7.6 m (25 ft) away from potential ignition sources such as energized trolley wire, energized electrical equipment, and other operating equipment.

7.5.3.3 The aggregate quantity of flammable liquids, including aerosol cans, in a flammable liquid storage area shall not exceed 227 L (60 gal).

7.5.4 Dispensing Flammable Liquids.

7.5.4.1 Flammable liquids shall be drawn from or transferred into containers using only the following methods:

- (1) From safety cans
- (2) From a container by means of a device that draws through an opening in the top of the container
- (3) By gravity through a listed or approved self-closing valve or self-closing faucet

7.5.4.2 Transferring flammable liquids by means of an electric pump or pressurizing a container with air shall be prohibited.

7.5.4.3 Transferring flammable liquids by pressure of inert gas shall be permitted only if controls, including pressure relief devices, are provided to limit the pressure so it cannot exceed the design pressure of the container.

7.5.4.4 At least one portable fire extinguisher having a nominal capacity of 9.1 kg (20 lb) with a minimum rating of 4-A:60-B:C shall be located not more than 9.1 m (30 ft) from any area where flammable liquid is dispensed.

7.6 Combustible Liquids Stored and Used Underground.

7.6.1 General.

7.6.1.1 This chapter shall not apply to combustible liquids in use, such as the following:

- (1) Diesel fuel in the fuel tanks of diesel-powered vehicles
- (2) Hydraulic fluid in the reservoirs of hydraulic equipment
- (3) Lubricating oil in the lubrication reservoirs of operating equipment

7.6.1.2 Combustible liquids in approved tanks or containers meeting the following requirements shall be exempt from the requirements for storage areas:

- (1) Class II combustible liquids stored in containers meeting the requirements of this chapter and not exceeding 227 L (60 gal)
- (2) Class III combustible liquids stored in containers or approved tanks as specified in this chapter and not exceeding 2498 L (660 gal)

7.6.1.3 Combustible liquid containers shall be stored and shall be kept closed while stored in the following manner:

- (1) Drums holding 208 L (55 gal) and 114 L (30 gal) shall be set vertically, unless seam height will not allow, and not over one drum high.
- (2) Drums holding 60.6 L (16 gal) shall be set vertically and not over two drums high.
- (3) Pails holding 19 L (5 gal) shall be set vertically and not over four pails high.
- (4) Cartons holding grease cartridges shall not be stacked over three cartons high.

7.6.1.4 Ventilation shall be provided wherever combustible liquids are stored to prevent the accumulation of ignitable vapors.

7.6.2 Combustible Liquid Containers and Tanks.

7.6.2.1 Tanks for handling combustible liquids shall be substantially constructed and fitted with filler caps, vents, and discharge valves that are protected in the event of derailment or ribbing of the vehicle carrying the tanks.

7.6.2.2* Containers shall be acceptable to the authority having jurisdiction.

7.6.2.3 Containers larger than 19 L (5 gal) shall be provided with vacuum and pressure relief.

7.6.2.4 The capacity limitations for combustible liquids in containers and portable tanks shall be in accordance with the definitions for *container* and *portable tank* in Chapter 3.

7.6.2.5 Combustible liquid storage tanks intended for fixed installation and portable installations in accordance with NFPA 30 shall be of materials compatible with the liquid stored.

7.6.2.6 Atmospheric tanks shall be built in accordance with NFPA 30.

7.6.2.7 The operating pressure of storage tanks shall not exceed their design working pressure.

7.6.2.8 Low-pressure tanks shall be built in accordance with NFPA 30.

7.6.2.9 The operating pressure of the vessel shall not exceed the design working pressure.

7.6.2.10* Pressure vessels shall be built in accordance with NFPA 30.

7.6.2.11 Storage tanks shall be vented to prevent the development of vacuum or pressure from distorting the shell or roof of the tank as a result of filling or emptying and atmospheric temperature changes.

7.6.2.12 Protection shall also be provided to prevent overpressure from any filling source exceeding the design pressure of the tank.

7.6.2.13* Storage tank vents shall be at least as large as the filling or withdrawing lines but no less than 31.7 mm (1¼ in.) nominal inside diameter.

7.6.2.14 If more than one fill or withdraw line can be used simultaneously, the vent capacity shall be based on the maximum anticipated simultaneous flow.

7.6.2.15 Vent pipes shall be constructed to drain toward the tank without sags or traps to collect liquid.

7.6.2.16 Connections for all tank openings shall be liquid-tight.

7.6.2.17 Each connection to a tank through which liquid normally can flow shall be provided with an external valve located at the shell of the tank.

7.6.2.18 Tanks containing combustible liquids shall be provided with a means for quick cutoff of flow in the event of fire in the vicinity of the tank.

7.6.2.19 Openings for manual gauging, if independent of the fill pipe, shall be kept closed when not gauging.

7.6.2.19.1 Each opening for any liquid shall be protected against liquid overflow and possible vapor release by means of a spring-loaded cap or other device.

7.6.2.19.2 Substitutes for manual gauging shall be permitted.

7.6.3* Transfer and Transport of Combustible Liquids.

7.6.3.1 Combustible liquid shall be permitted to be transferred into the mine by pipeline, portable tank, closed container, or safety can.

7.6.3.2 When combustible liquid is transferred into the mine, it shall be transported or transferred directly to the storage area or location where it will be used.

7.6.3.3 Combustible liquid shall not be transported in the same conveyance with personnel unless the items are secured or are small enough to be carried by hand without increasing the risk of an accident.

7.6.3.4 Combustible liquid containers or tanks loaded on rail or trackless vehicles shall be secured against shifting and damage during transit.

7.6.3.5 Rail or trackless vehicles that carry supplies for production areas in addition to combustible liquids shall have provisions for securing or separating those supplies from the lubricants and combustible liquids so that, in the event of derailment or ribbing, the supplies will not puncture containers or tanks.

7.6.3.6 Vehicles carrying combustible liquids shall be kept clean of accumulations of oil, grease, and other combustible material.

7.6.3.7 Spilled combustible liquids shall be cleaned up immediately.

7.6.3.8 Any remaining residue shall be covered with an oil absorbent or rock dust.

7.6.3.9 Combustible liquid containers or tanks shall be at least 305 mm (12 in.) below energized trolley wires or protected from contacting the wire by insulation while being transported by trolley wire-powered systems.

7.6.3.10* The quantity of combustible liquid in containers or tanks off-loaded from transport vehicles and stored in an operating area shall not exceed a 3-day supply for operations in that area.

7.6.3.11 A single tank or container with a capacity exceeding a 3-day supply shall be permitted.

7.6.3.12* Pipeline systems used for combustible liquid transfer shall be permitted to be either wet or dry pipe installations.

7.6.3.12.1 Piping, valves, and fittings used for combustible liquid transfer shall be designed for the expected working pressures and structural stresses as follows:

- (1) Piping, valve, and fitting burst strengths shall be at least four times the static pressure.
- (2) The pipeline shall be designed to withstand the mechanical and thermal stresses caused by exposure to fire.

7.6.3.12.2 A manual shutoff valve shall be installed in the pipeline at the surface storage tank and at the point of underground discharge.

7.6.3.12.3 An additional shutoff valve shall also be installed in each branch line where the branch line joins the main line.

7.6.3.12.4 The pipeline system shall be guarded and protected against physical damage.

7.6.3.12.5 Guarding by choice of location shall be considered an acceptable practice.

7.6.4 Temporary Areas for the Storage of Combustible Liquids in Portable Containers.

7.6.4.1 Portable combustible liquid storage areas shall meet one of the following criteria:

- (1) They shall be located a minimum of 30.5 m (100 ft) from explosives magazines, electrical substations, shops, working faces, or other combustible liquid storage areas.
- (2) They shall be separated from explosives magazines, electrical substations, shops, working faces, or other combustible liquid storage areas by unexcavated coal or rock or by a masonry bulkhead.

7.6.4.2 Unless equipped with an approved fire protection system, the storage area shall be a minimum of 30.5 m (100 ft) from any shaft station and 7.6 m (25 ft) from energized trolley wire.

7.6.4.3 A portable combustible liquid storage area shall be recessed or otherwise located and protected from accidental damage by mobile equipment or blasting.

7.6.4.4 The aggregate quantity of diesel fuel in a combustible liquid storage area for portable containers or tanks shall not exceed 1893 L (500 gal).

7.6.4.5 The aggregate quantity of Class II and Class III combustible liquids in a combustible liquid storage area for portable containers or tanks shall not exceed 3785 L (1000 gal).

7.6.5* Fixed Areas for Class II Liquid Storage.

7.6.5.1 Fixed combustible liquid storage areas shall be located as follows:

- (1) A minimum of 30.5 m (100 ft) from explosives magazines, electrical substations, shaft stations, slope bottoms, and shops
- (2) A minimum of 30.5 m (100 ft) from other ignitable (flammable or combustible) liquid storage areas or separated by one of the following:
 - (a) Unexcavated coal
 - (b) Rock
 - (c) Masonry bulkhead with a minimum thickness of 102 mm (4 in.) of blocks or 51 mm (2 in.) of reinforced gunite
- (3) A minimum of 30.5 m (100 ft) from any working face and out of the line of sight of blasting or a minimum of 152 m (500 ft) within line of sight from any working face to avoid damage from fly rock
- (4) A minimum of 7.6 m (25 ft) from normally energized trolley wire

7.6.5.2 All fixed combustible liquid storage areas shall be enclosed and protected by an approved, fixed automatic fire suppression system.

7.6.5.2.1 All fixed combustible liquid storage area enclosures shall be of noncombustible construction, including floor, roof, roof supports, doors, and door frames.

7.6.5.2.2 Exposed coal within all fixed combustible liquid storage areas shall be covered with noncombustible materials such as gunite, shotcrete, or preformed masonry.

7.6.5.2.3 Bulkheads, if used, shall be sealed and be built of or covered with noncombustible materials.

7.6.5.2.4 All fixed combustible liquid storage area enclosures shall be constructed to provide suitable spill containment or shall be provided with a suitable floor drain to direct spilled liquid to a containment sump or vessel.

7.6.5.2.5 All openings to the storage area enclosures shall be sealed with fire-resistive stoppings.

7.6.5.2.6 The access opening through which containers are moved shall be located on the intake side.

7.6.5.2.7* All doors shall be of the self-closing type and shall be listed or approved and constructed of noncombustible materials.

7.6.5.2.8 A personnel door shall be provided on the side where air enters the enclosure.

7.6.5.2.9 The storage area enclosure shall be vented directly to the return or the surface.

7.6.5.2.10* Tanks shall rest 305 mm (12 in.) above the ground or on foundations made of concrete, masonry, piling, or steel.

7.6.5.2.11 Tank foundations shall be designed to prevent accumulation of combustible liquid under the tank, to minimize the possibility of uneven settling of the tank, and to minimize corrosion in any part of the tank resting on the foundation.

7.6.5.2.12 All piping, valves, and fittings shall be suitable for the expected working pressures and structural stresses.

7.6.5.2.13 Ventilation shall be provided to prevent the accumulation of ignitable vapors.

7.6.5.2.14 Empty or idle combustible pallet storage within the combustible liquid storage area shall not be permitted.

7.6.5.2.15 The aggregate quantity of Class II and Class III combustible liquids in a fixed combustible liquid storage area shall not exceed 18,927 L (5000 gal), of which Class II shall not exceed 3785 L (1000 gal).

7.6.6 Fixed Storage Areas for Class III Combustible Liquids. Class III combustible liquids shall be stored in fire-resistive containers within an enclosure of fire-resistant construction.

7.6.7 Storage, Transport, and Dispensing of Combustible Liquids Using Mobile Equipment.

7.6.7.1 Where combustible liquids are stored on mobile equipment such as mobile service trucks, the equipment shall be parked at a fixed location or a location that meets the requirements of 7.6.4 when not in use.

7.6.7.2 The aggregate quantity of combustible liquids carried on mobile equipment shall not exceed 3785 L (1000 gal).

7.6.7.3 Diesel fuel tank trucks shall not exceed 1893 L (500 gal) storage capacity.

7.6.8* Dispensing Combustible Liquids.

7.6.8.1 Class III combustible liquids shall be permitted to be dispensed through the application of positive pressure to containers or tanks only where the containers or tanks are certified as pressure vessels.

7.6.8.2 Class II combustible liquids shall not be dispensed using compressed gas.

7.6.8.3 Where electrically powered pumps are used to dispense combustible liquids, a switch or circuit breaker shall be provided at a location away from dispensing devices, including remote pumping systems, to shut off the power to all dispensing devices in an emergency.

7.6.8.4 Dispensing nozzles for Class II combustibles shall be of the self-closing type without a latch-open device.

7.6.8.5 At least one portable fully charged and operable fire extinguisher having a nominal capacity of 9.1 kg (20 lb) with a minimum rating of 4-A:60-B:C shall be located not more than 9.1 m (30 ft) from any area where combustible liquid is dispensed.

7.6.8.6 Dispensing Class II combustible liquid from containers or tanks shall be accomplished by an approved transfer pump or by gravity flow.

7.6.8.6.1 Where needed, containers or tanks shall be equipped with an approved vent.

7.6.8.6.2 If a manual valve is used, it shall be of the self-closing type without a latch-open device.

7.6.8.7 Spillage shall be cleaned up.

7.6.8.8 Remaining residue shall be covered with an oil absorbent or rock dust.

Chapter 8 Mine Surface Buildings

8.1 Construction.

8.1.1 This chapter shall include mine offices, bathhouses, warehouses, vehicle storage, shops, and permanent miscellaneous buildings.

8.1.2 Offices over 1394 m² (15,000 ft²), warehouses over 929 m² (10,000 ft²), and shops over 465 m² (5000 ft²) shall be constructed of noncombustible materials or provided with an automatic sprinkler system installed in accordance with NFPA 13.

8.2 Fire Prevention.

8.2.1 No smoking shall be allowed in warehouses.

8.2.2 Combustible storage shall be maintained at least 0.9 m (3 ft) from electrical panels and electric resistance heaters.

8.2.3 Oily waste or rags that can create a fire hazard shall be placed in covered metal containers.

8.2.4 Battery rooms shall be in accordance with Article 480 of NFPA 70.

8.2.4.1 Battery-charging installations shall be located in a designated area that is protected against damage from mobile equipment.

8.2.4.2 Each battery-charging installation shall be equipped with the following:

- (1) Approved portable multipurpose fire extinguisher(s)
- (2) Ventilation for the removal of generated gases from charging batteries
- (3) A means for flushing spilled electrolyte

8.3 Life Safety.

8.3.1 Two means of egress shall be provided from multistory buildings.

8.3.2 For office, bathhouse, and warehouse areas, emergency lighting shall be provided in each stairwell or hallway that is the means of egress in accordance with NFPA 101.

8.3.3 For office, bathhouse, and warehouse areas, emergency exit signs shall be provided along the means of egress.

8.4 Ignitable (Flammable and Combustible) Liquids.

8.4.1 All storage and handling of ignitable (flammable and combustible) liquids shall conform to the guidelines established in NFPA 30.

8.4.2 The quantity of flammable liquids and aerosols stored outside a flammable liquids storage cabinet shall not exceed 94.6 L (25 gal).

8.4.3 Other than in shops, the quantity of combustible liquids outside a flammable liquids storage cabinet or room constructed in accordance with NFPA 30 shall not exceed 454 L (120 gal).

8.4.4 Dispensing of ignitable (flammable or combustible) liquids in warehouses shall be prohibited.

8.4.5 Storage of acetylene, oxygen, or other welding gases inside warehouses shall be prohibited.

8.4.6 Drip pans shall be provided to catch leakage or spillage wherever ignitable (flammable or combustible) liquids are dispensed.

8.4.7 Fusible link-actuated automatic closers shall be provided on all parts cleaning tanks.

8.5* Compressed Gas Storage and Usage. Storage and use of compressed gases in and around mine buildings shall be in accordance with Section 7.1.

8.6 Fire Detection and Protection.

8.6.1 For multistory office buildings, a central station or proprietary alarm system shall be installed in accordance with NFPA 72.

8.6.1.1 Alarms shall include smoke detectors, duct detectors, and manual pull stations.

8.6.1.2 In addition, if sprinklers are installed, water flow, valve tamper, and low building temperature alarms shall be provided.

8.6.1.3 All equipment shall be listed or approved for its intended use.

8.6.2* If sprinkler systems are installed, they shall be in accordance with NFPA 13.

8.6.3* If fire hydrants are installed, they shall be in accordance with NFPA 24.

8.6.4 If a building is more than two stories high, a standpipe system shall be installed in accordance with NFPA 14.

8.6.5 If a gaseous fire suppression system is installed in a computer or telephone equipment room, it shall be in accordance with NFPA 2001.

8.6.6* Fire extinguishers shall be provided and maintained in accordance with NFPA 10.

8.6.6.1 Fire extinguishers shall be inspected at least every 6 months.

8.7 Water Supplies. If sprinklers or fire hydrants are installed, water supplies shall be capable of providing the required flow rate and pressure necessary for the fire protection features for at least one hour.

Chapter 9 Coal Conveyance and Storage

9.1* Conveyors — General.

9.1.1* Belt conveyors shall meet the following minimum requirements:

- (1) Belt alignment limit switches shall be provided on conveyors to shut down belts that are tracking improperly.
- (2) Slip switches shall be provided to detect a slipping or jammed belt and shall be interlocked to shut off driving power when the belt stops or slows down by more than 20 percent of its normal speed.
- (3) Slip switches shall be tested on an annual basis.
- (4) **An interlock** shall be provided on contributing conveyors to prevent any operating conveyor from discharging material to a stopped downstream conveyor.
- (5) Means shall be provided to remove tramp metal and other foreign objects as early in the handling process as possible.
- (6) Hydraulic systems for belt alignment, if provided, shall use only listed fire-retardant hydraulic fluids or shall be protected by an automatic fire protection system.
- (7) Alarms shall annunciate in the operator's control room or constantly attended location.
- (8) Electrical equipment shall be classified as Class II, Division 2, Group F in all areas where required by *NFPA 70*.
- (9) Guarding for machinery in the drive area and at other points along the belt shall be made of noncombustible material.

9.1.2* Structures supporting belt conveyors shall be designed to prevent coal accumulations.

9.1.2.1 The design shall include any surface near the conveyor that can catch and retain combustible dust.

9.1.3 Consideration shall be given to the possibility of static electrical discharge at the conveyor head and tail pulleys located in dry climates where bituminous and lower ranking-type coals are handled.

9.1.3.1 Factors that shall be considered are belting materials, belt speed, and housekeeping of spilled coal dust.

9.1.3.2 Where such conditions as described in 9.1.3 exist, the use of static dissipators or eliminators shall be considered.

Δ 9.1.4 Attention shall be given to the prevention of and cleaning of accumulations of coal dust beneath and close to belt conveyors.

N 9.1.5 Prior to extended idle periods, the conveyor system shall be cleared of coal pieces and coal dust.

9.2 Overland Conveyors.

9.2.1 Chute plug alarms shall be provided for long runs of belt or critical conveyor systems.

9.2.2 The conveyor path shall be kept free of all grass, weeds, trash, or any other material that could create an exposure to the belt should it catch on fire.

9.2.3 Motor control center (MCC) buildings for conveyor systems shall be kept free of accumulations of coal dust.

9.3 Below-Grade Reclaim Conveyors.

9.3.1 Methane and carbon monoxide detection shall be provided in belowgrade reclaim conveyor areas.

N 9.3.1.1 The detection equipment shall be listed for its intended purpose and be compatible with the environment in which it is installed.

N 9.3.1.2 The detectors shall be placed so that air flows naturally across the sensor and is not in a stagnant air area.

N 9.3.1.3 The methane and carbon monoxide sensors shall include a fixed set point and rate of rise.

N 9.3.1.4 An alarm shall be transmitted to a constantly attended location when either condition exceeds a normal or safe level.

N 9.3.1.5 An alarm shall provide local audio-visual notification of high methane and carbon monoxide levels or trend at the entrance and within the underground area.

9.3.2 Equipment shall be interlocked to de-energize upon detection of a 2 percent concentration of methane.

9.3.3 Portable methane detectors are an acceptable alternative to fixed detectors, provided a reading is taken once per shift.

9.3.4 Hydraulic units more than 7.6 m (25 ft) inside the entrance and greater than 189 L (50 gal) total capacity shall have listed fire-resistive hydraulic fluid or shall be provided with an automatic fire suppression system. The fire suppression system shall be interlocked to shut down the hydraulic unit and send an alarm to a constantly attended location.

9.3.5 Belowgrade reclaim conveyors shall be provided with an automatic sprinkler system in accordance with 9.4.6.3.

9.3.5.1 Belowgrade reclaim conveyors less than 152.4 m (500 ft) in length shall not be required to be provided with an automatic sprinkler system.

9.3.5.2 Sprinkler protection shall not be required on the underside of belts less than 1.2 m (4 ft) in width.

9.3.6 Means of egress shall be provided in belowgrade reclaim conveyor tunnels.

9.3.6.1 Means of egress shall be provided every 91.4 m (300 ft) of travel distance in reclaim conveyor tunnels not provided with an automatic sprinkler system.

9.3.6.2 Means of egress shall be provided every 152.4 m (500 ft) of travel distance in reclaim conveyor tunnels provided with an automatic sprinkler system.

N 9.3.6.3* If a secondary emergency escape path is provided, it shall meet the criteria in 9.3.6.3.1 through 9.3.6.3.4.

N 9.3.6.3.1 A self-closing fire-rated door with a minimum rating of 1½ hours separating the main areas from the escape pathway shall be provided.

N 9.3.6.3.2 The pathway shall allow persons to pass through the area without crawling.

N 9.3.6.3.3 Emergency lighting or the use of alternative methods to mark the exit pathway shall be provided.

N 9.3.6.3.4 The exit shall not be obstructed.

9.4 Underground Conveyors.

9.4.1 Underground conveyor belts shall be of a flame-resistant material and approved by the authority having jurisdiction.

9.4.2 Entries in which belt conveyors are installed shall be kept free of accumulations of coal and coal dust around the belt idlers, pulleys, and belt edges and shall be rock-dusted.

9.4.3* Fixed combustible material such as posts, cribbing, and roof supports shall be guarded from contact with the belt by the use of noncombustible material or by distance and shall be located at a distance of at least 152.4 mm (6 in.) from any idler or pulley.

9.4.4 Belt conveyor installations shall use a support structure without a deck between the upper and lower belt flights.

9.4.5 Belts that carry the load of the belt on a low-friction metal deck without rollers shall be permitted to be used.

9.4.6 Automatic Fire Suppression Systems at the Belt Drive.

9.4.6.1 Deluge water spray systems, foam systems, closed-head sprinkler systems, or dry chemical systems automatically actuated by rise in temperature shall be installed at main and secondary belt conveyor drives.

9.4.6.1.1 If sprinkler or water systems are installed, they shall comply with 4.3.3.3 and 9.4.6.3 of this standard.

9.4.6.1.2 If dry chemical systems are installed, they shall be installed and maintained in accordance with NFPA 17 and the manufacturer's instructions.

9.4.6.2 Fire suppression systems shall extend to the drive areas of belt conveyors, including drive motor(s), reducer, head pulley, and belt storage unit (takeup), including any hydraulic power unit; its electrical controls; and the top and bottom of the first 15.2 m (50 ft) of belt from the drive on the downwind side.

9.4.6.2.1 Where a pre-engineered dry chemical fire suppression system is to be used, protection shall also be provided for the top surface of both the top and bottom belts, and the bottom surface of the top belt of the first 15.2 m (50 ft) of fire-resistant belt or 45.7 m (150 ft) of non-fire-resistant belt from the drive on the downward side.

9.4.6.3 Water-Based Fire Suppression Systems.

9.4.6.3.1 Water Supply.

9.4.6.3.1.1 The water supply shall be free of excessive sediment and corrosives. An approved strainer with a flush-out connection and manual shutoff valve shall be provided.

9.4.6.3.1.2 The water supply shall provide the required flow for not less than 60 minutes.

9.4.6.3.1.3* Approved or listed flexible connections shall be permitted from the water main to the pressure reducing device or shutoff valve to the sprinkler system.

(A) The flexible connection shall be rated at a pressure that exceeds the maximum water pressure expected on the system.

(B) If a non-metallic connection is used, it shall not be within 3.0 m (10 ft) of the belt drive motors or primary roller drive.

9.4.6.3.1.4 If a pressure regulator is used, it shall be set below the maximum pressure allowed by the pressure rating of the piping and fittings.

9.4.6.3.1.5 If a pressure regulator is used, it shall be inspected and tested on a weekly basis to ensure that it is functioning properly and the sprinkler system has the right amount of pressure.

9.4.6.3.2 General Sprinkler Requirements. Sprinkler systems shall meet the following requirements:

- (1) The sprinklers shall be installed in accordance with NFPA 13 as much as practical, and shall have components that have been listed.
- (2) The sprinkler activation temperature shall not be less than 65.6°C (150°F) or greater than 148.9°C (300°F).
- (3) Sprinklers shall be kept free of excessive rock dust, muck, conveyor string, or any other material that can block the discharge or insulate the fusible link.
- (4) The application rate shall not be less than 10.2 L/min/m² (0.25 gpm/ft²) over the top surface of the upper belt, and the discharge shall be directed at both the top and bottom surfaces of the upper belt and to the top surface of the lower belt.
- (5) With a water flow and pressure that is present under normal mine operating conditions, the residual pressure measured downstream of the opened sprinklers or the eight-head inspector's test connection of 70 kPa (10 psi) or greater for belt drive systems shall be maintained at all times.
- (6) Maximum distance between nozzles on a branch line shall not exceed 2.4 m (8 ft).
- (7) Piping for the deluge, foam, or closed-head sprinkler system shall be metal and listed for sprinkler applications.
- (8)* Sprinkler piping shall be supported by UL-listed pipe hangers or other substantial metal supports such as angle iron, U bolts, or heavy chain.
- (9) The system shall be interlocked to shut down the conveyor and shall provide an audible and visual alarm.
- (10) The components of the system shall be located so as to minimize the possibility of damage by roof collapse or by the moving belt and its load.
- (11) Wet pipe sprinklers shall be spaced a minimum of 1.8 m (6 ft) apart.

9.4.6.3.3 Deluge Water Systems. Deluge water spray systems shall meet the requirements of 9.4.6.3.3.1 through 9.4.6.3.3.4.

9.4.6.3.3.1 The system shall be activated by heat detectors or no less effective means.

(A) Detectors shall be located at the belt drive, hydraulic takeup unit (unless fire-resistive fluid is used), discharge roller, and the roof above the conveyor.

(B) Detectors at the roof line should be spaced 2.4 m to 3.0 m (8 ft to 10 ft) apart along the entire length of the protected area of the belt.

9.4.6.3.3.2 The water spray nozzles shall be full cone, corrosion resistant [if less than 0.95 cm ($\frac{3}{8}$ in.) inside diameter or K-factor 4.2 or lower], and provided with blow-off dust covers.

9.4.6.3.3.3 If water spray sprinklers or open-head sprinklers are used, blow-off dust covers are not required to keep them clean as long as they are flow tested in accordance with 4.3.3.5.5.3.

9.4.6.3.3.4 A closed-head sprinkler shall be used over the electrical controls.

9.4.6.3.4 Foam Systems.

9.4.6.3.4.1 Foam systems shall meet the requirements of 9.4.6.3.4.2 through 9.4.6.3.4.5.

9.4.6.3.4.2 The system shall be activated by heat detectors or no less effective means.

(A) Detectors shall be located at the belt drive, hydraulic takeup unit (unless fire-resistive fluid is used), discharge roller, and the roof above the conveyor.

(B) Detectors at the roof line should be spaced 2.4 m to 3.0 m (8 ft to 10 ft) apart along the entire length of the protected area of the belt.

9.4.6.3.4.3 The nozzles shall be full cone, corrosion resistant [if less than 0.95 cm ($\frac{3}{8}$ in.) inside diameter or K-factor 4.2 or lower], and provided with blow-off dust covers.

9.4.6.3.4.4 The system shall have a capacity to last 25 minutes.

9.4.6.3.4.5 A closed-head sprinkler shall be used over the electrical controls.

9.4.6.3.5 Maintenance and Testing. Fire suppression systems shall be maintained and tested in accordance with 4.3.3.5.

9.4.7 Manual Extinguishing.

9.4.7.1 Water lines shall be installed parallel to the entire length of belt conveyors and shall be equipped with fire taps with valves at 91.4 m (300 ft) intervals.

9.4.7.2 The threads on the hose taps shall be protected against dirt and rock grit that can prevent a quick connection.

9.4.7.3 The hose tap at the belt drive area shall be at least 15.2 m (50 ft) upwind of the belt drive.

9.4.7.4* At least 152.4 m (500 ft) of fire hose with fittings shall be stored at strategic locations along the conveyor belt, that is, at transfer points, drive areas, and tailpieces.

9.4.7.5 For each conveyor belt exceeding 610 m (2000 ft) in length, an additional cache of materials as specified in 9.4.7.4 shall be provided.

9.4.7.6 For mines using a track haulage system, the same criteria as those in Section 9.2 through 9.2.3 shall be met.

9.4.7.7 The following materials shall be stored within 91.4 m (300 ft) or 5 minutes of a belt drive:

- (1) 152.4 m (500 ft) of fire hose or a high-expansion foam device and 61 m (200 ft) of hose
- (2) Tools to open a stopping between the belt entry and the adjacent intake entry
- (3) 109 kg (240 lb) of rock dust

9.4.7.8 Foam.

9.4.7.8.1 The foam generator shall produce foam sufficient to fill 30.5 m (100 ft) of belt haulageway in not more than 5 minutes.

9.4.7.8.2 A 1-hour supply of foam shall be kept on hand.

9.4.7.9 The entry containing the main water line and crosscuts containing water outlets shall be accessible.

9.4.7.10 Suitable communication lines to the surface shall be provided in the belt haulageway or adjacent entry.

9.4.7.11 A crew consisting of at least five members for each shift shall be trained in firefighting operations. Fire drills shall be held at intervals not exceeding 6 months.

9.4.7.12 Two 9.1 kg (20 lb) dry chemical extinguishers shall be located at the drive areas.

9.4.8* A dust suppression water spray system actuated by a "conflow" switch or similar device shall be provided at the belt feeder.

9.4.9 Electrical equipment shall be permissible where required by the authority having jurisdiction.

N 9.4.10 Fire detection shall be provided in accordance with 4.3.2.

9.5* Coal Storage — General. Coal bins, bunkers, and silos shall meet the following requirements:

- (1) Storage durations shall be limited to prevent spontaneous combustion.
- (2) Equipment shall be of noncombustible construction designed to minimize coal hang-up.
- (3) Means shall be provided to remove burning, wet, or smoldering coal so it can be disposed of without producing an explosion or a fire.

9.5.1 Storage Bins.

9.5.1.1 All interior bins handling dusty material shall be vented in accordance with 6.2.2.

9.5.1.2 Storage bins for coal shall be located so that sources of heat not intended specifically to control the temperature of coal do not raise the temperature of the coal in the bin, causing spontaneous combustion materially.

9.5.2 Coal Silos.

9.5.2.1 Coal shall not be stored in silos and bunkers for long periods. If coal must be stored for a long period, air entrainment shall be prevented using the following methods:

- (1) Covering the top of the stored coal with a binder material
- (2) Inerting the stored coal with recommended inert gas

9.5.2.2 Areas in the storage (hideouts) that can allow pockets of coal to form, dry, and combust spontaneously shall be removed.

9.5.2.3 Storage silos shall be constructed of noncombustible material.

9.5.2.4 Electrical equipment shall be installed to meet the requirements of *NFPA 70* in effect at the time of installation.

9.5.2.5 If a dust collector is provided, it shall be equipped with explosion relief panels in accordance with *NFPA 68*. The dust collector shall be grounded and have antistatic, fire-resistant bags.

9.5.2.6 Wash-down hoses shall be provided at the bottom of the silo.

9.5.2.7 Dual high-level cutoff switches shall be provided for the silo. The feed conveyor shall be interlocked to shut down on the low-high indication.

9.5.2.8 The silo shall be maintained on a regular cleaning schedule to minimize the buildup of coal beneath the hopper and other areas inside the silo.

9.5.2.9 Deluge water spray systems, foam systems, closed-head sprinkler systems, wet chemical systems, or dry chemical systems automatically actuated by rise in temperature shall be installed over the belt drive areas on top of a silo.

9.5.3* Stackers Tubes and Coal Storage Piles.

9.5.3.1 Coal piles shall be designed to minimize the entrainment of air.

9.5.3.1.1 Minimization shall be permitted by development of a compacted edge around the pile.

9.5.3.1.2 The edge described in 9.5.3.1.1 shall be sealed with binder to aid in sealing.

9.5.3.2 Hot spots or areas of spontaneous combustion shall be removed by digging.

9.5.3.3 The use of water for extinguishment shall be used at a minimum.

9.5.3.4 Active storage piles shall be worked to prevent dead pockets of coal, a potential source of spontaneous heating.

9.5.3.5 Coal piles shall not be located above heat sources, such as steam lines, or sources of air, such as manholes.

9.5.3.6 Coal placed in long-term storage shall be piled in layers, appropriately spread, and compacted prior to the addition of subsequent layers to reduce air movement and to minimize water infiltration into the pile.

9.5.3.7 Where possible, storage piles shall be arranged to allow access to the pile with earth-moving equipment in the event of developing hot spots or fire.

Chapter 10 Truck, Rail, and Barge Loadouts

10.1* Construction.

10.1.1 The loadout shall be constructed of noncombustible material.

10.1.2 Conveyor systems shall be in accordance with Section 9.1.

10.2 Fire Prevention.

10.2.1 No smoking shall be allowed in the loadout control room.

10.2.2* Loadout control rooms shall be designed, constructed, and maintained to reduce the chances of coal dust entering the room.

10.2.3 Combustible storage shall be maintained at least 0.9 m (3 ft) from all electrical panels, gas-fired heaters, and electric resistance heaters.

10.2.4 Trash and other unnecessary combustibles shall not be allowed to accumulate in the loadout control room.

10.2.5 Motor control centers shall be thermographically scanned on an annual basis to identify hot spots and loose electrical connections.

10.2.6 Hydraulic equipment shall have the following alarms interlocked to shut down the equipment:

- (1) Low oil pressure
- (2) High oil temperature
- (3) Low oil level

10.3 Life Safety.

10.3.1 Two means of egress shall be provided from the loadout control room if the room is more than two levels high.

10.3.2 For multistory buildings, emergency lighting shall be provided in accordance with *NFPA 101*.

10.3.3 For multistory buildings, emergency exit signs shall be provided along the means of egress.

10.4 Fire Detection and Protection.

10.4.1 A smoke detector system shall be installed in the loadout control room in accordance with *NFPA 72*.

10.4.1.1 The smoke detector system shall actuate an audible and visual alarm system.

10.4.1.2 For infrequently occupied or remote locations, the system shall send an alarm to a constantly attended location.

10.4.2* A gaseous fire suppression system shall be installed in loadout control rooms that are not regularly occupied and located in remote areas.

10.4.3 An automatic fire suppression system shall be installed to protect hydraulic pumps that have a capacity over 189.3 L (50 gal) and are located on an upper floor.

10.4.3.1 The system shall be actuated by a heat detector system.

10.4.3.2 The system shall be interlocked to shut off the power to the unit.

10.4.3.3 A listed fire-resistive fluid shall be an acceptable alternative to an automatic fire suppression system.

10.5 Manual Firefighting.

10.5.1* Fire extinguishers shall be provided in accordance with *NFPA 10*.

10.5.2 For multistory buildings, an emergency response plan shall be developed with the input of the local fire department.

10.5.3 For areas subject to flood, an emergency response plan shall be developed to include firefighting procedures during a flood.

N 10.5.4 Where portable fire extinguishers are provided in compliance with NFPA 10, intended users shall be educated on the potential hazard of creating a suspension of combustible dust from its use.

Δ Chapter 11 Emergency Response, Manual Firefighting, and Training

11.1* Emergency Procedures.

11.1.1 Emergency procedures shall be provided to instruct all miners in the location and use of firefighting equipment, location of escapeways and exits, and evacuation procedures.

11.1.2 The emergency procedures shall include a specific firefighting and evacuation plan with procedures for evacuation of all miners not required for firefighting activities, rapid assembly and transportation of personnel and equipment to the fire scene, and operation of the fire suppression equipment available at the mine.

11.1.3 Instruction in emergency procedures shall be provided to all miners on an annual basis.

11.1.4 Instruction in the location of firefighting equipment, location of escapeways and exits, and evacuation procedures shall be provided to all miners prior to entering an active mining area for the first time.

11.1.5 All employees shall receive annual instruction on emergency evacuation procedures.

11.1.6 All employees shall receive annual instruction on the procedures for discharging portable fire extinguishers and the proper method of fire attack.

11.1.7 For underground mines, the following additional criteria shall be met:

- (1) Fire drills shall be held on a 90-day basis. A record of the drill shall be kept and include the date, the number of persons participating, the area of the mine involved, the procedures followed, and the equipment used.
- (2) At least two miners in each working section on each production shift shall be proficient in the use of all fire suppression equipment in that section and know the location of the equipment.
- (3) Visitors shall be trained on the hazards they might encounter and in the appropriate emergency procedures.

11.1.8 The local fire department shall be requested or invited to make an annual tour of the surface area of the mine buildings. The tour shall include all surface buildings, major equipment, the location of ignitable (flammable and combustible) liquid storage, a discussion of the water supply availability, and the location of electrical shutoffs.

11.2 Underground Operations.

11.2.1 General.

11.2.1.1 An emergency response team shall be available and trained in basic firefighting techniques that would include, but not be limited to, fire hose, foam generators, fire extinguishers, and smoke control.

11.2.1.2 Each operator of attended equipment and each miner assigned to job duties normally in sight of the equipment shall be proficient in the use of the fire suppression devices on that equipment.

11.2.1.3 On a maintenance shift, the foreman and at least one miner for every five shall be proficient in the use of fire suppression equipment available in the mine and know the location of the equipment.

11.2.2 Firefighting Team. Mines shall have a firefighting team trained in basic firefighting techniques, for example, hose streams and foam generation.

11.2.2.1 The firefighting team shall have at least 16 hours of refresher training per year.

11.2.2.2 The team shall consist of at least five members on each shift.

11.2.2.3 Self-contained breathing apparatus (SCBA) and fire-retardant coats, boots, and gloves shall be provided for the firefighting team.

11.2.3 Emergency Vehicle.

11.2.3.1 All mines shall be provided with an emergency vehicle outfitted with fire hose, appropriate fittings, a “Y” or a “siamese” connection, two adjustable fire department-quality fog nozzles, various tools, and pressure regulators (where necessary).

11.2.3.2 If an underground water car is provided, it shall be at least 3785 L (1000 gal) capacity and shall have at least 91.4 m (300 ft) of fire hose with nozzles.

11.2.3.2.1 A water car shall be capable of providing flow through a hose of 190 L/min (50 gpm) at a nozzle pressure of 345 kPa (50 psi).

11.2.3.2.2 A portable wet or dry chemical car shall be permitted to be provided as long as it carries the extinguishing capacity equivalent to a water car.

11.2.3.2.3 The wet or dry chemical car described in 11.2.3.2.2 shall be no farther than 3.2 km (2 mi) from each working section.

11.2.4 Foam Generator. A high-expansion foam generator shall be available within 60 minutes of fire notification and have enough foam to supply the firefighting operation for 35 minutes.

11.2.5 Fire Hose and Hydrants.

11.2.5.1* Water lines installed parallel to haulage tracks using mechanized equipment in the track or adjacent entry shall be equipped with outlet valves at intervals of not more than 152.4 m (500 ft), and with 152.4 m (500 ft) of fire hose with fittings suitable for connection shall be provided at strategic locations.

11.2.5.2 Hydrants shall be provided along belt conveyors at intervals not to exceed 91.4 m (300 ft).

11.2.5.3 At least 152.4 m (500 ft) of fire hose shall be provided for each belt flight and strategically positioned within that belt flight.

11.2.5.4 The threads on the hose and hydrants shall be protected against dirt and rock grit.

11.2.5.5* Multiple hydrant assemblies, with the tools needed for their installation, shall be provided as part of each cache of emergency materials.

11.2.5.6 Fire hose shall be lined with a material having flame-resistant qualities meeting requirements for hose in the US Bureau of Mines' "Schedule 2G."

11.2.5.6.1 The covers of the fire hose shall be polyester or other material with flame-spread qualities and mildew resistance equal or superior to polyester.

11.2.5.6.2 The bursting pressure shall be at least four times the water pressure at the valve to the hose inlet with the valve closed.

11.2.5.6.3 The maximum water pressure in the hose nozzle shall not exceed a gauge pressure of 689.5 kPa (100 psi).

N 11.2.5.7 Fire hose stations, if provided, shall be equipped with electric-rated nozzles.

N 11.2.5.8 Users shall be trained in their use and the potential hazard of creating suspended combustible dust.

11.2.6 Emergency Materials. In addition to specific area equipment, the following equipment shall be readily available at locations not exceeding 3.2 km (2 mi) from each working section:

- (1) 304.8 m (1000 ft) of brattice boards
- (2) Two rolls of brattice cloth
- (3) Two hand saws
- (4) 11.3 kg (25 lb) of 8d nails
- (5) 11.3 kg (25 lb) of 10d nails
- (6) 11.3 kg (25 lb) of 16d nails
- (7) Three claw hammers
- (8) 25 bags of wood fiber plaster or 10 bags of cement (or equivalent material)
- (9) 4536 kg (5 tons) of rock dust

11.3 Surface Operations.

11.3.1* Surface mines shall meet the same requirements for firefighting teams listed in 11.2.2 unless public firefighters are available within 30 minutes with the capability to fight the most difficult fire at the mine site.

11.3.2 Fire extinguishers shall be provided in accordance with NFPA 10.

11.3.3 If fire hydrants are provided, they shall be installed in accordance with NFPA 24.

11.3.4 If fire hydrants are not provided, water trucks shall be the firefighting water source.

11.3.4.1 Water trucks shall be equipped with a pump, fire hose, nozzles, and appropriate fittings.

11.3.4.2 The water truck shall be equipped with a water cannon (turret).

11.3.4.3 The water truck shall be equipped with a connection to enable the fire department to take suction from the tank.

11.3.5 Fire hose and couplings shall be listed or approved. Cotton- or cotton-polyester-jacketed hose shall be treated in accordance with the US Department of Agriculture Forest Service Specification 5100-186(d) for mildew resistance.

11.3.6 Water lines shall be capable of delivering at least 378.5 L/min (100 gpm) at a hose nozzle pressure of 689.5 kPa (100 psi).

11.3.7 The water pressure at the hose nozzle shall not be excessively high so as to present a hazard to the hose operator.

11.3.8 The hose connections shall have threads compatible with the local fire department's hoses, or a supply of adapters shall be available to adapt the hose connections to the fire department hoses. The local fire department shall be consulted to ensure thread compatibility for hose connections.

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.1.1.1 In the development of this document, the data in NIOSH Information Circular 9470, "Analysis of Mine Fires for All Underground and Surface Coal Mining Categories: 1990–1999," were examined. Table A.1.1.1(a) shows the number of fires for underground coal mines; surface fires at underground coal mines, at surface coal mines, and at coal preparation plants; as well as the number of fire injuries and coal production for the time period from 1990 to 1999. Table A.1.1.1(b) provides the number of coal mines and preparation plant fires, injuries due to fire, and coal production from 2001 to 2016.

Analysis of the data shows a general decrease in the number of fires over the 10-year period, particularly from 1996 to 1999, while coal production increased slightly. The largest number of fires over the 10-year period, as well as for each 2-year time period, occurred at surface coal mines. There were 164 injuries due to fire during the 10-year period, with the number decreasing significantly over the last 4 years. There were two fatalities in 1991.

There are four classes of coal, each with characteristics that might differ from mine to mine. ASTM D388, *Standard Classification of Coals by Rank*, is a recognized method for classifying coals. Table A.1.1.1(c) provides a relationship between fixed carbon, volatile matter, and calorific value (Btu/lb)/(Mj/kg) and the classes and grouping of coals.

A.1.3 Because of the uniqueness of coal mining, provisions in this standard can differ from commonly accepted fire protection standards and guides for other types of occupancies.

Δ A.3.2.1 Approved. The National Fire Protection Association does not approve, inspect, or certify any installations, procedures, equipment, or materials nor does it approve or evaluate testing laboratories. In determining the acceptability of installations or procedures, equipment, or materials, the "authority having jurisdiction" may base acceptance on compliance with NFPA or other appropriate standards. In the absence of such standards, 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.

Table A.1.1.1(a) Number of Coal Mine and Preparation Plant Fires, Injuries Due to Fire, and Coal Production from 1990 to 1999

Years	Number of Fires*					
	Underground Coal Mines	Surface at Underground Coal Mines	Surface Coal Mines	Coal Preparation Plants	Number of Fire Injuries*	Coal Production [†] (10 ⁶ short tons)
1990–1991	25	17	67	23	59	2,004
1992–1993	18	14	37	22	29	1,928
1994–1995	23	16	47	18	39	2,059
1996–1997	6	7	40	8	19	2,155
1998–1999	15	11	24	20	18	2,218
Total	87	65	215	91	164	10,364

*Derived from MSHA “Fire Accident Abstract” and “Fire Accident Report” publications.

[†]Derived from MSHA “Injury Experience in Coal Mining” publications.**Table A.1.1.1(b) Number of Coal Mine and Preparation Plant Fires, Injuries Due to Fire, and Coal Production from 2001 to 2016**

Years	Number of Fires*					
	Underground Coal Mines	Surface at Underground Coal Mines	Surface Coal Mines	Coal Preparation Plants	Number of Fire Injuries*	Coal Production [†] (10 ⁶ short tons)
2001–2002	9	7	22	10	48	2,221
2003–2004	12	6	17	15	24	2,184
2005–2006	11	6	41	13	25	2,294
2007–2008	14	9	31	14	24	2,318
2009–2010	11	9	31	18	15	2,159
2011–2012	5	3	40	7	20	2,112
2013–2014	7	13	42	7	15	1,985
2015–2016	3	4	26	13	15	1,625
Total	72	57	250	97	186	16,898

*Derived from MSHA Datasets.

[†]Derived from the US Energy Information Administration, *Annual Coal Report*, 2017.**Table A.1.1.1(c) Coal Classification**

Class	Group	Fixed Carbon		Volatile Matter		Energy	
		Dry %	Moist %	Dry %	Moist %	Dry (Btu/lb)	Moist (Mj/kg)
Anthracite	Met. Anthracite	>98	>92	<2	<2	13,500	31.4
	Anthracite	92–98	89–85	2–8	2–8	15,300	35.5
	Semi-Anthracite	86–92	81–89	8–14	8–15	14,900	34.6
Bituminous	Low-volatile	78–86	73–81	14–22	13–21	15,400	35.8
	Medium volatile	69–78	65–73	21–31	21–29	14,900	34.6
	High-volatile A	<69	58–65	>31	>30	>14,000	>32.5
	High-volatile B	57	53	57	40	13,000–14,000	30.2–32.5
Sub-bituminous	High-volatile C	54	45	54	40	10,500–13,000	24.4–30.2
	A	55	45	55	38	10,500–11,500	24.4–26.7
	B	56	43	56	35	9,500–10,500	22.1–24.4
	C	53	37	53	36	8,300–9,500	19.3–22.1
Lignite (brown coal)	Lignite A	52	32	35	38	6,300–8,300	14.7–19.3
	Lignite B	52	26	32	50	<6,300	<14.

Source: ASTM D388, *Standard Classification of Coals by Rank*.

A.3.2.2 Authority Having Jurisdiction (AHJ). The phrase “authority having jurisdiction,” or its acronym AHJ, is used in NFPA standards in a broad manner because 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.3.2.4 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.3.3.33 Mobile Equipment. Mobile equipment includes, but is not limited to, wheeled, skid-mounted, track-mounted, or rail-mounted equipment capable of moving or being moved.

A.4.2 Potential sources of ignition include, but are not limited to, the following:

- (1) Smoking
- (2) Open flames
- (3) Cutting and welding
- (4) Hot surfaces
- (5) Frictional heat
- (6) Static, electrical, and mechanical sparks
- (7) Spontaneous ignition, including heat-producing chemical reactions
- (8) Radiant heat

A.4.2.5.1 Automatic-closing doors provide a higher level of fire protection and are therefore recommended.

A.4.2.6 Belt fires originating away from the drive area usually have been caused by idlers with defective or stuck bearings. Tests have shown that such idlers can become moderately hot [93.3°C to 149°C (200°F to 300°F)]. The coal task group has been unable to find reliable evidence that idlers can become hot enough to ignite fire-retardant belting directly.

It appears that a warm or hot idler can cause fine coal dust accumulated around the idler to ignite. Then, when the belt has been stopped, coal burning beneath the belt ignites the belting.

The key to avoiding belt fires is to prevent the accumulation of fine coal dust around idlers. If a metal deck is provided between the carrying strand and the return strand of the belt, coal dust accumulates around the troughing idlers. Where possible, return idlers should be supported at a substantial height above the bottom so that coal dust is not likely to build up around return idlers. With proper clearance beneath these idlers, accumulations of coal dust can be cleaned up more easily.

Slat-type, self-cleaning tail pulleys are recommended. Coal dust discharged by such pulleys should be cleaned up

frequently. Both good maintenance and good fire prevention necessitate that noisy bearings, which might indicate probable failure, be changed promptly before they become hot.

Conveyor belt fires have been caused by belts that lose proper alignment, with the edge of the moving belt then contacting combustible material. Loss of alignment can result from a number of factors, including displacement of idlers or pulleys and movement of supporting structure, spillage of conveyed material, and failure of a bearing (typically on a pulley). Where alignment is affected significantly, the edge of the belt can rub abrasively on the structure and objects near the edge of the belt. If the object on which the belt rubs is metal, the metal can become worn and heated. The edge of the belt can be damaged extensively, but the belt probably will not ignite because a point on the edge of the moving belt is in contact with the metal for only a very short period and will cool before it returns to the point of contact. The metal can become quite warm, but because it is a good conductor of heat, it will not become hot enough to ignite the belt if the belt stops. Nevertheless, if the material contacted is wood or another combustible, the combustible material could be heated by the friction of the edge of the moving belt until it ignites. Keeping combustible material away from the edge of the belt and use of alignment switches should prevent such fires.

A.4.2.11 Spontaneous combustion potential of coal depends on a number of factors, including mining practices, mining conditions, geology, and reactivity of the coal. The contributions of these factors can be determined by using a number of methods, including a NIOSH computer program named SPONCOM, which is available from the NIOSH web page.

A.4.2.11.2 Means to reduce the risk of spontaneous combustion include but are not limited to monitoring and trending of combustible gases, sealing, inerting, and using ventilation controls.

A.4.2.12.1 Transformers with mineral oil or other combustible coolants create an unnecessary risk in underground coal mines. Air-cooled transformers, nitrogen-cooled transformers, and transformers with approved less-flammable coolants are acceptable alternatives to mineral oil-filled transformers. If less-flammable oil transformers are used, they should be FM approved.

A.4.2.13 ASTM E1934, *Standard Guide for Examining Electrical and Mechanical Equipment with Infrared Thermography*, can be used as a guideline when performing thermographic scanning.

A.4.2.14 The provisions of 4.2.14 do not require inherently noncombustible materials to be tested in order to be classified as noncombustible materials. [101:A.4.6.13]

A.4.2.14(1) Examples of such materials include steel, concrete, masonry, and glass. [101:A.4.6.13.1(1)]

A.4.3 For further information see NIOSH Information Circular 9452, “An Underground Coal Mine Fire Preparedness and Response Checklist: The Instrument.”

A.4.3.1.1.1 Routing of water lines has caused severe problems in fighting fires at some large mines. These mines had multiple intake shafts spaced apart at considerable distances. Such ventilation can create a neutral point between the shafts, with fresh air moving from each shaft toward the neutral point. At the original opening of one mine, a water source was established and the water line was extended as the mining developed

farther away from the original opening. With the water line extended to each new intake shaft and passing through each neutral point, a condition of opposite direction of flow of air and water existed beyond each neutral point.

If a fire occurs in an area of opposite flow, the fire has to be approached in the same direction as the airflow, but the water flow is moving through the fire area. Usually water lines in a fire area are damaged or broken by falling sections of burning roof. When a water line breaks in such a situation, the firefighters are without water, and direct firefighting is no longer possible. The fire then can be controlled only by sealing. At least one large coal mining company now provides an additional water source at each new intake shaft to ensure the ability to fight such fires.

The likelihood of this problem appears to be increasing as more mines are ventilating belt entries with air moving outby, while the water flow is inby. In some cases, mine management has recognized the problem and has developed procedures to change the direction of airflow in the event of a fire. Reversing the airflow should be done at a point close to and outby the fire to avoid pushing smoke-laden air back onto the fire. After the belt entry outby the fire has been cleared of smoke, the airflow can be reversed for the full length of the entry if desired.

Mines that obtain their water supply from an underground source also can have this problem of opposite directions of air flow and water flow. Usually there is no sure solution except to provide an alternative source of water or a large storage of water on the surface. If the power for the pumps is fed from the high-voltage system that feeds the mine and the fire damages the high-voltage cable anywhere on the system, the power can trip the entire system and shut down the pumps. Coordination of the electrical protective equipment or even a separate power supply might be needed to ensure that the pumps continue to supply water for firefighting.

Even in situations where air and water are flowing in the same direction, management must recognize that water lines or hydrants in a burning entry are likely to be broken by the falling sections of burning roof. In such situations, a planned shut-down of the water line should be undertaken as soon as possible so a multiple hydrant can be installed in the water line at a convenient location close to the fire. With the multiple hydrant in place, at least three fire hose can be served effectively from the water line.

Because of the many factors that should guide the choice of location of water lines and hydrants, management should be properly qualified to select these locations, but management also should be able to justify its choice. Reliability of the water supply and ability of fire hose streams to reach a fire at any location or entry served by the water line should be the criteria by which the location is chosen.

A.4.3.1.1.9 Shutoff valve intervals of 305 m (1000 ft) are recommended. Indicator-type shutoff valves with labels specifying the normal operating position are recommended.

A.4.3.1.2.1 Water distribution lines generally cannot meet the capacity requirements of 4.3.1.2.1 unless 127 mm (5 in.) or 152.4 mm (6 in.) pipe is used for main water lines and 101.6 mm (4 in.) pipe is used for branch lines to producing areas. Higher nozzle pressures are recommended.

A.4.3.1.2.2 The required hose stream water demand equals a minimum supply of 817,650 L (216,000 gal).

A.4.3.1.3.1 Hydrants in a coal mine normally are only a valve screwed onto a tee that is installed on the water line. For the female coupling of a fire hose to be connected to a male thread, a pipe nipple usually is screwed into the discharge side of the valve. Because the threads of steel pipe nipples generally corrode if left exposed, brass nipples often are used instead of steel nipples. Many mines have begun to use Schedule 80 plastic nipples instead of steel. Regardless of the nipple material, the threads of the nipple should be protected against physical damage.

A properly designed system of hydrants and fire hose should make a good connection of fire hose lines to the hydrants without the need for tools.

The choice of locations for hydrants should be made to ensure that fire hose lines can be laid quickly from hydrants located on the water line through crosscuts to a fire located in any parallel entry or crosscut, rather than to provide convenience for use in the entry where the water line is located.

A.4.3.1.3.2 Hydrants should preferably be located in crosscuts, and stoppings in such crosscuts should be fitted with a man door.

A.4.3.2 Automatic detection systems and automatic sprinkler systems in mining facilities need to be specifically addressed for the following reasons:

- (1) The contents of a mine occupancy are continually changing. Most items are not fixed and are designed to be moved with the mining operation. A mine operates as a heavy-duty excavation construction site and, thus, has the same transitory nature as a construction site.
- (2) Unlike aboveground industrial occupancies, great distances are not unusual within an underground mine. Mines covering 64.75 km² (25 mi²) or more are common.
- (3) Mines have extremely harsh and unusual environments compared to aboveground industrial occupancies. Heavy concentrations of combustible dusts, the presence of explosive gases, temperature extremes, saturated humidity conditions, standing water, unstable strata, roof-to-floor heights that vary from 710 mm to 6.1 m (28 in. to 20 ft), and complex ventilation systems are all commonplace. The possibility of abuse from heavy machinery is a common hazard.
- (4) Mining occupancies exhibit unique physical characteristics not found in any other type of occupancy. One example is the extreme pressures that can occur in a water line.
- (5) Mines employ specialized facilities, equipment, and production processes not utilized in other industries. Fire protection efforts that fail to consider the unusual operating characteristics and fire protection requirements of underground coal mining systems could result in nonoptimal protection or the inadvertent introduction of hazards.

30 CFR 75.1103-4 provides requirements for installing fire detection systems in underground coal mines in the United States.

A.4.3.2.1.1 An automatic fire detector is a device designed to detect the presence of fire and initiate action. For the purpose

of this standard, automatic fire detectors are classified as follows:

- (1) *Heat detector*: a device that detects an abnormally high temperature or rate of temperature rise
- (2) *Smoke detector*: a device that detects the visible or invisible particles of combustion
- (3) *Flame detector*: a device that detects the infrared, ultraviolet, or visible radiation produced by a fire
- (4) *Fire-gas detector*: a device that detects gases produced by a fire
- (5) *Other fire detectors*: devices that detect a phenomenon other than heat, smoke, flame, or gases produced by a fire

Fire detectors should be installed as follows:

- (1) *Vertical Placement*. Because the hot gases from a fire will rise owing to buoyancy forces, combustion products initially will be stratified near the roof of an entry. As the stratified gas layer moves away from the fire, the resultant cooling and dilution eventually will produce a well-mixed flow of combustion products. Data from full-scale fires indicate that some degree of stratification can exist at distances of hundreds of feet from the source of the fire. Because of this effect, fire detectors should be located at a vertical distance from the entry roof that does not exceed 25 percent of the average entry height. For example, in an entry with a height of 1.8 m (6 ft), the maximum distance from the roof at which a sensor should be located is 0.5 m (1½ ft). The maximum distance refers to the location of the actual sampling intake of the detector used.
- (2) *Lateral Placement*. In general, the point of origin of a fire is unpredictable. It can occur along the floor, ribs, or roof of the entry. To provide optimum protection, it is recommended that the fire detectors be located within 0.6 m (2 ft) of the approximate midpoint of the entry. For entries in which the point of origin of the fire can be better estimated (such as a belt entry), the detectors should be located in such a manner that they provide for the estimated best coverage of that entry.

A.4.3.2.1.3 Batteries charged by the mine power system should indicate the condition of the batteries upon either manual or automatic activation of a battery check circuit.

For further information see *NFPA 72*.

A.4.3.2.1.4 Electrical equipment classified as “permissible” or “intrinsically safe” is certified as meeting the requirements of Chapter 1 of 30 CFR 18.

A.4.3.2.2.1 Based on US Bureau of Mines Report of Investigation 9570, “Hazards of Conveyor Belt Fires,” CO and smoke detectors provide a significant improvement over point type heat detectors in warning of a potential fire on conveyor belts.

A.4.3.2.2.2 US Bureau of Mines Report of Investigation 9380, “Fire Detection for Conveyor Belt Entries,” provides information on smoke and CO sensor alarm levels and sensor spacing as a function of belt entry cross-sectional area and belt entry air velocity.

A.4.3.2.2.10 A motor control center (MCC) is one example of the type of building described in 4.3.2.2.10.

A.4.3.3.1.1(3) Depending on the size of the equipment, additional manual actuators could be needed to provide quick access for activation of the system.

A.4.3.3.1.1(4) For further information on flame resistance, see 30 CFR 18.65.

A.4.3.3.1.1(6) Open-head deluge and water spray systems can be kept free of blockage by regular flow of water through the system. For example, fire suppression on continuous miners can be flowed once per shift to keep the nozzles clean. Deluge water spray systems at belt drives can be flowed weekly to keep the nozzles clean.

A.4.3.3.1.4 For criteria of equivalent protection, see 30 CFR 75.1107-13.

A.4.3.3.2.1 Wet-pipe automatic sprinkler systems have been found to be the preferred fire suppression systems for underground coal mines for the following reasons:

- (1) They are the simplest systems available.
- (2) They are the most reliable systems available.
- (3) They provide selective operation, because only sprinklers close to the fire operate.
- (4) They have the best performance record, especially on fires of Class A materials and of Class IIIB combustible liquids.
- (5) They need minimal maintenance.
- (6) They are nonelectrical.
- (7) They use a limited quantity of water.
- (8) The initial investment is low.

The major problem associated with automatic sprinkler systems in underground coal mines is the possibility of exposure to freezing conditions during cold weather. Another problem that can exist in very deep mines is that some of the listed components for automatic sprinkler systems might be unable to withstand the very high water pressure encountered (see US Bureau of Mines Report of Investigation 9451, “Effect of Pressure on Leakage of Automatic Sprinklers”). It is not uncommon to encounter pressures above a gauge pressure of 3448 kPa (500 psi). The committee recommends testing sprinkler system components under anticipated maximum pressures. If sprinkler components are found to be unable to withstand the maximum pressure of the water line, the use of pressure regulators might be necessary. Experience has shown that pressure regulators can require considerable maintenance. Also, if the pressure regulating valve should leak, it might be necessary to provide a small relief valve on the discharge side of the regulating valve to prevent overpressure.

A.4.3.3.2.1.1(1) Under Report No. H0122086, “Suppression of Fires on Underground Coal Mine Conveyor Belts,” the Department of the Interior, US Bureau of Mines (USBM), conducted a series of full-scale fire tests.

The tests demonstrated that standard, 12.7 mm (½ in.) orifice, nominal 100°C (212°F) automatic sprinklers, located over the belt on 3 m (10 ft) centers, effectively controlled every test fire while opening only two sprinklers, with residual pressure held to a constant a gauge pressure of 69 kPa (10 psi).

From the time that the USBM tests were conducted, underground belts have tended to become wider to carry increased tonnage; therefore, belt fire suppression systems should be designed to supply more sprinklers than indicated by these tests. Because many conveyor belts stretch a long distance in a straight line, a fire scenario would involve only a portion of the belt, regardless of the overall length of the belt. Because the actual incidence of belt fires is low in underground coal mines, and most of those are in the area of the belt drive and the belt

takeup, protection of only the area from the discharge pulley to the end of the takeover is needed. If the belt structure contains a deck between upper and lower strands of the belt, automatic sprinklers should be located beneath the deck, virtually doubling the size of the sprinkler system.

If the sprinkler system is extended to cover a distance greater than 30.5 m (100 ft) in one direction from the point where the pipe holding the automatic sprinklers along the roof is fed, then a hydraulic calculation of the system is recommended. Long runs of pipe should be flow tested as required by 4.3.3.5.5.1, with the eight open sprinklers installed at the distant end of the pipe run. Branch piping intended to protect limited areas should be piped with adequately sized pipe to carry the required water flow. Table A.4.3.3.2.1.1(1) should be used to determine the minimum size of pipe.

Larger systems should be separately flow tested as required by 4.3.3.5.5.1.

A.4.3.3.2.2 Because many air compressors are moved frequently, the fire suppression system needs to be equally portable. Some compressors that have a deck or lid over the compressor have been fitted with piping and sprinklers attached to the underside of the deck. Other compressors without a deck have suitable piping with at least two sprinklers 3 m (10 ft) apart. The piping is made to be attached to roof bolts or otherwise suitably supported over the centerline of the compressor. The piping needs to be equipped with a pressure switch that prevents the operation of the compressor unless the piping is under pressure and with a flow switch that shuts the compressor down if water flows. If a fire hose is used to connect the piping to a water line, the connection point of the hose to the sprinkler piping should be located so that a fire on the compressor will not damage the fire hose.

A.4.3.3.3.1 NFPA 13 requires a minimum 140 kPa (20 psi) residual pressure for ordinary hazard pipe schedule sprinkler systems.

A.4.3.3.3.2.1 Pipe and fittings that permit limited motion of the pipe are recommended, as they allow the pipe to be held closer to the roof. If threaded fittings are used, steel pipe with extra-strength threaded fittings is recommended. Copper, aluminum, or other approved materials could be permitted if they are adequate for the pressure.

A number of mines use aluminum pipe or tubing with groove-type couplings and fittings. Where water pressure does not exceed 3448 kPa (500 psi), grooved couplings that have a

12.7 mm (½ in.) female national pipe thread (FNPT) outlet are used to provide connections for sprinklers. Piping put together in this manner can be located closer to an undulating roof, especially if the pipe lengths are short enough to put the couplings (and the automatic sprinklers) on 3 m (10 ft) centers. Mines that use groove-type couplings can have most of the piping pre-cut and grooved in the shop, which simplifies installation underground. Rolled grooves are recommended because they do not reduce the strength of the pipe as much as the cut grooves do. If cut grooves are used, Schedule 40 or heavier pipe should be used.

A.4.3.3.3.2.5 Some automatic sprinklers might not withstand the water pressure that can be encountered in deep mines. Information on the effect of high water pressure on automatic sprinklers can be found in US Bureau of Mines Report of Investigation 9451, "Effect of Pressure on Leakage of Automatic Sprinklers."

Under US Bureau of Mines Report of Investigation 9538, "Performance of Automatic Sprinkler Systems for Extinguishing Incipient and Propagating Conveyor Belt Fires Under Ventilated Conditions," NIOSH conducted a series of full-scale fire tests under ventilated conditions of 1.1 and 4.0 m/s (225 and 800 ft/min) for fires up to 10.8 MW. The tests demonstrated that pendent and horizontal sidewall types were both able to extinguish incipient belt fires. Directional sprinklers showed a slightly improved performance in terms of maximum heat release rate at the lower airflow. Both pendent and horizontal sidewall sprinkler types were able to extinguish propagating fires. Horizontal sidewall sprinklers showed an increased effectiveness compared to the pendent sprinklers because of the increased upstream coverage area of the water discharge in terms of maximum heat release rate.

A.4.3.3.3.2.6 The restrictions on sprinkler spacing apply to sprinklers on the same line and those located between sprinklers on adjacent lines.

A.4.3.3.3.2.7 Where sprinkler positioning is such that full coverage can be impaired, such as where a single line of sprinklers protects a belt conveyor with little clearance, a flow test should be conducted to determine if adequate wetting of surface areas is achieved. Additional sprinklers should be provided in the event that adequate coverage is not achieved, or alternative arrangements such as rotated lines or sidewall sprinklers should be considered. Consideration also should be given to the need for noncombustible baffles to protect sprinklers from the discharge of adjacent sprinklers located within 1.8 m (6 ft).

A.4.3.3.3.5 Dry-pipe automatic sprinkler systems are more complex and more difficult to design and install than wet-pipe systems. The committee recommends that all systems be designed and installed by skilled and experienced personnel.

A pressure relief valve, set to relieve at a pressure below the maximum pressure rating of the dry-pipe valve, should be installed between the pressure regulating valve and the dry-pipe valve. The reclosing pressure of the relief valve should be higher than the set pressure of the regulating valve.

A.4.3.3.3.6.1 Underground shaft mines that use diesel-powered equipment generally employ underground diesel fuel storage areas to facilitate equipment refueling. Adit-type mines in the western United States might initially locate diesel fuel storage and refueling facilities on the surface; however, as the

Table A.4.3.3.2.1.1(1) Minimum Pipe Sizes per Number of Sprinklers

Pipe Size	Maximum Number of Sprinklers on Pipe
1 in.	2
1¼ in.	3
1½ in.	5
2 in.	10
2½ in.	20
3 in.	40
3½ in.	65
4 in.	100

For SI units, 1 in. = 25.4 mm.