

NFPA® 13

Standard for the Installation of Sprinkler Systems

2010 Edition



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NFPA® 13
Standard for the
Installation of Sprinkler Systems
2010 Edition

This edition of NFPA 13, *Standard for the Installation of Sprinkler Systems*, was prepared by the Technical Committee on Hanging and Bracing of Water-Based Fire Protection Systems, Private Water Supply Piping Systems, Residential Sprinkler Systems, Sprinkler System Discharge Criteria, and Sprinkler System Installation Criteria and released by the Technical Correlating Committee on Automatic Sprinkler Systems, and acted on by NFPA at its June Association Technical Meeting held June 8-11, 2009, in Chicago, IL. It was issued by the Standards Council on August 6, 2009, with an effective date of August 26, 2009, and supersedes all previous editions.

This edition of NFPA 13 was approved as an American National Standard on August 26, 2009.

Origin and Development of NFPA 13

NFPA 13 represents the first standard published under the auspices of the NFPA Committee on Automatic Sprinklers. Originally titled *Rules and Regulations of the National Board of Fire Underwriters for Sprinkler Equipments, Automatic and Open Systems*, the standard has been continuously updated to keep in step with change.

Full information about the NFPA actions on various changes will be found in the NFPA Proceedings. The dates of successive editions are as follows: 1896, 1899, 1902, 1905, 1907, 1908, 1912, 1913, 1915, 1916, 1917, 1919, 1920, 1921, 1922, 1923, 1924, 1925, 1926, 1927, 1928, 1929. In 1930, a separate standard was published on Class B systems. This was integrated into the 1931 edition. Further revisions were adopted in 1934, 1935, and 1936. A two-step revision was presented in the form of a progress report in 1939 and finally adopted in 1940. Further amendments were made in 1947, 1950, 1953, 1956, 1958, 1960, 1961, 1963, 1964, 1965, 1966, 1968, 1969, 1971, 1972, 1973, 1974, 1975, 1976, 1978, 1980, 1982, 1984, 1986, and 1989.

The 1991 edition incorporated an entire rewrite of the standard to make the overall format user friendly. Substantive changes were made to numerous terms, definitions, and descriptions, with additional refinements made in 1994.

The centennial (1996) edition included a significant rework of the requirements pertaining to the application, placement, location, spacing, and use of various types of sprinklers. Other changes provided information on extended coverage sprinklers and recognized the benefits of fast-response sprinkler technology.

The 1999 edition encompassed a major reorganization of NFPA's Sprinkler Project that included the establishment of a Technical Correlating Committee on Automatic Sprinkler Systems and four new sprinkler systems technical committees, the consolidation of NFPA's sprinkler system design and installation requirements, and the implementation of numerous technical changes.

The scope of NFPA 13 was expanded to address all sprinkler system applications. The 1999 edition contained information on the installation of underground pipe from NFPA 24 and sprinkler system discharge criteria for on-floor and rack storage of Class I, II, III, IV, and plastic commodities, rubber tires, baled cotton, and roll paper that were previously located in NFPA 231, 231C, 231D, 231E, and 231F. Additionally, sprinkler system information for specialized hazards from over 40 NFPA documents was either copied into NFPA 13 using NFPA's extract policy or specifically referenced. A new chapter was also added to address the structural aspects of exposed and buried system piping. A table of cross-references to previous editions and material that was located in other NFPA documents was included at the end of the 1999 edition.

More specific changes included a new sprinkler identification marking system and the designation of sprinkler sizes by nominal K-factors. New criteria for the use of steel pipe in underground applications was added, as well as a new provision to guard against microbio-

logically influenced corrosion. Obstruction rules for specific sprinkler types and rules for locating sprinklers in concealed spaces were revised. New limitations were placed on the sprinkler sizes in storage applications, and criteria for the K-25 sprinkler was added. Additionally, the requirements for protecting sprinklers against seismic events also underwent significant revision.

The 2002 edition of NFPA 13 underwent style formatting and technical revisions. The style formatting was completed to comply with the *Manual of Style for NFPA Technical Committee Documents* and to reorganize many of the requirements in NFPA 13 into unique chapters. Editorially, NFPA 13 eliminated all of the exceptions and reworded them as requirements where applicable, moved the mandatory references to Chapter 2, and relocated all of the definitions to Chapter 3. In reorganizing NFPA 13, several new chapters were created to consolidate requirements including the following: Chapter 10 contained all of the applicable requirements for underground piping including materials, installation, and acceptance testing; Chapter 11 contained design approaches including pipe schedule, density/area method, room design method, special design areas, residential sprinklers, exposure protection, and water curtains; Chapter 12 contained the design approaches for the protection of storage, including idle pallets, miscellaneous storage, storage less than 12 ft, palletized, solid pile, bin box, and shelf storage, rack storage less than 25 ft, rack storage greater than 25 ft, rubber tire, baled cotton, rolled paper, and special storage designs; Chapter 13 contained all of the design and installation requirements from all of the various documents that have been extracted into NFPA 13.

The 2002 edition made specific technical changes to address several key issues. Three major areas of irregular ceiling were addressed, including skylights, stepped ceilings, and ceiling pockets. The design requirements for ESFR sprinklers were expanded to allow the user to choose the storage height and then the building height for any allowable arrangement. Design requirements for the protection of storage on solid shelves were added. Requirements for the installation of residential sprinklers were added that parallel the requirements for other types of sprinklers.

For the 2007 edition, definitions were reorganized to locate all of the storage definitions in one area, and several new definitions addressing private water supply terms were added. The definitions and requirements of Ordinary Hazard Group 1 and 2 Occupancies were clarified where storage is present. The requirements for trapeze hangers were clarified and made consistent for all components, and the seismic bracing criteria were updated to ensure that NFPA 13 contains all of the appropriate requirements for installation and design of seismic bracing of fire sprinkler systems. The requirements for storage were further reorganized and divided into separate chapters addressing general requirements for storage; miscellaneous storage; protection of Class I to Class IV commodities that are stored palletized, solid piled, bin boxes, or self storage; protection of plastic and rubber commodities that are stored palletized, solid piled, bin boxes, or shelf storage; protection of Class I through Class IV commodities that are stored on racks; protection of plastic and rubber commodities that are stored on racks; protection of rubber tire storage; protection of roll paper; and special designs of storage protection.

Prior editions of this document have been translated into languages other than English, including French and Spanish.

For the 2010 edition many of the major changes relate to the requirements for storage protection. First is the combining of large drop sprinkler and the specific application control mode sprinkler requirements and revising the terminology to now identify them as Control Mode Specific Application sprinklers (CMSA). Next, new criteria for use of smoke vents have been added to Chapter 12. The density/area curves in the storage chapters have been reduced to a maximum 3000 ft² operating area; this is a significant reduction of some curves that had extended up to 6000 ft². Changes to rack storage in this edition include a new method to calculate the rack shelf area. Finally, the provisions for back to back shelf storage have been added to the storage chapters.

Criteria for the protection of three new special storage arrangements have been added to Chapter 20. These include protection of carton records storage with catwalk access; compact shelving of commodities consisting of paper files, magazines, books, and similar documents in folders and miscellaneous supplies with no more than 5 percent plastics up to 8 ft high; and protection of high bay record storage.

In Chapter 9, a number of changes occurred regarding sway bracing of sprinkler systems including the introduction of new zone of influence tables for Schedule 5 steel pipe, CPVC, and Type M copper tube. Also the means for calculating the loads in the zone of influence have been modified to correlate with SEI/ASCE-7 and a new Annex E describes this calculation.

Other areas of change include requirements for listed expansion chambers; clarification of ceiling pocket rules; and clarification of the formulas used in calculating large antifreeze systems.

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Committee Scope: This Committee shall have the primary responsibility for documents on private piping systems supplying water for fire protection and for hydrants, hose houses, and valves. The Committee is also responsible for documents on fire flow testing and marking of hydrants.

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

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

Committee Scope: This Committee shall have primary responsibility for documents on the design and installation of automatic sprinkler systems in dwellings and residential occupancies up to and including four stories in height, including the character and adequacy of water supplies, and the selection of sprinklers, piping, valves, and all materials and accessories.



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

Committee Scope: This Committee shall have primary responsibility for those portions of NFPA 13 that pertain to the classification of various fire hazards and the determination of associated discharge criteria for sprinkler systems employing automatic and open sprinklers.

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

Committee Scope: This Committee shall have the primary responsibility for those portions of NFPA 13 that pertain to the criteria for the use and installation of sprinkler systems components (with the exception of those components used for supporting of piping), position of sprinklers, types of systems, plans and calculations, water supplies, and acceptance testing.



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NFPA 13

Standard for the Installation of Sprinkler Systems

2010 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.

Changes other than editorial are indicated by a vertical rule beside the paragraph, table, or figure in which the change occurred. These rules are included as an aid to the user in identifying changes from the previous edition. Where one or more complete paragraphs have been deleted, the deletion is indicated by a bullet (•) between the paragraphs that remain.

A reference in brackets [] following a section or paragraph indicates material that has been extracted from another NFPA document. As an aid to the user, the complete title and edition of the source documents for extracts in mandatory sections of the document are given in Chapter 2 and those for extracts in informational sections are given in Annex F. 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 publications can be found in Chapter 2 and Annex F.

Chapter 1 Administration

1.1* Scope.

1.1.1 This standard shall provide the minimum requirements for the design and installation of automatic fire sprinkler systems and exposure protection sprinkler systems covered within this standard.

1.1.2 This standard is written with the assumption that the sprinkler system shall be designed to protect against a single fire originating within the building.

1.2* Purpose.

1.2.1 The purpose of this standard shall be to provide a reasonable degree of protection for life and property from fire through standardization of design, installation, and testing requirements for sprinkler systems, including private fire service mains, based on sound engineering principles, test data, and field experience.

1.2.2 Sprinkler systems and private fire service mains are specialized fire protection systems and shall require knowledgeable and experienced design and installation.

1.3 Application.

1.3.1 This standard shall apply to the following:

- (1) Character and adequacy of water supplies
- (2) Selection of sprinklers
- (3) Fittings
- (4) Piping
- (5) Valves
- (6) All materials and accessories, including the installation of private fire service mains

1.3.2 This standard shall also apply to “combined service mains” used to carry water for both fire service and other uses as well as to mains for fire service use only.

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.

1.5 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.

1.6 New Technology.

1.6.1 Nothing in this standard shall be intended to restrict new technologies or alternate arrangements, provided the level of safety prescribed by this standard is not lowered.

1.6.2 Materials or devices not specifically designated by this standard shall be utilized in complete accord with all conditions, requirements, and limitations of their listings.

1.7 Units and Symbols.

1.7.1 Units.

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

1.7.1.2 Two units (liter and bar), outside of but recognized by SI, are commonly used in international fire protection.

1.7.1.3 These units with conversion factors shall be used as listed in Table 1.7.1.3.

1.7.1.4 If a value for measurement as given in this standard is followed by an equivalent value in other units, the first stated shall be regarded as the requirement.

Table 1.7.1.3 Conversion Factors

Name of Unit	Unit Symbol	Conversion Factor
liter	L	1 gal = 3.785 L
millimeter per minute	mm/min	1 gpm/ft ² = 40.746 mm/min = 40.746 (L/min)/m ²
cubic decimeter	dm ³	1 gal = 3.785 dm ³
pascal	Pa	1 psi = 6894.757 Pa
bar	bar	1 psi = 0.0689 bar
bar	bar	1 bar = 10 ⁵ Pa

Note: For additional conversions and information, see ASTM SI 10, *Standard for Use of the International System of Units (SI): The Modern Metric System*.

1.7.2 Hydraulic Symbols. The standard abbreviations in Table 1.7.2 shall be used on the hydraulic calculation form discussed in Chapter 22.

Table 1.7.2 Hydraulic Symbols

Symbol or Abbreviation	Item
p	Pressure in psi
gpm	U.S. gallons per minute
q	Flow increment in gpm to be added at a specific location
Q	Summation of flow in gpm at a specific location
P_t	Total pressure in psi at a point in a pipe
P_f	Pressure loss due to friction between points indicated in location column
P_e	Pressure due to elevation difference between indicated points. This can be a plus value or a minus value. If minus, the (–) shall be used; if plus, no sign need be indicated.
P_v	Velocity pressure in psi at a point in a pipe
P_n	Normal pressure in psi at a point in a pipe
E	90-degree ell
EE	45-degree ell
Lt.E	Long-turn elbow
Cr	Cross
T	Tee-flow turned 90 degrees
GV	Gate valve
BV	Butterfly (wafer) check valve
Del V	Deluge valve
ALV	Alarm valve
DPV	Dry pipe valve
CV	Swing check valve
WCV	Butterfly (wafer) check valve
St	Strainer
psi	Pounds per square inch
v	Velocity of water in pipe in feet per second

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 11, *Standard for Low-, Medium-, and High-Expansion Foam*, 2005 edition.

NFPA 14, *Standard for the Installation of Standpipe and Hose Systems*, 2007 edition.

NFPA 15, *Standard for Water Spray Fixed Systems for Fire Protection*, 2007 edition.

NFPA 20, *Standard for the Installation of Stationary Pumps for Fire Protection*, 2010 edition.

NFPA 22, *Standard for Water Tanks for Private Fire Protection*, 2008 edition.

NFPA 24, *Standard for the Installation of Private Fire Service Mains and Their Appurtenances*, 2010 edition.

NFPA 25, *Standard for the Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems*, 2008 edition.

NFPA 30, *Flammable and Combustible Liquids Code*, 2008 edition.

NFPA 30B, *Code for the Manufacture and Storage of Aerosol Products*, 2007 edition.

NFPA 33, *Standard for Spray Application Using Flammable or Combustible Materials*, 2007 edition.

NFPA 40, *Standard for the Storage and Handling of Cellulose Nitrate Film*, 2007 edition.

NFPA 51B, *Standard for Fire Prevention During Welding, Cutting, and Other Hot Work*, 2009 edition.

NFPA 59, *Utility LP-Gas Plant Code*, 2008 edition.

NFPA 59A, *Standard for the Production, Storage, and Handling of Liquefied Natural Gas (LNG)*, 2009 edition.

NFPA 70®, *National Electrical Code®*, 2008 edition.

NFPA 72®, *National Fire Alarm and Signaling Code*, 2010 edition.

NFPA 82, *Standard on Incinerators and Waste and Linen Handling Systems and Equipment*, 2009 edition.

NFPA 96, *Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations*, 2008 edition.

NFPA 120, *Standard for Fire Prevention and Control in Coal Mines*, 2004 edition.

NFPA 170, *Standard for Fire Safety and Emergency Symbols*, 2009 edition.

NFPA 214, *Standard on Water-Cooling Towers*, 2005 edition.

NFPA 251, *Standard Methods of Tests of Fire Resistance of Building Construction and Materials*, 2006 edition.

• NFPA 259, *Standard Test Method for Potential Heat of Building Materials*, 2008 edition.

NFPA 409, *Standard on Aircraft Hangars*, 2004 edition.

NFPA 703, *Standard for Fire Retardant-Treated Wood and Fire-Retardant Coatings for Building Materials*, 2009 edition.

NFPA 780, *Standard for the Installation of Lightning Protection Systems*, 2008 edition.

NFPA 1963, *Standard for Fire Hose Connections*, 2009 edition.

NFPA 5000®, *Building Construction and Safety Code®*, 2009 edition.

2.3 Other Publications.

2.3.1 ASCE Publications. American Society of Civil Engineers, 1801 Alexander Bell Drive, Reston, VA 20191-4400.

ASCE 7-05, *Minimum Design Loads for Buildings and Other Structures*, 2005.



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

ASME BPVC-IX, *BPVC Section IX — Welding and Brazing Qualifications*, 2004.

ASME A17.1, *Safety Code for Elevators and Escalators*, 2000.

ASME B1.20.1, *Pipe Threads, General Purpose (Inch)*, 2001.

ASME B16.1, *Cast Iron Pipe Flanges and Flanged Fittings, Classes 25, 125, and 250*, 1998.

ASME B16.3, *Malleable Iron Threaded Fittings, Classes 150 and 300*, 1998.

ASME B16.4, *Cast Iron Threaded Fittings, Classes 125 and 250*, 1998.

ASME B16.5, *Pipe Flanges and Flanged Fittings*, 1996.

ASME B16.9, *Factory-Made Wrought Steel Butt welding Fittings*, 2001.

ASME B16.11, *Forged Steel Fittings, Socket-Welding and Threaded*, 1996.

ASME B16.18, *Cast Copper Alloy Solder Joint Pressure Fittings*, 1994.

ASME B16.22, *Wrought Copper and Copper Alloy Solder Joint Pressure Fittings*, 1995.

ASME B16.25, *Butt welding Ends*, 1997.

ANSI/ASME B31.1, *Code for Power Piping*, 2001.

ANSI/ASME B36.10M, *Welded and Seamless Wrought Steel Pipe*, 2000.

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

ANSI/ASTM A 53, *Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless*, 2001.

ASTM A 106, *Standard Specification for Seamless Carbon Steel Pipe for High Temperature Service*, 2008.

ASTM A 135, *Standard Specification for Electric-Resistance-Welded Steel Pipe*, 2001.

ASTM A 153A/153M, *Standard Specification for Zinc Coating (Hot Dip) on Iron and Steel Hardware*, 2004.

ASTM A 234, *Standard Specification for Piping Fittings of Wrought-Carbon Steel and Alloy Steel for Moderate and High Temperature Service*, 2001.

ASTM A 795, *Standard Specification for Black and Hot-Dipped Zinc-Coated (Galvanized) Welded and Seamless Steel Pipe for Fire Protection Use*, 2000.

ASTM B 32, *Standard Specification for Solder Metal*, 2000.

ASTM B 75, *Standard Specification for Seamless Copper Tube*, 1999.

ASTM B 88, *Standard Specification for Seamless Copper Water Tube*, 1999.

ASTM B 251, *Standard Specification for General Requirements for Wrought Seamless Copper and Copper-Alloy Tube*, 1997.

ASTM B 446, *Standard Specification for Nickel-Chromium-Molybdenum-Columbium Alloy (UNSN 06625) and Nickel-Chromium-Molybdenum-Silicon Alloy (UNSN 06219) Rod and Bar*, 2000.

ASTM B 813, *Standard Specification for Liquid and Paste Fluxes for Soldering Applications of Copper and Copper-Alloy Tube*, 2000.

ASTM B 828, *Standard Practice for Making Capillary Joints by Soldering of Copper and Copper Alloy Tube and Fittings*, 2000.

ASTM C 635, *Standard Specification for the Manufacture, Performance, and Testing of Metal Suspension Systems for Acoustical Tile and Lay-In Panel Ceilings*, 2004.

ASTM C 636, *Standard Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-In Panels*, 2004.

ASTM E 84, *Standard Test Method for Surface Burning Characteristics of Building Materials*, 2004.

ASTM E 119, *Standard Test Methods for Fire Tests of Building Construction and Materials*, 2000.

ASTM E 136, *Standard Test Method for Behavior of Materials in a Vertical Tube Furnace at 750°C*, 1999.

ASTM F 437, *Standard Specification for Threaded Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80*, 1999.

ASTM F 438, *Standard Specification for Socket-Type Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 40*, 2001.

ASTM F 439, *Standard Specification for Socket-Type Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80*, 2001.

ASTM F 442, *Standard Specification for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe (SDR-PR)*, 1999.

ASTM F 1121, *Standard Specification for International Shore Connections for Marine Fire Applications*, 1998.

ASTM SI 10, *Standard for Use of the International System of Units (SI): The Modern Metric System*, 1997.

2.3.4 AWS Publications. American Welding Society, 550 N.W. LeJeune Road, Miami, FL 33126.

AWS A5.8, *Specification for Filler Metals for Brazing and Braze Welding*, 1992.

AWS B2.1, *Specification for Welding Procedure and Performance Qualification*, 2000.

2.3.5 AWWA Publications. American Water Works Association, 6666 West Quincy Avenue, Denver, CO 80235.

AWWA C104, *Cement Mortar Lining for Ductile Iron Pipe and Fittings for Water*, 1995.

AWWA C105, *Polyethylene Encasement for Ductile Iron Pipe Systems*, 1999.

AWWA C110, *Ductile Iron and Gray Iron Fittings, 3-in. Through 48-in. (76 mm Through 1219 mm), for Water and Other Liquids*, 1998.

AWWA C111, *Rubber Gasket Joints for Ductile Iron Pressure Pipe and Fittings*, 2000.

AWWA C115, *Flanged Ductile Iron Pipe with Ductile Iron or Gray Iron Threaded Flanges*, 1999.

AWWA C 116, *Protective Fusion-Bonded Epoxy Coatings Internal and External Surface Ductile-Iron/Gray-Iron Fittings*, 2003.

AWWA C150, *Thickness Design of Ductile Iron Pipe*, 1996.

AWWA C151, *Ductile Iron Pipe, Centrifugally Cast for Water*, 1996.

AWWA C153, *Ductile-Iron Compact Fittings for Water Service*, 2000.

AWWA C200, *Steel Water Pipe 6 in. (150 mm) and Larger*, 1997.

AWWA C203, *Coal-Tar Protective Coatings and Linings for Steel Water Pipelines Enamel and Tape — Hot Applied*, 1997.

AWWA C205, *Cement-Mortar Protective Lining and Coating for Steel Water Pipe 4 in. (100 mm) and Larger — Shop Applied*, 2000.

AWWA C206, *Field Welding of Steel Water Pipe*, 1997.

AWWA C207, *Steel Pipe Flanges for Waterworks Service — Sizes 4 in. Through 144 in. (100 mm Through 3,600 mm)*, 1994.

AWWA C208, *Dimensions for Fabricated Steel Water Pipe Fittings*, 1996.

AWWA C300, *Reinforced Concrete Pressure Pipe, Steel-Cylinder Type, for Water and Other Liquids*, 1997.

AWWA C301, *Prestressed Concrete Pressure Pipe, Steel-Cylinder Type, for Water and Other Liquids*, 1999.

AWWA C302, *Reinforced Concrete Pressure Pipe, Non-Cylinder Type, for Water and Other Liquids*, 1995.

AWWA C303, *Reinforced Concrete Pressure Pipe, Steel-Cylinder Type, Pretensioned, for Water and Other Liquids*, 1995.

AWWA C400, *Standard for Asbestos-Cement Distribution Pipe, 4 in. Through 16 in. (100 mm Through 400 mm), for Water and Other Liquids*, 1998.

AWWA C401, *Standard Practice for the Selection of Asbestos-Cement Water Pipe, 4 in. Through 16 in. (100 mm Through 400 mm)*, 1998.

AWWA C600, *Standard for the Installation of Ductile Iron Water Mains and Their Appurtenances*, 1999.

AWWA C602, *Cement-Mortar Lining of Water Pipe Lines 4 in. (100 mm) and Larger — in Place*, 2000.

AWWA C603, *Standard for the Installation of Asbestos-Cement Water Pipe*, 1996.

AWWA C900, *Polyvinyl Chloride (PVC) Pressure Pipe, 4 in. Through 12 in. (100 mm Through 300 mm), for Water and Other Liquids*, 1997.

AWWA C906, *Polyethylene (PE) Pressure Pipe and Fittings, 4 in. (100 mm) Th. 63 in. (1,575 mm), for Water Distribution and Transportation*, 1999.

AWWA M11, *A Guide for Steel Pipe Design and Installation*, 3rd edition, 1989.

2.3.6 IEEE Publications. Institute of Electrical and Electronics Engineers, Three Park Avenue, 17th Floor, New York, NY 10016-5997.

IEEE 45, *Recommended Practice for Electric Installations on Shipboard*, 1998.

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

ANSI/UL 723, *Standard for Surface Burning Characteristics of Building Materials*, 2008.

2.3.8 U.S. Government Publications. U.S. Government Printing Office, Washington, DC 20402.

Title 46, CFR, Parts 54.15-10 Safety and Relief Valves, 56.20 Valves, 56.20-5(a) Markings, 56.50-95 Overboard Discharges and Shore Connections, 56.60 Materials, and 58.01-40 Machinery, Angle of Inclination.

Title 46, CFR, Subchapter F, “Marine Engineering.”

Title 46, CFR, Subchapter J, “Electrical Engineering.”

2.3.9 Other Publications.

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

2.4 References for Extracts in Mandatory Sections.

NFPA 24, *Standard for the Installation of Private Fire Service Mains and Their Appurtenances*, 2010 edition.

NFPA 33, *Standard for Spray Application Using Flammable or Combustible Materials*, 2007 edition.

NFPA 37, *Standard for the Installation and Use of Stationary Combustion Engines and Gas Turbines*, 2006 edition.

NFPA 40, *Standard for the Storage and Handling of Cellulose Nitrate Film*, 2007 edition.

NFPA 45, *Standard on Fire Protection for Laboratories Using Chemicals*, 2004 edition.

NFPA 51, *Standard for the Design and Installation of Oxygen-Fuel Gas Systems for Welding, Cutting, and Allied Processes*, 2007 edition.

NFPA 55, *Compressed Gases and Cryogenic Fluids Code*, 2010 edition.

NFPA 59, *Utility LP-Gas Plant Code*, 2008 edition.

NFPA 59A, *Standard for the Production, Storage, and Handling of Liquefied Natural Gas (LNG)*, 2009 edition.

NFPA 70®, *National Electrical Code®*, 2008 edition.

NFPA 75, *Standard for the Protection of Information Technology Equipment*, 2009 edition.

NFPA 76, *Standard for the Fire Protection of Telecommunications Facilities*, 2009 edition.

NFPA 82, *Standard on Incinerators and Waste and Linen Handling Systems and Equipment*, 2009 edition.

NFPA 86, *Standard for Ovens and Furnaces*, 2007 edition.

NFPA 91, *Standard for Exhaust Systems for Air Conveying of Vapors, Gases, Mists, and Noncombustible Particulate Solids*, 2004 edition.

NFPA 99, *Standard for Health Care Facilities*, 2005 edition.

NFPA 99B, *Standard for Hypobaric Facilities*, 2010 edition.

NFPA 120, *Standard for Fire Prevention and Control in Coal Mines*, 2004 edition.

NFPA 122, *Standard for Fire Prevention and Control in Metal/Nonmetal Mining and Metal Mineral Processing Facilities*, 2004 edition.

NFPA 130, *Standard for Fixed Guideway Transit and Passenger Rail Systems*, 2010 edition.

NFPA 140, *Standard on Motion Picture and Television Production Studio Soundstages, Approved Production Facilities, and Production Locations*, 2008 edition.

NFPA 150, *Standard on Fire and Life Safety in Animal Housing Facilities*, 2009 edition.

NFPA 214, *Standard on Water-Cooling Towers*, 2005 edition.

NFPA 307, *Standard for the Construction and Fire Protection of Marine Terminals, Piers, and Wharves*, 2006 edition.

NFPA 318, *Standard for the Protection of Semiconductor Fabrication Facilities*, 2009 edition.

NFPA 415, *Standard on Airport Terminal Buildings, Fueling Ramp Drainage, and Loading Walkways*, 2008 edition.

NFPA 423, *Standard for Construction and Protection of Aircraft Engine Test Facilities*, 2004 edition.

NFPA 804, *Standard for Fire Protection for Advanced Light Water Reactor Electric Generating Plants*, 2006 edition.

NFPA 805, *Performance-Based Standard for Fire Protection for Light Water Reactor Electric Generating Plants*, 2006 edition.

NFPA 850, *Recommended Practice for Fire Protection for Electric Generating Plants and High Voltage Direct Current Converter Stations*, 2005 edition.

NFPA 851, *Recommended Practice for Fire Protection for Hydroelectric Generating Plants*, 2005 edition.

NFPA 909, *Code for the Protection of Cultural Resource Properties — Museums, Libraries, and Places of Worship*, 2010 edition.



Chapter 3 Definitions

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

3.2 NFPA Official Definitions.

3.2.1* Approved. Acceptable to the authority having jurisdiction.

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

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

3.2.4 Shall. Indicates a mandatory requirement.

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

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

3.3 General Definitions.

3.3.1 Automatic Sprinkler. A fire suppression or control device that operates automatically when its heat-activated element is heated to its thermal rating or above, allowing water to discharge over a specified area.

3.3.2* Bathroom. Within a dwelling unit, any room or compartment dedicated to personal hygiene, containing a toilet, sink, or bathing capability such as a shower or tub.

3.3.3 Ceiling Height. The distance between the floor and the underside of the ceiling above (or roof deck) within the area.

3.3.4* Ceiling Pocket. An architectural ceiling feature that consists of a bounded area of ceiling located at a higher elevation than the attached lower ceiling.

3.3.5 Ceiling Types.

3.3.5.1 Flat Ceiling. A continuous ceiling in a single plane.

3.3.5.2 Horizontal Ceiling. A ceiling with a slope not exceeding 2 in 12.

3.3.5.3 Sloped Ceiling. A ceiling with a slope exceeding 2 in 12.

3.3.5.4 Smooth Ceiling. A continuous ceiling free from significant irregularities, lumps, or indentations.

3.3.6 Compartment. A space completely enclosed by walls and a ceiling. Each wall in the compartment is permitted to have openings to an adjoining space if the openings have a minimum lintel depth of 8 in. (200 mm) from the ceiling and the total width of the openings in each wall does not exceed 8 ft (2.4 m). A single opening of 36 in. (900 mm) or less in width without a lintel is permitted when there are no other openings to adjoining spaces.

3.3.7 Drop-Out Ceiling. A suspended ceiling system, which is installed below the sprinklers, with listed translucent or opaque panels that are heat sensitive and fall from their setting when exposed to heat.

3.3.8 Dwelling Unit. One or more rooms arranged for the use of one or more individuals living together, as in a single house-keeping unit normally having cooking, living, sanitary, and sleeping facilities. For purposes of this standard, dwelling unit includes hotel rooms, dormitory rooms, apartments, condominiums, sleeping rooms in nursing homes, and similar living units.

3.3.9 Fire Control. Limiting the size of a fire by distribution of water so as to decrease the heat release rate and pre-wet adjacent combustibles, while controlling ceiling gas temperatures to avoid structural damage.

3.3.10 Fire Suppression. Sharply reducing the heat release rate of a fire and preventing its regrowth by means of direct and sufficient application of water through the fire plume to the burning fuel surface.

3.3.11 Fuel-Fired Heating Unit. An appliance that produces heat by burning fuel.

3.3.12 Hydraulically Designed System. A calculated sprinkler system in which pipe sizes are selected on a pressure loss basis to provide a prescribed water density, in gallons per minute per square foot (mm/min), or a prescribed minimum discharge pressure or flow per sprinkler, distributed with a reasonable degree of uniformity over a specified area.

3.3.13* Limited-Combustible (Material). Refers to a building construction material not complying with the definition of noncombustible material that, in the form in which it is used, has a potential heat value not exceeding 3500 Btu/lb (8141 kJ/kg), where tested in accordance with NFPA 259, *Standard Test Method for Potential Heat of Building Materials*, and includes either of the following: (1) materials having a structural base of noncombustible material, with a surfacing not exceeding a thickness of 1/8 in. (3.2 mm) that has a flame spread index not greater than 50; or (2) materials, in the form and thickness used, having neither a flame spread index greater than 25 nor evidence of continued progressive combustion, and of such composition that surfaces that would be exposed by cutting through the material on any plane would have neither a flame spread index greater than 25 nor evidence of continued progressive combustion, when tested in accordance with ASTM E 84, *Standard Test Method of Surface Burning Characteristics of Building Materials*, or ANSI/UL 723, *Standard Test Method of Surface Burning Characteristics of Building Materials*.

3.3.14 Noncombustible Material. 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; materials that are reported as passing ASTM E 136, *Standard Test Method for Behavior of Materials in a Vertical Tube Furnace at 750 Degrees C*, shall be considered noncombustible materials.

3.3.15 Pipe Schedule System. A sprinkler system in which the pipe sizing is selected from a schedule that is determined by the occupancy classification and in which a given number of sprinklers are allowed to be supplied from specific sizes of pipe.

3.3.16 Shop-Welded. As used in this standard, *shop* in the term *shop-welded* means either (1) a sprinkler contractor's or fabricator's premise or (2) an area specifically designed or authorized for welding, such as a detached outside location, maintenance shop, or other area (either temporary or permanent) of noncombustible or fire-resistive construction free of combustible and flammable contents and suitably segregated from adjacent areas.

3.3.17 Small Room. A room of light hazard occupancy classification having unobstructed construction, and a floor area not exceeding 800 ft² (74.3 m²) that is enclosed by walls and a ceiling. Each wall in the small room is permitted to have openings to an adjoining space if the openings have a minimum lintel depth of 8 in. (200 mm) from the ceiling and the total width of the openings in each wall does not exceed 8 ft (2.4 m). A single opening of 36 in. (900 mm) or less in width without a lintel is permitted.

3.3.18* Sprinkler System. For fire protection purposes, an integrated system of underground and overhead piping designed in accordance with fire protection engineering standards. The installation includes at least one automatic water supply that supplies one or more systems. The portion of the sprinkler system above ground is a network of specially sized or hydraulically designed piping installed in a building, structure, or area, generally overhead, and to which sprinklers are attached in a systematic pattern. Each system has a control valve located in the system riser or its supply piping. Each sprinkler system includes a device for actuating an alarm when the system is in operation. The system is usually activated by heat from a fire and discharges water over the fire area.

3.3.19 System Working Pressure. The maximum anticipated static (nonflowing) or flowing pressure applied to sprinkler system components exclusive of surge pressures and exclusive of pressure from the fire department connection.

3.3.20 Thermal Barrier. A material that limits the average temperature rise of the unexposed surface to not more than 250°F (139°C) above ambient for a specified fire exposure duration using the standard time-temperature curve of NFPA 251, *Standard Methods of Tests of Fire Resistance of Building Construction and Materials*, or ASTM E 119, *Standard Test Methods for Fire Tests of Building Construction and Materials*.

3.4 Sprinkler System Type Definitions.

3.4.1 Antifreeze Sprinkler System. A wet pipe sprinkler system employing automatic sprinklers that are attached to a piping system that contains an antifreeze solution and that are connected to a water supply. The antifreeze solution is discharged, followed by water, immediately upon operation of sprinklers opened by heat from a fire.

3.4.2 Circulating Closed-Loop Sprinkler System. A wet pipe sprinkler system having non-fire protection connections to automatic sprinkler systems in a closed-loop piping arrangement for the purpose of utilizing sprinkler piping to conduct water for heating or cooling, where water is not removed or used from the system but only circulated through the piping system.

3.4.3 Combined Dry Pipe-Preaction Sprinkler System. A sprinkler system employing automatic sprinklers attached to a piping system containing air under pressure with a supplemental

detection system installed in the same areas as the sprinklers. Operation of the detection system actuates tripping devices that open dry pipe valves simultaneously and without loss of air pressure in the system. Operation of the detection system also opens listed air exhaust valves at the end of the feed main, which usually precedes the opening of sprinklers. The detection system also serves as an automatic fire alarm system.

3.4.4 Deluge Sprinkler System. A sprinkler system employing open sprinklers that are attached to a piping system that is connected to a water supply through a valve that is opened by the operation of a detection system installed in the same areas as the sprinklers. When this valve opens, water flows into the piping system and discharges from all sprinklers attached thereto.

3.4.5 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.

3.4.6* Gridded Sprinkler System. A sprinkler system in which parallel cross mains are connected by multiple branch lines. An operating sprinkler will receive water from both ends of its branch line while other branch lines help transfer water between cross mains.

3.4.7* Looped Sprinkler System. A sprinkler system in which multiple cross mains are tied together so as to provide more than one path for water to flow to an operating sprinkler and branch lines are not tied together.

3.4.8 Multi-Cycle System. A type of sprinkler system capable of repeated on-off flow cycles in response to heat.

3.4.9* Preaction Sprinkler System. A sprinkler system employing automatic sprinklers that are attached to a piping system that contains air that might or might not be under pressure, with a supplemental detection system installed in the same areas as the sprinklers.

3.4.10 Wet Pipe Sprinkler System. A sprinkler system employing automatic sprinklers attached to a piping system containing water and connected to a water supply so that water discharges immediately from sprinklers opened by heat from a fire.

3.5* System Component Definitions.

3.5.1 Air Receiver. A chamber, compatible with an air compressor, that can store air under pressure that is higher in pressure than that in the dry pipe or preaction system piping.

3.5.2 Air Reservoir. A chamber that can store air at the same pressure that is in the wet pipe system piping.

3.5.3 Arm-Over. A horizontal pipe that extends from the branch line to a single sprinkler or a sprinkler above and below a ceiling.

3.5.4 Branch Lines. The pipes supplying sprinklers, either directly or through sprigs, drops, return bends, or arm-overs.

3.5.5 Cross Mains. The pipes supplying the branch lines, either directly or through risers.

3.5.6 Feed Mains. The pipes supplying cross mains, either directly or through risers.

3.5.7 Flexible Listed Pipe Coupling. A listed coupling or fitting that allows axial displacement, rotation, and at least 1 degree of angular movement of the pipe without inducing harm on the



pipe. For pipe diameters of 8 in. (203.2 mm) and larger, the angular movement shall be permitted to be less than 1 degree but not less than 0.5 degree.

3.5.8 Riser Nipple. Vertical piece of pipe between the main and branch line.

3.5.9 Risers. The vertical supply pipes in a sprinkler system.

3.5.10 Sprig. A pipe that rises vertically and supplies a single sprinkler.

3.5.11 Supervisory Device. A device arranged to supervise the operative condition of automatic sprinkler systems.

3.5.12 System Riser. The aboveground horizontal or vertical pipe between the water supply and the mains (cross or feed) that contains a control valve (either directly or within its supply pipe) and a waterflow alarm device.

3.5.13 Waterflow Alarm Device. An attachment to the sprinkler system that detects a predetermined water flow and is connected to a fire alarm system to initiate an alarm condition or is used to mechanically or electrically initiate a fire pump or local audible or visual alarm.

3.6 Sprinkler Definitions.

3.6.1* General Sprinkler Characteristics. The following are characteristics of a sprinkler that define its ability to control or extinguish a fire. (a) Thermal sensitivity. A measure of the rapidity with which the thermal element operates as installed in a specific sprinkler or sprinkler assembly. One measure of thermal sensitivity is the response time index (RTI) as measured under standardized test conditions. (1) Sprinklers defined as fast response have a thermal element with an RTI of 50 (meters-seconds)^{1/2} or less. (2) Sprinklers defined as standard response have a thermal element with an RTI of 80 (meters-seconds)^{1/2} or more. (b) Temperature rating. (c) Orifice size (*see Chapter 6*). (d) Installation orientation (*see 3.6.2*). (e) Water distribution characteristics (i.e., application rate, wall wetting). (f) Special service conditions (*see 3.6.3*).

3.6.2 Installation Orientation. The following sprinklers are defined according to orientation.

3.6.2.1 Concealed Sprinkler. A recessed sprinkler with cover plate.

3.6.2.2 Flush Sprinkler. A sprinkler in which all or part of the body, including the shank thread, is mounted above the lower plane of the ceiling.

3.6.2.3 Pendent Sprinkler. A sprinkler designed to be installed in such a way that the water stream is directed downward against the deflector.

3.6.2.4 Recessed Sprinkler. A sprinkler in which all or part of the body, other than the shank thread, is mounted within a recessed housing.

3.6.2.5 Sidewall Sprinkler. A sprinkler having special deflectors that are designed to discharge most of the water away from the nearby wall in a pattern resembling one-quarter of a sphere, with a small portion of the discharge directed at the wall behind the sprinkler.

3.6.2.6 Upright Sprinkler. A sprinkler designed to be installed in such a way that the water spray is directed upwards against the deflector.

3.6.3 Special Service Conditions. The following sprinklers are defined according to special application or environment.

3.6.3.1 Corrosion-Resistant Sprinkler. A sprinkler fabricated with corrosion-resistant material, or with special coatings or platings, to be used in an atmosphere that would normally corrode sprinklers.

3.6.3.2* Dry Sprinkler. A sprinkler secured in an extension nipple that has a seal at the inlet end to prevent water from entering the nipple until the sprinkler operates.

3.6.3.3 Institutional Sprinkler. A sprinkler specially designed for resistance to load-bearing purposes and with components not readily converted for use as weapons.

3.6.3.4 Intermediate Level Sprinkler/Rack Storage Sprinkler. A sprinkler equipped with integral shields to protect its operating elements from the discharge of sprinklers installed at higher elevations.

3.6.3.5 Ornamental/Decorative Sprinkler. A sprinkler that has been painted or plated by the manufacturer.

3.6.3.6 Pilot Line Detector. A standard spray sprinkler or thermostatic fixed-temperature release device used as a detector to pneumatically or hydraulically release the main valve, controlling the flow of water into a fire protection system.

3.6.4 Sprinkler Types. The following sprinklers are defined according to design and performance characteristics.

3.6.4.1* Control Mode Specific Application (CMSA) Sprinkler. A type of spray sprinkler that is capable of producing characteristic large water droplets and that is listed for its capability to provide fire control of specific high-challenge fire hazards.

3.6.4.2* Early Suppression Fast-Response (ESFR) Sprinkler. A type of fast-response sprinkler that meets the criteria of 3.6.1(a)(1) and is listed for its capability to provide fire suppression of specific high-challenge fire hazards.

3.6.4.3 Extended Coverage Sprinkler. A type of spray sprinkler with maximum coverage areas as specified in Sections 8.8 and 8.9 of this standard.

3.6.4.4 Nozzles. A device for use in applications requiring special water discharge patterns, directional spray, or other unusual discharge characteristics.

3.6.4.5 Old-Style/Conventional Sprinkler. A sprinkler that directs from 40 percent to 60 percent of the total water initially in a downward direction and that is designed to be installed with the deflector either upright or pendent.

3.6.4.6 Open Sprinkler. A sprinkler that does not have actuators or heat-responsive elements.

3.6.4.7* Quick-Response (QR) Sprinkler. A type of spray sprinkler that meets the fast response criteria of 3.6.1(a)(1) and is listed as a quick-response sprinkler for its intended use.

3.6.4.7.1* Quick-Response Early Suppression (QRES) Sprinkler. A type of quick-response sprinkler that meets the criteria of 3.6.1(a)(1) and is listed for its capability to provide fire suppression of specific fire hazards.

3.6.4.7.2 Quick-Response Extended Coverage Sprinkler. A type of quick-response sprinkler that meets the criteria of 3.6.1(a)(1) and complies with the extended protection areas defined in Chapter 8.

3.6.4.8 Residential Sprinkler. A type of fast-response sprinkler having a thermal element with an RTI of 50 (meters-seconds)^{1/2} or less, that has been specifically investigated for its ability to enhance survivability in the room of fire origin, and that is listed for use in the protection of dwelling units.

3.6.4.9 Special Sprinkler. A sprinkler that has been tested and listed as prescribed in 8.4.8.

3.6.4.10 Spray Sprinkler. A type of sprinkler listed for its capability to provide fire control for a wide range of fire hazards.

3.6.4.10.1 Standard Spray Sprinkler. A spray sprinkler with maximum coverage areas as specified in Sections 8.6 and 8.7 of this standard.

3.7 Construction Definitions.

3.7.1* Obstructed Construction. Panel construction and other construction where beams, trusses, or other members impede heat flow or water distribution in a manner that materially affects the ability of sprinklers to control or suppress a fire.

3.7.2* Unobstructed Construction. Construction where beams, trusses, or other members do not impede heat flow or water distribution in a manner that materially affects the ability of sprinklers to control or suppress a fire. Unobstructed construction has horizontal structural members that are not solid, where the openings are at least 70 percent of the cross-section area and the depth of the member does not exceed the least dimension of the openings, or all construction types where the spacing of structural members exceeds 7½ ft (2.3 m) on center.

3.8 Private Water Supply Piping Definitions.

3.8.1 General Definitions from NFPA 24.

3.8.1.1 Appurtenance. An accessory or attachment that enables the private fire service main to perform its intended function. [24, 2010]

3.8.1.2 Corrosion Resistant Piping. Piping that has the property of being able to withstand deterioration of its surface or its properties when exposed to its environment. [24, 2010]

3.8.1.3 Corrosion Retardant Material. A lining or coating material that when applied to piping or appurtenances has the property of reducing or slowing the deterioration of the object's surface or properties when exposed to its environment. [24, 2010]

3.8.1.4 Fire Department Connection. A connection through which the fire department can pump supplemental water into the sprinkler system, standpipe, or other system, furnishing water for fire extinguishment to supplement existing water supplies. [24, 2010]

3.8.1.5 Fire Pump. A pump supplying water at the flow and pressure required by water-based fire protection systems. [24, 2010]

3.8.1.6 Hose House. An enclosure located over or adjacent to a hydrant or other water supply designed to contain the necessary hose nozzles, hose wrenches, gaskets, and spanners to be used in fire fighting in conjunction with and to provide aid to the local fire department. [24, 2010]

3.8.1.7 Hydrant Butt. The hose connection outlet of a hydrant. [24, 2010]

3.8.1.8 Hydraulically Calculated Water Demand Flow Rate. The water flow rate for a system or hose stream that has been calculated using accepted engineering practices. [24, 2010]

3.8.1.9 Pressure.

3.8.1.9.1 Residual Pressure. The pressure that exists in the distribution system, measured at the residual hydrant at the time the flow readings are taken at the flow hydrants. [24, 2010]

3.8.1.9.2 Static Pressure. The pressure that exists at a given point under normal distribution system conditions measured at the residual hydrant with no hydrants flowing. [24, 2010]

3.8.1.10 Pressure Regulating Device. A device designed for the purpose of reducing, regulating, controlling, or restricting water pressure. Examples include pressure-reducing valves, pressure-control valves, and pressure-restricting devices. [24, 2010]

3.8.1.11* Private Fire Service Main. Private fire service main, as used in this standard, is that pipe and its appurtenances on private property (1) between a source of water and the base of the system riser for water-based fire protection systems, (2) between a source of water and inlets to foam-making systems, (3) between a source of water and the base elbow of private hydrants or monitor nozzles, and (4) used as fire pump suction and discharge piping, (5) beginning at the inlet side of the check valve on a gravity or pressure tank. [24, 2010]

3.8.1.12 Pumper Outlet. The hydrant outlet intended for use by fire departments for taking supply from the hydrant for pumpers. [24, 2010]

3.8.1.13 Rated Capacity. The flow available from a hydrant at the designated residual pressure (rated pressure) either measured or calculated. [24, 2010]

3.8.1.14 Test.

3.8.1.14.1 Flow Test. A test performed by the flow and measurement of water from one hydrant and the static and residual pressures from an adjacent hydrant for the purpose of determining the available water supply at that location. [24, 2010]

3.8.1.14.2 Flushing Test. A test of a piping system using high velocity flows to remove debris from the piping system prior to it being placed in service. [24, 2010]

3.8.1.14.3 Hydrostatic Test. A test of a closed piping system and its attached appurtenances consisting of subjecting the piping to an increased internal pressure for a specified period of duration to verify system integrity and leak rates. [24, 2010]

3.8.1.15 Valve.

3.8.1.15.1 Check Valve. A valve that allows flow in one direction only. [24, 2010]

3.8.1.15.2 Indicating Valve. A valve that has components that show if the valve is open or closed. Examples are outside screw and yoke (OS&Y) gate valves and underground gate valves with indicator posts. [24, 2010]

3.8.2 Hydrant Definitions from NFPA 24.

3.8.2.1 Hydrant. An exterior valved connection to a water supply system that provides hose connections. [24, 2010]

3.8.2.1.1 Dry Barrel Hydrant. This is the most common type of hydrant; it has a control valve below the frost line between the footpiece and the barrel. A drain is located at the bottom of the barrel above the control valve seat for proper drainage after operation. [24, 2010]

3.8.2.1.2 Flow Hydrant. The hydrant that is used for the flow and flow measurement of water during a flow test. [24, 2010]

3.8.2.1.3 Private Fire Hydrant. A valved connection on a water supply system having one or more outlets and that is used to supply hose and fire department pumpers with water on private property. Where connected to a public water system, the private hydrants are supplied by a private service main that begins at the point of service designated by the authority having jurisdiction, usually at a manually operated valve near the property line. [24, 2010]

3.8.2.1.4 Public Hydrant. A valved connection on a water supply system having one or more outlets and that is used to supply hose and fire department pumpers with water. [24, 2010]

3.8.2.1.5 Residual Hydrant. The hydrant that is used for measuring static and residual pressures during a flow test. [24, 2010]

3.8.2.1.6 Wet Barrel Hydrant. A type of hydrant that sometimes is used where there is no danger of freezing weather. Each outlet on a wet barrel hydrant is provided with a valved outlet threaded for fire hose. [24, 2010]

3.9 Storage Definitions.

3.9.1* General.

3.9.1.1* Available Height for Storage. The maximum height at which commodities can be stored above the floor and still maintain necessary clearance from structural members and the required clearance below sprinklers.

3.9.1.2 Cartoned. A method of storage consisting of corrugated cardboard or paperboard containers fully enclosing the commodity.

3.9.1.3* Carton Records Storage. A Class III commodity consisting predominantly of paper records in cardboard cartons.

3.9.1.4 Catwalk. For the purposes of carton records storage, a storage aid consisting of either open metal grating or solid horizontal barriers supported from a rack storage system that is utilized as a walkway for access to storage at elevated levels. Catwalks are accessed using stairs and are not separate floors of a building.

3.9.1.5 Clearance. The distance from the top of storage to the ceiling sprinkler deflectors.

3.9.1.6 Commodity. The combination of products, packing material, and container that determines commodity classification.

3.9.1.7 Compact Storage. Storage on solid shelves not exceeding 36 in. (0.9 m) in total depth, arranged as part of a compact storage module, with no more than 30 in. (0.76 m) between shelves vertically and with no internal vertical flue spaces other than those between individual shelving sections.

3.9.1.8 Compact Storage Module. A type of shelving unit consisting of compact storage whereby the units move to

allow for storage to be pushed together creating a storage unit with no flues or minimal spaces between units. Aisles are created by moving the shelving unit. Compact storage modules can be manual or electric in operation.

3.9.1.9* Compartmented. The rigid separation of the products in a container by dividers that form a stable unit under fire conditions.

3.9.1.10* Container (Shipping, Master, or Outer Container). A receptacle strong enough, by reason of material, design, and construction, to be shipped safely without further packaging.

3.9.1.11* Conventional Pallets. A material-handling aid designed to support a unit load with openings to provide access for material-handling devices. (See Figure A.3.9.1.11.)

3.9.1.12 Encapsulation. A method of packaging consisting of a plastic sheet completely enclosing the sides and top of a pallet load containing a combustible commodity or a combustible package or a group of combustible commodities or combustible packages. Combustible commodities individually wrapped in plastic sheeting and stored exposed in a pallet load also are to be considered encapsulated. Totally noncombustible commodities on wood pallets enclosed only by a plastic sheet as described are not covered under this definition. Banding (i.e., stretch-wrapping around the sides only of a pallet load) is not considered to be encapsulation. Where there are holes or voids in the plastic or waterproof cover on the top of the carton that exceed more than half of the area of the cover, the term *encapsulated* does not apply. The term *encapsulated* does not apply to plastic-enclosed products or packages inside a large, nonplastic, enclosed container.

3.9.1.13 Expanded (Foamed or Cellular) Plastics. Those plastics, the density of which is reduced by the presence of numerous small cavities (cells), interconnecting or not, dispersed throughout their mass.

3.9.1.14 Exposed Group A Plastic Commodities. Those plastics not in packaging or coverings that absorb water or otherwise appreciably retard the burning hazard of the commodity. (Paper wrapped or encapsulated, or both, should be considered exposed.)

3.9.1.15 Free-Flowing Plastic Materials. Those plastics that fall out of their containers during a fire, fill flue spaces, and create a smothering effect on the fire. Examples include powder, pellets, flakes, or random-packed small objects [e.g., razor blade dispensers, 1 oz to 2 oz (28 g to 57 g) bottles].

3.9.1.16 High-Challenge Fire Hazard. A fire hazard typical of that produced by fires in combustible high-piled storage.

3.9.1.17 High-Piled Storage. Solid-piled, palletized, rack storage, bin box, and shelf storage in excess of 12 ft (3.7 m) in height.

3.9.1.18* Miscellaneous Storage. Storage that does not exceed 12 ft (3.66 m) in height and is incidental to another occupancy use group. Such storage shall not constitute more than 10 percent of the building area or 4000 ft² (372 m²) of the sprinklered area, whichever is greater. Such storage shall not exceed 1000 ft² (93 m²) in one pile or area, and each such pile or area shall be separated from other storage areas by at least 25 ft (7.62 m).

3.9.1.19* Open-Top Container. A container of any shape that is entirely or partially open on the top.

3.9.1.20 Packaging. A commodity wrapping, cushioning, or container.

3.9.1.21 Plastic Pallet. A pallet having any portion of its construction consisting of a plastic material.

3.9.1.22* Reinforced Plastic Pallet. A plastic pallet incorporating a secondary reinforcing material (such as steel or fiberglass) within the pallet.

3.9.1.23 Roof Height. The distance between the floor and the underside of the roof deck within the storage area.

3.9.1.24 Slave Pallet. A special pallet captive to a material-handling system. (See Figure A.3.9.1.11.)

3.9.1.25 Storage Aids. Commodity storage devices, such as pallets, dunnage, separators, and skids.

3.9.1.26 Unit Load. A pallet load or module held together in some manner and normally transported by material-handling equipment.

3.9.1.27 Wood Pallet. A pallet constructed entirely of wood with metal fasteners.

3.9.2 Palletized, Solid Pile, Bin Box, and Shelf Storage.

3.9.2.1 Array.

3.9.2.1.1 Closed Array. A storage arrangement where air movement through the pile is restricted because of 6 in. (152 mm) or less vertical flues.

3.9.2.1.2* Open Array. A storage arrangement where air movement through the pile is enhanced because of vertical flues larger than 6 in. (152 mm).

3.9.2.2 Bin Box Storage. Storage in five-sided wood, metal, or cardboard boxes with open face on the aisles. Boxes are self-supporting or supported by a structure so designed that little or no horizontal or vertical space exists around boxes.

3.9.2.3 Palletized Storage. Storage of commodities on pallets or other storage aids that form horizontal spaces between tiers of storage.

3.9.2.4* Pile Stability, Stable Piles. Those arrays where collapse, spillage of content, or leaning of stacks across flue spaces is not likely to occur soon after initial fire development.

3.9.2.5* Pile Stability, Unstable Piles. Those arrays where collapse, spillage of contents, or leaning of stacks across flue spaces occurs soon after initial fire development.

3.9.2.6* Shelf Storage. Storage on structures up to and including 30 in. (0.76 m) deep and separated by aisles at least 30 in. (0.76 m) wide.

3.9.2.6.1* Back-to-Back Shelf Storage. Two solid or perforated shelves up to 30 in. (0.76 m) in depth each, not exceeding a total depth of 60 in. (1.52 m), separated by a longitudinal vertical barrier such as plywood, particleboard, sheet metal, or equivalent, with a maximum 0.25 in. (6.4 mm) diameter penetrations and no longitudinal flue space and a maximum storage height of 15 ft (4.57 m).

3.9.2.7 Solid-Piled Storage. Storage of commodities stacked on each other.

3.9.2.8 Solid Unit Load of a Nonexpanded Plastic (Either Carbonated or Exposed). A load that does not have voids (air) within the load and that burns only on the exterior of the load; water from sprinklers might reach most surfaces available to burn.

3.9.3 Rack Storage.

3.9.3.1* Aisle Width. The horizontal dimension between the face of the loads in racks under consideration.

3.9.3.2 Automotive Components on Portable Racks. Automotive components on portable racks are defined as the following: instrument panels, windshields, metal and plastic gasoline tanks, heater housings, door panels, interior trim, bumper facia, wiring harnesses, sheet metal, body components, engines, driveline components, steering mechanisms, auxiliary motors, and lighting — all with or without expanded plastic donnage. This definition does not include the storage of air bags, tires, and seats on portable racks.

3.9.3.3 Bulkhead. A vertical barrier across the rack.

3.9.3.4* Face Sprinklers. Standard sprinklers that are located in transverse flue spaces along the aisle or in the rack, are within 18 in. (0.46 m) of the aisle face of storage, and are used to oppose vertical development of fire on the external face of storage.

3.9.3.5 Horizontal Barrier. A solid barrier in the horizontal position covering the entire rack, including all flue spaces at certain height increments, to prevent vertical fire spread.

3.9.3.6* Longitudinal Flue Space. The space between rows of storage perpendicular to the direction of loading with a width not exceeding 24 in. (610 mm) between storage.

3.9.3.7* Rack. Any combination of vertical, horizontal, and diagonal structural members that support stored materials or commodities. [1, 2009]

3.9.3.7.1 Double-Row Racks. Racks less than or equal to 12 ft (3.7 m) in depth or single-row racks placed back to back having an aggregate depth up to 12 ft (3.7 m), with aisles having an aisle width of at least 3.5 ft (1.1 m) between loads on racks.

3.9.3.7.2 Movable Racks. Racks on fixed rails or guides. They can be moved back and forth only in a horizontal, two-dimensional plane. A moving aisle is created as abutting racks are either loaded or unloaded, then moved across the aisle to abut other racks.

3.9.3.7.3 Multiple-Row Racks. Racks greater than 12 ft (3.7 m) in depth or single- or double-row racks separated by aisles less than 3.5 ft (1.1 m) wide having an overall width greater than 12 ft (3.7 m).

3.9.3.7.4 Portable Racks. Racks that are not fixed in place. They can be arranged in any number of configurations.

3.9.3.7.5 Single-Row Racks. Racks that have no longitudinal flue space and that have a depth up to 6 ft (1.8 m) with aisles having a width of at least 3.5 ft (1.1 m) between loads on racks.

3.9.3.7.6 Rack Shelf Area. The area of the horizontal surface of a shelf in a rack defined by perimeter aisle(s) or nominal 6 in. (152 mm) flue spaces on all four sides, or by the placement of loads that block openings that would otherwise serve as the required flue spaces.

3.9.3.7.7 Open Rack. Racks without shelving or with shelving in racks that are fixed in place with shelves having a solid surface and a shelf area equal to or less than 20 ft² (1.9 m²) or with shelves having a wire mesh, slatted surface, or other material with openings representing at least 50 percent of the shelf area including the horizontal area of rack members and where the flue spaces are maintained.

3.9.3.7.8 Slatted Shelf Rack. A rack where shelves are fixed in place with a series of narrow individual solid supports used as the shelf material and spaced apart with regular openings.

3.9.3.7.9 Solid Shelf Rack. A rack where shelves are fixed in place with a solid, slatted, or wire mesh barrier used as the shelf material and having limited openings in the shelf area.

3.9.3.8 Solid Shelving. Solid shelving is fixed in place, slatted, wire mesh, or other type of shelves located within racks. The area of a solid shelf is defined by perimeter aisle or flue space on all four sides. Solid shelves having an area equal to or less than 20 ft² (1.9 m²) shall be defined as open racks. Shelves of wire mesh, slats, or other materials more than 50 percent open and where the flue spaces are maintained shall be defined as open racks.

3.9.3.9 Transverse Flue Space. The space between rows of storage parallel to the direction of loading. (See Figure A.3.9.3.6.)

3.9.4 Rubber Tire Storage Definitions.

3.9.4.1 Banded Tires. A storage method in which a number of tires are strapped together.

3.9.4.2 Horizontal Channel. Any uninterrupted space in excess of 5 ft (1.5 m) in length between horizontal layers of stored tires. Such channels can be formed by pallets, shelving, racks, or other storage arrangements.

3.9.4.3 Laced Tire Storage. Tires stored where the sides of the tires overlap, creating a woven or laced appearance. [See Figure A.3.9.4.9(g).]

3.9.4.4* Miscellaneous Tire Storage. The storage of rubber tires that is incidental to the main use of the building. Storage areas shall not exceed 2000 ft² (186 m²). On-tread storage piles, regardless of storage method, shall not exceed 25 ft (7.6 m) in the direction of the wheel holes. Acceptable storage arrangements include (a) on-floor, on-side storage up to 12 ft (3.7 m) high; (b) on-floor, on-tread storage up to 5 ft (1.5 m) high; (c) double-row or multirow fixed or portable rack storage on-side or on-tread up to 5 ft (1.5 m) high; (d) single row fixed or portable rack storage on-side or on-tread up to 12 ft (3.7 m) high; and (e) laced tires in racks up to 5 ft (1.5 m) in height.

3.9.4.5 On-Side Tire Storage. Tires stored horizontally or flat.

3.9.4.6 On-Tread Tire Storage. Tires stored vertically or on their treads.

3.9.4.7 Palletized Tire Storage. Storage on portable racks of various types utilizing a conventional pallet as a base.

3.9.4.8 Pyramid Tire Storage. On-floor storage in which tires are formed into a pyramid to provide pile stability.

3.9.4.9* Rubber Tire Rack Illustrations. See Figure A.3.9.4.9(a) through Figure A.3.9.4.9(g).

3.9.4.10 Rubber Tires. Pneumatic tires for passenger automobiles, aircraft, light and heavy trucks, trailers, farm equipment, construction equipment (off-the-road), and buses.

3.9.5 Roll Paper Definitions.

3.9.5.1 Array (Paper).

3.9.5.1.1 Closed Array (Paper). A vertical storage arrangement in which the distances between columns in both directions are short [not more than 2 in. (50 mm) in one direction and 1 in. (25 mm) in the other].

3.9.5.1.2 Open Array (Paper). A vertical storage arrangement in which the distance between columns in both directions is lengthy (all vertical arrays other than closed or standard).

3.9.5.1.3* Standard Array (Paper). A vertical storage arrangement in which the distance between columns in one direction is short [1 in. (25 mm) or less] and is in excess of 2 in. (50 mm) in the other direction.

3.9.5.2 Banded Roll Paper Storage. Rolls provided with a circumferential steel strap [$\frac{3}{8}$ in. (9.5 mm) or wider] at each end of the roll.

3.9.5.3 Column. A single vertical stack of rolls.

3.9.5.4 Core. The central tube around which paper is wound to form a roll.

3.9.5.5 Paper (General Term). The term for all kinds of felted sheets made from natural fibrous materials, usually vegetable but sometimes mineral or animal, and formed on a fine wire screen from water suspension.

3.9.5.6 Roll Paper Storage.

3.9.5.6.1 Horizontal Roll Paper Storage. Rolls stored with the cores in the horizontal plane (on-side storage).

3.9.5.6.2 Vertical Roll Paper Storage. Rolls stored with the cores in the vertical plane (on-end storage).

3.9.5.6.3* Wrapped Roll Paper Storage. Rolls provided with a complete heavy kraft covering around both sides and ends.

3.9.5.7* Roll Paper Storage Height. The maximum vertical distance above the floor at which roll paper is normally stored.

3.9.6 Baled Cotton Definitions.

3.9.6.1* Baled Cotton. A natural seed fiber wrapped and secured in industry-accepted materials, usually consisting of burlap, woven polypropylene, or sheet polyethylene, and secured with steel, synthetic or wire bands, or wire; also includes linters (lint removed from the cottonseed) and motes (residual materials from the ginning process). (See Table A.3.9.6.1.)

3.9.6.2* Tiered Storage. An arrangement in which bales are stored directly on the floor, two or more bales high.

3.10 Marine Definitions. These definitions apply to Chapter 17 only.

3.10.1 A-Class Boundary. A boundary designed to resist the passage of smoke and flame for 1 hour when tested in accordance with ASTM E 119, *Standard Test Methods for Fire Tests of Building Construction and Materials*.

3.10.2 B-Class Boundary. A boundary designed to resist the passage of flame for $\frac{1}{2}$ hour when tested in accordance with

ASTM E 119, *Standard Test Methods for Fire Tests of Building Construction and Materials*.

3.10.3 Central Safety Station. A continuously manned control station from which all of the fire control equipment is monitored. If this station is not the bridge, direct communication with the bridge shall be provided by means other than the ship's service telephone.

3.10.4* Heat-Sensitive Material. A material whose melting point is below 1700°F (926.7°C).

3.10.5 Heel. The inclination of a ship to one side.

3.10.6 Heel Angle. The angle defined by the intersection of a vertical line through the center of a vessel and a line perpendicular to the surface of the water.

3.10.7* International Shore Connection. A universal connection to the vessel's fire main to which a shoreside fire-fighting water supply can be connected.

3.10.8* Marine System. A sprinkler system installed on a ship, boat, or other floating structure that takes its supply from the water on which the vessel floats.

3.10.9* Marine Thermal Barrier. An assembly that is constructed of noncombustible materials and made intact with the main structure of the vessel, such as shell, structural bulkheads, and decks. A marine thermal barrier shall meet the requirements of a B-Class boundary. In addition, a marine thermal barrier shall be insulated such that, if tested in accordance with ASTM E 119, *Standard Test Methods for Fire Tests of Building Construction and Materials*, for 15 minutes, the average temperature of the unexposed side does not rise more than 250°F (193°C) above the original temperature, nor does the temperature at any one point, including any joint, rise more than 405°F (225°C) above the original temperature.

3.10.10 Marine Water Supply. The supply portion of the sprinkler system from the water pressure tank or the sea suction of the designated sprinkler system pump up to and including the valve that isolates the sprinkler system from these two water sources.

3.10.11 Supervision. A visual and audible alarm signal given at the central safety station to indicate when the system is in operation or when a condition that would impair the satisfactory operation of the system exists. Supervisory alarms shall give a distinct indication for each individual system component that is monitored.

3.10.12 Survival Angle. The maximum angle to which a vessel is permitted to heel after the assumed damage required by stability regulations is imposed.

3.10.13 Type 1 Stair. A fully enclosed stair that serves all levels of a vessel in which persons can be employed.

3.11 Hanging and Bracing Definitions.

3.11.1 C_p . The seismic coefficient that combines ground motion and seismic response factors from ASCE 7-05, *Minimum Design Loads for Buildings and Other Structures*.

3.11.2 F_{pw} . The horizontal force due to seismic load acting on a brace at working stress levels.

3.11.3 Four-Way Brace. A sway brace intended to resist differential movement of the piping system in all horizontal directions.

3.11.4 Lateral Brace. A sway brace intended to resist differential movement perpendicular to the axis of the pipe.

3.11.5 Longitudinal Brace. A sway brace intended to resist differential movement parallel to the axis of the pipe.

3.11.6* Post-Installed Anchors. A device used for fastening pipe to the building structure, installed in hardened concrete.

3.11.7 S_s . The maximum considered earthquake ground motion for 0.2 second spectral response acceleration (5 percent of critical damping), site Class B for a specific site.

3.11.8 Sway Brace. An assembly intended to be attached to the piping to resist horizontal earthquake loads.

Chapter 4 General Requirements

4.1 Level of Protection. A building, where protected by an automatic sprinkler system installation, shall be provided with sprinklers in all areas except where specific sections of this standard permit the omission of sprinklers.

4.2 Limited Area Systems.

4.2.1 When partial sprinkler systems are installed, the requirements of this standard shall be used insofar as they are applicable.

4.2.2 The authority having jurisdiction shall be consulted in each case.

4.3* Owner's Certificate. The owner(s) of a building or structure where the fire sprinkler system is going to be installed or their authorized agent shall provide the sprinkler system installer with the following information prior to the layout and detailing of the fire sprinkler system [see Figure A.22.1(b)]:

- (1) Intended use of the building including the materials within the building and the maximum height of any storage
- (2) A preliminary plan of the building or structure along with the design concepts necessary to perform the layout and detail for the fire sprinkler system
- (3) Any special knowledge of the water supply, including known environmental conditions that might be responsible for corrosion, including microbiologically influenced corrosion (MIC)

4.4* Additives. Additives or chemicals intended to stop leaks, such as sodium silicate or derivatives of sodium silicate, brine, or similar acting chemicals, shall not be used in sprinkler systems.

Chapter 5 Classification of Occupancies and Commodities

5.1* Classification of Occupancies.

5.1.1 Occupancy classifications for this standard shall relate to sprinkler design, installation, and water supply requirements only.

5.1.2 Occupancy classifications shall not be intended to be a general classification of occupancy hazards.

5.2* Light Hazard Occupancies. Light hazard occupancies shall be defined as occupancies or portions of other occupancies where the quantity and/or combustibility of contents is low and fires with relatively low rates of heat release are expected.

5.3* Ordinary Hazard Occupancies.

5.3.1* Ordinary Hazard (Group 1).

5.3.1.1 Ordinary hazard (Group 1) occupancies shall be defined as occupancies or portions of other occupancies where



combustibility is low, quantity of combustibles is moderate, stockpiles of combustibles do not exceed 8 ft (2.4 m), and fires with moderate rates of heat release are expected.

5.3.1.2 Dedicated and miscellaneous storage shall be protected in accordance with Chapter 12 and Chapter 13 as applicable.

5.3.2* Ordinary Hazard (Group 2).

5.3.2.1 Ordinary hazard (Group 2) occupancies shall be defined as occupancies or portions of other occupancies where the quantity and combustibility of contents are moderate to high, where stockpiles of contents with moderate rates of heat release do not exceed 12 ft (3.66 m) and stockpiles of contents with high rates of heat release do not exceed 8 ft (2.4 m).

5.3.2.2 Dedicated and miscellaneous storage shall be protected in accordance with Chapter 12 and Chapter 13 as applicable.

5.4 Extra Hazard Occupancies.

5.4.1* Extra Hazard (Group 1). Extra hazard (Group 1) occupancies shall be defined as occupancies or portions of other occupancies where the quantity and combustibility of contents are very high and dust, lint, or other materials are present, introducing the probability of rapidly developing fires with high rates of heat release but with little or no combustible or flammable liquids.

5.4.2* Extra Hazard (Group 2). Extra hazard (Group 2) occupancies shall be defined as occupancies or portions of other occupancies with moderate to substantial amounts of flammable or combustible liquids or occupancies where shielding of combustibles is extensive.

5.5* Special Occupancy Hazards.

5.6* Commodity Classification. See Section C.2.

5.6.1 General.

5.6.1.1* Classification of Commodities.

5.6.1.1.1 Commodity classification and the corresponding protection requirements shall be determined based on the makeup of individual storage units (i.e., unit load, pallet load).

5.6.1.1.2 When specific test data of commodity classification by a nationally recognized testing agency are available, the data shall be permitted to be used in determining classification of commodities.

5.6.1.2 Mixed Commodities.

5.6.1.2.1 Protection requirements shall not be based on the overall commodity mix in a fire area.

5.6.1.2.2 Unless the requirements of 5.6.1.2.3 or 5.6.1.2.4 are met, mixed commodity storage shall be protected by the requirements for the highest classified commodity and storage arrangement.

5.6.1.2.3 The protection requirements for the lower commodity class shall be permitted to be utilized where all of the following are met:

- (1) Up to 10 pallet loads of a higher hazard commodity, as described in 5.6.3 and 5.6.4, shall be permitted to be present in an area not exceeding 40,000 ft² (3716 m²).
- (2) The higher hazard commodity shall be randomly dispersed with no adjacent loads in any direction (including diagonally).

- (3) Where the ceiling protection is based on Class I or Class II commodities, the allowable number of pallet loads for Class IV or Group A plastics shall be reduced to five.

5.6.1.2.4 Mixed Commodity Segregation. The protection requirements for the lower commodity class shall be permitted to be utilized in the area of lower commodity class, where the higher hazard material is confined to a designated area and the area is protected to the higher hazard in accordance with the requirements of this standard.

5.6.2 Pallet Types.

5.6.2.1 General. When loads are palletized, the use of wood or metal pallets, or listed pallets equivalent to wood, shall be assumed in the classification of commodities.

5.6.2.2* Unreinforced Plastic Pallets. For Class I through Class IV commodities, when unreinforced polypropylene or unreinforced high-density polyethylene plastic pallets are used, the classification of the commodity unit shall be increased one class.

5.6.2.2.1 Unreinforced polypropylene or unreinforced high-density polyethylene plastic pallets shall be marked with a permanent symbol to indicate that the pallet is unreinforced.

5.6.2.3* For Class I through Class IV commodities, when reinforced polypropylene or reinforced high-density polyethylene plastic pallets are used, the classification of the commodity unit shall be increased two classes except for Class IV commodity, which shall be increased to a cartoned unexpanded Group A plastic commodity.

5.6.2.3.1 Pallets shall be assumed to be reinforced if no permanent marking or manufacturer's certification of non-reinforcement is provided.

5.6.2.4 No increase in the commodity classification shall be required for Group A plastic commodities stored on plastic pallets.

5.6.2.5 For ceiling-only sprinkler protection, the requirements of 5.6.2.2 and 5.6.2.3 shall not apply where plastic pallets are used and where the sprinkler system uses spray sprinklers with a minimum K-factor of K-16.8 (240).

5.6.2.6 The requirements of 5.6.2.2 through 5.6.2.7 shall not apply to nonwood pallets that have demonstrated a fire hazard that is equal to or less than wood pallets and are listed as such.

5.6.2.7 For Class I through Class IV commodities stored on plastic pallets when other than wood, metal, or polypropylene or high-density polyethylene plastic pallets are used, the classification of the commodity unit shall be determined by specific testing conducted by a national testing laboratory or shall be increased two classes.

5.6.3* Commodity Classes.

5.6.3.1* Class I. A Class I commodity shall be defined as a noncombustible product that meets one of the following criteria:

- (1) Placed directly on wood pallets
- (2) Placed in single-layer corrugated cartons, with or without single-thickness cardboard dividers, with or without pallets
- (3) Shrink-wrapped or paper-wrapped as a unit load with or without pallets

5.6.3.2* Class II. A Class II commodity shall be defined as a noncombustible product that is in slatted wooden crates, solid

wood boxes, multiple-layered corrugated cartons, or equivalent combustible packaging material, with or without pallets.

5.6.3.3* Class III.

5.6.3.3.1 A Class III commodity shall be defined as a product fashioned from wood, paper, natural fibers, or Group C plastics with or without cartons, boxes, or crates and with or without pallets.

5.6.3.3.2 A Class III commodity shall be permitted to contain a limited amount (5 percent by weight or volume or less) of Group A or Group B plastics.

5.6.3.4* Class IV.

5.6.3.4.1 A Class IV commodity shall be defined as a product, with or without pallets, that meets one of the following criteria:

- (1) Constructed partially or totally of Group B plastics
- (2) Consists of free-flowing Group A plastic materials
- (3) Contains within itself or its packaging an appreciable amount (5 percent to 15 percent by weight or 5 percent to 25 percent by volume) of Group A plastics

5.6.3.4.2 The remaining materials shall be permitted to be metal, wood, paper, natural or synthetic fibers, or Group B or Group C plastics.

5.6.4* Classification of Plastics, Elastomers, and Rubber. Plastics, elastomers, and rubber shall be classified as Group A, Group B, or Group C.

5.6.4.1* Group A. The following materials shall be classified as Group A:

- (1) ABS (acrylonitrile-butadiene-styrene copolymer)
- (2) Acetal (polyformaldehyde)
- (3) Acrylic (polymethyl methacrylate)
- (4) Butyl rubber
- (5) EPDM (ethylene-propylene rubber)
- (6) FRP (fiberglass-reinforced polyester)
- (7) Natural rubber (if expanded)
- (8) Nitrile-rubber (acrylonitrile-butadiene-rubber)
- (9) PET (thermoplastic polyester)
- (10) Polybutadiene
- (11) Polycarbonate
- (12) Polyester elastomer
- (13) Polyethylene
- (14) Polypropylene
- (15) Polystyrene
- (16) Polyurethane
- (17) PVC (polyvinyl chloride — highly plasticized, with plasticizer content greater than 20 percent) (rarely found)
- (18) SAN (styrene acrylonitrile)
- (19) SBR (styrene-butadiene rubber)

5.6.4.2 Group B. The following materials shall be classified as Group B:

- (1) Cellulosics (cellulose acetate, cellulose acetate butyrate, ethyl cellulose)
- (2) Chloroprene rubber
- (3) Fluoroplastics (ECTFE — ethylene-chlorotrifluoro-ethylene copolymer; ETFE — ethylene-tetrafluoroethylene copolymer; FEP — fluorinated ethylene-propylene copolymer)
- (4) Natural rubber (not expanded)
- (5) Nylon (nylon 6, nylon 6/6)
- (6) Silicone rubber

5.6.4.3 Group C. The following materials shall be classified as Group C:

- (1) Fluoroplastics (PCTFE — polychlorotrifluoroethylene; PTFE — polytetrafluoroethylene)
- (2) Melamine (melamine formaldehyde)
- (3) Phenolic
- (4) PVC (polyvinyl chloride — flexible — PVCs with plasticizer content up to 20 percent)
- (5) PVDC (polyvinylidene chloride)
- (6) PVDF (polyvinylidene fluoride)
- (7) PVF (polyvinyl fluoride)
- (8) Urea (urea formaldehyde)

5.6.5* Classification of Rolled Paper Storage. For the purposes of this standard, the classifications of paper described in 5.6.5.1 through 5.6.5.4 shall apply and shall be used to determine the sprinkler system design criteria.

5.6.5.1 Heavyweight Class. Heavyweight class shall be defined so as to include paperboard and paper stock having a basis weight [weight per 1000 ft² (92.9 m²)] of 20 lb (9.1 kg).

5.6.5.2 Mediumweight Class. Mediumweight class shall be defined so as to include all the broad range of papers having a basis weight [weight per 1000 ft² (92.9 m²)] of 10 lb to 20 lb (4.5 kg to 9.1 kg).

5.6.5.3 Lightweight Class. Lightweight class shall be defined so as to include all papers having a basis weight [weight per 1000 ft² (92.9 m²)] of 10 lb (4.5 kg).

5.6.5.4 Tissue.

5.6.5.4.1 Tissue shall be defined so as to include the broad range of papers of characteristic gauzy texture, which, in some cases, are fairly transparent.

5.6.5.4.2 For the purposes of this standard, tissue shall be defined as the soft, absorbent type, regardless of basis weight — specifically, crepe wadding and the sanitary class including facial tissue, paper napkins, bathroom tissue, and toweling.

Chapter 6 System Components and Hardware

6.1 General. This chapter shall provide requirements for correct use of sprinkler system components and hardware.

6.1.1* Listing.

6.1.1.1 Materials or devices not specifically designated by this standard shall be used in accordance with all conditions, requirements, and limitations of their special listing.

6.1.1.1.1 All special listing requirements shall be included and identified in the product submittal literature and installation instructions.

6.1.1.2 Unless the requirements of 6.1.1.3, 6.1.1.4, or 6.1.1.5 are met, all materials and devices essential to successful system operation shall be listed.

6.1.1.3 Equipment as permitted in Table 6.3.1.1 and Table 6.4.1 shall not be required to be listed.

6.1.1.4 Materials meeting the requirements of 9.1.1.2, 9.1.1.4.2, and 9.1.1.4.3 shall not be required to be listed.

6.1.1.5 Components that do not affect system performance such as drain piping, drain valves, and signs shall not be required to be listed.



6.1.2 Reconditioned Components.

6.1.2.1 The use of reconditioned valves and devices as replacement equipment in existing systems shall be permitted.

6.1.2.2 Reconditioned sprinklers shall not be permitted to be utilized on any new or existing system.

6.1.3 Rated Pressure. System components shall be rated for the maximum system working pressure to which they are exposed but shall not be rated at less than 175 psi (12.1 bar) for components installed above ground and 150 psi (10.4 bar) for components installed underground.

6.2 Sprinklers.

6.2.1 General. Only new sprinklers shall be installed.

6.2.2* Sprinkler Identification. All sprinklers shall be permanently marked with one or two English uppercase alphabetic characters to identify the manufacturer, immediately followed by three or four numbers, to uniquely identify a sprinkler as to K-factor (orifice size) or orifice shape, deflector characteristic, pressure rating, and thermal sensitivity.

6.2.3 Sprinkler Discharge Characteristics.

6.2.3.1* General. Unless the requirements of 6.2.3.2, 6.2.3.3, or 6.2.3.4 are met, the K-factor, relative discharge, and marking identification for sprinklers having different orifice sizes shall be in accordance with Table 6.2.3.1.

6.2.3.2 Pipe Threads. Listed sprinklers having pipe threads different from those shown in Table 6.2.3.1 shall be permitted.

6.2.3.3 K-Factors Greater than K-28 (400). Sprinklers listed with nominal K-factors greater than K-28 (400) shall increase the flow by 100 percent increments when compared with a nominal K-5.6 (80) sprinkler.

6.2.3.4 Residential Sprinklers. Residential sprinklers shall be permitted with K-factors other than those specified in Table 6.2.3.1.

6.2.3.5 CMSA and ESFR K-Factors. Control mode specific application (CMSA) and early suppression fast-response (ESFR) sprinklers shall have a minimum nominal K-factor of K-11.2 (160).

6.2.3.6 ESFR Orifice Size. ESFR sprinkler orifice size shall be selected as appropriate for the hazard. (See Chapter 12.)

6.2.4 Occupancy Limitations. Unless the requirements of 6.2.4.1 or 6.2.4.2 are met, sprinklers shall not be listed for protection of a portion of an occupancy classification.

6.2.4.1 Residential Sprinklers. Residential sprinklers shall be permitted to be listed for portions of residential occupancies as defined in 8.4.5.1.

6.2.4.2 Special Sprinklers. Special sprinklers shall be permitted to be listed for protection of a specific construction feature in a portion of an occupancy classification. (See 8.4.8.)

6.2.5* Temperature Characteristics.

6.2.5.1 Automatic sprinklers shall have their frame arms, deflector, coating material, or liquid bulb colored in accordance with the requirements of Table 6.2.5.1 or the requirements of 6.2.5.2, 6.2.5.3, 6.2.5.4, or 6.2.5.5.

6.2.5.2 A dot on the top of the deflector, the color of the coating material, or colored frame arms shall be permitted for color identification of corrosion-resistant sprinklers.

6.2.5.3 Color identification shall not be required for ornamental sprinklers such as factory-plated or factory-painted sprinklers or for recessed, flush, or concealed sprinklers.

6.2.5.4 The frame arms of bulb-type sprinklers shall not be required to be color coded.

6.2.5.5 The liquid in bulb-type sprinklers shall be color coded in accordance with Table 6.2.5.1.

Table 6.2.3.1 Sprinkler Discharge Characteristics Identification

Nominal K-Factor [gpm/(psi) ^{1/2}]	Nominal K-Factor [L/min/(bar) ^{1/2}]	K-Factor Range [gpm/(psi) ^{1/2}]	K-Factor Range [L/min/(bar) ^{1/2}]	Percent of Nominal K-5.6 Discharge	Thread Type
1.4	20	1.3–1.5	19–22	25	½ in. NPT
1.9	27	1.8–2.0	26–29	33.3	½ in. NPT
2.8	40	2.6–2.9	38–42	50	½ in. NPT
4.2	57	4.0–4.4	59–64	75	½ in. NPT
5.6	80	5.3–5.8	76–84	100	½ in. NPT
8.0	115	7.4–8.2	107–118	140	¾ in. NPT
					or
					½ in. NPT
11.2	160	10.7–11.7	159–166	200	½ in. NPT
					or
					¾ in. NPT
14.0	200	13.5–14.5	195–209	250	¾ in. NPT
16.8	240	16.0–17.6	231–254	300	¾ in. NPT
19.6	280	18.6–20.6	272–301	350	1 in. NPT
22.4	320	21.3–23.5	311–343	400	1 in. NPT
25.2	360	23.9–26.5	349–387	450	1 in. NPT
28.0	400	26.6–29.4	389–430	500	1 in. NPT

Table 6.2.5.1 Temperature Ratings, Classifications, and Color Codings

Maximum Ceiling Temperature		Temperature Rating		Temperature Classification	Color Code	Glass Bulb Colors
°F	°C	°F	°C			
100	38	135–170	57–77	Ordinary	Uncolored or black	Orange or red
150	66	175–225	79–107	Intermediate	White	Yellow or green
225	107	250–300	121–149	High	Blue	Blue
300	149	325–375	163–191	Extra high	Red	Purple
375	191	400–475	204–246	Very extra high	Green	Black
475	246	500–575	260–302	Ultra high	Orange	Black
625	329	650	343	Ultra high	Orange	Black

6.2.6 Special Coatings.**6.2.6.1* Corrosion Resistant.**

6.2.6.1.1 Listed corrosion-resistant sprinklers shall be installed in locations where chemicals, moisture, or other corrosive vapors sufficient to cause corrosion of such devices exist.

6.2.6.1.2* Unless the requirements of 6.2.6.1.3 are met, corrosion-resistant coatings shall be applied only by the manufacturer of the sprinkler and in accordance with the requirements of 6.2.6.1.3.

6.2.6.1.3 Any damage to the protective coating occurring at the time of installation shall be repaired at once using only the coating of the manufacturer of the sprinkler in the approved manner so that no part of the sprinkler will be exposed after installation has been completed.

6.2.6.2* Painting.

6.2.6.2.1 Sprinklers shall only be painted by the sprinkler manufacturer.

6.2.6.2.2 Where sprinklers have had paint applied by other than the sprinkler manufacturer, they shall be replaced with new listed sprinklers of the same characteristics, including orifice size, thermal response, and water distribution.

6.2.6.3 Ornamental Finishes.

6.2.6.3.1 Ornamental finishes shall only be applied to sprinklers and, if applicable, their concealed cover plates, by the sprinkler manufacturer.

6.2.6.3.2 Sprinklers with ornamental finishes where utilized shall be specifically listed.

6.2.6.4 Protective Coverings.

6.2.6.4.1 Sprinklers protecting spray areas and mixing rooms in resin application areas shall be protected against overspray residue so that they will operate in the event of fire.

6.2.6.4.2* Where protected in accordance with 6.2.6.4.1, cellophane bags having a thickness of 0.003 in. (0.076 mm) or less or thin paper bags shall be used.

6.2.6.4.3 Coverings shall be replaced periodically so that heavy deposits of residue do not accumulate.

6.2.6.4.4 Sprinklers that have been painted or coated shall be replaced in accordance with the requirements of 6.2.6.2.2.

6.2.7 Escutcheons and Cover Plates.

6.2.7.1 Plates, escutcheons, or other devices used to cover the annular space around a sprinkler shall be metallic or shall be listed for use around a sprinkler.

6.2.7.2* Escutcheons used with recessed, flush-type, or concealed sprinklers shall be part of a listed sprinkler assembly.

6.2.7.3 Cover plates used with concealed sprinklers shall be part of the listed sprinkler assembly.

6.2.8 Guards. Sprinklers subject to mechanical injury shall be protected with listed guards.

6.2.9 Stock of Spare Sprinklers.

6.2.9.1* A supply of at least six spare sprinklers (never fewer than six) shall be maintained on the premises so that any sprinklers that have operated or been damaged in any way can be promptly replaced.

6.2.9.2 The sprinklers shall correspond to the types and temperature ratings of the sprinklers in the property.

6.2.9.3 The sprinklers shall be kept in a cabinet located where the temperature to which they are subjected will at no time exceed 100°F (38°C).

6.2.9.4 Where dry sprinklers of different lengths are installed, spare dry sprinklers shall not be required, provided that a means of returning the system to service is furnished.

6.2.9.5 The stock of spare sprinklers shall include all types and ratings installed and shall be as follows:

- (1) For protected facilities having under 300 sprinklers — no fewer than six sprinklers
- (2) For protected facilities having 300 to 1000 sprinklers — no fewer than 12 sprinklers
- (3) For protected facilities having over 1000 sprinklers — no fewer than 24 sprinklers

6.2.9.6* One sprinkler wrench as specified by the sprinkler manufacturer shall be provided in the cabinet for each type of sprinkler installed to be used for the removal and installation of sprinklers in the system.

6.2.9.7 A list of the sprinklers installed in the property shall be posted in the sprinkler cabinet.

6.2.9.7.1* The list shall include the following:

- (1) Sprinkler Identification Number (SIN) if equipped; or the manufacturer, model, orifice, deflector type, thermal sensitivity, and pressure rating
- (2) General description
- (3) Quantity of each type to be contained in the cabinet
- (4) Issue or revision date of the list

6.3 Aboveground Pipe and Tube.

6.3.1 General.

6.3.1.1 Pipe or tube shall meet or exceed one of the standards in Table 6.3.1.1 or be in accordance with 6.3.6.

Table 6.3.1.1 Pipe or Tube Materials and Dimensions

Materials and Dimensions	Standard
Ferrous Piping (Welded and Seamless)	
<i>Specification for black and hot-dipped zinc-coated (galvanized) welded and seamless steel pipe for fire protection use</i>	ASTM A 795
<i>Specification for welded and seamless steel pipe</i>	ANSI/ASTM A 53
<i>Wrought steel pipe</i>	ANSI/ASME B36.10M
<i>Specification for electric-resistance-welded steel pipe</i>	ASTM A 135
Copper Tube (Drawn, Seamless)	
<i>Specification for seamless copper tube</i>	ASTM B 75
<i>Specification for seamless copper water tube</i>	ASTM B 88
<i>Specification for general requirements for wrought seamless copper and copper-alloy tube</i>	ASTM B 251
<i>Fluxes for soldering applications of copper and copper-alloy tube</i>	ASTM B 813
<i>Brazing filler metal (classification BCuP-3 or BCuP-4)</i>	AWS A5.8
<i>Solder metal, Section 1: Solder alloys containing less than 0.2% lead and having solidus temperatures greater than 400°F</i>	ASTM B 32
<i>Alloy materials</i>	ASTM B 446

6.3.1.2 Steel pipe shall be in accordance with 6.3.2, 6.3.3, or 6.3.4.

6.3.1.3 Copper tube shall be in accordance with 6.3.5.

6.3.1.4 Chlorinated polyvinyl chloride (CPVC) shall be in accordance with 6.3.6 and with the portions of the ASTM standards specified in Table 6.3.6.1 that apply to fire protection service.

6.3.2* Steel Pipe — Welded or Roll-Grooved. When steel pipe referenced in Table 6.3.1.1 is used and joined by welding as referenced in 6.5.2 or by roll-grooved pipe and fittings as referenced in 6.5.3, the minimum nominal wall thickness for pressures up to 300 psi (20.7 bar) shall be in accordance with Schedule 10 for pipe sizes up to 5 in. (125 mm), 0.134 in.

(3.40 mm) for 6 in. (150 mm) pipe, 0.188 in. (4.78 mm) for 8 in. and 10 in. (200 mm and 250 mm) pipe, and 0.330 in. (8.38 mm) for 12 in. (300 mm) pipe.

6.3.3 Steel Pipe — Threaded. When steel pipe referenced in Table 6.3.1.1 is joined by threaded fittings referenced in 6.5.1 or by fittings used with pipe having cut grooves, the minimum wall thickness shall be in accordance with Schedule 30 pipe [in sizes 8 in. (200 mm) and larger] or Schedule 40 pipe [in sizes less than 8 in. (200 mm)] for pressures up to 300 psi (20.7 bar).

6.3.4 Specially Listed Steel Pipe. Pressure limitations and wall thickness for steel pipe specially listed in accordance with 6.3.6 shall be permitted to be in accordance with the pipe listing requirements.

6.3.5* Copper Tube. Copper tube as specified in the standards listed in Table 6.3.1.1 shall have a wall thickness of Type K, Type L, or Type M where used in sprinkler systems.

6.3.6* Listed Pipe and Tubing.

6.3.6.1 Other types of pipe or tube investigated for suitability in automatic sprinkler installations and listed for this service, including but not limited to CPVC and steel, and differing from that provided in Table 6.3.1.1 or Table 6.3.6.1 shall be permitted where installed in accordance with their listing limitations, including installation instructions.

Table 6.3.6.1 Specially Listed Pipe or Tube Materials and Dimensions

Materials and Dimensions	Standard
<i>Nonmetallic piping specification for special listed chlorinated polyvinyl chloride (CPVC) pipe</i>	ASTM F 442

6.3.6.2 Pipe or tube listed for light hazard occupancies shall be permitted to be installed in ordinary hazard rooms of otherwise light hazard occupancies where the room does not exceed 400 ft² (37 m²).

6.3.6.3 Pipe or tube shall not be listed for portions of an occupancy classification.

6.3.6.4 Bending of listed pipe and tubing shall be permitted as allowed by the listing.

6.3.7 Pipe and Tube Bending.

6.3.7.1 Bending of Schedule 10 steel pipe, or any steel pipe of wall thickness equal to or greater than Schedule 10 and Types K and L copper tube, shall be permitted when bends are made with no kinks, ripples, distortions, or reductions in diameter or any noticeable deviations from round.

6.3.7.2 For Schedule 40 and copper tubing, the minimum radius of a bend shall be six pipe diameters for pipe sizes 2 in. (50 mm) and smaller and five pipe diameters for pipe sizes 2½ in. (65 mm) and larger.

6.3.7.3 For all other steel pipe, the minimum radius of a bend shall be 12 pipe diameters for all sizes.

6.3.8 Pipe and Tube Identification.

6.3.8.1* All pipe, including specially listed pipe allowed by 6.3.6, shall be marked along its length by the manufacturer in such a way as to properly identify the type of pipe.

6.3.8.2 The marking shall be visible on every piece of pipe over 2 ft (610 mm) long.

6.3.8.3 Pipe identification shall include the manufacturer's name, model designation, or schedule.

6.4 Fittings.

6.4.1 Fittings used in sprinkler systems shall meet or exceed the standards in Table 6.4.1 or be in accordance with 6.4.2 or 6.4.3.

Table 6.4.1 Fittings Materials and Dimensions

Materials and Dimensions	Standard
Cast Iron	
Cast iron threaded fittings, Class 125 and 250	ASME B16.4
Cast iron pipe flanges and flanged fittings	ASME B16.1
Malleable Iron	
Malleable iron threaded fittings, Class 150 and 300 steel	ASME B16.3
Factory-made wrought steel butt weld fittings	ASME B16.9
Butt welding ends for pipe, valves, flanges, and fittings	ASME B16.25
Specification for piping fittings of wrought carbon steel and alloy steel for moderate and elevated temperatures	ASTM A 234
Steel pipe flanges and flanged fittings	ASME B16.5
Forged steel fittings, socket welded and threaded copper	ASME B16.11
Wrought copper and copper alloy solder joint pressure fittings	ASME B16.22
Cast copper alloy solder joint pressure fittings	ASME B16.18

6.4.2 In addition to the standards in Table 6.4.1, CPVC fittings shall also be in accordance with 6.4.3 and with the portions of the ASTM standards specified in Table 6.4.3 that apply to fire protection service.

6.4.3* Other types of fittings investigated for suitability in automatic sprinkler installations and listed for this service including, but not limited to, CPVC, and steel differing from that provided in Table 6.4.3, shall be permitted when installed in accordance with their listing limitations, including installation instructions.

6.4.4* Fitting Pressure Limits.

6.4.4.1 Standard weight pattern cast-iron fittings 2 in. (50 mm) in size and smaller shall be permitted where pressures do not exceed 300 psi (20.7 bar).

6.4.4.2 Standard weight pattern malleable iron fittings 6 in. (150 mm) in size and smaller shall be permitted where pressures do not exceed 300 psi (20.7 bar).

6.4.4.3 Listed fittings shall be permitted for system pressures up to the limits specified in their listings.

Table 6.4.3 Specially Listed Fittings Materials and Dimensions

Materials and Dimensions	Standard
Chlorinated polyvinyl chloride (CPVC) specification for Schedule 80 CPVC threaded fittings	ASTM F 437
Specification for Schedule 40 CPVC socket-type fittings	ASTM F 438
Specification for Schedule 80 CPVC socket-type fittings	ASTM F 439

6.4.4.4 Fittings not meeting the requirements of 6.4.4.1 through 6.4.4.3 shall be extra-heavy pattern where pressures exceed 175 psi (12.1 bar).

6.4.5* Couplings and Unions.

6.4.5.1 Screwed unions shall not be used on pipe larger than 2 in. (50 mm).

6.4.5.2 Couplings and unions of other than screwed-type shall be of types listed specifically for use in sprinkler systems.

6.4.6 Reducers and Bushings.

6.4.6.1 Unless the requirements of 6.4.6.2 or 6.4.6.3 are met, a one-piece reducing fitting shall be used wherever a change is made in the size of the pipe.

6.4.6.2 Hexagonal or face bushings shall be permitted in reducing the size of openings of fittings when standard fittings of the required size are not available.

6.4.6.3 Hexagonal bushings as permitted in 8.15.19.2 shall be permitted to be used.

6.4.6.4 The requirements of 6.4.6.1 and 6.4.6.2 shall not apply to CPVC fittings.

6.5 Joining of Pipe and Fittings.

6.5.1 Threaded Pipe and Fittings.

6.5.1.1 All threaded pipe and fittings shall have threads cut to ASME B1.20.1, *Pipe Threads, General Purpose (Inch)*.

6.5.1.2* Steel pipe with wall thicknesses less than Schedule 30 [in sizes 8 in. (200 mm) and larger] or Schedule 40 [in sizes less than 8 in. (200 mm)] shall only be permitted to be joined by threaded fittings where the threaded assembly is investigated for suitability in automatic sprinkler installations and listed for this service.

6.5.1.3 Joint compound or tape shall be applied only to male threads.

6.5.2 Welded Pipe and Fittings.

6.5.2.1 General.

6.5.2.1.1 Welding shall be permitted as a means of joining sprinkler piping in accordance with 6.5.2.2 through 6.5.2.6.

6.5.2.2* Fabrication.

6.5.2.2.1 When welding sprinkler pipe, the pipe shall be shop welded unless the requirements of 6.5.2.2 or 6.5.2.3 are met.

6.5.2.2.2 Where the design specifications require any part of the piping system to be welded in place, welding of sprinkler piping shall be permitted where the welding process is per-



formed in accordance with NFPA 51B, *Standard for Fire Prevention During Welding, Cutting, and Other Hot Work*, and the mechanical fittings required by 8.15.21 and 8.16.3 are provided.

6.5.2.2.3 Tabs for longitudinal earthquake bracing shall be permitted to be welded to in-place piping where the welding process is performed in accordance with NFPA 51B, *Standard for Fire Prevention During Welding, Cutting, and Other Hot Work*.

6.5.2.2.4 Welding shall not be performed where there is impingement of rain, snow, sleet, or high wind on the weld area of the pipe product.

6.5.2.2.5 Torch cutting and welding shall not be permitted as a means of modifying or repairing sprinkler systems.

6.5.2.3 Fittings.

6.5.2.3.1* Welded fittings used to join pipe shall be listed fabricated fittings or manufactured in accordance with Table 6.4.1.

6.5.2.3.2 Fittings referenced in 6.5.2.3.1 shall be joined in conformance with a qualified welding procedure as set forth in this section and shall be an acceptable product under this standard, provided that materials and wall thickness are compatible with other sections of this standard.

6.5.2.3.3 Fittings shall not be required where pipe ends are butt welded in accordance with the requirements of 6.5.2.4.2.

6.5.2.3.4 When the pipe size in a run of piping is reduced, a reducing fitting designed for that purpose shall be used in accordance with the requirements of 6.5.2.3.1.

6.5.2.4 Welding Requirements.

6.5.2.4.1* Welds between pipe and welding outlet fittings shall be permitted to be attached by full penetration welds, partial penetration groove welds, or fillet welds. The minimum throat thickness shall be not less than the thickness of the pipe, the thickness of the welding fitting, or $\frac{3}{16}$ in. (4.8 mm), whichever is least.

6.5.2.4.2* Circumferential butt joints shall be cut, beveled, and fit so that full penetration is achievable. Full penetration welding shall not be required.

6.5.2.4.3 Where slip-on flanges are welded to pipe with a single fillet weld, the weld shall be on the hub side of the flange and the minimum throat weld thickness shall not be less than 1.25 times the pipe wall thickness or the hub thickness, whichever is less.

6.5.2.4.4 Face welds on the internal face of the flange shall be permitted as a water seal in addition to the hub weld required in 6.5.2.4.3.

6.5.2.4.5 Tabs for longitudinal earthquake bracing shall have minimum throat weld thickness not less than 1.25 times the pipe wall thickness and welded on both sides of the longest dimension.

6.5.2.4.6 When welding is performed, the following shall apply:

- (1) Holes in piping for outlets shall be cut to the full inside diameter of fittings prior to welding in place of the fittings.
- (2) Discs shall be retrieved.
- (3) Openings cut into piping shall be smooth bore, and all internal slag and welding residue shall be removed.
- (4) Fittings shall not penetrate the internal diameter of the piping.

(5) Steel plates shall not be welded to the ends of piping or fittings.

(6) Fittings shall not be modified.

(7) Nuts, clips, eye rods, angle brackets, or other fasteners shall not be welded to pipe or fittings, except as permitted in 6.5.2.2.3 and 6.5.2.4.5.

(8) Completed welds shall be free from cracks, incomplete fusion, surface porosity greater than $\frac{1}{16}$ in. (1.6 mm) diameter, and undercut deeper than 25 percent of the wall thickness or $\frac{1}{32}$ in. (0.8 mm), whichever is less.

(9) Completed circumferential butt weld reinforcement shall not exceed $\frac{3}{32}$ in. (2.4 mm).

6.5.2.5 Qualifications.

6.5.2.5.1 A welding procedure shall be prepared and qualified by the contractor or fabricator before any welding is done.

6.5.2.5.2 Qualification of the welding procedure to be used and the performance of all welders and welding operators shall be required and shall meet or exceed the requirements of AWS B2.1, *Specification for Welding Procedure and Performance Qualification*; ASME Boiler and Pressure Vessel Code, Section IX, *Welding and Brazing Qualifications*; or other applicable qualification standard as required by the authority having jurisdiction, except as permitted by 6.5.2.5.3.

6.5.2.5.3 Successful procedure qualification of complete joint penetration groove welds shall qualify partial joint penetration (groove/fillet) welds and fillet welds in accordance with the provisions of this standard.

6.5.2.5.4 Welding procedures qualified under standards recognized by previous editions of this standard shall be permitted to be continued in use.

6.5.2.5.5 Contractors or fabricators shall be responsible for all welding they produce.

6.5.2.5.6 Each contractor or fabricator shall have available to the authority having jurisdiction an established written quality assurance procedure ensuring compliance with the requirements of 6.5.2.4.

6.5.2.6 Records.

6.5.2.6.1 Welders or welding machine operators shall, upon completion of each welded pipe, place their identifiable mark or label onto each piece adjacent to a weld.

6.5.2.6.2 Contractors or fabricators shall maintain certified records, which shall be available to the authority having jurisdiction, of the procedures used and the welders or welding machine operators employed by them, along with their welding identification.

6.5.2.6.3 Records shall show the date and the results of procedure and performance qualifications.

6.5.3 Groove Joining Methods.

6.5.3.1* Pipe joined with grooved couplings shall be joined by a listed combination of couplings, gaskets, and groove dimensions.

6.5.3.2* Grooved connections of fittings and valves, and grooves cut or rolled on pipe shall be dimensionally compatible with the couplings.

6.5.3.3 Grooved couplings, including gaskets used on dry pipe, preaction, and deluge systems, shall be listed for dry pipe service.

6.5.4* Brazed and Soldered Joints.

6.5.4.1 Solder joints, where permitted, shall be fabricated in accordance with the methods and procedures listed in ASTM B 828, *Standard Practice for Making Capillary Joints by Soldering of Copper and Copper Alloy Tube and Fittings*.

6.5.4.2 Unless the requirements of 6.5.4.3 or 6.5.4.4 are met, joints for the connection of copper tube shall be brazed.

6.5.4.3 Solder joints shall be permitted for exposed wet pipe systems in light hazard occupancies where the temperature classification of the installed sprinklers is of the ordinary- or intermediate-temperature classification.

6.5.4.4 Solder joints shall be permitted for wet pipe systems in light hazard and ordinary hazard (Group 1) occupancies where the piping is concealed, irrespective of sprinkler temperature ratings.

6.5.4.5* Soldering fluxes shall be in accordance with Table 6.3.1.1.

6.5.4.6 Brazing fluxes, if used, shall not be of a highly corrosive type.

6.5.5 Other Joining Methods.

6.5.5.1 Other joining methods investigated for suitability in automatic sprinkler installations and listed for this service shall be permitted where installed in accordance with their listing limitations, including installation instructions.

6.5.5.2 Outlet Fittings. Rubber-gasketed outlet fittings that are used on sprinkler systems shall meet the following requirements:

- (1) Be installed in accordance with the listing and manufacturer's installation instructions
- (2) Have all disks retrieved
- (3) Have smooth bores cut into the pipe, with all cutting residue removed
- (4) Not be modified

6.5.6 End Treatment.

6.5.6.1 After cutting, pipe ends shall have burrs and fins removed.

6.5.6.2 Pipe used with listed fittings and its end treatment shall be in accordance with the fitting manufacturer's installation instructions and the fitting's listing.

6.6* Hangers. Hangers shall be in accordance with the requirements of Section 9.1.

6.7 Valves.

6.7.1 General.

6.7.1.1 Valve Pressure Requirements. When water pressures exceed 175 psi (12.1 bar), valves shall be used in accordance with their pressure ratings.

6.7.1.2 Valve Closure Time. Listed indicating valves shall not close in less than 5 seconds when operated at maximum possible speed from the fully open position.

6.7.1.3 Listed Indicating Valves. Unless the requirements of 6.7.1.3.1, 6.7.1.3.2, or 6.7.1.3.3 are met, all valves controlling connections to water supplies and to supply pipes to sprinklers shall be listed indicating valves.

6.7.1.3.1 A listed underground gate valve equipped with a listed indicator post shall be permitted.

6.7.1.3.2 A listed water control valve assembly with a reliable position indication connected to a remote supervisory station shall be permitted.

6.7.1.3.3 A nonindicating valve, such as an underground gate valve with approved roadway box, complete with T-wrench, and where accepted by the authority having jurisdiction, shall be permitted.

6.7.2 Wafer-Type Valves. Wafer-type valves with components that extend beyond the valve body shall be installed in a manner that does not interfere with the operation of any system components.

6.7.3 Drain Valves and Test Valves. Drain valves and test valves shall be approved.

6.7.4* Identification of Valves.

6.7.4.1 All control, drain, and test connection valves shall be provided with permanently marked weatherproof metal or rigid plastic identification signs.

6.7.4.2 The identification sign shall be secured with corrosion-resistant wire, chain, or other approved means.

6.7.4.3 The control valve sign shall identify the portion of the building served.

6.7.4.3.1* Systems that have more than one control valve that must be closed to work on a system or space shall have a sign referring to existence and location of other valves.

6.8 Fire Department Connections.

6.8.1* Unless the requirements of 6.8.1.1, 6.8.1.2, or 6.8.1.3 are met, the fire department connection(s) shall consist of two 2½ in. (65 mm) connections using NH internal threaded swivel fitting(s) with "2.5–7.5 NH standard thread," as specified in NFPA 1963, *Standard for Fire Hose Connections*.

6.8.1.1 Where local fire department connections do not conform to NFPA 1963, *Standard for Fire Hose Connections*, the authority having jurisdiction shall be permitted to designate the connection to be used.

6.8.1.2 The use of threadless couplings shall be permitted where required by the authority having jurisdiction and where listed for such use.

6.8.1.3 A single-outlet fire department connection shall be acceptable where piped to a 3 in. (80 mm) or smaller riser.

6.8.2 Fire department connections shall be equipped with approved plugs or caps, properly secured and arranged for easy removal by fire departments.

6.8.3 Fire department connections shall be of an approved type.

6.9 Waterflow Alarm Devices.

6.9.1 General. Waterflow alarm devices shall be listed for the service and so constructed and installed that any flow of water from a sprinkler system equal to or greater than that from a single automatic sprinkler of the smallest orifice size installed on the system will result in an audible alarm on the premises within 5 minutes after such flow begins and until such flow stops.

6.9.2 Waterflow Detecting Devices.

6.9.2.1 Wet Pipe Systems. The alarm apparatus for a wet pipe system shall consist of a listed alarm check valve or other listed



waterflow-detecting alarm device with the necessary attachments required to give an alarm.

6.9.2.2 Dry Pipe Systems.

6.9.2.2.1 The alarm apparatus for a dry pipe system shall consist of listed alarm attachments to the dry pipe valve.

6.9.2.2.2 Where a dry pipe valve is located on the system side of an alarm valve, connection of the actuating device of the alarms for the dry pipe valve to the alarms on the wet pipe system shall be permitted.

6.9.2.3 Preaction and Deluge Systems. The alarm apparatus for deluge and preaction systems shall consist of alarms actuated independently by the detection system and the flow of water.

6.9.2.3.1 Deluge and preaction systems activated by pilot sprinklers shall not require an independent detection system alarm.

6.9.2.4* Paddle-Type Waterflow Devices. Paddle-type waterflow alarm indicators shall be installed in wet systems only.

6.9.3 Attachments — General.

6.9.3.1* An alarm unit shall include a listed mechanical alarm, horn, or siren or a listed electric gong, bell, speaker, horn, or siren.

6.9.3.2* Outdoor water motor-operated or electrically operated bells shall be weatherproofed and guarded.

6.9.3.3 All piping to water motor-operated devices shall be galvanized steel, brass, copper, or other approved metallic corrosion-resistant material of not less than $\frac{3}{4}$ in. (20 mm) nominal pipe size.

6.9.3.4 Piping between the sprinkler system and a pressure-actuated alarm-initiating device shall be galvanized steel, brass, copper, or other approved metallic corrosion-resistant material of not less than $\frac{1}{2}$ in. (10 mm) nominal pipe size.

6.9.4* Attachments — Electrically Operated.

6.9.4.1 Electrically operated alarm attachments forming part of an auxiliary, central station, local protective, proprietary, or remote station signaling system shall be installed in accordance with *NFPA 72, National Fire Alarm and Signaling Code*.

6.9.4.2 Sprinkler waterflow alarm systems that are not part of a required protective signaling system shall not be required to be supervised and shall be installed in accordance with *NFPA 70, National Electrical Code*, Article 760.

6.9.4.3 Outdoor electric alarm devices shall be listed for outdoor use.

6.9.5 Alarm Device Drains. Drains from alarm devices shall be so arranged that there will be no overflowing at the alarm apparatus, at domestic connections, or elsewhere with the sprinkler drains wide open and under system pressure. (See 8.16.2.6.)

7.1.1.2 Pressure gauges shall be installed above and below each alarm check valve or system riser check valve where such devices are present.

7.1.1.2.1 Pressure gauges below check valves required by 8.17.5.2.2(1) shall not be required.

7.1.2 Relief Valves.

7.1.2.1 Unless the requirements of 7.1.2.2 are met, a wet pipe system shall be provided with a listed relief valve not less than $\frac{1}{2}$ in. (12 mm) in size and set to operate at 175 psi (12.1 bar) or 10 psi (0.7 bar) in excess of the maximum system pressure, whichever is greater.

7.1.2.2 Where auxiliary air reservoirs are installed to absorb pressure increases, a relief valve shall not be required.

7.1.3 Auxiliary Systems. A wet pipe system shall be permitted to supply an auxiliary dry pipe, preaction, or deluge system, provided the water supply is adequate.

7.2* Dry Pipe Systems.

7.2.1 Pressure Gauges. Listed pressure gauges conforming with 8.17.3 shall be connected as follows:

- (1) On the water side and air side of the dry pipe valve
- (2) At the air pump supplying the air receiver where one is provided
- (3) At the air receiver where one is provided
- (4) In each independent pipe from air supply to dry pipe system
- (5) At accelerators

7.2.2 Sprinklers. The following types of sprinklers and arrangements shall be permitted for dry pipe systems:

- (1) Upright sprinklers
- (2)*Listed dry sprinklers
- (3) Pendent sprinklers and sidewall sprinklers installed on return bends, where the sprinklers, return bend, and branch line piping are in an area maintained at or above 40°F (4°C)
- (4) Horizontal sidewall sprinklers installed so that water is not trapped
- (5) Pendent sprinklers and sidewall sprinklers, where the sprinklers and branch line piping are in an area maintained at or above 40°F (4°C), the water supply is potable, and the piping for the dry pipe system is copper or CPVC specifically listed for dry pipe applications

7.2.3* Size of Systems.

7.2.3.1* The system capacity (volume) controlled by a dry pipe valve shall be determined by 7.2.3.2, 7.2.3.3, 7.2.3.4, 7.2.3.5, or 7.2.3.7.

7.2.3.1.1 Dry pipe systems protecting dwelling unit portions of any occupancy shall not be permitted to use the options outlined in 7.2.3.3 or 7.2.3.4.

7.2.3.2 System size shall be such that initial water is discharged from the system test connection in not more than 60 seconds, starting at the normal air pressure on the system and at the time of fully opened inspection test connection.

7.2.3.3 A system size of not more than 500 gal (1893 L) shall be permitted without a quick-opening device and shall not be required to meet any specific water delivery requirement to the inspection test connection.

7.2.3.4 A system size of not more than 750 gal (2839 L) shall be permitted with a quick-opening device and shall not be

Chapter 7 System Requirements

7.1 Wet Pipe Systems.

7.1.1 Pressure Gauges.

7.1.1.1 A listed pressure gauge conforming to 8.17.3 shall be installed in each system riser.

required to meet any specific water delivery requirement to the inspection test connection.

7.2.3.5 System size shall be based on dry pipe systems being calculated for water delivery in accordance with 7.2.3.6.

7.2.3.6 Dry Pipe System Water Delivery.

7.2.3.6.1 Calculations for dry pipe system water delivery shall be based on the hazard shown in Table 7.2.3.6.1.

Table 7.2.3.6.1 Dry Pipe System Water Delivery

Hazard	Number of Most Remote Sprinklers Initially Open	Maximum Time of Water Delivery (seconds)
Light	1	60
Ordinary I	2	50
Ordinary II	2	50
Extra I	4	45
Extra II	4	45
High piled	4	40

7.2.3.6.2 The calculation program and method shall be listed by a nationally recognized testing laboratory.

7.2.3.6.3 For dry pipe systems protecting dwelling unit portions of any occupancy, the sprinklers in the dwelling unit shall have a maximum water delivery time of 15 seconds to the single most remote sprinkler.

7.2.3.6.4 Residential sprinklers shall be listed for dry pipe applications.

7.2.3.7* System size shall be such that initial water discharge from the system trip test connection or manifold outlets is not more than the maximum time of water delivery specified in Table 7.2.3.6.1, starting at normal air pressure on the system and at the time of fully opened test connection.

7.2.3.7.1 When flow is from four sprinklers, the test manifold shall be arranged to simulate two sprinklers on each of two sprinkler branch lines.

7.2.3.7.2 When flow is from three sprinklers, the test manifold shall be arranged to simulate two sprinklers on the most remote branch line and one sprinkler on the next adjacent branch line.

7.2.3.7.3 When flow is from two sprinklers, the test manifold shall be arranged to simulate two sprinklers on the most remote branch line.

7.2.3.7.4 When flow is from one sprinkler, the test manifold shall be installed as per the requirements for a trip test connection in accordance with 8.17.4.3.

7.2.3.7.5 A system meeting the requirements of this section shall not be required to also meet the requirements of 7.2.3.2 or 7.2.3.5.

7.2.3.8 Dry pipe systems with water delivery times other than 7.2.3.2, 7.2.3.5, and 7.2.3.7 shall be acceptable where listed by a nationally recognized testing laboratory.

7.2.3.9 Unless installed in a heated enclosure, check valves shall not be used to subdivide the dry pipe systems.

7.2.3.10 Gridded dry pipe systems shall not be installed.

7.2.4 Quick-Opening Devices.

7.2.4.1 A listed quick-opening device shall be permitted to help meet the requirements of 7.2.3.2, 7.2.3.5, 7.2.3.7, or 7.2.3.8.

7.2.4.2 The quick-opening device shall be located as close as practical to the dry pipe valve.

7.2.4.3 To protect the restriction orifice and other operating parts of the quick-opening device against submergence, the connection to the riser shall be above the point at which water (priming water and back drainage) is expected when the dry pipe valve and quick-opening device are set, except where design features of the particular quick-opening device make these requirements unnecessary.

7.2.4.4 Where a valve is installed in the connection between a dry pipe sprinkler riser and a quick-opening device, it shall be an indicating-type valve that is sealed, locked, or electrically supervised in the open position.

7.2.4.5 A check valve shall be installed between the quick-opening device and the intermediate chamber of the dry pipe valve, where the quick-opening device requires protection against submergence after system operation.

7.2.4.6 If the quick-opening device requires pressure feedback from the intermediate chamber, a valve type that will clearly indicate whether it is opened or closed shall be permitted in place of that check valve.

7.2.4.7 Where a valve is utilized in accordance with 7.2.4.6, the valve shall be constructed so that it can be locked or sealed in the open position.

7.2.4.8 Antiflooding Device.

7.2.4.8.1 Unless the requirements of 7.2.4.8.2 are met, a listed antiflooding device shall be installed in the connection between the dry pipe sprinkler riser and the quick-opening device.

7.2.4.8.2 A listed antiflooding device shall not be required where the quick-opening device has built-in antiflooding design features.

7.2.5* Location and Protection of Dry Pipe Valve.

7.2.5.1* General. The dry pipe valve and supply pipe shall be protected against freezing and mechanical injury.

7.2.5.2 Valve Rooms.

7.2.5.2.1 Valve rooms shall be lighted and heated.

7.2.5.2.2 The source of heat shall be of a permanently installed type.

7.2.5.2.3 Heat tape shall not be used in lieu of heated valve enclosures to protect the dry pipe valve and supply pipe against freezing.

7.2.5.3 Supply. The supply for the sprinkler in the dry pipe valve enclosure shall be from the dry side of the system.

7.2.5.4 High Water Level Protection.

7.2.5.4.1 Where it is possible to reseal the dry valve after actuation without first draining the system, protection against occurrence of water above the clapper shall be permitted in accordance with 7.2.5.4.3.

7.2.5.4.2 Low Differential Dry Pipe Valve. Protection against accumulation of water above the clapper shall be provided for low differential dry pipe valves in accordance with 7.2.5.4.3.



7.2.5.4.3 High Water Level Device. An automatic high water level signaling device or an automatic drain shall be permitted.

7.2.6 Air Pressure and Supply.

7.2.6.1 Maintenance of Air Pressure. Air or nitrogen pressure shall be maintained on dry pipe systems throughout the year.

7.2.6.2* Air Supply.

7.2.6.2.1 The compressed air supply shall be from a source available at all times.

7.2.6.2.2* The air supply shall have a capacity capable of restoring normal air pressure in the system within 30 minutes.

7.2.6.2.3 The requirements of 7.2.6.2.2 shall not apply in refrigerated spaces maintained below 5°F (-15°C), where normal system air pressure shall be permitted to be restored within 60 minutes.

7.2.6.3 Air Supply Connections.

7.2.6.3.1 Connection pipe from the air supply to the dry pipe valve shall not be less than ½ in. (15 mm) in diameter and shall enter the system above the priming water level of the dry pipe valve.

7.2.6.3.2 A check valve shall be installed in the air filling connection, and a listed or approved shutoff valve of either the renewable disc or ball valve type shall be installed on the supply side of this check valve and shall remain closed unless filling the system.

7.2.6.4 Relief Valve. An approved relief valve shall be provided between the air supply and the shutoff valve and shall be set to relieve pressure no less than 10 psi (0.7 bar) in excess of system air pressure provided in 7.2.6.6.1 and shall not exceed the manufacturer's limitations.

7.2.6.5 Automatic Air Maintenance.

7.2.6.5.1* Unless the requirements of 7.2.6.5.2 are met, where the air supply to a dry pipe system is maintained automatically, the air supply shall be from a dependable plant system or an air compressor with an air receiver, and shall utilize an air maintenance device specifically listed for such service and capable of controlling the required air pressure on, and maximum airflow to, the dry pipe system.

7.2.6.5.2 Where the air compressor supplying the dry pipe system has a capacity less than 5.5 ft³/min (156 L/min) at 10 psi (0.7 bar), an air receiver or air maintenance device shall not be required.

7.2.6.5.3 The automatic air supply to more than one dry pipe system shall be connected to enable individual maintenance of air pressure in each system.

7.2.6.5.4 A check valve or other positive backflow prevention device shall be installed in the air supply to each system to prevent airflow or waterflow from one system to another.

7.2.6.6 System Air Pressure.

7.2.6.6.1 The system air pressure shall be maintained in accordance with the instruction sheet furnished with the dry pipe valve, or shall be 20 psi (1.4 bar) in excess of the calculated trip pressure of the dry pipe valve, based on the highest normal water pressure of the system supply.

7.2.6.6.2 The permitted rate of air leakage shall be as specified in 24.2.2.

7.2.6.7 Nitrogen. Where used, nitrogen shall be introduced through a pressure regulator and shall be in accordance with 7.2.6.5.

7.3 Preaction Systems and Deluge Systems.

7.3.1* General.

7.3.1.1* All components of pneumatic, hydraulic, or electrical systems shall be compatible.

7.3.1.2 The automatic water control valve shall be provided with hydraulic, pneumatic, or mechanical manual means for operation that is independent of detection devices and of the sprinklers.

7.3.1.3 Pressure Gauges. Listed pressure gauges conforming with 8.17.3 shall be installed as follows:

- (1) Above and below preaction valve and below deluge valve
- (2) On air supply to preaction and deluge valves

7.3.1.4 A supply of spare fusible elements for heat-responsive devices, not less than two of each temperature rating, shall be maintained on the premises for replacement purposes.

7.3.1.5 Hydraulic release systems shall be designed and installed in accordance with manufacturer's requirements and listing for height limitations above deluge valves or deluge valve actuators to prevent water column.

7.3.1.6 Location and Spacing of Releasing Devices.

7.3.1.6.1 Spacing of releasing devices, including automatic sprinklers used as releasing devices, shall be in accordance with their listing and manufacturer's specifications.

7.3.1.6.2 The release system shall serve all areas that the preaction system protects.

7.3.1.6.3 Where thermal activation is utilized, the activation temperature of the release system shall be lower than the activation temperature of the sprinkler.

7.3.1.7 Devices for Test Purposes and Testing Apparatus.

7.3.1.7.1 Where detection devices installed in circuits are located where not readily accessible for testing, an additional detection device shall be provided on each circuit for test purposes at an accessible location and shall be connected to the circuit at a point that will ensure a proper test of the circuit.

7.3.1.7.2 Testing apparatus capable of producing the heat or impulse necessary to operate any normal detection device shall be furnished to the owner of the property with each installation.

7.3.1.7.3 Where explosive vapors or materials are present, hot water, steam, or other methods of testing not involving an ignition source shall be used.

7.3.1.8 Location and Protection of System Water Control Valves.

7.3.1.8.1 System water control valves and supply pipes shall be protected against freezing and mechanical injury.

7.3.1.8.2 Valve Rooms.

7.3.1.8.2.1 Valve rooms shall be lighted and heated.

7.3.1.8.2.2 The source of heat shall be of a permanently installed type.

7.3.1.8.2.3 Heat tape shall not be used in lieu of heated valve enclosure rooms to protect preaction and deluge valves and supply pipe against freezing.

7.3.2 Preaction Systems.

7.3.2.1 Preaction systems shall be one of the following types:

- (1) A single interlock system, which admits water to sprinkler piping upon operation of detection devices
- (2) A non-interlock system, which admits water to sprinkler piping upon operation of detection devices or automatic sprinklers
- (3) A double interlock system, which admits water to sprinkler piping upon operation of both detection devices and automatic sprinklers

7.3.2.2 Size of Systems — Single and Non-Interlock Preaction Systems. Not more than 1000 automatic sprinklers shall be controlled by any one preaction valve.

7.3.2.3 Size of Systems — Double Interlock Preaction Systems.

7.3.2.3.1 The system size controlled by a double interlock preaction valve shall be determined by either 7.3.2.3.1.1, 7.3.2.3.1.2, 7.3.2.3.1.3, and 7.3.2.3.1.4.

7.3.2.3.1.1 A system size for double interlock preaction systems of not more than 500 gal (1893 L) shall be permitted and shall not be required to meet any specific water delivery requirement to the trip test connection.

7.3.2.3.1.2 The system size for double interlock preaction systems shall be designed to deliver water to the system test connection in no more than 60 seconds, starting at the normal air pressure on the system, with the detection system activated and the inspection test connection fully opened simultaneously.

7.3.2.3.1.3 The system size for double interlock preaction systems shall be based on calculating water delivery in accordance with 7.2.3.6, anticipating that the detection system activation and sprinkler operation will be simultaneous.

7.3.2.3.1.4* The system size for double interlock preaction systems shall be designed to deliver water to the system trip test connection or manifold outlets in not more than the maximum time of water delivery specified in Table 7.2.3.6.1, starting at the normal air pressure on the system, with the detection system activated and the inspection trip test connection or manifold opened simultaneously.

7.3.2.3.2 A listed quick-opening device shall be permitted to be used to help meet the requirements of 7.3.2.3.1.2, 7.3.2.3.1.3, and 7.3.2.3.1.4.

7.3.2.4* Supervision.

7.3.2.4.1 Sprinkler piping and fire detection devices shall be automatically supervised where more than 20 sprinklers are on the system.

7.3.2.4.2 Except as permitted by 7.3.2.4.3, air or nitrogen supervising pressure for preaction systems shall be installed in conformance with the dry pipe system air pressure and supply rules of 7.2.6.

7.3.2.4.3 The relief valves required by 7.2.6 shall be permitted to be omitted for the type of preaction system described in 7.3.2.1(1) when the air pressure is supplied from a source that is not capable of developing pressures in excess of 15 psi (1.0 bar).

7.3.2.4.4 All preaction system types described in 7.3.2.1(2) and 7.3.2.1(3) shall maintain a minimum supervising air or nitrogen pressure of 7 psi (0.5 bar).

7.3.2.5 Sprinklers. The following types of sprinklers and arrangements shall be permitted for preaction systems:

- (1) Upright sprinklers
- (2)*Listed dry sprinklers
- (3) Pendent sprinklers and sidewall sprinklers installed on return bends, where the sprinklers, return bend, and branch line piping are in an area maintained at or above 40°F (4°C)
- (4) Horizontal sidewall sprinklers, installed so that water is not trapped
- (5) Pendent sprinklers and sidewall sprinklers, where the sprinklers and branch line piping are in an area maintained at or above 40°F (4°C), the water supply is potable, and the piping for the preaction system is copper or CPVC specifically listed for dry pipe applications

7.3.2.6 System Configuration. Preaction systems of the type described in 7.3.2.1(3) and all preaction systems protecting storage occupancies, excluding miscellaneous storage, shall not be gridded.

7.3.3* Deluge Systems.

7.3.3.1 The detection devices or systems shall be automatically supervised.

7.3.3.2 Deluge systems shall be hydraulically calculated.

7.4 Combined Dry Pipe and Preaction Systems for Piers, Terminals, and Wharves.

7.4.1 In addition to the requirements of Section 7.4, design and installation requirements for piers, terminals, and wharves shall be in accordance with Section 21.22.

7.4.2* General.

7.4.2.1* Combined automatic dry pipe and preaction systems shall be so constructed that failure of the detection system shall not prevent the system from functioning as a conventional automatic dry pipe system.

7.4.2.2 Combined automatic dry pipe and preaction systems shall be so constructed that failure of the dry pipe system of automatic sprinklers shall not prevent the detection system from properly functioning as an automatic fire alarm system.

7.4.2.3 Provisions shall be made for the manual operation of the detection system at locations requiring not more than 200 ft (61 m) of travel.

7.4.2.4 Sprinklers. The following types of sprinklers and arrangements shall be permitted for combined dry pipe and preaction systems:

- (1) Upright sprinklers
- (2)*Listed dry sprinklers
- (3) Pendent sprinklers and sidewall sprinklers installed on return bends, where both the sprinklers and the return bends are located in a heated area
- (4) Horizontal sidewall sprinklers, installed so that water is not trapped

7.4.3 Dry Pipe Valves in Combined Systems.

7.4.3.1 Where the system consists of more than 600 sprinklers or has more than 275 sprinklers in any fire area, the entire system shall be controlled through two 6 in. (150 mm) dry pipe valves connected in parallel and shall feed into a common feed main.



7.4.3.2* Where parallel dry pipe valves are required by 7.4.3.1, these valves shall be checked against each other.

7.4.3.3 Each dry pipe valve shall be provided with a listed tripping device actuated by the detection system.

7.4.3.4 Dry pipe valves shall be cross-connected through a 1 in. (25 mm) pipe connection to permit simultaneous tripping of both dry pipe valves.

7.4.3.5 The 1 in. (25 mm) cross-connection pipe shall be equipped with an indicating valve so that either dry pipe valve can be shut off and worked on while the other remains in service.

7.4.3.6 The check valves between the dry pipe valves and the common feed main shall be equipped with ½ in. (15 mm) bypasses so that a loss of air from leakage in the trimmings of a dry pipe valve will not cause the valve to trip until the pressure in the feed main is reduced to the tripping point.

7.4.3.7 An indicating valve shall be installed in each of these bypasses so that either dry pipe valve can be completely isolated from the main riser or feed main and from the other dry pipe valve.

7.4.3.8 Each combined dry pipe and preaction system shall be provided with listed quick-opening devices at the dry pipe valves.

7.4.4 Subdivision of System Using Check Valves.

7.4.4.1 Where more than 275 sprinklers are required in a single fire area, the system shall be divided into sections of 275 sprinklers or fewer by means of check valves.

7.4.4.2 Where the system is installed in more than one fire area or story, not more than 600 sprinklers shall be supplied through any one check valve.

7.4.4.3 Each section shall have a 1¼ in. (32 mm) drain on the system side of each check valve supplemented by a dry pipe system auxiliary drain.

7.4.4.4 Section drain lines and dry pipe system auxiliary drains shall be located in heated areas or inside heated cabinets to enclose drain valves and auxiliary drains for each section.

7.4.5 Time Limitation.

7.4.5.1 The sprinkler system shall be so constructed and the number of sprinklers controlled shall be so limited that water shall reach the farthest sprinkler within a period of time not exceeding 1 minute for each 400 ft (122 m) of common feed main from the time the heat-responsive system operates.

7.4.5.2 The maximum time permitted shall not exceed 3 minutes.

7.4.6 System Test Connection. The end section shall have a system test connection as required for dry pipe systems.

7.5 Multi-Cycle Systems.

7.5.1 All multi-cycle systems shall be specifically tested and listed as systems.

7.5.2 All multi-cycle systems shall be installed in compliance with the manufacturer's installation instructions.

7.6 Antifreeze Systems.

7.6.1* General.

7.6.1.1 The use of antifreeze solutions shall be in conformity with state and local health regulations.

7.6.1.2 Antifreeze shall not be used in ESFR systems unless at least one of the following two conditions is met:

- (1) For antifreeze solutions not referenced in this standard, the antifreeze solution shall be specifically listed for ESFR applications.
- (2) For antifreeze solutions referenced in this standard, the ESFR sprinkler shall be specifically listed for use with the antifreeze solution.

7.6.1.3 Where pendent sprinklers are utilized, the water shall be drained from the entire system after hydrostatic testing with water.

7.6.1.3.1 The requirements of 7.6.1.3 shall not apply where the system is hydrostatically tested with properly mixed antifreeze solution.

7.6.1.4 Where antifreeze systems are remote from the system riser, a placard shall be mounted on the system riser that indicates the number and location of all remote antifreeze systems supplied by that riser.

7.6.1.5 A placard shall be placed on the antifreeze system main valve that indicates the manufacture type and brand of the antifreeze solution, the concentration of the antifreeze solution used, and the volume of the antifreeze solution used in the system.

7.6.2* Antifreeze Solutions.

7.6.2.1 Where sprinkler systems are supplied by potable water connections, the use of antifreeze solutions other than water solutions of pure glycerine (C.P. or U.S.P. 96.5 percent grade) or propylene glycol shall not be permitted.

7.6.2.2 Glycerine-water and propylene glycol-water mixtures shown in Table 7.6.2.2 shall be considered suitable for use.

Table 7.6.2.2 Antifreeze Solution to Be Used if Potable Water Is Connected to Sprinklers

Material	Solution (by volume)	Specific Gravity at 60°F (15.6°C)	Freezing Point	
			°F	°C
Glycerine (C.P. or U.S.P. grade)	50% water	1.145	-20.9	-29.4
	40% water	1.171	-47.3	-44.1
	30% water	1.197	-22.2	-30.1
Hydrometer scale 1.000 to 1.200				
Propylene glycol	60% water	1.034	-6	-21.1
	50% water	1.041	-26	-32.2
	40% water	1.045	-60	-51.1
Hydrometer scale 1.000 to 1.200 (subdivisions 0.002)				

C.P.: Chemically pure. U.S.P.: United States Pharmacopoeia 96.5%.

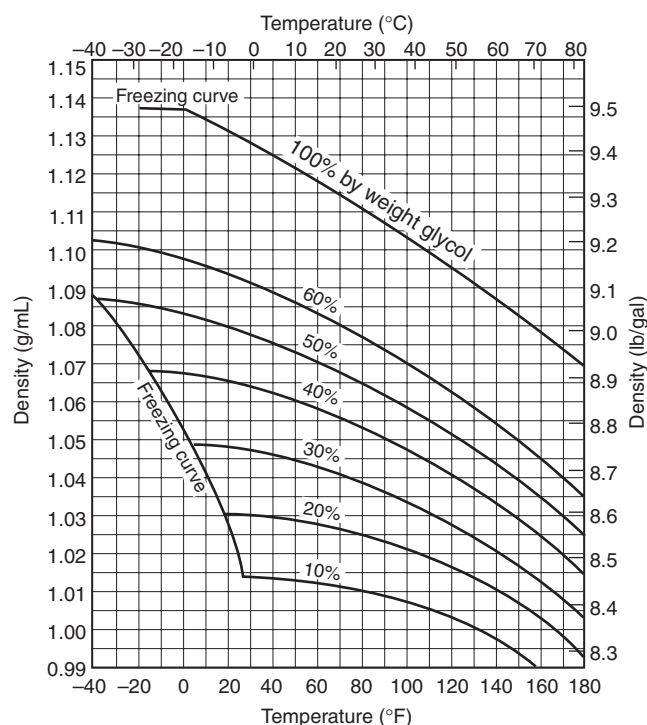
7.6.2.3 If potable water is not connected to sprinklers, the commercially available materials indicated in Table 7.6.2.3 shall be permitted for use in antifreeze solutions.

7.6.2.4* An antifreeze solution shall be prepared with a freezing point below the expected minimum temperature for the locality.

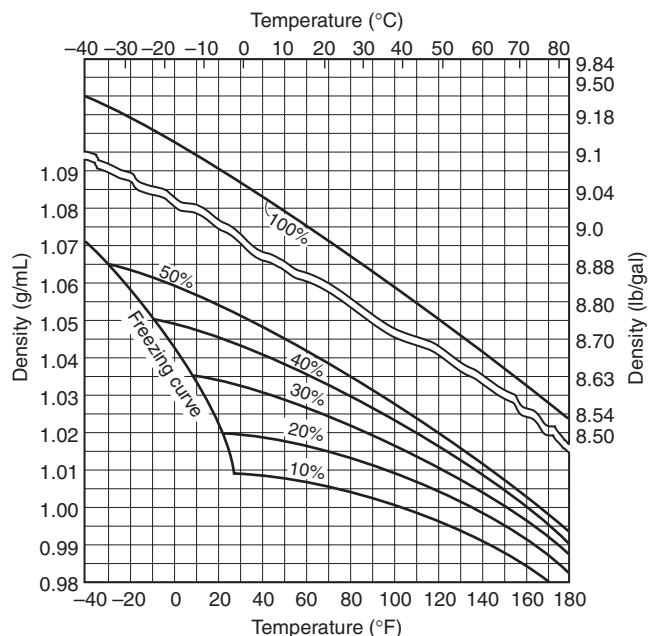
Table 7.6.2.3 Antifreeze Solution to Be Used if Nonpotable Water Is Connected to Sprinklers

Material	Solution (by volume)	Specific Gravity at 60°F (15.6°C)	Freezing Point	
			°F	°C
Glycerine	See Table 7.6.2.2.			
Diethylene glycol	50% water	1.078	-13	-25.0
	45% water	1.081	-27	-32.8
	40% water	1.086	-42	-41.1
Hydrometer scale 1.000 to 1.120 (subdivisions 0.002)				
Ethylene glycol	61% water	1.056	-10	-23.3
	56% water	1.063	-20	-28.9
	51% water	1.069	-30	-34.4
	47% water	1.073	-40	-40.0
Hydrometer scale 1.000 to 1.120 (subdivisions 0.002)				
Propylene glycol	See Table 7.6.2.2.			

7.6.2.5* The specific gravity of the prepared solution shall be checked by a hydrometer, in accordance with Figure 7.6.2.5(a), Figure 7.6.2.5(b), and Figure 7.6.2.5(c), with suitable scale or a refractometer having a scale calibrated for the antifreeze solution involved.



Note: The 100 percent concentration curves are provided for information only so that densities are known for calculating solutions.

FIGURE 7.6.2.5(a) Densities of Aqueous Ethylene Glycol Solutions (Percent by Weight).

Note: The 100 percent concentration curves are provided for information only so that densities are known for calculating solutions.

FIGURE 7.6.2.5(b) Densities of Aqueous Propylene Glycol Solutions (Percent by Weight).

7.6.2.6 The concentration of antifreeze solutions shall be limited to the minimum necessary for the anticipated minimum temperature.

7.6.3 Arrangement of Supply Piping and Valves.

7.6.3.1* Where the connection between the antifreeze system and the wet pipe system does not incorporate a backflow prevention device, and the conditions of 7.6.3.5 are not met, piping and valves shall be installed as illustrated in Figure 7.6.3.1.

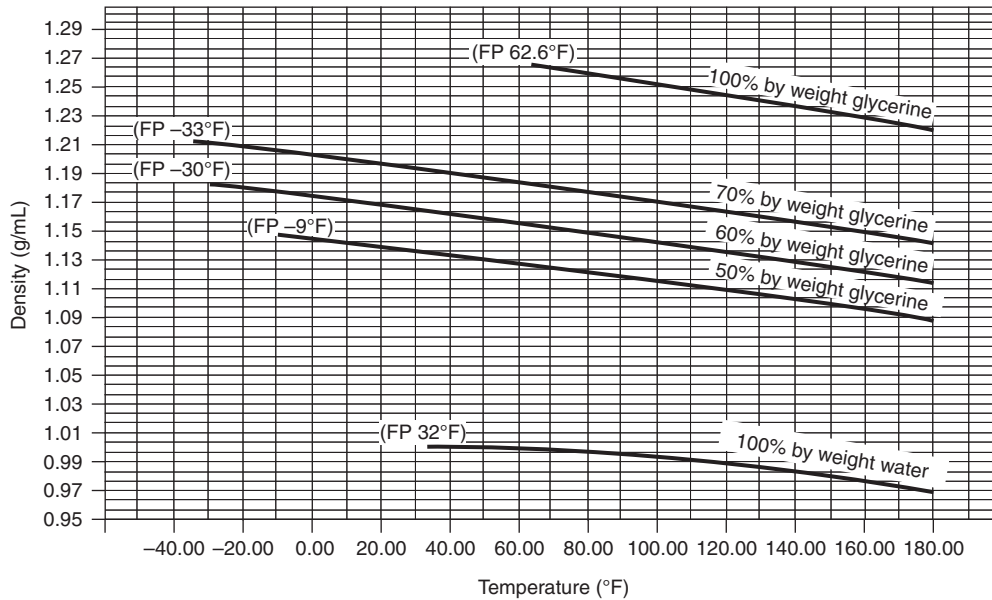
7.6.3.2* Where the connection between the antifreeze system and the wet pipe system incorporates a backflow prevention device, and the conditions of 7.6.3.5 are not met, piping and valves shall be installed as illustrated in Figure 7.6.3.3 or Figure 7.6.3.4.

7.6.3.3* Where the connection between the antifreeze system and the wet pipe system incorporates a backflow prevention device, and the conditions of 7.6.3.5 are not met, a listed expansion chamber shall be provided to compensate for thermal expansion of the antifreeze solution as illustrated in Figure 7.6.3.3.

7.6.3.3.1 When determining the size of the expansion chamber, the precharge air temperature and precharge air pressure shall be included. The size of the expansion chamber shall be such that the maximum system pressure does not exceed the rated pressure for any components of the antifreeze system.

7.6.3.4 A listed ½ in. (12 mm) relief valve shall be permitted in lieu of the expansion chamber required in 7.6.3.3 provided the antifreeze system volume does not exceed 40 gal (151 L) as illustrated in Figure 7.6.3.4.

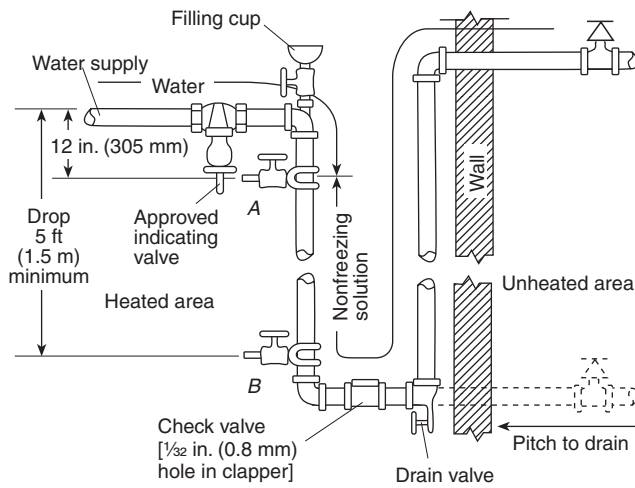




Note: The 100 percent concentration curves are provided for information only so that densities are known for calculating solutions.

FP = Freezing point

FIGURE 7.6.2.5(c) Densities of Aqueous Glycerine Solutions (Percent by Weight).



Notes:

1. Check valves are permitted to be omitted where sprinklers are below the level of valve A.
2. The $\frac{1}{32}$ in. (0.8 mm) hole in the check valve clapper is needed to allow for expansion of the solution during a temperature rise, thus preventing damage to sprinklers.

FIGURE 7.6.3.1 Arrangement of Supply Piping and Valves.

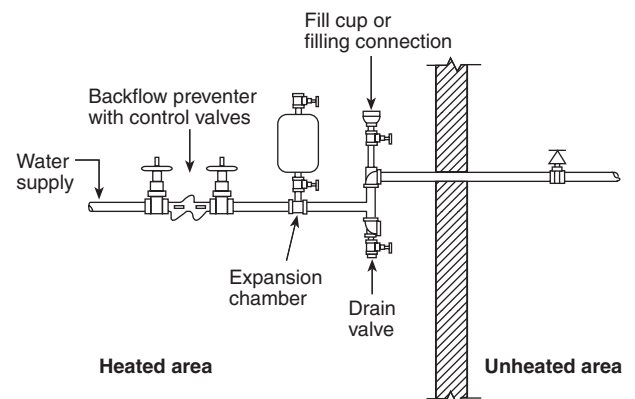
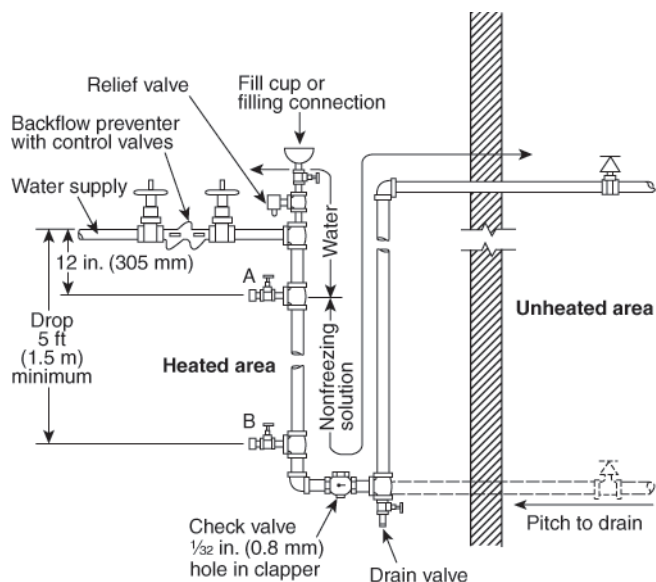


FIGURE 7.6.3.3 Arrangement of Supply Piping with Back-flow Device.



Notes:

1. Check valve can be omitted where sprinklers are below the level of valve A.
2. The 1/2 in. (0.8 mm) hole in the check valve clapper is needed to allow for expansion of the solution during a temperature rise, thus preventing damage to sprinklers.

FIGURE 7.6.3.4 Arrangement of Supply Piping with Relief Valve and Backflow Device.

7.6.3.5 The requirements of paragraphs 7.6.3.1, 7.6.3.2, and 7.6.3.3 shall not apply where the following three conditions are met:

- (1) The antifreeze system is provided with an automatic pressure pump or other device or apparatus to automatically maintain a higher pressure on the system side than on the supply side of the water supply check valve separating the antifreeze system from the water supply.
- (2) Provision is made to automatically release solution to prevent overpressurization due to thermal expansion of the solution.
- (3) Provision is made to automatically supply premixed solution as needed to restore system pressure due to thermal contraction.

7.6.3.6* A drain/test connection shall be installed at the most remote portion of the system.

7.6.3.7 For systems with a capacity larger than 150 gal (567.8 L), an additional test connection shall be provided for every 100 gal (378.5 L).

7.7 Automatic Sprinkler Systems with Non-Fire Protection Connections.

7.7.1 Circulating Closed-Loop Systems.

7.7.1.1 System Components.

7.7.1.1.1 A circulating closed-loop system is primarily a sprinkler system and shall comply with all provisions of this standard such as those for control valves, area limitations of a system, alarms, fire department connections, sprinkler spacing, and so forth, except as modified by Section 7.7.

7.7.1.1.2 Piping, fittings, valves, and pipe hangers shall meet the requirements specified in Chapter 6.

7.7.1.1.3 Unless the requirements of 7.7.1.1.4 are met, a dielectric fitting shall be installed in the junction where dissimilar piping materials are joined (e.g., copper to steel).

7.7.1.1.4 Dielectric fittings shall not be required in the junction where sprinklers are connected to piping.

7.7.1.1.5 Other auxiliary devices shall not be required to be listed for sprinkler service; however, these devices, such as pumps, circulating pumps, heat exchangers, radiators, and luminaires, shall be pressure rated at 175 psi or 300 psi (12.1 bar or 20.7 bar) (rupture pressure of five times rated water system working pressure) to match the required rating of sprinkler system components.

7.7.1.1.6 Auxiliary devices shall incorporate materials of construction and be so constructed that they will maintain their physical integrity under fire conditions to avoid impairment to the fire protection system.

7.7.1.1.7 Auxiliary devices, where hung from the building structure, shall be supported independently from the sprinkler portion of the system, following recognized engineering practices.

7.7.1.2* Hydraulic Characteristics. Piping systems for attached heating and cooling equipment shall have auxiliary pumps or an arrangement made to return water to the piping system in order to ensure the following:

- (1) Water for sprinklers shall not be required to pass through heating or cooling equipment.
- (2) At least one direct path shall exist for waterflow from the sprinkler water supply to every sprinkler.
- (3) Pipe sizing in the direct path shall be in accordance with the design requirements of this standard.
- (4) No portions of the sprinkler piping shall have less than the sprinkler system design pressure, regardless of the mode of operation of the attached heating or cooling equipment.
- (5) There shall be no loss or outflow of water from the system due to or resulting from the operation of heating or cooling equipment.
- (6) Shutoff valves and a means of drainage shall be provided on piping to heating or cooling equipment at all points of connection to sprinkler piping and shall be installed in such a manner as to make possible repair or removal of any auxiliary component without impairing the serviceability and response to the sprinkler system.
- (7) All auxiliary components, including the strainer, shall be installed on the auxiliary equipment side of the shutoff valves.

7.7.1.3 Water Temperature.

7.7.1.3.1 Maximum.

7.7.1.3.1.1 In no case shall maximum water temperature flowing through the sprinkler portion of the system exceed 120°F (49°C).

7.7.1.3.1.2 Protective control devices listed for this purpose shall be installed to shut down heating or cooling systems when the temperature of water flowing through the sprinkler portion of the system exceeds 120°F (49°C).

7.7.1.3.1.3 Where the water temperature exceeds 100°F (37.8°C), intermediate or higher temperature-rated sprinklers shall be used.



7.7.1.3.2 Minimum. Precautions shall be taken to ensure that temperatures below 40°F (4°C) are not permitted.

7.7.1.4 Obstruction to Discharge. Automatic sprinklers shall not be obstructed by auxiliary devices, piping, insulation, and so forth, from detecting fire or from proper distribution of water.

7.7.1.5 Signs.

7.7.1.5.1 Caution signs shall be attached to all valves controlling sprinklers.

7.7.1.5.2 The caution sign shall be worded as follows:

This valve controls fire protection equipment.
Do not close until after fire has been extinguished.
Use auxiliary valves when necessary
to shut off supply to auxiliary equipment.

CAUTION: Automatic alarm may be sounded if this valve is closed.

7.7.1.6 Water Additives.

7.7.1.6.1 Materials added to water shall not adversely affect the fire-fighting properties of the water and shall be in conformity with any state or local health regulations.

7.7.1.6.2 Due care and caution shall be given to the use of additives that can remove or suspend scale from older piping systems.

7.7.1.6.3 Where additives are necessary for proper system operation, due care shall be taken to ensure that additives are replenished after alarm testing or whenever water is removed from the system.

7.7.1.7 Waterflow Detection.

7.7.1.7.1 The supply of water from sprinkler piping through auxiliary devices, circulatory piping, and pumps shall not under any condition or operation, transient or static, cause false sprinkler waterflow signals.

7.7.1.7.2 A sprinkler waterflow signal shall not be impaired when water is discharged through an opened sprinkler or through the system test connection while auxiliary equipment is in any mode of operation (on, off, transient, stable).

7.8 Outside Sprinklers for Protection Against Exposure Fires (Exposure Protection Sprinkler Systems).

7.8.1 Applications.

7.8.1.1 Exposure protection sprinkler systems shall be permitted on buildings and structures regardless of whether the building's interior is protected by a sprinkler system.

7.8.1.2 Where exposure protection systems are required, they shall be installed to provide protection of windows and other openings within masonry walls, complete protection of walls, protection of roofs, or any combination thereof.

7.8.2 Water Supply and Control.

7.8.2.1 Unless the requirements of 7.8.2.2 are met, sprinklers installed for protection against exposure fires shall be supplied from a standard water supply as outlined in Chapter 23.

7.8.2.2 Where approved, other supplies, such as manual valves or pumps or fire department connections, shall be permitted to supply water to sprinklers for exposure protection.

7.8.2.3 Where fire department connections are used for water supply, they shall be so located that they will not be affected by the exposing fire.

7.8.3 Control.

7.8.3.1 Each system of outside sprinklers shall have an independent control valve.

7.8.3.2 Manually controlled open sprinklers shall be used only where constant supervision is present.

7.8.3.3 Sprinklers shall be of the open or automatic type.

7.8.3.4 Automatic sprinklers in areas subject to freezing shall be on dry pipe systems conforming to Section 7.2 or antifreeze systems conforming to Section 7.6.

7.8.3.5 Automatic systems of open sprinklers shall be controlled by the operation of fire detection devices designed for the specific application.

7.8.4 System Components.

7.8.4.1 Drain Valves. Each system of outside sprinklers shall have a separate drain valve installed on the system side of each control valve, except where an open sprinkler, top-fed system is arranged to facilitate drainage.

7.8.4.2 Check Valves.

7.8.4.2.1* Where sprinklers are installed on two adjacent sides of a building, protecting against two separate and distinct exposures, with separate control valves for each side, the end lines shall be connected with check valves located so that one sprinkler around the corner will operate.

7.8.4.2.2 The intermediate pipe between the two check valves shall be arranged to drain.

7.8.4.2.3* As an alternate solution, an additional sprinkler shall be installed on each system located around the corner from the system involved.

7.8.4.3 System Arrangement. Where one exposure affects two sides of the protected structure, the system shall not be subdivided between the two sides but rather shall be arranged to operate as a single system.

7.8.5 Pipe and Fittings. Pipe and fittings installed on the exterior of the building or structure shall be corrosion resistant.

7.8.6 Strainers. A listed strainer shall be provided in the riser or feed main that supplies sprinklers having nominal K-factors smaller than K-2.8 (40).

7.8.7 Gauge Connections. A listed pressure gauge conforming with 8.17.3 shall be installed immediately below the control valve of each system.

7.8.8 Sprinklers.

7.8.8.1 A single line of sprinklers is permitted to protect a maximum of two stories of wall area or two levels of vertically aligned windows where architectural features are sufficiently flush to allow rundown.

7.8.8.2 Where window sills or similar features result in recesses or projections exceeding 1 in. (25.4 mm) in depth, separate sprinklers shall be provided for each window on each level, regardless of whether protection is being provided for windows or complete walls.

7.8.8.3 For wall protection systems, sprinklers shall be located 6 in. to 12 in. (152 mm to 305 mm) from the wall surface

and within 6 in. (152 mm) of the top of the wall, with maximum spacing of 8 ft (2.44 m) or as indicated in the sprinkler listing for exposure protection use.

7.8.8.4 For protection of window and similar openings, listed window sprinklers shall be positioned within 2 in. (50.8 mm) of the top of the window sash in accordance with Table 7.8.8.4.

Table 7.8.8.4 Position of Window Sprinklers

Width of Window	Nominal K-Factor		Nominal Distance from Window
	U.S.	Metric	
Up to 3 ft	2.8	40	7 in.
>3 to 4 ft	2.8	40	8 in.
>4 to 5 ft	2.8	40	9 in.
	5.6	80	12 in.
>5 to 7 ft	11.2	160	12 in.
	Two 2.8	40	7 in.
>7 to 9.5 ft	14.0	200	12 in.
	Two 2.8	40	9 in.
>9.5 to 12 ft	Two 5.6	80	12 in.

For SI units, 1 ft = 0.3048 m.

7.8.8.5 Where exposure protection sprinkler systems are installed, listed cornice sprinklers shall be used to protect combustible cornices exceeding 12 in. (305 mm) in depth.

7.8.8.5.1 Cornice sprinklers shall be installed in each bay formed by cornice features and shall be spaced up to a maximum distance of 10 ft (3.05 m) apart, with deflectors 8 in. (203 mm) below the underside of the roof sheathing.

7.8.8.6 Open spray sprinklers (upright, pendent, or sidewall) shall be permitted for application in roof protection when installed in accordance with ordinary hazard Group 1 protection areas and discharge criteria, with deflectors aligned parallel to the slope and positioned a minimum 18 in. (457 mm) above the roof surface.

7.8.8.6.1 Upright sprinklers positioned as ridge pole sprinklers shall be permitted with their deflectors horizontal and minimum 6 in. (152 mm) above the ridge, with their maximum spacing and protection areas determined in the plan view rather than along the slope.

7.9* Refrigerated Spaces.

7.9.1 Spaces Maintained at Temperatures Above 32°F (0°C). Where temperatures are maintained above 32°F (0°C) in refrigerated spaces, the requirements in this section shall not apply.

7.9.2* Spaces Maintained at Temperatures Below 32°F (0°C).

7.9.2.1 General.

7.9.2.1.1 Where sprinkler pipe passes through a wall or floor into the refrigerated space, a section of pipe arranged for removal shall be provided immediately inside the space.

7.9.2.1.2 The removable length of pipe required in 7.9.2.1.1 shall be a minimum of 30 in. (762 mm).

7.9.2.2 Low Air Pressure Alarm.

7.9.2.2.1 Unless the requirements of 7.9.2.2.2 are met, a low air pressure alarm to a constantly attended location shall be installed.

7.9.2.2.2 Systems equipped with local low pressure alarms and an automatic air maintenance device shall not be required to alarm to a constantly attended location.

7.9.2.3 Piping Pitch. Piping in refrigerated spaces shall be installed with pitch as outlined in 8.16.2.3.3.

7.9.2.4* Air or Nitrogen Supply. Air or nitrogen supply for systems shall be one of the following:

- (1) Air from the room of lowest temperature to reduce the moisture content
- (2) Air compressor/dryer package listed for the application utilizing ambient air
- (3) Compressed nitrogen gas from cylinders used in lieu of compressed air

7.9.2.5* Control Valve. An indicating-type control valve for operational testing of the system shall be provided on each sprinkler riser outside of the refrigerated space.

7.9.2.6* Check Valve.

7.9.2.6.1 Unless the requirements of 7.9.2.6.2 are met, a check valve with a $\frac{3}{32}$ in. (2.4 mm) diameter hole in the clapper shall be installed in the system riser below the test valve required in 7.9.2.5.

7.9.2.6.2 Check valves shall not be required where dry pipe or preaction valves are used and designed to completely drain all water above the seat and that are listed for installation without priming water remaining and where priming water is not used in the system riser.

7.9.2.7* Air or Nitrogen Supply Piping.

7.9.2.7.1 The air or nitrogen supply piping entering the freezer area shall be as stated in 7.9.2.7.1.1 and 7.9.2.7.1.2.

7.9.2.7.1.1 Air Supply. The supply piping shall be equipped with two easily removable supply lines at least 6 ft (1.9 m) long and at least 1 in. (25 mm) in diameter as shown in Figure 7.9.2.7.1.1(a) or Figure 7.9.2.7.1.1(b).

7.9.2.7.1.2 Nitrogen Supply. The supply piping shall be equipped with a single easily removable supply line at least 6 ft (1.9 m) long and at least 1 in. (25 mm) in diameter.

7.9.2.7.2 Each supply line shall be equipped with control valves located in the warm area.

7.9.2.7.3 Only one air supply line shall be open to supply the system air at any one time.

7.9.2.8 Fire Detection for Praction Release.

7.9.2.8.1 Detectors for Praction Systems.

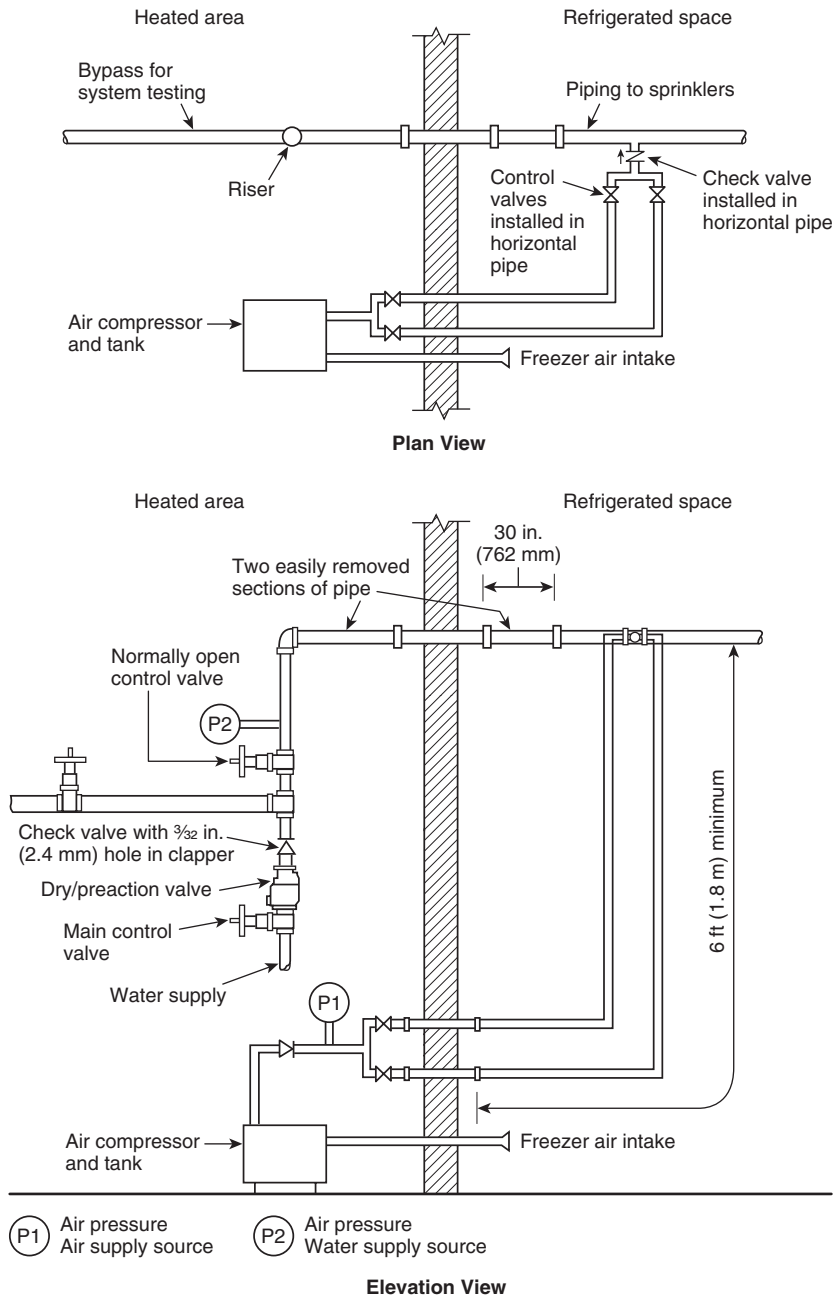
7.9.2.8.1.1* The release system shall be designed to operate prior to sprinkler operation, unless detectors meet the requirements of 7.9.2.8.1.2.

(A) Detectors shall be electric or pneumatic fixed temperature type with temperature ratings less than that of the sprinklers.

(B) Detection devices shall not be rate-of-rise type.

7.9.2.8.1.2 Where the system is a double interlock preaction system or single interlock preaction antifreeze system, detection devices shall be permitted to be any type specifically approved for use in a refrigerated area if installed in accordance with their listing requirements and *NFPA 72, National Fire Alarm and Signaling Code*.





Notes:

1. Check valve with 3/32 in. (2.4 mm) hole in clapper not required if prime water not used.
2. Supply air to be connected to top or side of system pipe.
3. Each removable air line to be a minimum of 1 in. (25 mm) diameter and a minimum of 6 ft (1.8 m) long.

FIGURE 7.9.2.7.1.1(a) Refrigerator Area Sprinkler System Used to Minimize the Chances of Developing Ice Plugs.

7.9.2.8.2 Detector Location at Ceiling.

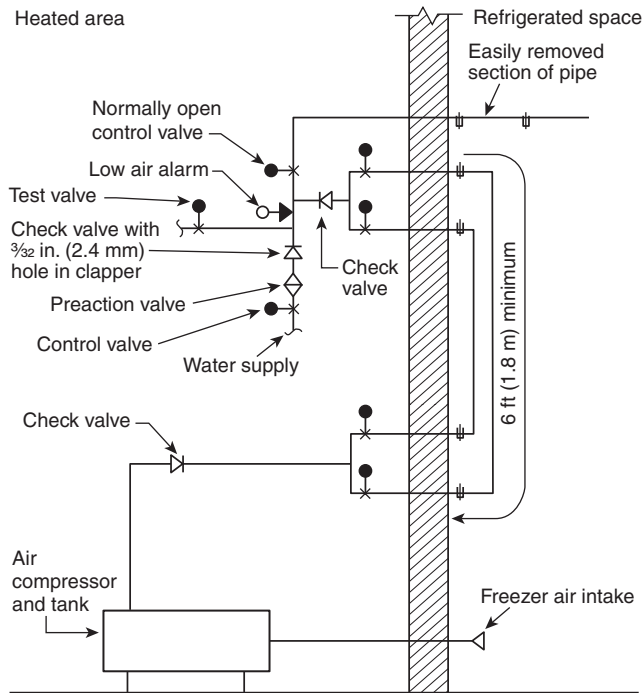
7.9.2.8.2.1 Under smooth ceilings, detectors shall be spaced not exceeding their listed spacing.

7.9.2.8.2.2 For other than smooth ceilings, detectors shall not exceed one-half of the listed linear detector spacing or full allowable sprinkler spacing, whichever is greater.

7.9.2.8.3 Detector Location in Racks.

7.9.2.8.3.1 Unless conditions in 7.9.2.8.4 are met, one level of detectors shall be installed for each level of sprinklers.

7.9.2.8.3.2 Detectors shall be installed vertically within one storage level of the rack sprinklers and as follows:



Notes:

1. Check valve with $\frac{3}{32}$ in. (2.4 mm) hole in clapper not required if prime water not used.
2. Each removable air line is to be installed a minimum of 1 in. (25 mm) in diameter and a minimum of 6 ft (1.8 m) long.

FIGURE 7.9.2.7.1.1(b) Preaction System Arrangement.

- (1) Detectors shall be located in the transverse flue in single-row racks and in the longitudinal flue in double-row racks.
- (2) For multiple-row racks, detectors shall be located in either longitudinal or transverse flue space and shall be within 5 ft (1.5 m) horizontally of each sprinkler.
- (3) Separate detection systems shall be installed for ceiling sprinkler systems and in-rack sprinkler systems.
- (4) Where system is double interlock preaction type, ceiling detection system shall operate solenoid valves on both ceiling and in-rack preaction systems.

7.9.2.8.4 Single Detection System for Ceiling and In-Rack Sprinklers. Ceiling detection only shall be permitted where all of the following conditions are met:

- (1) Maximum storage height is 35 ft (10.7 m).
- (2) Maximum ceiling height is 40 ft (12.2 m).
- (3) Maximum hazard of storage is Class III.
- (4) No solid shelves are present.
- (5) One preaction valve is used for both ceiling and in-rack sprinklers protecting the same area, with separate indicating control valves and check valves provided downstream as shown in Figure 7.9.2.8.4.
- (6) Detectors at the ceiling are spaced at a maximum of one-half the listed detector spacing but not less than the sprinkler spacing.

7.10 Commercial-Type Cooking Equipment and Ventilation.

7.10.1 General. In cooking areas protected by automatic sprinklers, additional sprinklers or automatic spray nozzles shall be

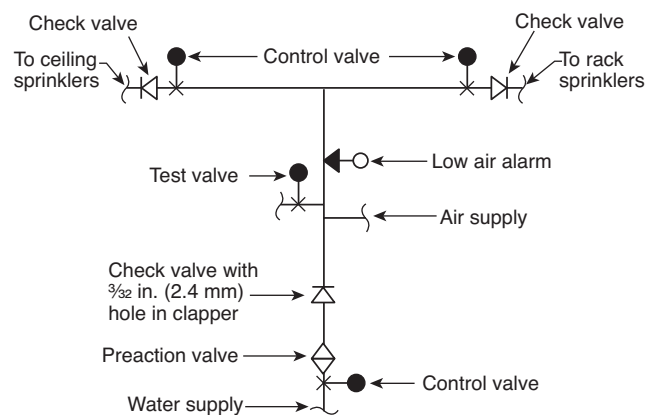


FIGURE 7.9.2.8.4 Valve Arrangement.

provided to protect commercial-type cooking equipment and ventilation systems that are designed to carry away grease-laden vapors unless otherwise protected.

7.10.2* Sprinklers and Automatic Spray Nozzles.

7.10.2.1 Unless the requirements of 7.10.2.2 are met, standard sprinklers or automatic spray nozzles shall be so located as to provide for the protection of exhaust ducts, hood exhaust duct collars, and hood exhaust plenum chambers.

7.10.2.2 Sprinklers or automatic spray nozzles in ducts, duct collars, and plenum chambers shall not be required where all cooking equipment is served by listed grease extractors.

7.10.2.3 Unless the requirements of 7.10.2.5 are met, standard sprinklers or automatic spray nozzles shall be so located as to provide for the protection of cooking equipment and cooking surfaces.

7.10.2.4 Hoods containing automatic fire-extinguishing systems are protected areas; therefore, these hoods are not considered obstructions to overhead sprinkler systems and shall not require floor coverage underneath.

7.10.2.5 Cooking equipment below hoods that contain automatic fire-extinguishing equipment is protected and shall not require protection from the overhead sprinkler system.

7.10.3 Sprinkler and Automatic Spray Nozzle Location — Ducts.

7.10.3.1 Unless the requirements of 7.10.3.2 or 7.10.3.4 are met, exhaust ducts shall have one sprinkler or automatic spray nozzle located at the top of each vertical riser and at the midpoint of each offset.

7.10.3.2 Sprinklers or automatic spray nozzles shall not be required in a vertical riser located outside of a building, provided the riser does not expose combustible material or provided the interior of the building and the horizontal distance between the hood outlet and the vertical riser is at least 25 ft (7.6 m).

7.10.3.3 Unless the requirements of 7.10.3.4 are met, horizontal exhaust ducts shall have sprinklers or automatic spray nozzle devices located on 10 ft (3 m) centers beginning no more than 5 ft (1.5 m) from the duct entrance.

7.10.3.4 Sprinklers or automatic spray nozzles shall be required in ducts.



7.10.3.4.1 Where ducts do not exceed 75 ft (22.86 m) in length and the entire exhaust duct is protected in accordance with NFPA 96, *Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations*, sprinkler(s) or automatic spray nozzle(s) shall not be required.

7.10.3.5 A sprinkler(s) or an automatic spray nozzle(s) in exhaust ducts subject to freezing shall be properly protected against freezing by approved means. (See 8.16.4.1.)

7.10.4 Sprinkler and Automatic Spray Nozzle Location — Duct Collar.

7.10.4.1 Each hood exhaust duct collar shall have one sprinkler or automatic spray nozzle located 1 in. minimum to 12 in. maximum (25 mm minimum to 305 mm maximum) above the point of duct collar connection in the hood plenum.

7.10.4.2 Hoods that have listed fire dampers located in the duct collar shall be protected with a sprinkler or automatic spray nozzle located on the discharge side of the damper and shall be so positioned as not to interfere with damper operation.

7.10.5 Sprinkler and Automatic Spray Nozzle Location — Exhaust Plenum Chambers.

7.10.5.1 Hood exhaust plenum chambers shall have one sprinkler or automatic spray nozzle centered in each chamber not exceeding 10 ft (3 m) in length.

7.10.5.2 Plenum chambers greater than 10 ft (3 m) in length shall have two sprinklers or automatic spray nozzles evenly spaced, with the maximum distance between the two sprinklers not to exceed 10 ft (3 m).

7.10.6 Sprinkler and Automatic Spray Nozzle Temperature Ratings and Orifice Sizes.

7.10.6.1 Where the exposed temperature is expected to be 300°F (149°C) or less, sprinklers or automatic spray nozzles being used in duct, duct collar, and plenum areas shall be of the extra high-temperature classification [325°F to 375°F (163°C to 191°C)].

7.10.6.2 When use of a temperature-measuring device indicates temperatures above 300°F (149°C), a sprinkler or automatic spray nozzle of higher classification shall be used.

7.10.6.3 Sprinklers or automatic spray nozzles being used in duct, duct collar, and plenum areas shall have orifices with K-factors not less than K-1.4 (20) and not more than K-5.6 (80).

7.10.7 Sprinkler and Automatic Spray Nozzle. Access shall be provided to all sprinklers or automatic spray nozzles for examination and replacement.

7.10.8 Cooking Equipment.

7.10.8.1 General. Cooking equipment (such as deep fat fryers, ranges, griddles, and broilers) that is considered to be a source of ignition shall be protected in accordance with the provisions of 7.10.1.

7.10.8.2 Deep Fat Fryers.

7.10.8.2.1 A sprinkler or automatic spray nozzle used for protection of deep fat fryers shall be listed for that application.

7.10.8.2.2 The position, arrangement, location, and water supply for each sprinkler or automatic spray nozzle shall be in accordance with its listing.

7.10.8.3 Fuel and Heat Shutoff.

7.10.8.3.1 The operation of any cooking equipment sprinkler or automatic spray nozzle shall automatically shut off all sources of fuel and heat to all equipment requiring protection.

7.10.8.3.2 Any gas appliance not requiring protection but located under ventilating equipment shall also be shut off.

7.10.8.3.3 All shutdown devices shall be of the type that requires manual resetting prior to fuel or power being restored.

7.10.9 Indicating Valves. A listed indicating valve shall be installed in the water supply line to the sprinklers and spray nozzles protecting the cooking and ventilating system.

7.10.10 Strainers. A listed line strainer shall be installed in the main water supply preceding sprinklers or automatic spray nozzles having nominal K-factors smaller than K-2.8 (40).

7.10.11 Test Connection. A system test connection shall be provided to verify proper operation of equipment specified in 7.10.8.3.

7.10.12 Sprinkler and Automatic Spray Nozzle Replacement.

7.10.12.1 Unless the requirements of 7.10.12.2 are met, sprinklers and automatic spray nozzles used for protecting commercial-type cooking equipment and ventilating systems shall be replaced annually.

7.10.12.2 Where automatic bulb-type sprinklers or spray nozzles are used and annual examination shows no buildup of grease or other material on the sprinklers or spray nozzles, such sprinklers or spray nozzles shall be permitted to be continued in use.

Chapter 8 Installation Requirements

8.1* Basic Requirements.

8.1.1* The requirements for spacing, location, and position of sprinklers shall be based on the following principles:

- (1) Sprinklers shall be installed throughout the premises.
- (2) Sprinklers shall be located so as not to exceed the maximum protection area per sprinkler.
- (3) Sprinklers shall be positioned and located so as to provide satisfactory performance with respect to activation time and distribution.
- (4) Sprinklers shall be permitted to be omitted from areas specifically allowed by this standard.
- (5) When sprinklers are specifically tested and test results demonstrate that deviations from clearance requirements to structural members do not impair the ability of the sprinkler to control or suppress a fire, their positioning and locating in accordance with the test results shall be permitted.
- (6) Clearance between sprinklers and ceilings exceeding the maximums specified in this standard shall be permitted, provided that tests or calculations demonstrate comparable sensitivity and performance of the sprinklers to those installed in conformance with these sections.
- (7) Furniture, such as portable wardrobe units, cabinets, trophy cases, and similar features not intended for occupancy, does not require sprinklers to be installed in them. This type of feature shall be permitted to be attached to the finished structure.

8.1.2* System valves and gauges shall be accessible for operation, inspection, tests, and maintenance.

8.2 System Protection Area Limitations.

8.2.1 The maximum floor area on any one floor to be protected by sprinklers supplied by any one sprinkler system riser or combined system riser shall be as follows:

- (1) Light hazard — 52,000 ft² (4831 m²)
- (2) Ordinary hazard — 52,000 ft² (4831 m²)
- (3) Extra hazard
 - (a) Pipe schedule — 25,000 ft² (2323 m²)
 - (b) Hydraulically calculated — 40,000 ft² (3716 m²)
- (4) Storage — High-piled storage (as defined in 3.9.1.17) and storage covered by other NFPA standards — 40,000 ft² (3716 m²)

8.2.2 The floor area occupied by mezzanines shall not be included in the area limits of 8.2.1.

8.2.3 Where single systems protect extra hazard, high-piled storage, or storage covered by other NFPA standards, and ordinary or light hazard areas, the extra hazard or storage area coverage shall not exceed the floor area specified for that hazard and the total area coverage shall not exceed 52,000 ft² (4831 m²).

8.2.4 Multiple buildings attached by canopies, covered breezeways, common roofs, or a common wall(s) shall be permitted to be supplied by a single fire sprinkler riser. The maximum system size shall comply with 8.2.1.

8.2.5* Detached Buildings.

8.2.5.1 Unless the requirements of 8.2.5.2 apply, detached buildings, regardless of separation distance, that do not meet the criteria of 8.2.4 shall be provided with separate fire sprinkler systems.

8.2.5.2 When acceptable to the authority having jurisdiction, detached structures shall be permitted to be supplied by the fire sprinkler system of an adjacent building.

8.3 Use of Sprinklers.

8.3.1 General.

8.3.1.1* Sprinklers shall be installed in accordance with their listing.

8.3.1.2 The requirements of 8.3.1.1 shall not apply where construction features or other special situations require unusual water distribution, and listed sprinklers shall be permitted to be installed in positions other than anticipated by their listing to achieve specific results.

8.3.1.3* Upright sprinklers shall be installed with the frame arms parallel to the branch line, unless specifically listed for other orientation.

8.3.1.4 Where solvent cement is used as the pipe and fittings bonding agent, sprinklers shall not be installed in the fittings prior to the fittings being cemented in place.

8.3.1.5 Protective Caps and Straps.

8.3.1.5.1* Protective caps and straps shall be removed using means that are in accordance with the manufacturer's installation instructions.

8.3.1.5.2* Protective caps and straps shall be removed from all sprinklers prior to the time when the sprinkler system is placed in service.

8.3.1.5.3 Protective caps and straps on all upright sprinklers or on any sprinklers installed more than 10 ft (3 m) above the floor shall be permitted to be removed from sprinklers immediately following their installation.

8.3.2 Temperature Ratings.

8.3.2.1* Unless the requirements of 8.3.2.2, 8.3.2.3, 8.3.2.4, or 8.3.2.5 are met, ordinary- and intermediate-temperature sprinklers shall be used throughout buildings.

8.3.2.2 Where maximum ceiling temperatures exceed 100°F (38°C), sprinklers with temperature ratings in accordance with the maximum ceiling temperatures of Table 6.2.5.1 shall be used.

8.3.2.3 High-temperature sprinklers shall be permitted to be used throughout ordinary and extra hazard occupancies and as allowed in this standard and other NFPA codes and standards.

8.3.2.4 Sprinklers of intermediate- and high-temperature classifications shall be installed in specific locations as required by 8.3.2.5.

8.3.2.5* The following practices shall be observed to provide sprinklers of other than ordinary-temperature classification unless other temperatures are determined or unless high-temperature sprinklers are used throughout, and temperature selection shall be in accordance with Table 8.3.2.5(a), Table 8.3.2.5(b), and Figure 8.3.2.5:

- (1) Sprinklers in the high-temperature zone shall be of the high-temperature classification, and sprinklers in the intermediate-temperature zone shall be of the intermediate-temperature classification.
- (2) Sprinklers located within 12 in. (305 mm) to one side or 30 in. (762 mm) above an uncovered steam main, heating coil, or radiator shall be of the intermediate-temperature classification.
- (3) Sprinklers within 7 ft (2.1 m) of a low-pressure blowoff valve that discharges free in a large room shall be of the high-temperature classification.
- (4) Sprinklers under glass or plastic skylights exposed to the direct rays of the sun shall be of the intermediate-temperature classification.
- (5) Sprinklers in an unventilated, concealed space, under an uninsulated roof, or in an unventilated attic shall be of the intermediate-temperature classification.
- (6) Sprinklers in unventilated show windows having high-powered electric lights near the ceiling shall be of the intermediate-temperature classification.
- (7) Sprinklers protecting commercial-type cooking equipment and ventilation systems shall be of the high- or extra high-temperature classification as determined by use of a temperature-measuring device. (See 7.10.6.)
- (8) Sprinklers protecting residential areas installed near specific heat sources identified in Table 8.3.2.5(c) shall be installed in accordance with Table 8.3.2.5(c).
- (9) Ordinary-temperature sprinklers located adjacent to a heating duct that discharges air that is less than 100°F (38°C) are not required to be separated in accordance with Table 8.3.2.5(a).
- (10) Sprinklers in walk-in type coolers and freezers with automatic defrosting shall be of the intermediate-temperature classification or higher.



Table 8.3.2.5(a) Temperature Ratings of Sprinklers Based on Distance from Heat Sources

Type of Heat Condition	Ordinary-Temperature Rating	Intermediate-Temperature Rating	High-Temperature Rating
(1) Heating ducts			
(a) Above	More than 2 ft 6 in.	2 ft 6 in. or less	
(b) Side and below	More than 1 ft 0 in.	1 ft 0 in. or less	
(c) Diffuser	Any distance except as shown under Intermediate-Temperature Rating column	<i>Downward discharge:</i> Cylinder with 1 ft 0 in. radius from edge extending 1 ft 0 in. below and 2 ft 6 in. above <i>Horizontal discharge:</i> Semicylinder or cylinder with 2 ft 6 in. radius in direction of flow extending 1 ft 0 in. below and 2 ft 6 in. above	
(2) Unit heater			
(a) Horizontal discharge		<i>Discharge side:</i> 7 ft 0 in. to 20 ft 0 in. radius pie-shaped cylinder (see Figure 8.3.2.5) extending 7 ft 0 in. above and 2 ft 0 in. below heater; also 7 ft 0 in. radius cylinder more than 7 ft 0 in. above unit heater	7 ft 0 in. radius cylinder extending 7 ft 0 in. above and 2 ft 0 in. below unit heater
(b) Vertical downward discharge (for sprinklers below unit heater, see Figure 8.3.2.5)		7 ft 0 in. radius cylinder extending upward from an elevation 7 ft 0 in. above unit heater	7 ft 0 in. radius cylinder extending from the top of the unit heater to an elevation 7 ft 0 in. above unit heater
(3) Steam mains (uncovered)			
(a) Above	More than 2 ft 6 in.	2 ft 6 in. or less	
(b) Side and below	More than 1 ft 0 in.	1 ft 0 in. or less	
(c) Blowoff valve	More than 7 ft 0 in.		7 ft 0 in. or less

For SI units, 1 in. = 25.4 mm; 1 ft = 0.3048 m.

Table 8.3.2.5(b) Ratings of Sprinklers in Specified Locations

Location	Ordinary-Temperature Rating	Intermediate-Temperature Rating	High-Temperature Rating
Skylights		Glass or plastic	
Attics	Ventilated	Unventilated	
Peaked roof: metal or thin boards, concealed or not concealed, insulated or uninsulated	Ventilated	Unventilated	
Flat roof: metal, not concealed	Ventilated or unventilated	Note: For uninsulated roof, climate and insulated or uninsulated occupancy can necessitate intermediate sprinklers. Check on job.	
Flat roof: metal, concealed, insulated or uninsulated	Ventilated	Unventilated	
Show windows	Ventilated	Unventilated	

Note: A check of job condition by means of thermometers might be necessary.