NFPA[®] 13

Standard for the Installation of Sprinkler Systems

2025 Edition



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NFPA® 13

Standard for the

Installation of Sprinkler Systems

2025 Edition

This edition of NFPA 13, *Standard for the Installation of Sprinkler Systems*, was prepared by the Technical Committees on Hanging and Bracing of Water-Based Fire Protection Systems, Private Water Supply Piping Systems, Sprinkler System Discharge Criteria, and Sprinkler System Installation Criteria, released by the Correlating Committee on Automatic Sprinkler Systems and acted on by the NFPA membership during the 2024 NFPA Technical Meeting held June 20, 2024. It was issued by the Standards Council on August 29, 2024, with an effective date of September 18, 2024, and supersedes all previous editions.

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

This edition of NFPA 13 was approved as an American National Standard on September 18, 2024.

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 brought 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 in other NFPA documents was included at the end of the 1999 edition.

Other 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 microbiologically 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 the exceptions and reworded them as requirements where applicable, moved the mandatory references to Chapter 2, and relocated all 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; and 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 place all 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 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 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 plastic and rubber tire storage; protection of roll paper; and special designs of storage protection.

For the 2010 edition, many of the major changes related to the requirements for storage protection. First was the combination of large drop sprinkler and the specific application control mode sprinkler requirements and the revision of the terminology to identify them as Control Mode Specific Application sprinklers (CMSA). Next, new criteria for use of smoke vents were added to Chapter 12. The density/area curves in the storage chapters were reduced to a maximum 3000 ft² (278 m²) operating area; this was a significant reduction of some curves that had extended up to 6000 ft² (557 m²). Changes to rack storage in the 2010 edition included a new method to calculate the rack shelf area. Finally, the provisions for back-to-back shelf storage were added to the storage chapters.

Criteria for the protection of three new special storage arrangements were added to Chapter 20. These included 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, several 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 were modified to correlate with SEI/ASCE-7, and a new Annex E was added that described this calculation.

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

The 2013 edition of NFPA 13 included changes to many technical requirements as well as the reorganization of multiple chapters. One significant change that was made to the administrative chapter of NFPA 13 was to clarify that watermist systems were not covered within NFPA 13 and that NFPA 750 should be used when looking for guidance on the design and installation of those systems. A series of new requirements addressed the need for a compatibility review where nonmetallic piping and fittings are installed in systems also using petroleum-based products such as cutting oils and corrosion inhibitors. Several modifications were made to the standard pertaining to freeze protection. The use of antifreeze in new NFPA 13 sprinkler systems was prohibited unless the solution use was listed, and the listing indicated the inability for the solution to ignite.

Other freeze protection modifications to the standard included clarification on the use of heat tracing, required barrel length for dry sprinklers, and the allowance for engineering analyses to be submitted to support an alternate freeze protection scheme. New sprinkler omission requirements were added for elevator machine rooms and other elevator associated spaces where certain criteria were met. Chapter 9 included updated information on shared support structures as well as a revised seismic bracing calculation form. Chapters 16 and 17 were reorganized to make the chapters easier to follow, to create more consistency between the various storage chapters. A new chapter on alternative approaches for storage applications was added to provide guidance on performance-based approaches dealing with storage arrangements.

One of the largest changes to the 2016 edition of NFPA 13 was the review of all metric conversions. Historically the document had used an "exact" conversion process, but in the 2016 edition an approximate conversion process was used. The intent of this change was to make the document more usable outside the United States. Another major change was the inclusion of a pipe venting requirement to eliminate as much air as possible from wet pipe systems. This requirement contemplates only a single vent in each wet system.

There were a significant number of changes to the storage chapters of NFPA 13. New design criteria were included for the protection of exposed, expanded Group A plastics stored in racks. Also, a ceiling and in-rack design approach, called an "alternative protection scheme," was added to Chapters 16 and 17. A similar concept had existed for sprinkler protection in NFPA 30 for several revision cycles.

A new section on sprinkler design where cloud ceilings are installed was added. This design scheme allows sprinklers to be omitted above cloud ceilings when the gap between clouds (or clouds and walls) meets a maximum allowable dimension based on the floor-to-cloud ceiling height. This new language was created based on a project conducted by the Fire Protection Research Foundation. Chapter 10, which is extracted from NFPA 24, was significantly revised based on the rewrite of NFPA 24. Most of the technical content remained the same, although the organization and structure were modified.

The 2019 edition of NFPA 13 has undergone a complete reorganization and is now fashioned in order of how one would approach the design of a sprinkler system. Users will now find hazard classifications, water supplies, and underground piping at the beginning of the standard. Chapter 8 has been divided into several new chapters, breaking out general rules for sprinkler locations into one chapter and several other chapters specific to sprinkler technology. The storage chapters have also been reorganized by sprinkler technology and address ceiling-only design. Chapter 25 has been revised and now contains all the requirements for in-rack sprinklers.

Requirements for vertical pipe chases have been clarified as have requirements for electrical equipment rooms where sprinklers can be omitted. Additionally, new beam rules for residential sprinklers have been added and details provided.

Due to the extensive reorganization of the 2019 edition, new features were added to help users locate requirements and identify sections with technical changes. The 2016–2019 Roadmap comparing the section numbers of the 2016 edition to the 2019 edition was compiled and is located after the index. It was provided for information only, to be used as a quick-reference locator. Technical changes from the last edition were also indicated and should be used as a guide. Shaded text identified requirements that were modified because of additions and deletions except for tables and figures. New requirements were marked with the N symbol. Users can view complete revision details in the First and Second Draft Reports in the NFPA 13 archived revision section at www.nfpa.org/docinfo.

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

The 2022 edition of NFPA 13 underwent a philosophical change, moving away from the use of density/area curves in favor of single-point density design options for new systems. Existing systems can still use the density/area curves. Many new definitions were added and several existing definitions were modified. Several revisions to Chapter 4 delineate miscellaneous and low-piled storage requirements. As nitrogen generators were new to NFPA 13, supplementary requirements were added throughout the standard. Considerations associated with water flow tests have been added to Chapter 5. Supervision requirements for dry pipe systems were added to Chapter 8. Requirements were added to Chapter 9 to address the use of intermediate-temperature residential and quick-response sprinklers. Also, a new section on small, temporarily occupied spaces was added to address conditions where pods are installed. Obstruction criteria was added for suspended or floor-mounted obstructions in ordinary-hazard occupancies. Chapter 14's ESFR sprinkler location criteria were modified, and obstruction requirements were revised to align with the results of a recent Fire Protection Research Foundation report.

In Chapter 16, the process for determining whether freeze protection is needed has been modified to require the use of the lowest mean temperature for 1 day, obtained for an approved source, and no longer permits the use of the isothermal map. Also, criteria were added to address the protection of piping subject to mechanical damage.

Criteria on multiple-row rack depth was added to Chapter 20, and several tables throughout the storage chapters were revised or reconfigured. New ESFR sprinklers with K-factors of K-28 (400) and K-33.6 (480) were added to Chapter 23. Chapter 25 was rewritten and reorganized completely. The chapter covers the single-point density change and moves existing system criteria to its own sections and special design criteria for storage applications have all been combined into Chapter 26.

The 2025 edition of NFPA 13 includes many technical additions and revisions. Many definitions have been revised or added. One major addition is the inclusion of listed vacuum dry pipe systems in Chapter 8. In addition to allowing listed vacuum dry

pipe systems, provisions have been added to Chapter 7 allowing vapor phase corrosion inhibitors to be added to the air supply for dry pipe and preaction sprinkler systems as a method to reduce corrosion.

Several revisions for sprinkler placement and allowable omissions are included in the 2025 edition. In Chapter 4, miscellaneous and low-piled storage protection requirements have been divided into two different sections. Requirements for sprinklers installed in nonstorage occupancies with ceilings over 30 ft high have been provided in Chapter 9. In addition, based on large-scale fire testing, guidance is provided for sprinklers installed under sloped ceilings. Also, the allowable omission of sprinklers in elevator hoistways, in most situations, has been added to Chapter 9.

Revisions to Chapter 18 have been made, including updating load tables to incorporate seismic forces from piping and changing of seismic coefficient (Cp) values to align with ASCE/SEI 7, *Minimum Design Loads and Associated Criteria for Buildings and Other Structures.* For locations outside of the United States, Annex E has been modified to allow conformance with ASCE/SEI 7.

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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 components and devices used for the support of water-based fire protection system piping including protection against seismic events.

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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 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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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, sprinkler system plans and calculations, and water supplies.

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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),

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Conversion Factor Adjustments for

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NFPA 13

Standard for the

Installation of Sprinkler Systems

2025 Edition

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

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

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

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 shall not provide requirements for the design or installation of water mist fire protection systems.

1.1.2.1 Water mist fire protection systems shall not be considered fire sprinkler systems.

1.1.2.2 The design and installation of water mist fire protection systems shall comply with NFPA 750.

1.1.3* 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 design and installation by knowledgeable and trained personnel.

1.3 Application.

1.3.1 This standard shall apply to the following:

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

1.3.2 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.

1.3.3 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 shall 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 Units and Symbols.

1.6.1 Units.

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

1.6.1.2 These units with conversion factors shall be used as listed in Table 1.6.1.2.

1.6.1.3* 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.

1.6.2 Hydraulic Symbols. The standard abbreviations in Table 1.6.2 shall be used on the hydraulic calculation form discussed in Chapter 28.

1.6.3* Some dimensions used in this standard are exact and some are not. Nominal dimension are often used, such as the

A Table 1.6.1.2 Conversion Factors

dimensions used for pipe sizes. The metric equivalent shown in this standard might not be an exact conversion to the SI unit, but the nominal metric equivalent is typically used or a reasonably equivalent value or approximate conversion is used. It shall be acceptable to use the exact conversion or the conversions stated in the standard, even though they might not be exact.

1.7 New Technology.

1.7.1 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.

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

	Name of Unit	Unit Symbol	Conversion Factor
Length	Millimeter	mm	1 in. = 25 mm
0	Meter	m	1 ft = 0.3048 m
Area	Square millimeters	mm^2	$1 \text{ in.}^2 = 645.2 \text{ mm}^2$
	Square meter	m^2	$1 \text{ ft}^2 = 0.0929 \text{ m}^2$
Volume	Cubic millimeter	mm^3	$1 \text{ in.}^3 = 16,387 \text{ mm}^3$
	Cubic meter	m^3	$1 \text{ ft}^3 = 0.02832 \text{ m}^3$
Fluid capacity	Liter	L	~ 21 fl oz = 0.02957 L
1 /	Liter	L	1 gal = 3.785 L
Flow	Liter per minute	L/min	1 gpm = 3.7848 L/min
Pressure	Bar	bar	1 psi = 0.0689 bar
Discharge density	Millimeter/minute	mm/min 🗸	$1 \text{ gpm/ft}^2 = 40.746 \text{ mm/min}$
0 ,	Liter/minute/m2	$(L/min)/m^2$	$1 \text{ gpm/ft}^2 = 40.746 (L/min)/m^2$
K-factor	K-factor	$L/min/(bar)^2$	$1 \text{ gpm}/(\text{psi})^2 = 14.285 \text{ L/min}/(\text{bar})^2$
Weight	Kilogram	kg	1 lb = 0.4536 kg
Density	Kilogram/cubic meter	kg/m^3	$1 \text{ lb/ft}^3 = 16.02 \text{ kg/m}^3$
Temperature	Fahrenheit	• °F	$F^{\circ} = \frac{9}{5} \times C^{\circ} + 32$
1	Celsius	°C	$C^{\circ} = \frac{5}{9} (F^{\circ} - 32)$
Velocity	Kilometers per hour	km/h	1 mph = 1.609 km/h
Pound force	Newtons	Ν	1 lb force = 4.44822 N
Gauge (sheet steel)	Millimeter	mm	12 gauge = 2.8 mm
0			14 gauge = 1.98 mm
			16 gauge = 1.57 mm
			22 gauge = 0.78 mm
			24 gauge = 0.63 mm

Note: For additional conversions and information, see ASTM SI 10, IEEE/ASTM SI 10 American National Standard for Metric Practice.

A Table 1.6.2 Hydraulic Symbols

Symbol or Abbreviation	Item
þ	Pressure in psi
gpm	US 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
C.	indicated points. This can be a plus value or a minus value. If minus, the (–) shall be used; if plus, no sign is needed.
P_{π}	Velocity pressure in psi at a point in a pipe
$P_r^{'}$	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
Т	Tee-flow turned 90 degrees
GV	Gate valve
BV	Butterfly (wafer) 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
Κ	K-factor
C-factor	Friction loss coefficient

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, 2024 edition.

NFPA 14, Standard for the Installation of Standpipe and Hose Systems, 2024 edition.

NFPA 20, Standard for the Installation of Stationary Pumps for Fire Protection, 2025 edition.

NFPA 22, Standard for Water Tanks for Private Fire Protection, 2023 edition.

NFPA 25, Standard for the Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems, 2023 edition.

NFPA 30, Flammable and Combustible Liquids Code, 2024 edition.

NFPA 30B, Code for the Manufacture and Storage of Aerosol Products, 2023 edition.

NFPA 32, Standard for Drycleaning Facilities, 2021 edition. NFPA 33, Standard for Spray Application Using Flammable or

Combustible Materials, 2024 edition.

NFPA 34, Standard for Dipping, Coating, and Printing Processes Using Flammable or Combustible Liquids, 2024 edition. NFPA 36, Standard for Solvent Extraction Plants, 2025 edition. NFPA 37, Standard for the Installation and Use of Stationary Combustion Engines and Gas Turbines, 2024 edition. NFPA 40, Standard for the Storage and Handling of Cellulose Nitrate Film, 2025 edition. NFPA 45, Standard on Fire Protection for Laboratories Using Chemicals, 2024 edition. NFPA 51, Standard for the Design and Installation of Oxygen-Fuel Gas Systems for Welding, Cutting, and Allied Processes, 2023 edition. NFPA 51B, Standard for Fire Prevention During Welding, Cutting, and Other Hot Work, 2024 edition. NFPA 55, Compressed Gases and Cryogenic Fluids Code, 2023 edition. NFPA 59, Utility LP-Gas Plant Code, 2024 edition. NFPA 59A, Standard for the Production, Storage, and Handling of Liquefied Natural Gas (LNG), 2023 edition. NFPA 70[®], National Electrical Code[®], 2023 edition. NFPA 72[®], National Fire Alarm and Signaling Code[®], 2025 edition. NFPA 75, Standard for the Fire Protection of Information Technology Equipment, 2024 edition. NFPA 76, Standard for the Fire Protection of Telecommunications Facilities, 2024 edition. NFPA 82, Standard on Incinerators and Waste and Linen Handling Systems and Equipment, 2024 edition. NFPA 86, Standard for Ovens and Furnaces, 2023 edition. NFPA 91, Standard for Exhaust Systems for Air Conveying of Vapors, Gases, Mists, and Particulate Solids, 2020 edition. NFPA 96, Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations, 2024 edition. NFPA 99, Health Care Facilities Code, 2024 edition. NFPA 101[®], Life Safety Code[®], 2024 edition. NFPA 120, Standard for Fire Prevention and Control in Coal Mines, 2023 edition. NFPA 122, Standard for Fire Prevention and Control in Metal/ Nonmetal Mining and Metal Mineral Processing Facilities, 2023 edition. NFPA 130, Standard for Fixed Guideway Transit and Passenger Rail Systems, 2023 edition. NFPA 140, Standard on Motion Picture and Television Production Studio Soundstages, Approved Production Facilities, and Production Locations, 2024 edition. NFPA 150, Fire and Life Safety in Animal Housing Facilities Code, 2025 edition. NFPA 170, Standard for Fire Safety and Emergency Symbols, 2024 edition. NFPA 214, Standard on Water-Cooling Towers, 2021 edition. NFPA 259, Standard Test Method for Potential Heat of Building Materials, 2023 edition. NFPA 307, Standard for the Construction and Fire Protection of Marine Terminals, Piers, and Wharves, 2021 edition. NFPA 318, Standard for the Protection of Semiconductor Fabrication Facilities, 2025 edition. NFPA 400, Hazardous Materials Code, 2025 edition. NFPA 409, Standard on Aircraft Hangars, 2022 edition. NFPA 415, Standard on Airport Terminal Buildings, Fueling Ramp Drainage, and Loading Walkways, 2022 edition.

NFPA 423, Standard for Construction and Protection of Aircraft Engine Test Facilities, 2022 edition.

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NFPA 701, Standard Methods of Fire Tests for Flame Propagation of Textiles and Films, 2023 edition.

NFPA 703, Standard for Fire-Retardant-Treated Wood and Fire-Retardant Coatings for Building Materials, 2024 edition.

NFPA 750, Standard on Water Mist Fire Protection Systems, 2023 edition.

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

NFPA 804, Standard for Fire Protection for Advanced Light Water Reactor Electric Generating Plants, 2020 edition.

NFPA 805, Performance-Based Standard for Fire Protection for Light Water Reactor Electric Generating Plants, 2020 edition.

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

NFPA 915, Standard for Remote Inspections and Tests, 2024 edition.

NFPA 1960, Standard for Fire Hose Connections, Spray Nozzles, Manufacturer's Design of Fire Department Ground Ladders, Fire Hose, and Powered Rescue Tools, 2024 edition.

2.3 Other Publications.

2.3.1 ACI Publications. American Concrete Institute, 38800 Country Club Drive, Farmington Hills, MI 48331-3439.

ACI 318, Building Code Requirements for Structural Concrete and Commentary, 2019, reapproved, 2022.

ACI 355.2, Qualification of Post-Installed Mechanical Anchors in Concrete and Commentary, 2019.

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

ASCE/SEI 7, Minimum Design Loads and Associated Criteria for Buildings and Other Structures, 2022.

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

Boiler and Pressure Vessel Code, Section IX, "Welding, Brazing, and Fusing Qualifications," 2021.

ASME A17.1/CSA B44, Safety Code for Elevators and Escalators, 2022.

ASME B1.20.1, Pipe Threads, General Purpose, Inch, 2013 (R2018).

ASME B16.1, Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250, 2020.

ASME B16.3, Malleable Iron Threaded Fittings: Classes 150 and 300, 2021.

ASME B16.4, Gray Iron Threaded Fittings: Classes 125 and 250, 2021.

ASME B16.5, Pipe Flanges and Flanged Fittings: NPS ¹/₂ through NPS 24 Metric/Inch Standard, 2020.

ASME B16.9, Factory-Made Wrought Buttwelding Fittings, 2018.

ASME B16.11, Forged Fittings, Socket-Welding and Threaded, 2021.

ASME B16.15, Cast Copper Alloy Threaded Fittings: Classes 125 and 250, 2018.

ASME B16.18, Cast Copper Alloy Solder Joint Pressure Fittings, 2021.

ASME B16.22, Wrought Copper and Copper Alloy Solder — Joint Pressure Fittings, 2021.

ASME B16.25, Buttwelding Ends, 2017.

ASME B36.10M, Welded and Seamless Wrought Steel Pipe, 2018.

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

ASTM A53/A53M, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless, 2022.

ASTM A106/A106M, Standard Specification for Seamless Carbon Steel Pipe for High Temperature Service, 2019.

ASTM A135/A135M, Standard Specification for Electric-Resistance-Welded Steel Pipe, 2021.

ASTM A234/A234M, Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service, 2023.

ASTM A312/A312M, Standard Specification for Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipes, 2022.

ASTM A403/A403M, Standard Specification for Wrought Austenitic Stainless Steel Piping Fittings, 2022.

ASTM A795/A795M, Standard Specification for Black and Hot-Dipped Zinc-Coated (Galvanized) Welded and Seamless Steel Pipe for Fire Protection Use, 2021.

ASTM B32, Standard Specification for Solder Metal, 2020.

ASTM B43, Standard Specification for Seamless Red Brass Pipe, Standard Sizes, 2020.

ASTM B75/B75M, Standard Specification for Seamless Copper Tube, 2020.

ASTM B88, Standard Specification for Seamless Copper Water Tube, 2022.

ASTM B251/B251M, Standard Specification for General Requirements for Wrought Seamless Copper and Copper-Alloy Tube, 2017.

ASTM B446, Standard Specification for Nickel-Chromium-Molybdenum-Columbium Alloy (UNS N06625), Nickel-Chromium-Molybdenum-Silicon Alloy (UNS N06219), and Nickel-Chromium-Molybdenum-Tungsten Alloy (UNS N06625) Rod and Bar, 2019.

ASTM B813, Standard Specification for Liquid and Paste Fluxes for Soldering of Copper and Copper Alloy Tube, 2016.

ASTM B828, Standard Practice for Making Capillary Joints by Soldering of Copper and Copper Alloy Tube and Fittings, 2016.

ASTM C635/C635M, Standard Specification for Manufacture, Performance, and Testing of Metal Suspension Systems for Acoustical Tile and Lay-In Panel Ceilings, 2022.

ASTM C636/C636M, Standard Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-In Panels, 2019.

ASTM E84, Standard Test Method for Surface Burning Characteristics of Building Materials, 2021.

ASTM E119, Standard Test Methods for Fire Tests of Building Construction and Materials, 2022.

ASTM E136, Standard Test Method for Assessing Combustibility of Materials Using a Vertical Tube Furnace at 750°C, 2022.

ASTM E2652, Standard Test Method for Assessing Combustibility of Materials Using a Tube Furnace with a Cone-shaped Airflow Stabilizer, at 750°C, 2022.

ASTM E2768, Standard Test Method for Extended Duration Surface Burning Characteristics of Building Materials (30 min Tunnel Test), reapproved 2018.

ASTM E2965, Standard Test Method for Determination of Low Levels of Heat Release Rate for Materials and Products Using an Oxygen Consumption Calorimeter, 2022.

ASTM F437, Standard Specification for Threaded Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80, 2021.

ASTM F438, Standard Specification for Socket-Type Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe Füttings, Schedule 40, 2023.

ASTM F439, Standard Specification for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80, 2019.

ASTM F442/F442M, Standard Specification for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe (SDR-PR), 2023.

ASTM F1121, Standard Specification for International Shore Connections for Marine Fire Applications, 1987, 2019.

ASTM SI 10, IEEE/ASTM SI 10 American National Standard for Metric Practice, 2016.

2.3.5 AWS Publications. American Welding Society, 8669 NW 36 Street, #130, Miami, FL 33166–6672.

AWS A5.8M/A5.8, Specification for Filler Metals for Brazing and Braze Welding, 2019.

AWS B2.1/B2.1M, Specification for Welding Procedure and Performance Qualification, 2021.

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

AWWA C104/A21.4, Cement-Mortar Lining for Ductile-Iron Pipe and Fittings, 2023.

AWWA C105/A21.5, Polyethylene Encasement for Ductile-Iron Pipe Systems, 2018.

AWWA C110/A21.10, Ductile-Iron and Gray-Iron Fittings, 2021.

AWWA C111/A21.11, Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings, 2017.

AWWA C115/A21.15, Flanged Ductile-Iron Pipe with Ductile-Iron or Gray-Iron Threaded Flanges, 2020.

AWWA C150/A21.50, Thickness Design of Ductile-Iron Pipe, 2021.

AWWA C151/A21.51, Ductile-Iron Pipe, Centrifugally Cast, 2017, errata, 2018.

AWWA C153/A21.53, Ductile-Iron Compact Fittings, 2019.

AWWA C300, Reinforced Concrete Pressure Pipe, Steel-Cylinder Type, 2022.

AWWA C301, Prestressed Concrete Pressure Pipe, Steel-Cylinder Type, 2014, Reaffirmed without Revision 2019.

AWWA C302, Reinforced Concrete Pressure Pipe, Non-Cylinder Type, 2022.

AWWA C303, Reinforced Concrete Pressure Pipe, Bar-Wrapped, Steel-Cylinder Type, 2017.

AWWA C600, Installation of Ductile-Iron Water Mains and Their Appurtenances, 2017.

AWWA C602, Cement-Mortar Lining of Water Pipelines in Place, 4 in. (100 mm) and Larger, 2023.

AWWA C900, Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4 in. Through 60 in. (100 mm Through 1,500 mm), 2022.

AWWA C906, Polyethylene (PE) Pressure Pipe and Fittings, 4 in. (100 mm) Through 65 in. (1,650 mm), for Waterworks, 2021.

AWWA C909, Molecularly Oriented Polyvinyl Chloride (PVCO) Pressure Pipe, 4 in. Through 24 in. (100 mm Through 600 mm), for Water, Wastewater, and Reclaimed Water Service, 2022.

AWWA M9, Concrete Pressure Pipe, 2008, errata, 2014.

AWWA M23, PVC Pipe — Design and Installation, 2020.

AWWA M55, PE Pipe — Design and Installation, 2020.

2.3.7 ICC-ES Publications. ICC Evaluation Service, 900 Montclair Road, Suite A, Birmingham, AL 35213.

ICC-ES AC446, Acceptance Criteria for Headed Cast-in Specialty Inserts in Concrete, 2018.

2.3.8 IEEE Publications. IEEE Operations Center, 445 Hoes Lane, Piscataway, NJ 08854-4141.

IEEE 45, Recommended Practice for Electric Installations on Shipboard, 2002.

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

UL 263, Fire Tests of Building Construction and Materials, 2011, revised 2022.

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

UL 2556, Wire and Cable Test Methods, 2015, revised 2021.

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

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, Angles of Inclination.

Title 46, CFR, Subchapter F, "Marine Engineering."

Title 46, CFR, Subchapter J, "Electrical Engineering."

2.3.11 Other Publications.

Merriam-Webster's Collegiate Dictionary, 11th edition, Merriam-Webster, Inc., Springfield, MA, 2020.

\Delta 2.4 References for Extracts in Mandatory Sections.

NFPA 1, *Fire Code*, 2024 edition. NFPA 14, *Standard for the Installation of Standpipe and Hose Systems*, 2024 edition. NFPA 20, Standard for the Installation of Stationary Pumps for Fire Protection, 2025 edition.

NFPA 24, Standard for the Installation of Private Fire Service Mains and Their Appurtenances, 2025 edition.

NFPA 5000[®], Building Construction and Safety Code[®], 2024 edition.

Chapter 3 Definitions

Δ 3.1 General.

- **N** 3.1.1 The definitions contained in this chapter shall apply to the terms used in this standard.
- **N 3.1.2** 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.
- **N 3.1.3** *Merriam-Webster's Collegiate Dictionary*, 11th edition, shall be the source for the ordinarily accepted meaning.

3.2 NFPA Official Definitions.

3.2.1* Approved. Acceptable to the authority having jurisdiction.

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

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

3.2.4 Shall. Indicates a mandatory requirement.

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

3.2.6 Standard. An NFPA standard, the main text of which contains only mandatory provisions using the word "shall" to indicate requirements and that is in a form generally suitable for mandatory reference by another standard or code or for adoption into law. Nonmandatory provisions are not to be considered a part of the requirements of a standard and shall be located in an appendix, annex, footnote, informational note, or other means as permitted in the NFPA manuals of style. When used in a generic sense, such as in the phrases "standards development process" or "standards development activities," the term "standards, recommended practices, and guides.

3.3 General Definitions.

3.3.1 A-Class Boundary. See 3.3.130.1.

3.3.2 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. (AUT-SSI)

3.3.3 Air Reservoir. A chamber that can store air at the same pressure that is in the wet pipe system piping. (AUT-SSI)

3.3.4* Aisle Width. The horizontal dimension between the face of the loads in racks under consideration. (AUT-SSD)

N 3.3.5* Alcove. An area in a compartment or corridor that is set back from the rest of the wall it is located along. (AUT-SSI)

3.3.6 Antifreeze Sprinkler System. See 3.3.224.1.

3.3.7 Appurtenance. An accessory or attachment that enables the private fire service main to perform its intended function. **[24, 2025]** (AUT-PRI)

N 3.3.8 Area of Discharge. The floor area covered by a sprinkler that takes into account any walls or obstructions whose summation determines the remote area. (*See Figure A.28.2.4.2.1.*) (AUT-SSD)

3.3.9 Arm-Over. A horizontal pipe that extends from the branch line to a single sprinkler or a sprinkler above and below a ceiling. (AUT-SSI)

3.3.10 Array.

3.3.10.1 Closed Array (Palletized, Solid-Piled, Bin Box, and Shelf Storage). A storage arrangement where air movement through the pile is restricted because of 6 in. (150 mm) or less vertical flues. (AUT-SSD)

3.3.10.2 *Closed Array (Rolled 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]. (AUT-SSD)

3.3.10.3* Open Array (Palletized, Solid-Piled, Bin Box, and Shelf Storage). A storage arrangement where air movement through the pile is enhanced because of vertical flues larger than 6 in. (150 mm). (AUT-SSD)

3.3.10.4 *Open Array (Rolled Paper)*. A vertical storage arrangement in which the distance between columns in both directions is lengthy (all vertical arrays other than closed or standard). (AUT-SSD)

3.3.10.5* *Standard Array (Rolled 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. (AUT-SSD)

3.3.11 Automated Inspection and Testing. The performance of inspections and tests at a distant location from the system or component being inspected or tested through the use of electronic devices or equipment installed for the purpose. (AUT-SSI)

3.3.12 Automatic Sprinkler. See 3.3.223.1.

3.3.13 Automotive Components on Portable Racks. All automotive components with or without expanded Group A plastic dunnage; excludes the storage of air bags, tires, and seats on portable racks. (AUT-SSD)

3.3.14 Average Roof Height. See 3.3.24, Building Height. (AUT-HBS)

3.3.15* Back-to-Back Shelf Storage. Two solid or perforated shelves up to 30 in. (750 mm) in depth each, not exceeding a total depth of 60 in. (1.5 m), separated by a longitudinal vertical barrier such as plywood, particleboard, sheet metal, or

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equivalent, with a maximum 0.25 in. (6 mm) diameter penetrations and no longitudinal flue space and a maximum storage height of 15 ft (4.6 m). (AUT-SSD)

3.3.16* 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 and motes. (AUT-SSD)

3.3.17 Banded Roll Paper Storage. See 3.3.197.1.

3.3.18 Banded Tires. A storage method in which a number of tires are strapped together. (AUT-SSD)

3.3.19* 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. (AUT-SSI)

3.3.20 B-Class Boundary. See 3.3.130.2.

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

N 3.3.22* Blocking. A means by which the horizontal spread of flame or heat during a fire event is stopped by the installation of materials that will stay in place before and during sprinkler operation to limit the channeling of heat between structural members. (AUT-SSD)

3.3.23 Branch Lines. The pipes supplying sprinklers, either directly or through sprigs, drops, return bends, or arm-overs. (AUT-SSI)

3.3.24 Building Height. For the purposes of seismic protection, the vertical distance from the grade plane to the average elevation of the highest roof surface. (AUT-HBS)

3.3.25 Bulkhead. A vertical barrier across the rack. (AUT-SSI)

3.3.26* Carton Records Storage. A Class III commodity consisting predominantly of paper records in cardboard cartons. (AUT-SSD)

3.3.27 Cartoned. A method of storage consisting of corrugated cardboard or paperboard containers fully enclosing the commodity. (AUT-SSD)

3.3.28 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. (AUT-SSD)

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

3.3.30* Ceiling Pocket. An architectural ceiling feature that consists of a bounded area of ceiling located at a higher elevation than the attached lower ceiling. (AUT-SSI)

3.3.31 Ceiling Types.

3.3.31.1 *Flat Ceiling.* A continuous ceiling in a single plane. (AUT-SSI)

3.3.31.2 *Horizontal Ceiling.* A ceiling with a slope not exceeding 2 in 12 (16.7 percent). (AUT-SSI)

3.3.31.3 *Sloped Ceiling.* A ceiling with a slope exceeding 2 in 12 (16.7 percent). (AUT-SSI)

3.3.31.4 *Smooth Ceiling.* A continuous ceiling free from irregularities, lumps, or indentations greater than 4 in. (100 mm) in depth. (AUT-SSI)

3.3.32 Central Safety Station. See 3.3.130.3.

3.3.33 Check Valve. See 3.3.243.1.

3.3.34 Clearance to Ceiling. The distance from the top of storage to the ceiling above. (AUT-SSD)

3.3.35 Closed Array (Palletized, Solid-Piled, Bin Box, and Shelf Storage). See 3.3.10.1.

3.3.36 Closed Array (Rolled Paper). See 3.3.10.2.

3.3.37 Cloud Ceiling. Any ceiling system, not including sloped ceilings, installed in the same plane with horizontal openings to the structure above on two or more sides. (AUT-SSI)

3.3.38 Column (Rolled Paper). A single vertical stack of rolls. (AUT-SSD)

3.3.39 Combined Dry Pipe Preaction Sprinkler System. See 3.3.224.2.

3.3.40 Commodity. The combination of products, packing material, and container that determines commodity classification. (AUT-SSD)

3.3.41 Compact Storage. Storage on solid shelves not exceeding 36 in. (900 mm) in total depth, arranged as part of a compact storage module, with no more than 30 in. (750 mm) between shelves vertically and with no internal vertical flue spaces other than those between individual shelving sections. (AUT-SSD)

3.3.42 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. (AUT-SSD)

3.3.43 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 where there are no other openings to adjoining spaces. (AUT-SSI)

3.3.44* Compartmented. The rigid separation of the products in a container by dividers that form a stable unit under fire conditions. (AUT-SSD)

3.3.45 Concealed Sprinkler. See 3.3.223.3.1.

3.3.46 Construction Definitions.

3.3.46.1* *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. (AUT-SSI)

3.3.46.2* 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, with the exception of panel construction, where the spacing of structural members exceeds $7\frac{1}{2}$ ft (2.3 m) on center. (AUT-SSI)

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

3.3.48 Continuous Obstruction. See 3.3.147.1.

3.3.49 Control Mode Density/Area (CMDA) Sprinkler. See 3.3.223.4.1.

3.3.50 Control Mode Specific Application (CMSA) Sprinkler. See 3.3.223.4.2.

3.3.51 Control Valve. See 3.3.243.3.

3.3.52 Conventional Pallet. See 3.3.161.1.

3.3.53 Core (Rolled Paper). The central tube around which paper is wound to form a roll. (AUT-SSD)

3.3.54 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**, **2025**] (AUT-PRI)

3.3.55 Corrosion-Resistant Sprinkler. See 3.3.223.4.3.

3.3.56 Corrosion-Retarding 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, 2025]** (AUT-PRI)

3.3.57 Cross Mains. The pipes supplying the branch lines, either directly or through riser nipples. (AUT-SSI)

3.3.58 Deluge Sprinkler System. See 3.3.224.3.

△ 3.3.59 Design Spectral Response Acceleration at Short Periods, S_{DS^*} The spectral response acceleration at short periods for the site of the building or structure being designed to satisfy the seismic requirements of ASCE/SEI 7 *Minimum Design Loads and Associated Criteria for Buildings and Other Structures*, based on ASCE/SEI 7 Chapter 22 seismic ground motion maps and Chapter 11 seismic design criteria, or directly from the ASCE/SEI 7 Hazard Tool, or by using the site-specific ground motion procedures of ASCE/SEI 7 Chapter 21. (AUT-HBS)

3.3.60 Differential Dry Pipe Valve. See 3.3.243.5.1.

3.3.61 Distance Monitoring. The monitoring of various conditions of a system or component from a distant location from the system or component through the use of electronic devices, meters, or equipment installed for the purpose. (AUT-SSI)

3.3.62 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. (AUT-SSD)

3.3.63* Draft Curtain. A fixed or deployable barrier that protrudes downward from the ceiling to channel, contain, or prevent the migration of smoke and/or heat. (AUT-SSD)

3.3.64 Drop. A vertical pipe supplying one sprinkler from above. (AUT-SSI)

3.3.65 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. (AUT-SSI)

3.3.66 Dry Barrel Hydrant (Frostproof Hydrant). See 3.3.112.1.

3.3.67 Dry Pipe Sprinkler System. See 3.3.224.4.

3.3.68 Dry Sprinkler. See 3.3.223.4.4.

3.3.69* Dwelling Unit (for sprinkler system installations). One or more rooms arranged for the use of one or more individuals living together, as in a single housekeeping unit normally having cooking, living, sanitary, and sleeping facilities that include, but are not limited to, hotel rooms, dormitory rooms, apartments, condominiums, sleeping rooms in nursing homes, and similar living units. (AUT-SSI)

3.3.70 Early Suppression Fast-Response (ESFR) Sprinkler. See 3.3.223.4.5.

3.3.71 Electrically Operated Sprinkler. See 3.3.223.4.6.

3.3.72* Encapsulation. A method of packaging that either consists of a plastic sheet completely enclosing the sides and top of a pallet load containing a combustible commodity, a combustible package, or a group of combustible commodities or combustible packages, or consists of combustible commodities individually wrapped in plastic sheeting and stored exposed in a pallet load. (AUT-SSD)

3.3.73 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. (AUT-SSD)

3.3.74 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.) (AUT-SSD)

3.3.75 Extended Coverage Sprinkler. See 3.3.223.4.7.

3.3.76 Extension Fitting. A male by female adapter intended to be used with a sprinkler to adjust the final fit where the sprinkler is installed in a finished ceiling or wall. (AUT-SSI)

3.3.77 Exterior Projection. An extension beyond an exterior wall capable of collecting heat below. (AUT-SSI)

3.3.78 Extra Hazard (Group 1) (EH1). See 3.3.148.1.

3.3.79 Extra Hazard (Group 2) (EH2). See 3.3.148.2.

3.3.80* Face Sprinklers. Standard sprinklers that are located in transverse flue spaces along the aisle or in the rack, are

within 18 in. (450 mm) of the aisle face of storage, and are used to oppose vertical development of fire on the external face of storage. (AUT-SSD)

3.3.81 Feed Mains. The pipes supplying cross mains, either directly or through risers. (AUT-SSI)

3.3.82 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. (AUT-SSD)

3.3.83 Fire Department Connection. A connection through which the fire department can pump supplemental water into the sprinkler system, standpipe, or other water-based fire protection systems, furnishing water for fire extinguishment to supplement existing water supplies. **[24, 2025]** (AUT-PRI)

3.3.84 Fire Pump. A pump that is a provider of liquid flow and pressure dedicated to fire protection. **[20, 2025]** (AUT-SSI)

3.3.85 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. (AUT-SSD)

3.3.86 Flat Ceiling. See 3.3.31.1.

3.3.87 Flexible 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. (200 mm) and larger, the angular movement is permitted to be less than 1 degree but not less than 0.5 degree. (AUT-HBS)

3.3.88 Flow Hydrant. See 3.3.112.2.

3.3.89 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, 2025]** (AUT-PRI)

3.3.90 Flush Sprinkler. See 3.3.223.3.2.

3.3.91 Flushing Test. A test of a piping system using flowrates intended to remove debris from the piping system prior to it being placed in service. [24, 2025] (AUT-SSI)

3.3.92* Four-Way Bracing. Adjacent sway braces or a sway brace assembly intended to resist differential movement of the system piping in all horizontal directions. (AUT-HBS)

3.3.93* 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. (AUT-SSD)

3.3.94 Fuel-Fired Heating Unit. An appliance that produces heat by burning fuel. (AUT-SSI)

3.3.95 General Sprinkler Characteristics. See 3.3.223.2.

3.3.96 Grade Plane. A reference plane upon which vertical measurements of a building are based representing the average of the finished ground level adjoining the building at all exterior walls. [See also 3.3.222, Finished Ground Level (Grade), of NFPA 5000.] [5000, 2024] (AUT-HBS)

3.3.97 Gridded Sprinkler System. See 3.3.224.5.

3.3.98 Hanger. A device or assembly used to support the gravity load of the system piping. (AUT-HBS)

3.3.99 Heat-Sensitive Material. See 3.3.130.4.

3.3.100 Heel. See 3.3.130.5.

3.3.101 Heel Angle. See 3.3.130.6.

3.3.102 High Volume Low Speed Fan. A ceiling fan that is approximately 6 ft (1.8 m) to 24 ft (7.3 m) in diameter with a rotational speed of approximately 30 to 70 revolutions per minute. (AUT-SSD)

3.3.103 High-Challenge Fire Hazard. A fire hazard typical of that produced by fires in combustible high-piled storage. (AUT-SSD)

3.3.104* High-Piled Storage. Solid-piled, palletized, rack storage, bin box, and shelf storage of Class I through Class IV commodities more than 12 ft (3.7 m) in height and solid-piled, palletized, rack storage, bin box, and shelf storage of Group A plastic commodities more than 5 ft (1.5 m) in height. (AUT-SSD)

3.3.105 Horizontal Barrier. A solid barrier in the horizontal position covering the rack at certain height increments to prevent vertical fire spread. (AUT-SSD)

3.3.106 Horizontal Ceiling. See 3.3.31.2.

3.3.107 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. (AUT-SSD)

3.3.108 Horizontal Force, $F_{\mu\nu}$. The horizontal force due to seismic load acting on a sprinkler system at working stress levels. (AUT-HBS)

3.3.109 Horizontal Roll Paper Storage. See 3.3.197.2.

3.3.110 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 firefighting in conjunction with and to provide aid to the local fire department. **[24, 2025]** (AUT-PRI)

N 3.3.111 Hose Station. A combination of a hose rack or reel, hose nozzle, hose, and hose connection. [14, 2024] (AUT-SSI)

3.3.112 Hydrant. An exterior valved connection to a water supply system that provides hose connections. **[24, 2025]** (AUT-PRI)

3.3.112.1 *Dry Barrel Hydrant (Frostproof Hydrant).* A type of hydrant with the main control valve below the frost line between the footpiece and the barrel. [24, 2025] (AUT-PRI)

3.3.112.2 *Flow Hydrant.* The hydrant that is used for the flow and flow measurement of water during a flow test. [24, 2025] (AUT-PRI)

3.3.112.3 *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. [24, 2025] (AUT-PRI)

3.3.112.4 *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, 2025] (AUT-PRI)

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3.3.112.5 *Residual Hydrant.* The hydrant that is used for measuring static and residual pressures during a flow test. **[24, 2025]** (AUT-PRI)

3.3.112.6 *Wet Barrel Hydrant.* A type of hydrant that is intended for use where there is no danger of freezing weather, where each outlet is provided with a valve and an outlet. [24, 2025] (AUT-PRI)

3.3.113 Hydrant Butt. The hose connection outlet of a hydrant. [24, 2025] (AUT-PRI)

3.3.114 Hydraulically Calculated Water Demand Flow Rate. The waterflow rate for a system or hose stream that has been calculated using accepted engineering practices. **[24, 2025]** (AUT-PRI)

3.3.115 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. (AUT-SSD)

3.3.116 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, 2025]** (AUT-PRI)

3.3.117 Indicating Valve. See 3.3.243.4.

3.3.118 Installation Orientation. See 3.3.223.3.

3.3.119 Institutional Sprinkler. See 3.3.223.4.8.

3.3.120 Intermediate-Level Sprinkler/Rack Storage Sprinkler. See 3.3.223.4.9.

3.3.121 International Shore Connection. See 3.3.130.7.

3.3.122 Laced Tire Storage. Tires stored where the sides of the tires overlap, creating a woven or laced appearance. [See Figure A.3.3.200(g).] (AUT-SSD)

3.3.123 Lateral Brace. A sway brace intended to resist differential movement perpendicular to the axis of the system piping. (AUT-HBS)

3.3.124 Light Hazard. See 3.3.148.3.

3.3.125* Limited-Combustible Material. See Section 4.9.

3.3.126 Longitudinal Brace. A sway brace intended to resist differential movement parallel to the axis of the system piping. (AUT-HBS)

3.3.127* Longitudinal Flue Space. The space between rows of storage perpendicular to the direction of loading with a width not exceeding 24 in. (600 mm) between storage. (AUT-SSD)

3.3.128 Looped Sprinkler System. See 3.3.224.6.

3.3.129* Low-Piled Storage. Solid-piled, palletized, rack storage, bin box, and shelf storage of Class I through Class IV commodities up to 12 ft (3.7 m) in height and solid-piled, palletized, rack storage, bin box, and shelf storage of Group A plastic commodities up to 5 ft (1.5 m) in height. (AUT-SSD)

3.3.130 Marine Definitions. These definitions apply to Chapter 31 only. (AUT-SSI)

- △ 3.3.130.1 A-Class Boundary. A boundary designed to resist the passage of smoke and flame for 1 hour when tested in accordance with ASTM E119, Standard Test Methods for Fire Tests of Building Construction and Materials, or UL 263, Fire Tests of Building Construction and Materials. (AUT-SSI)
- ▲ 3.3.130.2 B-Class Boundary. A boundary designed to resist the passage of flame for ½ hour when tested in accordance with ASTM E119, Standard Test Methods for Fire Tests of Building Construction and Materials, or UL 263, Fire Tests of Building Construction and Materials. (AUT-SSI)

3.3.130.3 *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 must be provided by means other than the ship's service telephone. (AUT-SSI)

3.3.130.4* *Heat-Sensitive Material*. A material whose melting point is below 1700°F (927°C). (AUT-SSI)

3.3.130.5 *Heel.* The inclination of a ship to one side. (AUT-SSI)

3.3.130.6 *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. (AUT-SSI)

3.3.130.7* *International Shore Connection*. A universal connection to the vessel's fire main to which a shoreside firefighting water supply can be connected. (AUT-SSI)

3.3.130.8* *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. (AUT-SSI)

3.3.130.9* *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; meets the requirements of a B-Class boundary; and is insulated such that, if tested in accordance with ASTM E119, Standard Test Methods for Fire Tests of Building Construction and Materials, or UL 263, *Fire Tests of Building Construction and Materials,* for 15 minutes, the average temperature of the unexposed side does not rise more than 250°F (139°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. (AUT-SSI)

3.3.130.10 *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. (AUT-SSI)

3.3.130.11 *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 must give a distinct indication for each individual system component that is monitored. (AUT-SSI)

3.3.130.12 *Survival Angle.* The maximum angle to which a vessel is permitted to heel after the assumed damage required by stability regulations is imposed. (AUT-SSI)

3.3.130.13 *Type 1 Stair.* A fully enclosed stair that serves all levels of a vessel in which persons can be employed. (AUT-SSI)

3.3.131 Marine System. See 3.3.130.8.

3.3.132 Marine Thermal Barrier. See 3.3.130.9.

3.3.133 Marine Water Supply. See 3.3.130.10.

3.3.134 Mechanical Dry Pipe Valve. See 3.3.243.5.2.

3.3.135* Miscellaneous Storage. Storage that does not exceed 12 ft (3.7 m) in height, is incidental to another occupancy use group, does not constitute more than 10 percent of the building area or 4000 ft² (370 m²) of the sprinklered area, whichever is greater, does not exceed 1000 ft² (93 m²) in one pile or area, and is separated from other storage areas by at least 25 ft (7.6 m). (AUT-SSD)

3.3.136* Miscellaneous Tire Storage. The storage of rubber tires that is incidental to the main use of the building; storage areas do not exceed 2000 ft² (185 m²), and on-tread storage piles, regardless of storage method, do 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. (AUT-SSD)

3.3.137 Movable Racks. Racks on fixed rails or guides that 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. (AUT-SSD)

3.3.138 Multicycle System. See 3.3.224.7.

3.3.139 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). (AUT-SSD)

3.3.140 Net Vertical Force. The vertical reaction due to the angle of installation of sway braces on system piping resulting from earthquake motion. (AUT-HBS)

3.3.141 Noncombustible Material. See Section 4.9.

3.3.142 Noncontinuous Obstruction. See 3.3.147.2.

- **N** 3.3.143* Non-Flat Obstruction. An obstruction where the underside of the obstruction is not in the same plane and not capable of collecting heat. (AUT-SSI)
- **N** 3.3.144* Non-Solid Obstruction. An obstruction that consists of openings that constitute at least 30 percent of the footprint of the obstruction. (AUT-SSI)

3.3.145 Nozzle. See 3.3.223.4.10.

3.3.146 Obstructed Construction. See 3.3.46.1.

3.3.147 Obstruction.

3.3.147.1 *Continuous Obstruction*. An obstruction located at or below the level of sprinkler deflectors that affect the discharge pattern of two or more adjacent sprinklers. (AUT-SSI)

3.3.147.2 *Noncontinuous Obstruction.* An obstruction at or below the level of the sprinkler deflector that affects the discharge pattern of a single sprinkler. (AUT-SSI)

3.3.148 Occupancies.

3.3.148.1 *Extra Hazard (Group 1) (EH1).* Occupancies or portions of other occupancies where the quantity and combustibility of contents are very high or 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. (AUT-SSD)

3.3.148.2 *Extra Hazard (Group 2) (EH2).* Occupancies or portions of other occupancies with moderate to substantial amounts of flammable or combustible liquids or occupancies where shielding of combustibles is extensive. (AUT-SSD)

3.3.148.3 *Light Hazard.* 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. (AUT-SSD)

3.3.148.4 Ordinary Hazard (Group 1) (OH1). Occupancies or portions of other occupancies where combustibility is low, quantity of combustibles is moderate, stockpiles of contents do not exceed 8 ft (2.4 m), and fires with moderate rates of heat release are expected. (AUT-SSD)

3.3.148.5 Ordinary Hazard (Group 2) (OH2). Occupancies or portions of other occupancies where the quantity and combustibility of contents are moderate to high, stockpiles of contents with moderate rates of heat release do not exceed 12 ft (3.7 m), and stockpiles of contents with high rates of heat release do not exceed 8 ft (2.4 m). (AUT-SSD)

3.3.149 Old-Style/Conventional Sprinkler. See 3.3.223.4.11.

3.3.150 On-Side Tire Storage. Tires stored horizontally or flat. (AUT-SSD)

3.3.151 On-Tread Tire Storage. Tires stored vertically or on their treads. (AUT-SSD)

3.3.152 Open Array (Palletized, Solid-Piled, Bin Box, and Shelf Storage). See 3.3.10.3.

3.3.153 Open Array (Rolled Paper). See 3.3.10.4.

3.3.154 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 $20 \text{ ft}^2 (1.9 \text{ m}^2)$ 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. (AUT-SSD)

3.3.155 Open Sprinkler. See 3.3.223.4.12.

3.3.156* Open-Top Container. A container of any shape that is entirely or partially open on the top and arranged so as to allow for the collection of discharging sprinkler water cascading through the storage array. (AUT-SSD)

3.3.157 Ordinary Hazard (Group 1) (OH1). See 3.3.148.4.

3.3.158 Ordinary Hazard (Group 2) (OH2). See 3.3.148.5.

3.3.159 Ornamental/Decorative Sprinkler. See 3.3.223.4.13.

3.3.160 Packaging. A commodity wrapping, cushioning, or container. (AUT-SSD)

3.3.161 Pallet.

3.3.161.1* *Conventional Pallet.* A material-handling aid designed to support a unit load with openings to provide access for material-handling devices. *(See Figure A.3.3.161.1.)* (AUT-SSD)

3.3.161.2 *Plastic Pallet*. A pallet having any portion of its construction consisting of a plastic material. (AUT-SSD)

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

3.3.161.4 *Slave Pallet.* A special pallet captive to a materialhandling system. (*See Figure A.3.3.161.1.*) (AUT-SSD)

3.3.161.5 *Wood Pallet*. A pallet constructed entirely of wood with metal fasteners. (AUT-SSD)

3.3.162 Palletized Storage. Storage of commodities on pallets or other storage aids that form horizontal spaces between tiers of storage. (AUT-SSD)

3.3.163 Palletized Tire Storage. Storage on portable racks of various types utilizing a conventional pallet as a base. (AUT-SSD)

N 3.3.164 Panel Construction. Ceiling panels formed by members capable of trapping heat to aid the operation of sprinklers and limited to a maximum of 300 ft² (28 m²) in area. See A.3.3.46.1(4). (AUT-SSI)

3.3.165 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. (AUT-SSD)

3.3.166 Pendent Sprinkler. See 3.3.223.3.3.

3.3.167* 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. (AUT-SSD)

3.3.168* Pile Stability, Unstable Piles. Those arrays where collapse, spillage of contents, or leaning of stacks across flue spaces occurs soon after initial fire development. (AUT-SSD)

3.3.169 Pilot Line Detector. See 3.3.223.4.14.

3.3.170 Pipe Schedule System. See 3.3.224.8.

3.3.171 Plastic Pallet. See 3.3.161.2.

3.3.172 Portable Racks. Racks that are not fixed in place and can be arranged in any number of configurations. (AUT-SSD)

3.3.173* Post-Installed Anchors. A device used for fastening pipe to the building structure, installed in hardened concrete. (AUT-HBS)

3.3.174 Preaction Sprinkler System. See 3.3.224.9.

3.3.175 Premixed Antifreeze Solution. A mixture of an antifreeze material with water that is prepared and factory-mixed by the manufacturer with a quality control procedure in place that ensures that the antifreeze solution remains homogeneous and that the concentration is as specified. (AUT-SSI) **3.3.176 Pressure Regulating Device.** A device designed for the purpose of reducing, regulating, controlling, or restricting water pressure. **[24, 2025]** (AUT-PRI)

3.3.177 Private Fire Hydrant. See 3.3.112.3.

3.3.178* 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, 2025]** (AUT-PRI)

3.3.179* Prying Factor. A factor based on fitting geometry and brace angle from vertical that results in an increase in tension load due to the effects of prying between the upper seismic brace attachment fitting and the structure. (AUT-HBS)

3.3.180 Public Hydrant. See 3.3.112.4.

3.3.181 Pumper Outlet. The hydrant outlet intended to be connected to a fire department pumper for use in taking supply from the hydrant for pumpers. **[24, 2025]** (AUT-PRI)

3.3.182 Pyramid Tire Storage. On-floor storage in which tires are formed into a pyramid to provide pile stability. (AUT-SSD)

N 3.3.183 Qualified Personnel. Competent and capable individual(s) having met the requirements and training for a given field acceptable to the AHJ. [**25**, 2023] (AUT-SSI)

3.3.184 Quick-Response Extended Coverage Sprinkler. See 3.3.223.4.15.

3.3.185 Quick-Response (QR) Sprinkler. See 3.3.223.4.16.

3.3.186* Rack. Any combination of vertical, horizontal, and diagonal members that supports stored materials. [1, 2024] (AUT-SSD)

3.3.187 Rack Shelf Area. The area of the horizontal surface of a shelf in a rack defined by perimeter aisle(s) or nominal 6 in. (150 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. (AUT-SSD)

3.3.188 Rated Capacity. The flow available from a hydrant at the designated residual pressure (rated pressure) either measured or calculated. **[24, 2025]** (AUT-PRI)

3.3.189* Raw Water Source. A water supply that has not been treated and could contain foreign material that could enter the sprinkler system. (AUT-SSD)

3.3.190 Recessed Sprinkler. See 3.3.223.3.4.

3.3.191 Reinforced Plastic Pallet. See 3.3.161.3.

3.3.192 Residential Sprinkler. See 3.3.223.4.17.

3.3.193 Residual Hydrant. See 3.3.112.5.

3.3.194 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, 2025]** (AUT-PRI)

3.3.195 Riser Nipple. A vertical pipe between the cross main and branch line. (AUT-SSI)

3.3.196 Risers. The vertical supply pipes in a sprinkler system. (AUT-SSI)

3.3.197 Roll Paper Storage.

3.3.197.1 Banded Roll Paper Storage. Rolls provided with a circumferential steel strap [$\frac{3}{8}$ in. (10 mm) or wider] at each end of the roll. (AUT-SSD)

3.3.197.2 *Horizontal Roll Paper Storage.* Rolls stored with the cores in the horizontal plane (on-side storage). (AUT-SSD)

3.3.197.3* *Roll Paper Storage Height.* The maximum vertical distance above the floor at which roll paper is normally stored. (AUT-SSD)

3.3.197.4 *Vertical Roll Paper Storage.* Rolls stored with the cores in the vertical plane (on-end storage). (AUT-SSD)

3.3.197.5* *Wrapped Roll Paper Storage*. Rolls provided with a complete heavy kraft covering around both sides and ends. (AUT-SSD)

3.3.198 Roll Paper Storage Height. See 3.3.197.3.

3.3.199 Roof Height. The distance between the floor and the underside of the roof deck within the storage area. (AUT-SSD)

3.3.200* Rubber Tire Rack Illustrations. See Figure A.3.3.200(a) through Figure A.3.3.200(g).

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

3.3.202 Seismic Coefficient, C_p . The seismic coefficient that combines ground motion and seismic response factors from ASCE/SEI 7, *Minimum Design Loads and Associated Criteria for Buildings and Other Structures*. (AUT-HBS)

3.3.203* Seismic Separation Assembly. An assembly of fittings, pipe, flexible pipe, and/or couplings that permits movement in all directions to accommodate seismic differential movement across building seismic separation joints. (AUT-HBS)

3.3.204* Shadow Area. The floor area within the protection area of a sprinkler created by the portion of sprinkler discharge that is blocked by a wall, partition, or other obstruction. (AUT-SSI)

3.3.205* Shelf Storage. Storage on structures up to and including 30 in. (750 mm) deep and separated by aisles at least 30 in. (750 mm) wide. (AUT-SSD)

3.3.206 Shop-Welded. Materials welded in a sprinkler contractor's or fabricator's premise or in an area specifically designed or authorized for welding, such as a detached outside location, maintenance shop, or other area. (AUT-SSI)

3.3.207 Sidewall Sprinkler. See 3.3.223.3.5.

3.3.208* 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. (AUT-SSD)

3.3.209 Site Class. A classification assigned to a site based on the types of soils present and their engineering properties as defined in Chapter 20 of ASCE/SEI 7, *Minimum Design Loads*

and Associated Criteria for Buildings and Other Structures. [ASCE/SEI 7:11.2] (AUT-HBS)

3.3.210 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. (AUT-SSD)

3.3.211 Slave Pallet. See 3.3.161.4.

3.3.212 Sloped Ceiling. See 3.3.31.3.

3.3.213* Small Openings. Openings in the ceiling or construction features of a concealed space that allow limited amounts of heat to enter the concealed space. (AUT-SSI)

3.3.214 Small Room. A compartment of light hazard occupancy classification having unobstructed construction and a floor area not exceeding $800 \text{ ft}^2 \text{ (74 m}^2\text{)}$. (AUT-SSI)

3.3.215 Smooth Ceiling. See 3.3.31.4.

3.3.216 Solid Shelf Rack. A rack that is not defined as an open 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. (AUT-SSD)

3.3.217* Solid Shelving. Shelving that 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 or by the placement of loads that block openings that would otherwise serve as the required flue spaces. Solid shelves having an area equal to or less than 20 ft² (1.9 m²) are defined as open racks. Shelves of wire mesh, slats, or other materials more than 50 percent open and where the flue spaces are maintained are defined as open racks. (AUT-SSD)

3.3.218 Solid Unit Load of Nonexpanded Plastic (Either Cartoned 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. (AUT-SSD)

3.3.219 Solid-Piled Storage. Storage of commodities stacked on each other. (AUT-SSD)

3.3.220 Special Sprinkler. See 3.3.223.4.18.

3.3.221 Spray Sprinkler. See 3.3.223.4.19.

3.3.222 Sprig. A pipe that rises vertically and supplies a single sprinkler. (AUT-SSI)

3.3.223 Sprinkler Definitions.

3.3.223.1 *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. (AUT-SSI)

3.3.223.2* *General Sprinkler Characteristics.* The following are characteristics of a sprinkler that define its ability to control or extinguish a fire. (1) 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. (a) Sprinklers defined as fast response have a thermal element with an RTI of 50 (meters-seconds)^{1/2} or less. (b) Sprinklers defined as standard response have a thermal element with

an RTI of 80 (meters-seconds)^{$\frac{1}{2}$} or more. (2) Temperature rating. (3) K-factor (*see Chapter 7*). (4) Installation orientation (*see 3.3.223.3*). (5) Water distribution characteristics (i.e., application rate, wall wetting). (6) Special service conditions. (AUT-SSI)

3.3.223.3 *Installation Orientation.* The following sprinklers are defined according to orientation. (AUT-SSI)

3.3.223.3.1 *Concealed Sprinkler*. A recessed sprinkler with cover plate. (AUT-SSI)

3.3.223.3.2 *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. (AUT-SSI)

3.3.223.3.3 *Pendent Sprinkler*: A sprinkler designed to be installed in such a way that the water stream is directed downward against the deflector. (AUT-SSI)

3.3.223.3.4 *Recessed Sprinkler.* A sprinkler in which all or part of the body, other than the shank thread, is mounted within a recessed housing. (AUT-SSI)

3.3.223.3.5 *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 onequarter of a sphere, with a small portion of the discharge directed at the wall behind the sprinkler. (AUT-SSI)

N 3.3.223.3.6 *Supplemental Sprinkler*. A sprinkler that is installed below an obstruction. (AUT-SSI)

3.3.223.3.7 *Upright Sprinkler*. A sprinkler designed to be installed in such a way that the water spray is directed upwards against the deflector. (AUT-SSI)

3.3.223.4 *Sprinkler Types.* The following sprinklers are defined according to design and/or performance characteristics. (AUT-SSI)

3.3.223.4.1* *Control Mode Density/Area (CMDA) Sprinkler.* A type of spray sprinkler intended to provide fire control in storage applications using the design density/area criteria described in this standard. (AUT-SSI)

3.3.223.4.2* 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. (AUT-SSI)

3.3.223.4.3 *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. (AUT-SSI)

3.3.223.4.4* *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. (AUT-SSI)

3.3.223.4.5* Early Suppression Fast-Response (ESFR) Sprinkler. A type of fast-response sprinkler that has a thermal element with an RTI of 50 (meters-seconds)^{l_2} or less and is listed for its capability to provide fire suppression of specific high-challenge fire hazards. (AUT-SSI)

3.3.223.4.6 *Electrically Operated Sprinkler*. A sprinkler equipped with an integral means of activation using electricity. (AUT-SSI)

3.3.223.4.7 *Extended Coverage Sprinkler.* A type of spray sprinkler with maximum coverage areas as specified in Sections 11.2 and 11.3. (AUT-SSI)

3.3.223.4.8 *Institutional Sprinkler*. A sprinkler specially designed for resistance to load-bearing purposes and with components not readily converted for use as weapons. (AUT-SSI)

3.3.223.4.9 *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. (AUT-SSI)

3.3.223.4.10 *Nozzle.* A device for use in applications requiring special water discharge patterns, directional spray, or other unusual discharge characteristics. (AUT-SSI)

3.3.223.4.11 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. (AUT-SSI)

3.3.223.4.12 *Open Sprinkler*. A sprinkler that does not have actuators or heat-responsive elements. (AUT-SSI)

3.3.223.4.13 *Ornamental/Decorative Sprinkler*: A sprinkler that has been painted or plated by the manufacturer. (AUT-SSI)

3.3.223.4.14 *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. (AUT-SSI)

3.3.223.4.15 *Quick-Response Extended Coverage Sprinkler.* A type of quick-response sprinkler that has a thermal element with an RTI of 50 (meter-seconds)^{$\frac{1}{2}$} or less and complies with the extended protection areas defined in Chapter 11. (AUT-SSI)

3.3.223.4.16* *Quick-Response (QR) Sprinkler.* A type of spray sprinkler that has a thermal element with an RTI of 50 (meter-seconds)^{$\frac{1}{2}$} or less and is listed as a quick-response sprinkler for its intended use. (AUT-SSI)

3.3.223.4.17 *Residential Sprinkler.* A type of fast-response sprinkler having a thermal element with an RTI of 50 (meters-seconds)^{$\frac{1}{2}$} 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. (AUT-SSI)

3.3.223.4.18 *Special Sprinkler*. A sprinkler that has been tested and listed as prescribed in Section 15.2. (AUT-SSI)

3.3.223.4.19 *Spray Sprinkler.* A type of sprinkler listed for its capability to provide fire control for a wide range of fire hazards. (AUT-SSI)

3.3.223.4.20 *Standard Spray Sprinkler*. A spray sprinkler with maximum coverage areas as specified in Sections 10.2 and 10.3. (AUT-SSI)

3.3.224* Sprinkler System. A system that is commonly activated by heat from a fire and discharges water over the fire area, that consists of an integrated network of piping designed in accordance with fire protection engineering standards, and that includes a water supply source, a control valve, a waterflow alarm (where required), and a drain. The portion of the sprinkler system above ground is a network of specifically sized or hydraulically designed piping installed in a building, structure, or area, generally overhead, and to which sprinklers are attached in a systematic pattern. (AUT-SSI)

3.3.224.1 *Antifreeze Sprinkler System.* A wet pipe system using automatic sprinklers that contains a liquid solution to prevent freezing of the system, intended to discharge the solution upon sprinkler operation, followed immediately by water from a water supply. (AUT-SSI)

3.3.224.2 *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. The detection system also serves as an automatic fire alarm system. (AUT-SSI)

3.3.224.3 *Deluge Sprinkler System.* A sprinkler system employing open sprinklers or nozzles 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 or the nozzles. When this valve opens, water flows into the piping system and discharges from all sprinklers or nozzles attached thereto. (AUT-SSI)

3.3.224.4 *Dry Pipe Sprinkler System.* A sprinkler system employing automatic sprinklers that are attached to a piping system containing air, nitrogen, or other approved gas 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. (AUT-SSI)

3.3.224.5* *Gridded Sprinkler System.* A sprinkler system in which parallel cross mains are connected by multiple branch lines, causing an operating sprinkler to receive water from both ends of its branch line while other branch lines help transfer water between cross mains. (AUT-SSD)

3.3.224.6* *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. (AUT-SSD)

3.3.224.7 *Multicycle System.* A type of sprinkler system capable of repeated on–off flow cycles in response to heat. (AUT-SSI)

3.3.224.8 *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. (AUT-SSD)

3.3.224.9* *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. (AUT-SSI)

- **N 3.3.224.10** *Vacuum Dry System.* A sprinkler system employing automatic sprinklers that are attached to a piping system containing air under negative gauge pressure, the release of which (as from the opening of a sprinkler) permits the air pressure detection to open the water flow valve, and the water then flows into the piping system and out the opened sprinklers. (AUT-SSI)
- **N** 3.3.224.11 *Vacuum Preaction System*. A sprinkler system employing automatic sprinklers that are attached to a piping system containing air under negative gauge pressure, with a supplemental detection system installed in the same areas as the sprinklers. (AUT-SSI)

3.3.224.12 *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. (AUT-SSI)

3.3.225 Sprinkler Types. See 3.3.223.4.

3.3.226 Standard Array (Rolled Paper). See 3.3.10.5.

3.3.227 Standard Spray Sprinkler. See 3.3.223.4.20.

3.3.228 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, 2025] (AUT-PRI)

3.3.229 Storage Aids. Commodity storage devices, such as pallets, dunnage, separators, and skids. (AUT-SSD)

3.3.230 Supervision. See 3.3.130.11.

3.3.231 Supervisory Device. A device arranged to supervise the operative condition of automatic sprinkler systems. (AUT-SSI)

3.3.232 Survival Angle. See 3.3.130.12.

3.3.233 Sway Brace. An assembly intended to be attached to the system piping to resist horizontal earthquake loads in two directions. (AUT-HBS)

3.3.234 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), a pressure gauge, a drain, and a waterflow alarm device. (AUT-SSI)

3.3.235 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. (AUT-SSI)

△ 3.3.236 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 ASTM E119, *Standard Test Methods for Fire Tests of Building Construction and Materials*, or UL 263, *Fire Tests of Building Construction and Materials*. (AUT-SSI)

3.3.237* Tiered Storage (Baled Cotton). An arrangement in which bales are stored directly on the floor, two or more bales high. (AUT-SSD)

3.3.238 Transverse Flue Space. The space between rows of storage parallel to the direction of loading. (*See Figure A.3.3.127.*) (AUT-SSD)

3.3.239 Type 1 Stair. See 3.3.130.13.

3.3.240 Unit Load. A pallet load or module held together in some manner and normally transported by material-handling equipment. (AUT-SSD)

3.3.241 Unobstructed Construction. See 3.3.46.2.

3.3.242 Upright Sprinkler. See 3.3.223.3.7.

3.3.243 Valve. A device for controlling the passage of fluid or gas through a pipe.

3.3.243.1 *Check Valve.* A valve that allows flow in one direction only. **[24, 2025]** (AUT-PRI)

N 3.3.243.2* *Automatic Breach Control Valve.* A hydraulic sensing device that detects abnormal water flow conditions and automatically isolates portions of a piping system when a catastrophic downstream breach or line break occurs. (AUT-SSI)

3.3.243.3* *Control Valve.* A valve capable of stopping the flow of water to water-based fire protection systems and devices. (AUT-SSI)

3.3.243.4* *Indicating Valve.* A valve that has components that provide the valve operating position, open or closed. **[24,** 2025] (AUT-PRI)

3.3.243.5* *Water Control Valve.* A valve that activates to allow water flow to a water-based fire protection system. (AUT-SSI)

3.3.243.5.1 *Differential Dry Pipe Valve.* A water control valve that is held in the closed position by the system pneumatic

3.3.243.5.2 *Mechanical Dry Pipe Valve.* A water control valve that uses a series of mechanical devices such as levers, springs, diaphragms, and latches to hold the valve in the closed position with pneumatic pressure and without using the clapper surface areas to provide a differential between system pneumatic and water pressures. (AUT-SSI)

- **N 3.3.243.5.3** *Deluge Valve.* A water control valve, used for deluge and preaction systems, that is held in the closed position by hydraulic pressure operating on a series of mechanical devices such as levers, pistons, springs, diaphragms, and latches, wherein the loss of hydraulic pressure due to automatic or manual operation of a releasing device or devices results in operation of the deluge valve. (AUT-SSI)
- **N 3.3.244* Vapor Corrosion Inhibitor (VCI).** A chemical compound (substance) that emits rust-inhibiting vapor to protect ferrous and nonferrous metals against corrosion in air-filled dry pipe or preaction sprinkler systems. (AUT-SSI)

3.3.245 Vertical Roll Paper Storage. See 3.3.197.4.

3.3.246 Water Control Valve. See 3.3.243.5.

3.3.247 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. (AUT-SSI)

3.3.248 Wet Barrel Hydrant. See 3.3.112.6.

3.3.249 Wet Pipe Sprinkler System. See 3.3.224.12.

3.3.250 Wood Pallet. See 3.3.161.5.

3.3.251 Wrapped Roll Paper Storage. See 3.3.197.5.

Chapter 4 General Requirements

4.1 Level of Protection.

4.1.1 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.

4.1.2 Limited Area Systems.

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

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

 Δ 4.2* Basis of Design for the 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.28.1(b)]:

- (1) Intended use of the building, including the materials within the building and the maximum height and arrangement of any storage configuration
- (2) Storage layout, including the maximum height, storage commodity, and arrangement of any storage configuration, where applicable
- (3) 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
- (4)* Determination and confirmation of the water supply including any necessary adjustments
- (5)* Any special knowledge of the water supply, including known environmental conditions that might be responsible for corrosion, including microbiologically influenced corrosion (MIC)
- (6) Whether seismic protection is required and the design spectral response acceleration at short periods, S_{DS}
- (7) Any special knowledge of the general environment in which the system will be installed that might be responsible for corrosion, including airborne chemicals that could contact system components or chemical solutions that might be exposed to the sprinkler system components

4.3* Classification of Hazard.

4.3.1 General.

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

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

4.3.1.3 Commodity classification and storage arrangements for miscellaneous and low-piled storage specified in 4.3.1.5 through 4.3.1.8 shall be determined in accordance with Sections 20.3 through 20.5.

4.3.1.4* Miscellaneous Storage.

4.3.1.4.1 Miscellaneous storage shall not exceed 12 ft (3.7 m) in height.

4.3.1.4.2 Miscellaneous storage shall not constitute more than 10 percent of the building area or 4000 ft² (370 m²) of the sprinklered area, whichever is greater.

4.3.1.4.3 Miscellaneous storage shall not exceed 1000 ft^2 (93 m²) in one pile or area.

4.3.1.4.4 Miscellaneous storage shall be separated from other storage piles or areas by at least 25 ft (7.6 m).

4.3.1.4.5 Solid shelf racks in accordance with the requirements of Section 25.3 shall not apply to miscellaneous storage of Class I through Class IV commodities up to 12 ft (3.7 m) and Group A plastics up to 5 ft (1.5 m).

4.3.1.5 Low-Piled Storage.

4.3.1.5.1 Low-piled storage of Class I through Class IV commodities shall not exceed 12 ft (3.7 m) in height.

4.3.1.5.2 Low-piled storage of Group A plastics shall not exceed 5 ft (1.5 m) in height.

4.3.1.6 Miscellaneous Tire Storage.

4.3.1.6.1 Miscellaneous tire storage shall not exceed 2000 ft^2 (185 m²).

4.3.1.6.2 Miscellaneous tire storage piles on-tread, regardless of storage method, shall not exceed 25 ft (7.6 m) in the direction of the wheel holes.

4.3.1.7 Protection Criteria for Miscellaneous and Low-Piled Storage.

▲ 4.3.1.7.1 The protection criteria for miscellaneous storage protected by ceiling sprinklers only shall be selected from Table 4.3.1.7.1.

4.3.1.7.2 For miscellaneous storage with open frame racks where in-rack sprinklers are required by Table 4.3.1.7.1, one level of in-rack sprinkler protection and ceiling design shall be in accordance with 25.2.1.

- **N 4.3.1.7.3** For miscellaneous storage having solid shelf racks where in-rack sprinklers are required by Table 4.3.1.7.1, in-rack sprinklers shall be in accordance with Section 25.3 and the ceiling design shall be in accordance with 25.2.1.4.
- **N 4.3.1.7.4** The protection criteria for low-piled storage protected by ceiling sprinklers only shall be selected from Table 4.3.1.7.4.
- **N** 4.3.1.7.5 For low-piled storage with open frame racks where in-rack sprinklers are required by Table 4.3.1.7.4, one level of in-rack sprinkler protection and ceiling sprinkler design shall be in accordance with 25.2.2.
- **N 4.3.1.7.6** For low-piled storage having solid shelf racks where in-rack sprinklers are required by Table 4.3.1.7.4, in-rack sprinklers shall be in accordance with Section 25.3 and the ceiling design shall be in accordance with 25.2.2.4.
- **N 4.3.1.7.7** Ceiling sprinkler design shall be in accordance with Section 19.2.

4.3.1.7.8 The maximum design area for miscellaneous and low-piled storage shall not exceed 3000 ft^2 (280 m²).

▲ 4.3.1.7.9 Hose connections shall not be required for the protection of miscellaneous storage.

△ Table 4.3.1.7.1 Discharge Criteria for Miscellaneous Storage

	Type of Storage	Storage	Height	Max Cei He	imum iling ight	Design from 19.2.3.1.1	In-Rack	Inside Hose		Total Combined Inside and Outside Hose		Denetion
Commodity		ft	m	ft	m		Sprinklers Required	gpm	L/min	gpm	L/min	Duration (minutes)
	1			Class I t	o Class	IV						
Class I	Solid-piled, palletized, bin box, shelf,	≤12	≤3.7	_	_	OH1	No	0, 50, 100	0, 190, 380	250	950	90
Class II	single-, double-, or multiple-row rack, and back-to-back	≤10	≤3.0	-	_	OH1	No	0, 50, 100	0, 190, 380	250	950	90
Class II	shelf storage	>10 to ≤12	>3.0 to ≤3.7	_	_	OH2	No	0, 50, 100	0, 190, 380	250	950	90
Class III		≤12	≤3.7	_	_	OH2	No	0, 50, 100	0, 190, 380	250	950	90
Class IV		≤10	≤3.0	_	_	OH2	No	0, 50, 100	$0, 190, \\ 380$	250	950	90
Class IV	Palletized, bin box, shelf, and solid-piled	>10 to ≤12	>3.0 to ≤3.7	32	9.8	OH2	No	0, 50, 100	0, 190, 380	250	950	90
	Single-, double-, or multiple-row rack, and back-to-back shelf storage	>10 to ≤12	>3.0 to ≤3.7	32	9.8	EH1	No	0, 50, 100	0, 190, 380	500	1900	120
	Single-, double-, or multiple-row rack	>10 to ≤12	>3.0 to ≤3.7	32	9.8	See 25.2.1.	Yes	0, 50, 100	0, 190, 380	250	950	90
			Gr	oup A P	lastic St	torage						
Cartoned Nonexpanded and expanded	Solid-piled, palletized, bin box, shelf, single-, double-, or multiple-row rack, and back-to-back shelf storage	≤5	≤1.5	_	_	OH2	No	0, 50, 100	0, 190, 380	250	950	90
		>5 to ≤10	>1.5 to ≤3.0	15	4.6	C EH1	No, unless solid shelf	0, 50, 100	0, 190, 380	500	1900	120
		>5 to ≤10	>1.5 to ≤3.0	20	6.1	EH2	No, unless solid shelf	0, 50, 100	0, 190, 380	500	1900	120
		>10 to ≤12	>3.0 to ≤3.7	17	5.2	EH2	No, unless solid shelf	0, 50, 100	0, 190, 380	500	1900	120
	Solid-piled, palletized, bin box, shelf, and back-to-back shelf storage	>10 to ≤12	>3.0 to ≤3.7	32	9.8	EH2	No, unless solid shelf	0, 50, 100	0, 190, 380	500	1900	120
	Single-, double-, or multiple-row rack	>10 to ≤12	>3.0 to ≤3.7	32	9.8	See 25.2.1.	Yes	0, 50, 100	0, 190, 380	250	950	90
A A	PANOT											(continues)
Δ Table 4.3.1.7.1 Continued

			Storage	e Height	Max Ce He	imum iling eight	Design	In-Rack	Inside	e Hose	Total C Insid Outsic	ombined le and le Hose	Duration
(Commodity	Type of Storage	ft	m	ft	m	19.2.3.1.1	Required	gpm	L/min	gpm	L/min	(minutes)
Exposed	Nonexpanded and expanded	Solid-piled, palletized, bin box, shelf, single-, double-, or multiple-row rack, and back-to-back shelf storage	≤5	≤1.5	_	_	OH2	No	0, 50, 100	0, 190, 380	250	950	90
		Solid-piled, palletized, bin box, shelf, and back-to-back shelf storage	>5 to ≤8	>1.5 to ≤2.4	28	8.5	EH2	No, unless solid shelf	0, 50, 100	0, 190, 380	500	1900	120
		Solid-piled, palletized, bin box, shelf, single-, double-, or multiple-row rack, and back-to-back shelf storage	>5 to ≤10	>1.5 to ≤3.0	15	4.6	EH2	No, unless solid shelf	0, 50, 100	0, 190, 380	500	1900	120
	Nonexpanded	Solid-piled, palletized, bin box, shelf, single-, double-, or multiple-row rack, and back-to-back shelf storage	>5 to ≤10	>1.5 to ≤3.0	20	6.1	EH2	No, unless solid shelf	0, 50, 100	0, 190, 380	500	1900	120
	Expanded	Single-, double-, or multiple-row rack	>5 to ≤ 10	>1.5 to ≤3.0	20	6.1	See 25.2.1.	Yes	0, 50, 100	0, 190, 380	250	950	90
	Nonexpanded and expanded	Solid-piled, palletized, bin box, shelf, and back-to-back shelf storage	>10 to ≤12	>3.0 to ≤3.7	17	5.2	EH2	No, unless solid shelf	0, 50, 100	0, 190, 380	500	1900	120
		Single-, double-, or multiple-row rack	>10 to ≤12	>3.0 to ≤3.7	17	5.2	EH2	No, unless solid shelf	0, 50, 100	0, 190, 380	500	1900	120
			>10 to ≤12	>3.0 to ≤3.7	32	9.8	See 25.2.1.	Yes	0, 50, 100	0, 190, 380	250	950	90
					Tire	Storage							
Tires		On floor or on side	>5 to ≤12	>1.5 to ≤3.7	32	9.8	EH1	N/A	0, 50, 100	0, 190, 380	500	1900	120
		On floor, on tread, or on side	≤5	≤1.5	-	_	OH2	N/A	0, 50, 100	0, 190, 380	250	950	90
		Single-, double-, or multiple-row racks, on tread or on side	≤5	≤1.5	_	_	OH2	No	0, 50, 100	0, 190, 380	250	950	90
		Single-row rack, portable, on tread or on side	>5 to ≤12	>1.5 to ≤3.7	32	9.8	EH1	No	0, 50, 100	0, 190, 380	500	1900	120
		Single-row rack, fixed, on tread or on side	>5 to ≤12	>1.5 to ≤3.7	32	9.8	EH1	No	0, 50, 100	0, 190, 380	500	950	120
			>5 to ≤12	>1.5 to ≤3.7	32	9.8	See 25.2.1.	Yes	0, 50, 100	0, 190, 380	250	950	90
				R	olled Pa	per Sto	orage						
Heavyweig medium	ght and nweight	On end	≤10	≤3.0	30	9.1	OH2	N/A	0, 50, 100	0, 190, 380	250	950	90
Tissue and	l lightweight	On end	≤10	≤3.0	30	9.1	EH1	N/A	0, 50, 100	0, 190, 380	250	950	120

N Table 4.3.1.7.4 Discharge Criteria for Low-Piled Storage

		Storage	e Height	Maximu He	m Ceiling ight	Design	In-Rack Sprinklers	Insid	e Hose	Total C Insid Outsid	ombined le and le Hose	Duration
Commodity	Type of Storage	ft	m	ft	m	19.2.3.1.1	Required	gpm	L/min	gpm	L/min	(minutes)
		T			Class I to	Class IV	1		1			
Class I	Solid-piled, palletized, bin box, shelf,	≤12	≤3.7	_	_	OH1	No, unless solid shelf	0, 50, 100	0, 190, 380	250	950	90
Class II	single-, double-, or multiple-row rack, and back- to-back shelf storage	≤10	≤3.0	—	_	OH1	No, unless solid shelf	0, 50, 100	0, 190, 380	250	950	90
Class II		>10 to ≤12	>3.0 to ≤3.7	—	_	OH2	No, unless solid shelf	0, 50, 100	0, 190, 380	250	950	90
Class III		≤12	≤3.7	—	_	OH2	No, unless solid shelf	0, 50, 100	0, 190, 380	250	950	90
Class IV		≤10	≤3.0	—	—	OH2	No, unless solid shelf	0, 50, 100	0, 190, 380	250	950	90
Class IV	Palletized, bin box, shelf, and solid-piled	>10 to ≤12	>3.0 to ≤3.7	32	9.8	OH2	No, unless solid shelf	0, 50, 100	0, 190, 380	250	950	90
	Single-, double-, or multiple- row rack, and back-to-back shelf storage	>10 to ≤12	>3.0 to ≤3.7	32	9.8	EH1	No, unless solid shelf	0, 50, 100	0, 190, 380	500	1900	120
	Single-, double-, or multiple- row rack	>10 to ≤12	>3.0 to ≤3.7	32	9.8	See 25.2.2	Yes	0, 50, 100	0, 190, 380	250	950	90
				Ċ	roup A Pla	stic Storage						
Group A Plastic (All)	Solid-piled, palletized, bin box, shelf, single-, double-, or multiple-row rack, and back- to-back shelf storage	≤5	≤1.5 COM	Ciliet	_	OH2	No, unless solid shelf	0, 50, 100	0, 190, 380	250	950	90

4.3.1.8 In-Rack Sprinklers. Miscellaneous and low-piled storage in accordance with 4.3.1.4 through 4.3.1.7 that require inrack sprinklers shall follow Chapter 25 for their installation and design requirements.

 Δ 4.3.2* Light Hazard. Spaces with low quantity and combustibility of contents shall be protected with light hazard occupancy criteria in this standard.

4.3.3* Ordinary Hazard Occupancies.

4.3.3.1* Ordinary Hazard (Group 1). The following shall be protected with OH1 occupancy criteria in this standard:

- (1) Spaces with moderate quantity and low combustibility of contents
- (2) Stockpiles of contents with low combustibility that do not exceed 8 ft (2.4 m)

4.3.3.2* Ordinary Hazard (Group 2). The following shall be protected with OH2 occupancy criteria in this standard:

- (1) Spaces with moderate to high quantity and combustibility of contents
- (2) Stockpiles of contents with moderate rates of heat release rate that do not exceed 12 ft (3.7 m) and stockpiles of contents with high rates of heat release that do not exceed 8 ft (2.4 m)

N 4.3.4 Extra Hazard Occupancies.

4.3.4.1* Extra Hazard (Group 1) (EH1). The following shall be protected with EH1 occupancy criteria in this standard:

- (1) Spaces with very high quantity and combustibility of contents
- (2) Spaces where dust, lint, or other materials are present, introducing the probability of rapidly developing fires

4.3.4.2* Extra Hazard (Group 2) (EH2). The following shall be protected with EH2 occupancy criteria in this standard:

- (1) Spaces with very high quantity and combustibility of contents
- (2) Spaces with substantial amounts of combustible or flammable liquids
- (3) Spaces where shielding of combustibles is extensive

4.3.5 High-Piled Storage. Storage arrangements that do not meet the requirements of 4.3.1.4 through 4.3.1.8 shall be protected in accordance with Chapters 20 through 25.

4.3.6* Special Occupancy Hazards. Special occupancies shall be in accordance with Chapter 27.

4.4 System Protection Area Limitations.

- △ 4.4.1 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 (4830 m²)
 - (2)* Light hazard protected with a wet pipe system and the system water flow and supervisory alarms are transmitted to a supervising station in accordance with NFPA 72 — 78,000 ft² (7250 m²)
 - (3) Ordinary hazard $52,000 \text{ ft}^2 (4830 \text{ m}^2)$
 - (4) Extra hazard, hydraulically calculated 40,000 ft² (3720 m²)
 - (5) High-piled storage (as defined in 3.3.105) and storage covered by other NFPA standards — 40,000 ft² (3720 m²)
 - (6) In-rack storage $40,000 \text{ ft}^2 (3720 \text{ m}^2)$

4.4.2 The floor area occupied by mezzanines shall comply with 4.4.2.1, 4.4.2.2, or 4.4.2.3.

4.4.2.1 In a building with only one sprinkler system, the floor area occupied by mezzanines shall not be included in the area limits of 4.4.1.

4.4.2.2 In a building with more than one sprinkler system, if a mezzanine is located entirely within the same sprinkler system boundary as the sprinklers protecting the ceiling above, the floor area occupied by mezzanine(s) shall not be included in the area limits of 4.4.1.

4.4.2.3 In a building with more than one sprinkler system, if any portion of the mezzanine floor area is located outside the system boundary of the riser supplying the sprinklers under the mezzanine, the area of the mezzanine outside the boundary of the overhead system shall be added to the system area from which it is supplied, and the total system area shall meet the limits of 4.4.1.

4.4.3 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 the area specified for the lesser hazard.

4.4.4 The area protected by a single in-rack system includes all of the floor area occupied by the racks, including aisles, regardless of the number of levels of in-rack sprinklers.

4.4.5 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.

4.4.6* Detached Buildings.

4.4.6.1 Unless the requirements of 4.4.6.2 apply, detached buildings, regardless of separation distance, that do not meet the criteria of 4.4.4 shall be provided with separate fire sprinkler systems.

4.4.6.2 When acceptable to the authority having jurisdiction, detached structures shall be permitted to be supplied by the fire sprinkler system of an adjacent building.

4.5 Water Supply Information.

4.5.1 Water Supply Capacity Information. The following information shall be included:

- (1) Location and elevation of static and residual test gauge with relation to the riser reference point
- (2) Flow location
- (3) Static pressure, psi (bar)
- (4) Residual pressure, psi (bar)
- (5) Flow, gpm (L/min)
- (6) Date
- (7) Time
- (8) Name of person who conducted the test or supplied the information
- (9) Other sources of water supply, with pressure or elevation

4.5.1.1* Where a waterflow test is used for the purposes of system design, the test shall be conducted no more than 12 months prior to working plan submittal unless otherwise approved by the authority having jurisdiction.

4.5.2 Water Supply Treatment Information. The following information shall be included when water supply treatment is provided in accordance with 5.1.4:

- (1) Type of condition that requires treatment
- (2) Type of treatment needed to address the problem
- (3) Details of treatment plan

4.6* 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.

4.7 Air, Nitrogen, or Other Approved Gas. Where air is used to charge, maintain, or supervise sprinkler systems, nitrogen or other approved gas shall also be permitted to be used.

4.8* Support of Nonsprinkler System Components. Sprinkler system components shall not be used to support nonsprinkler system components unless expressly permitted by this standard.

4.9 Noncombustible Materials and Limited-Combustible Materials.

4.9.1* Noncombustible Material.

4.9.1.1 A material that complies with any of the following shall be considered a noncombustible material:

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

the test method and procedure in ASTM E2652, Standard Test Method for Assessing Combustibility of Materials Using a Tube Furnace with a Cone-shaped Airflow Stabilizer, at 750°C. [5000:7.1.4.1.1]

4.9.1.2 Where the term *limited-combustible* is used in this standard, it shall also include the term *noncombustible*. [5000:7.1.4.1.2]

- Δ 4.9.2* Limited-Combustible Material. A material shall be considered a limited-combustible material where one of the following is met:
 - (1) The conditions of 7.1.4.2.1 and 7.1.4.2.2 of *NFPA 5006*, and the conditions of either 4.9.2.1 or 4.9.2.2, shall be met.
 - (2) The conditions of 4.9.2.3 shall be met.
 - **[5000:**7.1.4.2]
- ▲ 4.9.2.1 The material shall have a structural base of noncombustible material with a surfacing not exceeding a thickness of ½ in. (3.2 mm) where the surfacing exhibits a flame spread index not greater than 50 when tested in accordance with ASTM E84, Standard Test Method for Surface Burning Characteristics of Building Materials, or UL 723, Test for Surface Burning Characteristics of Building Materials. [5000:7.1.4.2.3]

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

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

- (1) The peak heat release rate shall not exceed 150 kW/m^2 for longer than 10 seconds.
- (2) The total heat released shall not exceed 8 MJ/m^2 .

[**5000:**7.1.4.2.5]

4.9.2.4 Where the term *limited-combustible* is used in this standard, it shall also include the term *noncombustible*. [5000:7.1.4.2.6]

Chapter 5 Water Supplies

5.1 General.

5.1.1 Number of Supplies. Every automatic sprinkler system shall have at least one automatic water supply.

5.1.2 Capacity. Water supplies shall be capable of providing the required flow and pressure for the remote design area determined using the requirements and procedures as specified in Chapters 19 through 27 including hose stream allowance where applicable for the required duration.

5.1.3* Size of Fire Mains.

5.1.3.1 Except as provided in 5.1.3.2 or 5.1.3.3, no pipe smaller than 6 in. (150 mm) in diameter shall be installed as a private service main.

5.1.3.2 Sizes smaller than 6 in. (150 mm) for fire mains that do not supply hydrants shall be permitted, provided that hydraulic calculations show the main will supply the total demand at the appropriate pressure.

5.1.3.3 Where a single main less than 4 in. (100 mm) in diameter serves both fire systems and other uses, the non-fire demand shall be added to the hydraulic calculations for the fire system at the point of connection unless provisions have been made to automatically isolate the non-fire demand during a fire event.

5.1.3.4 For pipe schedule systems, the underground supply pipe shall be at least as large as the system riser.

Δ 5.1.4* Water.

- Δ 5.1.4.1 Water supplies and environmental conditions shall be evaluated for the existence of microbes and conditions that contribute to microbiologically influenced corrosion (MIC).
- Δ 5.1.4.2 Water supplies and environmental conditions shall be evaluated for conditions that contribute to unusual corrosive properties.

5.1.4.3* Inhibitors.

5.1.4.3.1 Where used, listed bacterial inhibitors and/or corrosion inhibitors shall be compatible with system components.

5.1.4.3.2 Where used together, listed bacterial inhibitors and corrosion inhibitors shall be compatible with each other.

5.1.5 Arrangement.

5.1.5.1 Connection Between Underground and Aboveground Piping.

5.1.5.1.1 The connection between the system piping and underground piping shall be made with a transition piece in accordance with 6.3.3 or 6.3.3.1 that is properly strapped or fastened by approved devices.

5.1.5.1.2 Where required due to specific mechanical or environmental conditions, the transition piece shall be protected against possible damage from corrosive agents, solvent attack, or mechanical damage.

5.1.5.2* Connection Passing Through or Under Foundation Walls. When system piping pierces a foundation wall below grade or is located under the foundation wall, clearance shall be provided to prevent breakage of the piping due to building settlement.

5.1.6* Meters. Where meters are required by other authorities, they shall be listed.

5.1.7* Connection from Waterworks System.

5.1.7.1 The requirements of the public health authority having jurisdiction shall be determined and followed.

5.1.7.2 Where equipment is installed to guard against possible contamination of the public water system, such equipment and devices shall be listed for fire protection service.

5.2 Types.

5.2.1* Water supplies for sprinkler systems shall be one of the following or any combination:

- (1) A connection to an approved public or private waterworks system in accordance with 5.2.2
- (2) A connection including a fire pump in accordance with 5.2.3
- (3) A connection to a water storage tank at grade or below grade installed in accordance with NFPA 22 and filled from an approved source
- (4) A connection to a pressure tank in accordance with 5.2.4 and filled from an approved source
- (5) A connection to a gravity tank in accordance with 5.2.5 and filled from an approved source
- (6) A penstock, flume, river, lake, pond, or reservoir in accordance with 5.2.6
- (7)* A source of recycled or reclaimed water where the building owner (or their agent) has analyzed the source of the water and the treatment process (if any) that the water undergoes before being made available to the sprinkler system and determined that any materials, chemicals, or contaminants in the water will not be detrimental to the components of the sprinkler system it comes in contact with

5.2.2* Connections to Waterworks Systems.

5.2.2.1 A connection to a reliable waterworks system shall be an acceptable water supply source.

5.2.2.2* The volume and pressure of a public water supply shall be determined from waterflow test data or other approved method.

N 5.2.2.3* Where a waterflow test was conducted to provide the water supply information, the date, day of the week, and time of day that the test was conducted shall be recorded with the data.

5.2.3* Pumps. A single automatically controlled fire pump installed in accordance with NFPA 20 shall be an acceptable water supply source.

5.2.4 Pressure Tanks.

5.2.4.1 Acceptability.

5.2.4.1.1 A pressure tank installed in accordance with NFPA 22 shall be an acceptable water supply source.

5.2.4.1.2 Pressure tanks shall be provided with an approved means for automatically maintaining the required air pressure.

5.2.4.1.3 Where a pressure tank is the sole water supply, an approved supervisory signal(s) shall be provided to indicate low air pressure and low water level with the signal supplied from an electrical branch circuit independent of the air compressor

or, if the building has a fire alarm system, connected to the building's fire alarm system.

5.2.4.1.4 Pressure tanks shall not be used to supply other than sprinklers and hand hose attached to sprinkler piping.

5.2.4.2 Capacity.

5.2.4.2.1 In addition to the requirements of 5.1.2, the water capacity of a pressure tank shall include the extra capacity needed to fill dry pipe or preaction systems where installed.

5.2.4.2.2 The total volume shall be based on the water capacity plus the air capacity required by 5.2.4.3.

5.2.4.3* Water Level and Air Pressure.

5.2.4.3.1 Pressure tanks shall be kept with a sufficient supply of water to meet the demand of the fire protection system as

calculated in Chapter 28 for the duration required by Chapter 19, Chapter 20, or Chapter 27.

5.2.4.3.2 The pressure shall be sufficient to push all of the water out of the tank while maintaining the necessary residual pressure (required by Chapter 28) at the top of the system.

5.2.5 Gravity Tanks. An elevated tank installed in accordance with NFPA 22 shall be an acceptable water supply source.

5.2.6 Penstocks, Flumes, Rivers, or Lakes. Water supply connections from penstocks, flumes, rivers, lakes, or reservoirs shall be arranged to avoid mud and sediment and shall be provided with approved double removable screens or approved strainers installed in an approved manner.

Chapter 6 Installation of Underground Piping

N 6.1 General. The requirements of Chapter 6 shall apply to the installation of underground piping used for private fire service mains and any underground piping installed in a sprinkler system.

Δ 6.2* Piping. [24:10.1]

 Δ 6.2.1* All piping used in private fire service mains shall be in accordance with 6.2.1.1, 6.2.1.2, or 6.2.1.3.

6.2.1.1 Use. Piping manufactured in accordance with Table 6.2.1.1 shall be permitted to be used. [24:10.1.1.]

6.2.1.2 Piping specifically listed for use in private fire service mains shall be permitted to be used. [24:10.1.1.2]

6.2.1.2.1 Where listed pipe is used, it shall be installed in accordance with the listing limitations including installation instructions. [24:10.1.1.2.1]

6.2.1.2.2 Where listing limitations or installation instructions differ from the requirements of this standard, the listing limitations and installation instructions shall apply. [24:10.1.1.2.2]

6.2.1.3 Steel piping manufactured in accordance with Table 6.2.1.3 that is externally coated and wrapped and internally galvanized shall be permitted to be used between the hose coupling(s) on the fire department connection and the check valve installed in the fire department connection piping. **[24:**10.1.1.3]

6.2.1.3.1 External coating and wrapping as required by 6.2.1.3 shall be approved. [24:10.1.1.3.1]

N 6.2.1.3.2 The requirements of 6.2.1.3 shall not apply to listed stainless steel piping. [24:10.1.1.3.2]

6.2.1.4 Dry Pipe Underground.

6.2.1.4.1 Where necessary to place pipe that will be under air pressure underground, the pipe shall be protected against corrosion.

A Table 6.2.1.1 Manufacturing Standards for Underground Pipe

Materials and Dimensions	Standard
Ductile Iron	- OK
Cement-mortar lining for ductile-iron pipe and fittings	AWWA C104/A21.4
Polyethylene encasement for ductile-iron pipe systems	AWWA C105/A21.5
Rubber-gasket joints for ductile-iron pressure pipe and fittings	AWWA C111/A21.11
Flanged ductile-iron pipe with ductile-iron or gray-iron threaded flanges	AWWA C115/A21.15
Thickness design of ductile-iron pipe	AWWA C150/A21.50
Ductile-iron pipe, centrifugally cast	AWWA C151/A21.51
Ductile iron water mains and their appurtenances	AWWA C600
Concrete	
Reinforced concrete pressure pipe, steel-cylinder type	AWWA C300
Prestressed concrete pressure pipe, steel-cylinder type	AWWA C301
Reinforced concrete pressure pipe, non-cylinder type	AWWA C302
Reinforced concrete pressure pipe, steel-cylinder type, pretensioned	AWWA C303
Cement-mortar lining of water pipe lines in place, 4 in. (100 mm) and larger	AWWA C602
Plastic	
Polyvinyl chloride (PVC) pressure pipe and fabricated fittings, 4 in. through 60 in. (100 mm through 1500 mm)	AWWA C900
Polyethylene (PE) pressure pipe and fittings, 4 in. (100 mm) through 63 in. (1575 mm) for waterworks	AWWA C906
Molecularly oriented polyvinyl chloride (PVCO), 4 in. through 24 in. (100 mm through 600 mm) for water, wastewater, and reclaimed water service	AWWA C909
Brass	
Seamless red brass pipe, standard sizes	ASTM B43
Copper	
Seamless copper tube	ASTM B75/B75M
Seamless copper water tube	ASTM B88
Wrought seamless copper and copper-alloy tube	ASTM B251/B251M
Stainless Steel	
Seamless, welded, and heavily cold worked austenitic stainless steel pipes	ASTM A312/312M
[94 ·Table 10.1.1.1]	

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Table 6.2.1.3 Steel Piping for Fire Department Connections

Materials and Dimensions	Standard
Black and hot-dipped zinc-coated (galvanized) welded and seamless steel pipe for fire	ASTM A795/A795M
protection use Pipe, steel, black and hot-dipped,	ASTM A53/A53M
zinc-coated, welded and seamless Electric-resistance-welded steel pipe	ASTM A135/A135M
[24: Table 10.1.1.3]	

6.2.1.4.2 Unprotected cast-iron or ductile-iron pipe shall be permitted where joined with a gasketed joint listed for air service underground.

6.2.2* All piping used in private fire service mains shall be rated for the maximum system working pressure to which the piping is exposed to but shall not be rated at less than 150 psi (10.3 bar). [**24**:10.1.2]

6.2.3* When lined piping is used, the manufacturer's literature for internal diameter shall be used for all hydraulic calculations. **[24:10.1.3]**

6.2.4* Regardless of pipe type, underground piping shall be permitted to extend into the building through the slab or wall not more than 24 in. (600 mm). **[24:1**0.1.4]

6.2.4.1 Underground piping extended vertically into the building through the slab shall be installed plumb. **[24:**10.1.4.1]

Δ 6.3 Fittings. [24:10.2]

6.3.1 All fittings used in private fire service mains shall be in accordance with 6.3.1.1 or 6.3.1.2. [**24**:10.2.1]

6.3.1.1 Fittings manufactured in accordance with Table 6.3.1.1 shall be permitted to be used. [**24:**10.2.1.1]

6.3.1.2 Special Listed Fittings. Fittings specifically listed for use in private fire service mains shall be permitted to be used. **[24:1**0.2.1.2]

6.3.1.2.1 Where listed fittings are used, they shall be installed in accordance with their listing limitations including installation instructions. **[24:**10.2.1.2.1]

6.3.1.2.2 Where listing limitations or installation instructions differ from the requirements of this standard, the listing limitations and installation instructions shall apply. **[24:1**0.2.1.2.2]

6.3.2 All fittings used in private fire service mains shall be rated for the maximum system working pressure to which the fittings are exposed, but shall not be rated at less than 150 psi (10.3 bar). [**24**:10.2.2]

6.3.3 Where fittings installed in a private fire service main must be installed above grade, the fittings shall conform to NFPA 13. [**24**:10.2.3]

6.3.3.1 Fittings in accordance with 6.3.1 shall be permitted for the transition to the above ground piping or fittings. **[24:**10.2.3.1]

 Table 6.3.1.1 Fittings Materials and Dimensions

INSTALLATION OF UNDERGROUND PIPING

Materials and Dimensions	Standard
Cast Iron	
Gray iron threaded fittings, classes 125 and 250	ASME B16.4
Gray iron pipe flanges and flanged fittings, classes 25, 125, and 250	ASME B16.1
Ductile Iron	
Ductile-iron and gray-iron fittings Ductile-iron compact fittings	AWWA C110/A21.10 AWWA C153/A21.53
Malleable Iron	
Malleable iron threaded fittings, classes 150 and 300	ASME B16.3
Copper)
Wrought copper and copper alloy solder joint pressure fittings	ASME B16.22
Cast copper alloy solder joint pressure fitting	ASME B16.18
Bronze Fittings	
Cast copper alloy threaded fittings, classes 125 and 250	ASME B16.15
Stainless Steel	
Wrought austenitic stainless steel pipe fittings	ASTM A403/A403M
24: Table 10.2.1.1]	

6.4 Connection of Pipe, Fittings, and Appurtenances. [24:10.3]

6.4.1* Connection of all fittings and appurtenances to piping shall be in accordance with Section 6.4. **[24:1**0.3.1]

6.4.2 Connections of pipe and fittings indicated in Table 6.2.1.1 and Table 6.3.1.1 shall be in accordance with the referenced standard in the table. **[24:1**0.3.2]

6.4.3 Listed Connections. Connections utilizing listed products shall be in accordance with the listing limitations and the manufacturer's installation instructions. **[24:1**0.3.3]

6.4.3.1 Where listing limitations or installation instructions differ from the requirements of this standard, the listing limitations and installation instructions shall apply. **[24:1**0.3.3.1]

6.4.4 Threaded Pipe and Fittings. Where pipe, fittings or appurtenances are connected using threads, all threads shall be in accordance with ASME B1.20.1, *Pipe Threads, General Purpose*, *Inch.* [24:10.3.4]

6.4.5 Grooved Connections. Where pipe, fittings, or appurtenances are connected using grooves, they shall be connected in accordance with 6.4.5.1 through 6.4.5.3. [**24:**10.3.5]

6.4.5.1 Pipe, fittings, and appurtenances to be joined with grooved couplings shall contain cut, rolled, or cast grooves that are dimensionally compatible with the couplings. **[24:**10.3.5.1]

6.4.5.2 Pipe, fittings, and appurtenances that are connected with grooved couplings and are part of a listed assembly shall be permitted to be used. [**24:**10.3.5.2]

6.4.5.3* Pipe joined with grooved fittings shall be joined by a listed combination of fittings, gaskets, and grooves. [**24:**10.3.5.3]

N 6.4.6 Connection of Plain End Pipe. Plain end pipe, fittings, and appurtenances joined with couplings shall be joined by a listed combination of fittings, gaskets, and couplings. **[24:**10.3.6]

6.4.7 Copper Tube. All joints for the connection of copper tube shall be brazed or joined using pressure fittings as specified in Table 6.3.1.1. [24:10.3.7]

6.5 Protection of Private Fire Service Mains. [24:10.4]

Δ 6.5.1 Protection from Corrosion. [24:10.4.1]

6.5.1.1 Coatings. All bolted joint accessories shall be cleaned and thoroughly coated with asphalt, bituminous, or other corrosion-retarding material after installation. [**24**:10.4.1.1]

6.5.1.2 The requirements of 6.5.1.1 shall not apply to stainless steel or epoxy-coated fittings, valves, glands, or other accessories. [**24**:10.4.1.2]

6.5.1.3* Where it is necessary to join metal pipe with pipe of dissimilar metal, the joint shall be insulated against the passage of an electric current using an approved method. [**24**:10.4.1.3]

Δ 6.5.2* Protection of Piping. [24:10.4.2]

6.5.2.1 Protection from Freezing. The depth of cover for private fire service mains and their appurtenances to protect against freezing shall be in accordance with 6.5.2. **[24**:10.4.2.1]

6.5.2.1.1* The top of the pipe shall be buried not less than 1 ft (300 mm) below the frost line for the locality. [**24:**10.4.2.1.1]

6.5.2.1.2 The depth of piping shall be measured from the top of the piping to the final grade. [**24**:10.4.2.1.2]

6.5.2.1.3 Where listed piping is used and the bury depth differs from this standard, the listing limitations shall apply. **[24:**10.4.2.1.3]

6.5.2.1.4 Where private fire service mains are installed above ground, they shall be protected from freezing in accordance with NFPA 13. [**24:**10.4.2.1.4]

6.5.2.1.5 Private fire service mains installed in water raceways or shallow streams shall be installed so that the piping will remain in the running water throughout the year. [**24**:10.4.2.1.5]

6.5.2.1.6 Where piping is installed adjacent to a vertical face, it shall be installed from the vertical face at the same distance as if the piping were buried. [**24**:10.4.2.1.6]

6.5.2.1.7 Protection of private fire service mains from freezing using heat tracing shall be permitted when the heat tracing is specifically listed for underground use. [**24**:10.4.2.1.7]

6.5.2.1.7.1 Heat tracing not listed for underground use shall be permitted when piping is installed in accordance with 6.2.4. **[24:**10.4.2.1.7.1]

6.5.2.2 Protection from Mechanical Damage. The depth of cover for private fire service mains and their appurtenances to protect against mechanical damage shall be in accordance with 6.5.2.2. **[24:**10.4.2.2]

6.5.2.2.1 The depth of piping shall be measured from the top of the piping to the final grade. [**24**:10.4.2.2.1]

6.5.2.2.2 In locations where freezing is not a factor, the depth of cover shall not be less than 30 in. (750 mm) below grade to prevent mechanical damage. **[24:**10.4.2.2.2]

6.5.2.2.2.1 Where listed piping is used and the bury depth differs from this standard, the listing limitations shall apply. **[24:**10.4.2.2.2.1]

6.5.2.2.3 Private fire service mains installed under driveways or roadways shall be buried at a minimum depth of 36 in. (900 mm). [**24**:10.4.2.2.3]

6.5.2.2.3.1 Sidewalks, walkways, and other paved or concrete pedestrian passageways shall not be required to comply with 6.5.2.2.3. [**24:**10.4.2.2.3.1]

6.5.2.2.4 Private fire service mains installed under railroad tracks shall be buried at a minimum depth of 4 ft (1.2 m). [**24**:10.4.2.2.4]

6.5.2.2.4.1 Where railroad operators require a greater depth of bury, the greater depth shall apply. [**24:**10.4.2.2.4.1]

6.5.2.2.5 Private fire service mains installed under large piles of heavy commodities or subject to heavy shock and vibrations shall be buried at a minimum depth of 4 ft (1.2 m). [**24:**10.4.2.2.5]

6.5.2.2.6 Where private fire service mains are installed above ground, they shall be protected with bollards or other means as approved by the AHJ when subject to mechanical damage. **[24:1**0.4.2.2.6]

6.5.3 Private Fire Service Mains Beneath Buildings. Except as permitted by 6.5.3, private fire service mains shall not be installed beneath buildings. [**24**:10.4.3]

6.5.3.1* Private fire service mains supplying fire protection systems within the building shall be permitted to extend horizontally no more than 10 ft (3.0 m) cumulatively, as measured from the outside of the building, under the building to the riser location. **[24:1**0.4.3.1]

6.5.3.1.1* Pipe joints shall not be located directly under foundation footings. [**24**:10.4.3.1.1]

6.5.3.1.2* Piping shall be installed a minimum of 12 in. (300 mm) below the bottom of building foundations or footers. **[24:1**0.4.3.1.2]

6.5.3.1.2.1 The requirements of 6.5.3.1.2 shall not apply when the piping is sleeved with an approved material. **[24:**10.4.3.1.2.1]

6.5.3.2* Private fire service mains shall not be permitted to extend more than 10 ft (3 m) under the building except as allowed in 6.5.3.2.1. [**24:**10.4.3.2]

6.5.3.2.1* Where private fire service mains extend more than 10 ft (3 m) into the building, they shall be run in a covered trench. [**24:**10.4.3.2.1]

6.5.3.2.1.1* The trench shall be accessible from within the building. [**24:**10.4.3.2.1.1]

6.5.3.2.1.2 The trench shall have rigid walls and a base. **[24:**10.4.3.2.1.2]

6.5.3.2.1.3 The trench shall be constructed of noncombustible materials. [**24:**10.4.3.2.1.3]

6.5.3.2.1.4* Provisions for draining water shall be provided for the trench. [**24**:10.4.3.2.1.4]

6.5.3.2.1.5 Where the piping in the trench is installed under foundations or footers, clearance shall be provided in accordance with 6.5.3.1.2 or 6.5.3.1.2.1. [**24**:10.4.3.2.1.5]

6.5.3.2.2 Piping in the trench shall be permitted to be in accordance with 6.2.1. **[24:1**0.4.3.2.2]

6.5.3.2.2.1 Aboveground piping in accordance with NFPA 13 shall be permitted to be used. [**24:**10.4.3.2.2.1]

6.5.3.2.2.2 Where piping installed in the trench is in accordance with 6.2.1, all joints shall be restrained in accordance with 6.7.2 or 6.7.3. **[24:1**0.4.3.2.2.2]

6.5.3.2.3* Where piping is installed in a trench as permitted by 6.5.3.2.1, a valve shall be provided where the underground piping enters the trench. [**24**:10.4.3.2.3]

6.5.3.2.4 When piping is installed in a trench, bury depths of 6.5.2.2 shall not apply. [**24:**10.4.3.2.4]

6.5.3.2.4.1 Piping in the trench shall be protected from freezing in accordance with 6.5.2.1.4. [**24:**10.4.3.2.4.1]

Δ 6.6 Grounding and Bonding. [24:10.5]

6.6.1* In no case shall the underground piping be used as a grounding electrode for electrical systems. **[24:1**0.5.1]

6.6.1.1* The requirement of 6.6.1 shall not preclude the bonding of the underground piping to the lightning protection grounding system as required by NFPA 780 in those cases where lightning protection is provided for the structure. **[24:**10.5.1.1]

6.7* Restraint. Private fire service mains shall be restrained against movement at changes in direction in accordance with 6.7.1, 6.7.2, or 6.7.3. [24:10.6]

6.7.1* Thrust Blocks.

6.7.1.1 Thrust blocks shall be permitted where soil is stable and capable of resisting the anticipated thrust forces. **[24:10.6.1.1]**

N 6.7.1.1.1 The anticipated thrust forces shall be based on the test pressure. [**24**:10.6.1.1.1]

6.7.1.2 Thrust blocks shall be concrete of a mix not leaner than one part cement, two and one-half parts sand, and five parts stone. [**24:**10.6.1.2]

6.7.1.3 Thrust blocks shall be placed between undisturbed earth and the fitting to be restrained and shall be capable of resisting the calculated thrust forces. **[24:**10.6.1.3]

6.7.1.4 Wherever possible, thrust blocks shall be located so that the joints are accessible for repair. [**24**:10.6.1.4]

6.7.2* Restrained Joint Systems. Private fire service mains using restrained joint systems shall include one or more of the following:

- (1) Listed locking mechanical or push-on joints
- (2) Listed mechanical joints utilizing setscrew retainer glands
- (3) Listed bell joint restraints
- (4) Bolted flange joints

- (5) Pipe clamps and tie rods in accordance with 6.7.2.1
- (6) Other approved methods or devices
- [**24:**10.6.2]

Δ 6.7.2.1* Sizing Clamps, Rods, Bolts, and Washers. [24:10.6.2.1]

Δ 6.7.2.1.1 Clamps. [24:10.6.2.1.1]

6.7.2.1.1.1 Clamps shall have the following dimensions:

- (1) $\frac{1}{2}$ in. \times 2 in. (13 mm \times 50 mm) for 4 in. (100 mm) to 6 in. (150 mm) pipe
- (2) ⁵/₈ in. × 2¹/₂ in. (16 mm × 65 mm) for 8 in. (200 mm) to 10 in. (250 mm) pipe
- (3) ⁵/₈ in. × 3 in. (16 mm × 75 mm) for 12 in. (300 mm) pipe [**24:**10.6.2.1.1.]

6.7.2.1.1.2 The diameter of a bolt hole shall be $\frac{1}{8}$ in. (3.2 mm) larger than that of the corresponding bolt. [**24:**10.6.2.1.1.2]

Δ 6.7.2.1.2 Rods. [24:10.6.2.1.2]

6.7.2.1.2.1 Rods shall be not less than $\frac{5}{8}$ in. (16 mm) in diameter. [**24**:10.6.2.1.2.1]

6.7.2.1.2.2 Table 6.7.2.1.2.2 provides the numbers of various diameter rods that shall be used for a given pipe size. **[24:**10.6.2.1.2.2]

6.7.2.1.2.3 When using bolting rods, the diameter of mechanical joint bolts shall limit the diameter of rods to $\frac{3}{4}$ in. (20 mm). **[24:**10.6.2.1.2.3]

6.7.2.1.2.4 Threaded sections of rods shall not be formed or bent. [**24:**10.6.2.1.2.4]

6.7.2.1.2.5 Where using clamps, rods shall be used in pairs for each clamp. [**24**:10.6.2.1.2.5]

6.7.2.1.2.6 Assemblies in which a restraint is made by means of two clamps canted on the barrel of the pipe shall be permitted to use one rod per clamp if approved for the specific installation by the AHJ. **[24:**10.6.2.1.2.6]

6.7.2.1.2.7 Where using combinations of rods, the rods shall be symmetrically spaced. [**24:**10.6.2.1.2.7]

Table 6.7.2.1.2.2 Rod Number — Diameter Combinations

Nominal F	Pipe Size	⁵⁄∗ in.	¾ in.	⁷ ∕₅ in.	1 in.
in.	mm	(16 mm)	(20 mm)	(22 mm)	(25 mm)
4	100	2		_	_
6	150	2	_		
8	200	3	2		
10	250	4	3	2	
12	300	6	4	3	2
14	350	8	5	4	3
16	400	10	7	5	4

Note: This table has been derived using pressure of 225 psi (15.5 bar) and design stress of 25,000 psi (172.4 MPa). [24:Table 10.6.2.1.2.2] **6.7.2.1.3 Clamp Bolts.** Clamp bolts shall have the following diameters:

- (1) ⁵/₈ in. (16 mm) for pipe 4 in. (100 mm), 6 in. (150 mm), and 8 in. (200 mm)
- (2) $\frac{3}{4}$ in. (20 mm) for 10 in. (250 mm) pipe

(3) $\frac{7}{8}$ in. (22 mm) for 12 in. (300 mm) pipe

[**24:**10.6.2.1.3]

Δ 6.7.2.1.4 Washers. [24:10.6.2.1.4]

6.7.2.1.4.1 Washers shall be permitted to be cast iron or steel and round or square. [**24:**10.6.2.1.4.1]

6.7.2.1.4.2 Cast-iron washers shall have the following dimensions:

 % in. × 3 in. (16 mm × 75 mm) for 4 in. (100 mm), 6 in. (150 mm), 8 in. (200 mm), and 10 in. (250 mm) pipe

(2) ³/₄ in. × 3¹/₂ in. (20 mm × 90 mm) for 12 in. (300 mm) pipe [**24**:10.6.2.1.4.2]

6.7.2.1.4.3 Steel washers shall have the following dimensions:

- (1) ½ in. × 3 in. (12 mm × 75 mm) for 4 in. (100 mm), 6 in. (150 mm), 8 in. (200 mm), and 10 in. (250 mm) pipe
- (2) $\frac{1}{2}$ in. × $\frac{3}{2}$ in. (12 mm × 90 mm) for 12 in. (300 mm) pipe [**24**:10.6.2.1.4.3]

6.7.2.1.4.4 The diameter of holes shall be $\frac{1}{8}$ in. (3 mm) larger than that of bolts or rods. [**24:**10.6.2.1.4.4]

Δ 6.7.2.2 Sizes of Restraint Straps for Tees. [24:10.6.2.2]

6.7.2.2.1 Restraint straps for tees shall have the following dimensions:

- (1) ⁵/₈ in. (16 mm) thick and ²¹/₂ in. (65 mm) wide for 4 in. (100 mm), 6 in. (150 mm), 8 in. (200 mm), and 10 in. (250 mm) pipe
- (2) ⁵/₈ in. (16 mm) thick and 3 in. (75 mm) wide for 12 in. (300 mm) pipe

[**24:**10.6.2.2.1]

6.7.2.2.2 The diameter of rod holes shall be $\frac{1}{16}$ in. (1.6 mm) larger than that of rods. [**24**:10.6.2.2.2]

6.7.2.2.3 Figure 6.7.2.2.3 and Table 6.7.2.2.3 shall be used in sizing the restraint straps for both mechanical and push-on joint tee fittings. **[24:**10.6.2.2.3]



FIGURE 6.7.2.2.3 Restraint Straps for Tees. [24:Figure 10.6.2.2.3]

Δ 6.7.2.3 Sizes of Plug Strap for Bell End of Pipe. [24:10.6.2.3]

6.7.2.3.1 The strap shall be $\frac{3}{4}$ in. (20 mm) thick and $\frac{2}{2}$ in. (65 mm) wide. [**24:**10.6.2.3.1]

6.7.2.3.2 The strap length shall be the same as dimension *A* for tee straps as shown in Figure 6.7.2.2.3. [**24:**10.6.2.3.2]

6.7.2.3.3 The distance between the centers of rod holes shall be the same as dimension *B* for tee straps as shown in Figure 6.7.2.2.3. **[24:**10.6.2.3.3]

6.7.2.4 Material. Clamps, rods, rod couplings or turnbuckles, bolts, washers, restraint straps, and plug straps shall be of a material that has physical and chemical characteristics that indicate its deterioration under stress can be predicted with reliability. **[24:10.6.2.4]**

6.7.2.5 Corrosion Resistance. After installation, rods, nuts, bolts, washers, clamps, and other restraining devices shall be cleaned and thoroughly coated with a corrosion-retarding material. **[24:**10.6.2.5]

6.7.2.5.1 The requirements of 6.7.2.5 shall not apply to stainless steel or epoxy-coated fittings, valves, glands, or other accessories. **[24:**10.6.2.5.1]

6.7.3* Private fire service mains utilizing one or more of the following connection methods shall not require additional restraint, provided that such joints can pass the hydrostatic test of 6.11.2.2 without shifting of piping.

- (1) Threaded connections
- (2) Grooved connections
- (3) Welded connections
- (4) Heat-fused connections
- (5) Chemical or solvent cemented connections

[**24:**10.6.3]

A Table 6.7.2.2.3 Restraint Straps for Tees

Nomir Si	nal Pipe ize	А		В		C	4	D)
in.	mm	in.	mm	in.	mm	in.	mm	in.	mm
4	100	$12\frac{1}{2}$	315	$10\frac{1}{8}$	255	$2\frac{1}{2}$	65	$1\frac{3}{4}$	45
6	150	$14\frac{1}{2}$	365	$12\frac{1}{8}$	305	3^{9}_{16}	90	$2^{13}/_{16}$	70
8	200	$16\frac{3}{4}$	420	$14\frac{3}{8}$	360	$4^{21}/_{32}$	115	3^{29}_{32}	100
10	250	$19\frac{1}{16}$	475	$16^{11}/_{16}$	415	$5\frac{3}{4}$	145	5	125
12	300	$22^{5}/_{16}$	560	$19^{3}/_{16}$	480	$6\frac{3}{4}$	170	$5\frac{1}{8}$	145

[24:Table 10.6.2.2.3]

Δ 6.8 Steep Grades. [24:10.7]

6.8.1 On steep grades, mains shall be additionally restrained to prevent slipping. **[24:10.7.1]**

6.8.1.1 Pipe shall be restrained at the bottom of a hill and at any turns (lateral or vertical). [**24**:10.7.1.1]

6.8.1.1.1 The restraint specified in 6.8.1.1 shall be to natural rock or to piles or piers built on the downhill side of the bell. **[24:**10.7.1.1.1]

6.8.1.2 Bell ends shall be installed facing uphill. [24:10.7.1.2]

6.8.1.3 Straight runs on hills shall be restrained as determined by a design professional. [**24**:10.7.1.3]

Δ 6.9 Installation Requirements. [24:10.8]

6.9.1 Piping, valves, hydrants, gaskets, and fittings shall be inspected for damage when received and shall be inspected prior to installation. **[24:1**0.8.1]

6.9.2 The tightness of bolted joints shall be verified by the bolt torque or by the method described in the listing information or manufacturer's installation instructions. **[24:10.8.2]**

6.9.3 Pipe, valves, hydrants, and fittings shall be clean and free from internal debris. **[24:1**0.8.3]

6.9.4 When work is stopped, the open ends of piping, valves, hydrants, and fittings shall be plugged or covered to prevent foreign materials from entering. [**24:**10.8.4]

6.9.5 All piping, fittings, valves, and hydrants shall be examined for cracks or other defects while suspended above the trench and lowered into the trench using equipment designed for such use. [**24**:10.8.5]

6.9.6 Plain ends shall be inspected for signs of damage prior to installation. [**24**:10.8.6]

6.9.7 Piping, fittings, valves, hydrants, and appurtenances shall not be dropped, dumped or rolled or skidded against other materials. **[24:**10.8.7]

6.9.8 Pipes shall be supported in the trench throughout their full length and shall not be supported by the bell ends only or by blocks. **[24:1**0.8.8]

6.9.9 If the ground is soft, other means shall be provided to support the pipe. [**24**:10.8.9]

6.9.10 Valves and fittings used with nonmetallic pipe shall be supported and restrained in accordance with the manufacturer's installation instructions. **[24:1**0.8.10]

Δ 6.10 Backfilling. [24:10.9]

6.10.1 Backfill material shall be tamped in layers or in puddles under and around pipes to prevent settlement or lateral movement and shall contain no ashes, cinders, refuse, organic matter, or other corrosive materials. **[24:**10.9.1]

6.10.2 Backfill material shall not contain ash, cinders, refuse, organic matter or other corrosive materials. **[24:**10.9.2]

6.10.3* In the absence of specific guidelines or specifications, the maximum allowable particle size for backfill within 1 ft (300 mm) of the pipe shall not be larger than $1\frac{1}{2}$ in. (40 mm). [**24:**10.9.3]

6.10.3.1 Nominal pipe sizes of 4 in. (100 mm) or smaller shall not exceed $\frac{1}{2}$ in. (13 mm) maximum particle size. [**24:**10.9.3.1]

6.10.3.2 Nominal pipe sizes of 6 in. to 12 in. (150 mm to 300 mm) shall not exceed $\frac{3}{4}$ in. (19 mm) maximum particle size. [24:10.9.3.2]

6.10.4 Frozen earth shall not be used as backfill material. [**24**:10.9.4]

6.10.5 In trenches cut through rock, tamped backfill shall be used for at least 6 in. (150 mm) under and around the pipe and for at least 2 ft (600 mm) above the pipe. [**24:**10.9.5]

6.10.6 Where using piping listed for private fire service mains, the manufacturer's installation instructions for backfill shall be followed. **[24:**10.9.6]

Δ 6.11 Testing and Acceptance. [24:10.10]

Δ 6.11.1 Approval of Underground Piping. [24:10.10.1]

6.11.1.1 The installing contractor shall be responsible for the following:

- (1) Notifying the AHJ and the owner's representative of the time and date testing is to be performed
- (2) Performing all required acceptance tests
- (3) Completing and signing a contractor's material and test certificate(s) shown in Figure 6.11.1.1

[**24:**10.10.1.1]

6.11.1.2 Alternate forms or electronic records providing at minimum the required information found in Figure 6.11.1.1 shall be permitted. [**24**:10.10.1.2]

Δ 6.11.2 Acceptance Requirements. [24:10.10.2]

Δ 6.11.2.1* Flushing of Piping. [24:10.10.2.1]

6.11.2.1.1 Underground piping, from the water supply to the system riser, and lead-in connections to the system riser, including all hydrants, shall be completely flushed before connection is made to downstream fire protection system piping. **[24:**10.10.2.1.1]

6.11.2.1.2 The flushing operation shall continue until water flow is verified to be clear of debris. [**24:**10.10.2.1.2]

6.11.2.1.3* The minimum rate of flow shall be in accordance with Table 6.11.2.1.3. [**24**:10.10.2.1.3]

6.11.2.1.3.1 Where the flow rates established in Table 6.11.2.1.3 are not attainable, the maximum allowable flow rate at the minimum allowable residual pressure to the system shall be acceptable. **[24:**10.10.2.1.3.1]

Contracto	r's Material and Test Certificate for Underground	d Piping						
PROCEDURE Upon completion or representative. All	of work, inspection and tests shall be made by the contractor's representative and witnes defects shall be corrected and system left in service before contractor's personnel finall	ssed by an owner's y leave the job.						
A certificate shall b contractor. It is une workmanship or fa	be filled out and signed by both representatives. Copies shall be prepared for approving derstood the owner's representative's signature in no way prejudices any claim against villure to comply with approving authority's requirements or local ordinances.	authorities, owners, and contractor for faulty material, poor						
Property name		Date						
Property address								
	Accented by approving authorities (names)							
Plans								
	Installation conforms to accepted plans							
	If no, state deviations	Yes No						
	Has person in charge of fire equipment been instructed as to location of							
	control valves and care and maintenance of this new equipment?							
Instructions	Have copies of appropriate instructions and care and maintenance charts been provided to the owner or owner's representative? If no, explain	Yes 🗋 No						
Location	Supplies buildings	\checkmark						
	Pipe types and class Type joint							
Underground pipes and joints	Pipe conforms to standard Fittings conform to standard If no, explain	Yes No Yes No						
	Joints needing anchorage clamped, strapped, or blocked in accordance with standard	🛄 Yes 🛄 No						
Test description	Image: Flow the required rate until water is verified to be clear of debris at outlets such as hydrants and blow-offs. Flush at one of the flow rates as specified in 6.11.2.1.3.Hydrostatic:All piping and attached appurtenances subjected to system working pressure shall be hydrostatically tested at 200 psi (13.8 bar) or 50 psi (3.4 bar) in excess of the system working pressure, whichever is greater, and shall maintain that pressure ±5 psi (0.34 bar) for 2 hours.Hydrostatic Testing Allowance:Where additional water is added to the system to maintain the test pressures required by 6.11.2.2.1, the amount of water shall be measured and shall not exceed the limits of the following equation (for metric equation, see 6.11.2.2.6): $L = \underbrace{SDVP}{148,000}$ $L =$ testing allowance (makeup water), in gallons per hour (lpm) $D =$ nominal diameter of the pipe, in inches (mm)							
	New underground piping flushed according to	🔲 Yes 🛄 No						
	If no, explain							
Flushing	How flushing flow was obtained Through what t	ype opening utt						
tests	Lead-ins flushed according to standard by (company) If no, explain	Yes No						
	How flushing flow was obtained Through what Public water Tank or reservoir Fire pump Y connecting and spigot	type opening on to flange Dpen pipe						
		NFPA 13 (p. 1 of 2)						

△ FIGURE 6.11.1.1 Sample of Contractor's Material and Test Certificate for Underground Piping. [24:Figure 10.10.1.1]

		drostatically tested at		olu	ints covered	
Hydrostatic test	nsi (bar)	for	hours			
	Total amount of lookage mage					
	iotal amount of leakage meas	urea				
Leakage	gallons	(liters)	hours			
test	Allowable leakage					
	gallons	(liters)	hours			
Forward flow test of backflow preventer	Forward flow test performed in	accordance with 6.11.	2.5.2:		Yes	🗋 No
Hydrants	Number installed	Type and make	All	operate sa	atisfactorily	🔲 No
Control	Water control valves left wide of If no, state reason	open		20	Yes	No No
valves	Hose threads of fire departmer those of fire department answe	nt connections and hydr ring alarm	rants interchangeable with		🗋 Yes	🔲 No
	Date left in service					
Remarks						
			6			
	Name of installing contractor					
		Test	s witnessed by			
Signaturos	For property owner (signed)		Title		Date	
Signatures						
	For installing contractor (signe	d)	Title		Date	
Additional explana	tion and notes		1		1	
					NFPA 1	3 (p. 2 of 2)

△ FIGURE 6.11.1.1 Continued

Nominal Pipe Size (in.)	Flow Rate (gpm)	Nominal Pipe Size (mm)	Flow Rate (L/min)
2	100	50	380
$2\frac{1}{2}$	150	65	570
3	220	75	833
4	390	100	1,500
5	610	125	2,300
6	880	150	3,350
8	1,560	200	5,900
10	2.440	250	9.250

300

13.300

Table 6.11.2.1.3 Flow Required to Produce Velocity of 10 ft/sec (3.0 m/sec) in Pipes

[**24:**Table 10.10.2.1.3]

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 Δ 6.11.2.1.3.2 When connected to a fire pump, piping shall be flushed at a flow rate not less than indicated in Table 6.11.2.1.3.2 or at the hydraulically calculated water demand rate of the system, whichever is greater. [24:10.10.2.1.3.2]

3.520

- **N** (A) Flushing shall occur prior to hydrostatic test. [20:14.1.1.2]
- **N** (B) Where the maximum flow available from the water supply cannot provide the flow rate provided in Table 6.11.2.1.3.2, the flushing flow rate shall be equal to or greater than 150 percent of rated flow of the connected fire pump. [20:14.1.1.3]
- **N**(C) Where the maximum flow available from the water supply cannot provide a flow of 150 percent of the rated flow of the pump, the flushing flow rate shall be the greater of 100 percent of rated flow of the connected fire pump or the maximum flow demand of the fire protection system. [**20**:14.1.1.3.1]
- N (D) A reduced flushing flow capacity in accordance with 6.11.2.1.3.2(C) shall constitute an acceptable test, provided that the flow rate is as much as can be safely achieved and it exceeds the fire protection system design flow rate. [20: 14.1.1.3.2]

N Table 6.11.2.1.3.2 Minimum Flow Rates for Flushing Suction Piping

Nominal Pipe Size (in.)	Flow rate (gpm)	Nominal Pipe Size (mm)	Flow Rate (L/min)
1	37	25	140
$1\frac{1}{2}$	85	38	330
2	150	50	570
$2^{1/2}$	229	65	870
3	330	75	1,250
$3\frac{1}{2}$	450	85	1,710
4	590	100	2,240
5	920	125	3,490
6	1,360	150	5,150
8	2,350	200	8,900
10	3,670	250	13,900
12	5,290	300	20,100
14	7,200	350	27,300
16	9,400	400	35,600

[20:Table 14.1.1.1]

6.11.2.1.4* In lieu of flushing with the waterflow rates prescribed in 6.11.2.1.3 and 6.11.2.1.3.1, water main cleaning of the piping by the forceful introduction of swabs through the pipe shall be permitted. **[24:1**0.10.2.1.4]

6.11.2.1.4.1 Water main swabbing shall be repeated, as necessary, until the last swab that has fully penetrated the pipe is clean and the discharge water is clear. [**24**:10.10.2.1.4.1]

6.11.2.1.5 Provision shall be made for the disposal of water used for flushing or testing to minimize any water damage caused by the discharge. [**24**:10.10.2.1.5]

Δ 6.11.2.2 Hydrostatic Test. [24:10.10.2.2]

6.11.2.2.1* All piping and attached appurtenances subjected to system working pressure shall be hydrostatically tested at gauge pressure of 200 psi (14 bar) or 50 psi (3.4 bar) in excess of the system working pressure, whichever is greater, and shall maintain that pressure at gauge pressure of ± 5 psi (0.3 bar) for 2 hours. [**24**:10.10.2.2.1]

6.11.2.2.2 Successful test results shall be determined by indication of either a pressure loss less than gauge pressure of 5 psi (0.3 bar) or by no visual leakage. [**24**:10.10.2.2.2]

6.11.2.2.3 The test pressure shall be read from one of the following, located at the lowest elevation of the system or the portion of the system being tested:

- (1) A gauge located at one of the hydrant outlets
- (2) A gauge located at the lowest point where no hydrants are provided

[**24:**10.10.2.2.3]

6.11.2.2.4* The trench shall be backfilled between joints before testing to prevent movement of pipe. [**24**:10.10.2.2.4]

6.11.2.2.5 Where required for safety measures presented by the hazards of open trenches, the pipe and joints shall be permitted to be backfilled, provided the installing contractor takes the responsibility for locating and correcting leakage. **[24:**10.10.2.2.5]

6.11.2.2.6* Hydrostatic Testing Allowance. Where additional water is added to the system to maintain the test pressures required by 6.11.2.2.1, the amount of water shall be measured and shall not exceed the limits of Table 6.11.2.2.6, which are based upon the following equations:

US Customary Units:

[6.11.2.2.6a]

$$L = \frac{SD\sqrt{P}}{148,000}$$

where:

L = testing allowance (makeup water) [gph (gal/hr)]

S = length of pipe tested (ft)

D = nominal diameter of pipe (in.)

P = average test pressure during hydrostatic test (gauge psi)

Metric Units:

[6.11.2.2.6b]

$$L = \frac{SD\sqrt{P}}{794.797}$$

where:

L = testing allowance (makeup water) (L/hr)

S =length of pipe tested (m)

D = nominal diameter of pipe (mm)

P = average test pressure during hydrostatic test (kPa) [**24:**10.10.2.2.6]

6.11.2.3* Other Means of Hydrostatic Tests. Where acceptable to the AHJ, hydrostatic tests shall be permitted to be completed in accordance with the guidelines provided in AWWA C600, *Installation of Ductile Iron Water Mains and Their Appurtenances*, AWWA M9, *Concrete Pressure Pipe*, AWWA M23, *PVC Pipe — Design and Installation*, or AWWA M55, *PE Pipe — Design and Installation*, as long as the test pressure and test duration requirements of 6.11.2.2.1 are still employed. [**24:**10.10.2.3]

6.11.2.3.1* For existing system modifications or repairs that cannot be isolated, hydrostatic testing shall be limited to visual evidence of leakage at system working pressure. **[24:10.10.2.3.1]**

Δ 6.11.2.4 Operating Test. [24:10.10.2.4]

6.11.2.4.1 Each hydrant shall be fully opened and closed under system water pressure. [**24**:10.10.2.4.1]

6.11.2.4.2 Dry barrel hydrants shall be checked for drainage. [**24**:10.10.2.4.2]

6.11.2.4.3 All control valves shall be fully closed and opened under system water pressure to ensure operation. [**24:**10.10.2.4.3]

Δ Table 6.11.2.2.6	Hydrostatic Testing Allowance at 200 psi (14	4
bar)		

Nominal Pi	pe Diameter	Testing Allowance			
in. mm		gal/hr/100 ft	L/hr/100 m		
2	50	0.019	0.236		
4	100	0.03	0.472		
6	150	0.057	0.708		
8	200	0.076	0.944		
10	250	0.096	1.19		
12	300	0.115	1.43		
14	350	0.134	1.66		
16	400	0.153	1.90		
18	450	0.172	2.14		
20	500	0.191	2.37		
24	600	0.229	2.84		

Notes:

(1) For other length, diameters, and pressures, utilize Equation 6.11.2.2.6a or 6.11.2.2.6b to determine the appropriate testing allowance.

(2) For test sections that contain various sizes and sections of pipe, the testing allowance is the sum of the testing allowances for each size and section.

[24:Table 10.10.2.2.6]

6.11.2.4.4 Where fire pumps supply the private fire service main, the operating tests required by 6.11.2.4 shall be completed with the pumps running. [**24**:10.10.2.4.4]

Δ 6.11.2.5 Backflow Prevention Assemblies. [24:10.10.2.5]

6.11.2.5.1 The backflow prevention assembly shall be forward flow tested. [**24**:10.10.2.5.1]

6.11.2.5.2 The minimum flow rate tested in 6.11.2.5.1 shall be the system demand, including hose stream demand where applicable. [**24**:10.10.2.5.2]

Chapter 7 Requirements for System Components and Hardware

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

7.1.1* Listing.

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

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

7.1.1.2 Unless the requirements of 7.1.1.3, 7.1.1.4, or 7.1.1.5 are met, all materials and devices essential to successful system operation shall be listed.

7.1.1.2.1 Valve components (including valve trim, internal parts, gaskets, and the like) shall not be required to be individually listed.

7.1.1.3 Equipment as permitted in Table 7.3.1.1 and Table 7.4.1 shall not be required to be listed.

7.1.1.3.1 Nonmetallic pipe and fittings included in Table 7.3.1.1 and Table 7.4.1 shall be listed.

7.1.1.4 Materials meeting the requirements of 17.1.2, 17.1.6.2, 17.1.6.3, and 17.1.7.3 shall not be required to be listed.

7.1.1.5* Components that do not affect system performance shall not be required to be listed.

7.1.2 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 bar) for components installed above ground and 150 psi (10 bar) for components installed underground.

7.2 Sprinklers.

7.2.1* 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, deflector characteristic, pressure rating, and thermal sensitivity.

7.2.2 Sprinkler Discharge Characteristics.

7.2.2.1* General. Unless the requirements of 7.2.2.2, 7.2.2.3, or 7.2.2.4 are met, the K-factor, relative discharge, and marking identification for sprinklers having different K-factors shall be in accordance with Table 7.2.2.1.

7.2.2.2 Pipe Threads. Listed sprinklers having pipe threads different from those shown in Table 7.2.2.1 shall be permitted.

7.2.2.3 K-Factors Greater than K-28.0 (400). Sprinklers listed with nominal K-factors greater than K-28.0 (400) shall increase the flow by 100 percent increments when compared with a nominal K-5.6 (80) sprinkler.

7.2.2.4 Residential Sprinklers. Residential sprinklers shall be permitted with K-factors other than those specified in Table 7.2.2.1.

7.2.2.5 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).

7.2.2.6 ESFR K-Factor. ESFR sprinkler K-factor shall be selected as appropriate for the hazard. (*See Chapter 20.*)

7.2.3 Occupancy Limitations. Unless the requirements of 7.2.3.1 or 7.2.3.2 are met, sprinklers shall not be listed for protection of a portion of an occupancy classification.

				Percent of	
Nominal K-Factor	Nominal K-Factor	K-Factor Range	K-Factor Range	Nominal K-5.6	
$[\mathbf{gpm}/(\mathbf{psi})^{1/2}]$	$[L/min/(bar)^{1/2}]$	$[\mathbf{gpm}/(\mathbf{psi})^{1/2}]$	$[L/min/(bar)^{1/2}]$	Discharge	Thread Type
1.4	20	1.3-1.5	19-22	25	¹ / ₂ in. (15 mm) NPT
1.9	27	1.8 - 2.0	26-29	33.3	½ in. (15 mm) NPT
2.8	40	2.6-2.9	38-42	50	½ in. (15 mm) NPT
4.2	60	4.0-4.4	57-63	75	¹ / ₂ in. (15 mm) NPT
5.6	80	5.3 - 5.8	76-84	100	¹ / ₂ in. (15 mm) NPT
8.0	115	7.4-8.2	107-118	140	³ / ₄ in. (20 mm) NPT or
					$\frac{1}{2}$ in. (15 mm) NPT
11.2	160	10.7 - 11.7	159-166	200	$\frac{1}{2}$ in. (15 mm) NPT or
					³ / ₄ in. (20 mm) NPT
14.0	200	13.5-14.5	195-209	250	³ / ₄ in. (20 mm) NPT
16.8	240	16.0 - 17.6	231-254	300	³ / ₄ in. (20 mm) NPT
19.6	280	18.6-20.6	272-301	350	1 in. (25 mm) NPT
22.4	320	21.3-23.5	311-343	400	1 in. (25 mm) NPT
25.2	360	23.9-26.5	349-387	450	1 in. (25 mm) NPT
28.0	400	26.6-29.4	389-430	500	1 in. (25 mm) NPT
33.6	480	31.9-35.3	456-504	600	1¼ in. (32 mm) NPT

Table 7.2.2.1 Sprinkler Discharge Characteristics Identification

Note: The nominal K-factor for dry-type sprinklers are used for sprinkler selection. See 28.2.4.10.3 for use of adjusted dry-type sprinkler K-factors for hydraulic calculation purposes.

7.2.3.1 Residential Sprinklers. Residential sprinklers shall be permitted to be listed for portions of residential occupancies as defined in 12.1.1.

7.2.3.2 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 Section 15.2.*)

7.2.4* Temperature Characteristics.

7.2.4.1* Automatic sprinklers shall have their frame arms, deflector, coating material, or liquid bulb colored in accordance with the requirements of Table 7.2.4.1(a) and Table 7.2.4.1(b) or the requirements of 7.2.4.2, 7.2.4.3, 7.2.4.4, or 7.2.4.5.

7.2.4.2 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.

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

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

7.2.4.5 The liquid in bulb-type sprinklers shall be color coded in accordance with Table 7.2.4.1 (a).

7.2.5 Special Coatings.

7.2.5.1* Corrosion Resistant.

- **N** 7.2.5.1.1 Listed corrosion-resistant sprinklers shall be installed in locations where chemicals, moisture, or other corrosive vapors sufficient to cause corrosion of such devices exist.
- **N** 7.2.5.1.2* Unless the requirements of 7.2.5.1.3 are met, corrosion-resistant coatings shall be applied only by the manufacturer of the sprinkler and in accordance with the requirements of 7.2.5.1.3.
- **N 7.2.5.1.3** 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.

7.2.5.2* Painting. Sprinklers shall only be painted by the sprinkler manufacturer.

7.2.5.3 Ornamental Finishes.

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

7.2.5.3.2 Sprinklers with ornamental finishes shall be specifically listed.

1000000000000000000000000000000000000	Table 7.2.4.1(a)	Temperature Ratings.	Classifications.	and Color C	odings for	Glass Bulbs
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Maximum Ceiling Temperature °F °C		Temperat	ure Rating	2	
		°F °C		_ Temperature Classification	Glass Bulb Colors
100	38	135	57	Ordinary	Orange
120	49	155	68	Ordinary	Red
150	66	175	79	Intermediate	Yellow
150	66	200	93	Intermediate	Green
225	107	250-300	121-149	High	Blue
300	149	325-375	163-191	Extra high	Purple
375	191	400-475	204-246	Very extra high	Black
475	246	500-575	260-302	Ultra high	Black
625	329	650	343	Ultra high	Black

Table 7.2.4.1(b) Temperature Ratings, Classifications, and Color Codings for Fusible Links

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

- △ 7.2.6.1 Plates, escutcheons, or other devices used to cover the annular space around a sprinkler shall be metallic or listed for use around a sprinkler.
- Δ 7.2.6.2* Escutcheons used with recessed or flush-type sprinklers shall be part of a listed sprinkler assembly.

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

7.3 Aboveground Pipe and Tube.

7.3.1 General.

7.3.1.1 Pipe or tube shall meet or exceed one of the standards in Table 7.3.1.1 or be in accordance with 7.3.3.

7.3.2* Nonmetallic Pipe and Tubing.

7.3.2.1 Nonmetallic pipe in accordance with Table 7.3.1.1 shall be investigated for suitability in automatic sprinkler installations and listed for this service.

7.3.2.1.1 Other types of nonmetallic pipe or tube investigated for suitability in automatic sprinkler installations and listed for this service, including but not limited to CPVC, and differing from that provided in Table 7.3.1.1 shall be permitted where installed in accordance with their listing limitations.

7.3.2.1.2 Manufacturer's installation instructions shall include its listing limitations.

7.3.2.2 Nonmetallic pipe shall not be listed for portions of an occupancy classification.

7.3.3* Listed Metallic Pipe and Tubing.

7.3.3.1 Other types of pipe or tube investigated for suitability in automatic sprinkler installations and listed for this service, including steel, and differing from that provided in Table 7.3.1.1 shall be permitted where installed in accordance with their listing limitations, including installation instructions.

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

7.3.4 Pipe and Tube Identification.

7.3.4.1* All pipe shall be marked along its length by the manufacturer in such a way as to properly identify the type of pipe.

7.3.4.2 The marking shall be visible on every piece of pipe over 2 ft (600 mm) long.

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

7.4 Fittings.

7.4.1 Fittings used in sprinkler systems shall meet or exceed the standards in Table 7.4.1 or be in accordance with 7.4.2 or 7.4.4.

7.4.2 In addition to the standards in Table 7.4.1, nonmetallic fittings shall also be in accordance with 7.4.4.

7.4.3 Nonmetallic Fittings. Nonmetallic fittings in accordance with Table 7.4.1 shall be investigated for suitability in automatic sprinkler installations and listed for this service. Listed nonme-

Table 7.3.1.1 Pipe or Tube Materials and Dimensions

Materials and Dimensions	Standard
Ferrous Piping (Welded and Seamless)	
Standard Specification for Black and Hot-Dipped Zinc-Coated (Galvanized) Welded and Seamless Steel Pipe for Fire Protection Use	ASTM A795/A795M
Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless	ASTM A53/A53M
Welded and Seamless Wrought Steel Pipe Standard Specification for Electric- Resistance-Welded Steel Pipe	ASME B36.10M ASTM A135/A135M
Copper Tube (Drawn, Seamless)	
Standard Specification for Seamless Copper Tube	ASTM B75/B75M
Standard Specification for Seamless Copper Water Tube	ASTM B88
Standard Specification for General Requirements for Wrought Seamless Copper and Copper-Alloy Tube	ASTM B251
Standard Specification for Liquid and Paste Fluxes for Soldering of Copper and Copper Alloy Tube	ASTM B813
Specification for Filler Metals for Brazing and Braze Welding (Classification BCuP-3 or BCuP-4)	AWS A5.8M/A5.8
Standard Specification for Solder Metal, Section 1: Solder Alloys Containing Less Than 0.2% Lead and Having Solidus Temperatures Greater than 400°F	ASTM B32
Alloy Materials	ASTM B446
CPVC	
Standard Specification for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe (SDR-PR)	ASTM F442/F442M
Brass Pipe	
Standard Specification for Seamless Red Brass Pipe, Standard Sizes	ASTM B43
Stainless Steel	
Standard Specification for Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipes	ASTM A312/A312M

tallic fittings shall be installed in accordance with their listing limitations, including installation instructions.

7.4.4* Other types of fittings 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 7.4.1 shall be permitted when installed in accordance with their listing limitations, including installation instructions.

Materials and Dimensions	Standard
Cast Iron	
Gray Iron Threaded Fittings, Classes 125 and 250	ASME B16.4
Gray Iron Pipe Flanges and Flanged Fittings, Classes 25, 125, and 250	ASME B16.1
Malleable Iron	
Malleable Iron Threaded Fittings, Classes 150 and 300	ASME B16.3
Steel	
Factory-Made Wrought Buttwelding Fittings	ASME B16.9
Buttwelding Ends	ASME B16.25
Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service	ASTM A234/A234M
Pipe Flanges and Flanged Fittings, NPS ½ through NPS 24 Metric/ Inch Standard	ASME B16.5
Forged Fittings, Socket-Welding and Threaded	ASME B16.11
Copper	
Wrought Copper and Copper Alloy Solder Joint Pressure Fittings	ASME B16.22
Cast Copper Alloy Solder Joint Pressure Fittings	ASME B16.18
CPVC	
Standard Specification for Threaded Chlorinated Poly(Vinyl Chloride)	ASTM F437
(CPVC) Plastic Pipe Fittings,	
Schedule 80 Standard Spacification for Sochet	ASTM E429
Type Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe	A31M17436
Fittings, Schedule 40 Standard Specification for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80	ASTM F439
Bronze Fittings	
Cast Copper Alloy Threaded Fittings, Classes 125 and 250	ASME B16.15
Stainless Steel	
Standard Specification for Wrought Austenitic Stainless Steel Piping Fittings	ASTM A403/A403M

Δ Table 7.4.1 Fittings Materials and Dimensions

N 7.4.5 Flexible Sprinkler Hose Fittings. Listed flexible sprinkler hose fittings and their anchoring components intended for use in installations connecting the sprinkler system piping to a sprinkler shall be installed in accordance with their listing and manufacturer's instructions.

7.5 Joining of Pipe and Fittings.

7.5.1 Threaded Pipe and Fittings.

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

7.5.1.2* 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.

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

7.5.2 Welded Pipe and Fittings.

7.5.2.1 General.

7.5.2.1.1 Welding shall be permitted as a means of joining sprinkler piping in accordance with 7.5.2.2 through 7.5.2.6.

7.5.2.2* Fabrication.

7.5.2.2.1 When welding sprinkler pipe, the pipe shall be shop welded unless the requirements of 7.5.2.2 or 7.5.2.3 are met.

7.5.2.2.1.1 Repair of weld leaks on site shall be permitted provided the repairs are performed in accordance with 7.5.2.2.2 and 7.5.2.5.

7.5.2.2.2 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 performed in accordance with NFPA 51B and the fittings required by Section 16.6 are provided.

7.5.2.2.3 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.

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

7.5.2.3 Fittings.

7.5.2.3.1* Welded fittings used to join pipe shall be listed fabricated fittings or manufactured in accordance with Table 7.4.1.

7.5.2.3.2 Fittings referenced in 7.5.2.3.1 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.

7.5.2.3.3 Fittings shall not be required where pipe ends are buttwelded in accordance with the requirements of 7.5.2.4.3.

7.5.2.3.4 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 7.5.2.3.1.

7.5.2.4 Welding Requirements.

7.5.2.4.1* Welds between pipe and welding outlet fittings shall be permitted to be attached by full penetration welds, partial penetration groove welds, or fillet welds.

7.5.2.4.2* Where fillet welded joints are used, 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. (5 mm), whichever is least.

7.5.2.4.3* Circumferential butt joints shall be cut, beveled, and fit so that full penetration is achievable.

7.5.2.4.4 Full penetration welding shall not be required.

7.5.2.4.5 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.

7.5.2.4.6 Face welds on the internal face of the flange shall be permitted as a water seal in addition to the hub weld required in 7.5.2.4.5.

7.5.2.4.7 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.

7.5.2.4.8* When welding is performed, the following shall apply:

- (1) Holes in piping for outlets shall not be less than the full inside diameter of fittings prior to welding in place of the fittings.
- (2) Coupons 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 7.5.2.2.3 and 7.5.2.4.7.
- (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 ³/₃₂ in. (2 mm).
- (10) After completion of the weld for fittings directly connected to a sprinkler, the inside diameter of the entrance from the pipe into the weld shall not be less than the inside diameter of the fitting.

7.5.2.5 Qualifications.

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

7.5.2.5.2 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/B2.1M, *Specification for Welding Procedure and Performance Qualification*; ASME *Boiler and Pressure Vessel Code*, Section IX, "Welding, Brazing, and Fusing Qualifications"; or other applicable qualification standard as required by the authority having jurisdiction, except as permitted by 7.5.2.5.3.

7.5.2.5.3 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.

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

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

7.5.2.5.6 Each contractor or fabricator shall have available to the authority having jurisdiction an established written quality assurance procedure ensuring compliance with the requirements of 7.5.2.4.

7.5.2.6 Records.

7.5.2.6.1 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.

7.5.2.6.2 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.

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

7.5.3 Groove Joining Methods.

7.5.3.1* Pipe, fittings, valves, and devices to be joined with grooved couplings shall contain cut, rolled, or cast grooves that are dimensionally compatible with the couplings.

7.5.3.1.1* Pipe, fittings, valves, devices, and couplings that conform with or are listed in compliance with standardized groove specifications shall be considered compatible.

7.5.3.1.2 Other groove dimensions and grooving methods shall be acceptable in accordance with 7.5.5.1.

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

7.5.4* Brazed and Soldered Joints.

7.5.4.1 Solder joints, where permitted, shall be fabricated in accordance with the methods and procedures listed in ASTM B828, *Standard Practice for Making Capillary Joints by Soldering of Copper and Copper Alloy Tube and Fittings.*

7.5.4.2 Unless the requirements of 7.5.4.3 or 7.5.4.4 are met, joints for the connection of copper tube shall be brazed.

7.5.4.3 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.

7.5.4.4 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.

7.5.4.5* Soldering fluxes shall be in accordance with Table 7.3.1.1.

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

7.5.5 Other Joining Methods.

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

7.5.5.2 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 coupons retrieved
- (3) Have smooth bores cut into the pipe, with all cutting residue removed
- (4) Not be modified

7.5.6 End Treatment.

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

7.5.6.2 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.

7.6 Valves.

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

7.6.2 Automated Valves. A listed indicating control valve with automated controls shall be permitted.

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

7.6.2.2 An automated water control valve shall be able to be operated manually as well as automatically.

N 7.6.3* Automatic Breach Control Valves. Automatic breach control valves shall not be installed on any sprinkler system.

7.7 Waterflow Alarm Devices.

7.7.1* Mechanical 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 K-factor 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.

7.7.2* Electrical 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 K-factor installed on the system will result in an audible alarm on the premises within 100 seconds after such flow begins and until such flow stops.

7.8 Additives and Coatings.

7.8.1 Additives to the water supply intended for control of microbiological or other corrosion shall be listed for use within fire sprinkler systems.

7.8.2 Internal pipe coatings, excluding galvanizing, intended for control of microbiological or other corrosion shall be listed for use within fire sprinkler systems.

N 7.8.3* Additives to the air supply for control of corrosion shall be listed for use within fire sprinkler systems.

7.9 Automated Inspection and Testing Devices and Equipment.

7.9.1 Automated inspection devices and equipment shall be shown to be as effective as a manual examination.

7.9.2 Automated testing devices and equipment shall produce the same action required by this standard and NFPA 25 to test a device.

7.9.2.1 The installation of testing device or component shall be arranged to discharge water where required by this standard and NFPA 25.

7.9.3 Failure of automated inspection and testing devices and equipment shall not impair the operation of the system unless indicated by an audible and visual supervisory signal in accordance with *NFPA* 72 or other approved fire alarm code.

7.9.4 Failure of a system or component to pass automated inspection and testing devices and equipment shall result in an audible and visual supervisory signal in accordance with *NFPA* 72 or other approved fire alarm code.

7.9.5 Failure of automated inspection and testing devices and equipment shall result in an audible and visual trouble signal in accordance with *NFPA* 72 or other approved fire alarm code.

N 7.10 Air Supplies. Where an air compressor is dedicated for the sprinkler system, the air compressor shall be listed for fire protection.

Chapter 8 System Types and Requirements

8.1 Wet Pipe Systems.

8.1.1 Pressure Gauges.

8.1.1.1 An approved pressure gauge conforming to Section 16.13 shall be installed in each system riser.

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

8.1.1.2.1 A single pressure gauge shall be permitted to be installed on a manifold below multiple riser check valves or alarm check valves.

8.1.1.2.2 Pressure gauges below check valves required by 16.9.10 and 16.15.2.2(1) shall not be required.

8.1.2 Relief Valves.

8.1.2.1* Unless the requirements of 8.1.2.2 are met, a wet pipe system shall be provided with a listed relief valve not less than $\frac{1}{2}$ in. (15 mm) in size and set to operate at 175 psi (12 bar) or 10 psi (0.7 bar) in excess of the maximum system pressure, whichever is greater.

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

8.1.2.3 A relief valve per 8.1.2.1 shall be required downstream of check valves required by 16.15.2.2(1).

8.1.3 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.

8.1.4 Heat tracing shall not be used in lieu of heated valve enclosures to protect the valve and supply pipe from freezing.

8.1.5 Air Venting. A single air vent with a connection conforming to Section 16.7 shall be provided on each wet pipe system utilizing metallic pipe. (*See A.16.7.*)

8.1.5.1 Venting from multiple points on each system shall not be required.

N 8.2* Dry Systems.

N 8.2.1 Gridded Dry Pipe Systems. Gridded dry pipe systems shall not be installed.

N 8.2.2 Components.

N 8.2.2.1 Sprinklers.

N 8.2.2.1.1 The following orientations 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 above freezing
- (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 above freezing, the water supply is potable, and

the piping for the dry system is copper or CPVC specifically listed for dry pipe applications

N 8.2.2.1.2 Residential sprinklers installed on dry pipe systems shall be listed for dry pipe applications.

N 8.2.2.2 Pressure Gauges. Approved pressure gauges in accordance with Section 16.13 shall be provided as follows:

- (1) On the water side and pneumatic side of the dry pipe valve
- (2) At the air compressor supplying the system, where one is provided
- (3) At the air receiver, where one is provided
- (4) In each independent pipe from the pneumatic source to the dry pipe system
- (5) At mechanical quick-opening devices

N 8.2.3* Location and Protection of Dry Pipe Valve.

N 8.2.3.1* General. The dry pipe valve and supply pipe shall be protected against freezing and mechanical injury.

N 8.2.3.2 Valve Rooms.

N 8.2.3.2.1 Valve rooms shall be lighted and heated.

- **N 8.2.3.2.2** The source of heat shall be of a permanently installed type.
- **N 8.2.3.2.3** Heat tape shall not be used in lieu of heated valve enclosures to protect the dry pipe valve and supply pipe against freezing.
- **N 8.2.3.3 Enclosure Protection.** The valve enclosure shall be protected with a sprinkler or sprinklers supplied from the dry system or from a wet pipe system that protects the area where the enclosure is located.
- **N 8.2.3.4 High Water Level Prevention.** Protection against accumulation of water above the clapper shall be provided for dry pipe valves in accordance with 8.2.3.4.1.
- **N 8.2.3.4.1** An automatic high water level signaling device, an automatic drain, or a means to manually drain shall be permitted.
- **N** 8.2.4* **Dry Pipe System Water Delivery.** Dry pipe systems shall be sized such that water will be discharged from the system test connection within the time required by 8.2.4.1 for dwelling units and 8.2.4.2, 8.2.4.3, 8.2.4.4, or 8.2.4.5 for all other occupancies.
- **N 8.2.4.1 Dwelling Units.** For dry pipe systems protecting dwelling unit portions of any occupancy, initial water shall be discharged from the system test connection in not more than 15 seconds, starting at the normal air pressure on the system at the time of fully opened inspection test connection.
- **N 8.2.4.2 Single Orifice Test Connection.** 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 at the time of fully opened inspection test connection.
- N 8.2.4.2.1* A system size of not more than 500 gal (1900 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.
- **N 8.2.4.2.2** A system size of not more than 750 gal (2850 L) shall be permitted with a quick-opening device and shall not be

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

N 8.2.4.3 Water Delivery Calculations.

- **N 8.2.4.3.1** Initial water shall be discharged from the system test connection based on calculations using a program listed by a nationally recognized testing laboratory.
- **N 8.2.4.3.2** Water delivery calculation for each dry pipe system shall be based on the hazard shown in Table 8.2.4.3.2.
- **N 8.2.4.3.3** Water delivery calculation shall be based on the time interval between the calculated point in time when the selected most remote sprinkler(s) open and the calculated point in time when the minimum design pressure at the most remote sprinkler is reached or surpassed and maintained.

N 8.2.4.4* Manifold Test Connection.

- **N** 8.2.4.4.1 System size shall be such that initial water discharge from the system manifold test connection is not more than the maximum time of water delivery specified in Table 8.2.4.3.2, starting at the normal air pressure on the system at the time of fully opened inspection test connection.
- **N 8.2.4.4.2** When flow is from four sprinklers, the test manifold shall be arranged to simulate two sprinklers on the most remote sprinkler branch line and two sprinklers on the next adjacent branch line.
- **N 8.2.4.4.3** When flow is from two sprinklers, the test manifold shall be arranged to simulate two sprinklers on the most remote sprinkler branch line.
- **N 8.2.4.5** Dry pipe systems with water delivery times other than given in 8.2.4 shall be acceptable where listed by a nationally recognized testing laboratory.

N 8.2.4.6 Dry Pipe System Subdivision.

- **N 8.2.4.6.1** Subdividing of dry pipe systems using check valves to facilitate water delivery shall be permitted when all the conditions in 8.2.4.6.2 through 8.2.4.6.5 are met.
- **N 8.2.4.6.2** Check valves shall be located in a heated enclosure.
- **N 8.2.4.6.3** A $\frac{1}{8}$ in. (3 mm) diameter hole shall be drilled in the clapper of each check valve to permit equalization of air or nitrogen pressure among various parts of the system.
- **N 8.2.4.6.4** Auxiliary drains shall be provided for each subdivided section of the system.
- **N 8.2.4.6.5** Where auxiliary drains are not provided for each subdivided section, a bypass around each check valve incorpo-

N Table 8.2.4.3.2 Dry Pipe System Water Delivery

Hazard	Number of Most Remote Sprinklers Initially Open	Maximum Time of Water Delivery (seconds)
Dwelling unit	1	15
Light	1	60
Ordinary (Group 1)	2	50
Ordinary (Group 2)	2	50
Extra (Group 1)	4	45
Extra (Group 2)	4	45
High-piled	4	40

rating an approved and supervised normally closed indicating control valve shall be provided as a means to drain the subdivided section.

N 8.2.5 Quick-Opening Devices.

- **N 8.2.5.1** A listed quick-opening device shall be permitted to help meet the requirements of 8.2.4.
- **N 8.2.5.2** The quick-opening device shall be located as close as practical to the dry pipe valve.
- **N 8.2.5.3** Where a valve is installed in the connection between a dry pipe valve and the inlet of a quick-opening device, it shall be a supervised normally open indicating type valve.
- **N 8.2.5.4** To protect the quick-opening device against submergence, the connection to the riser shall be above the point at which water is expected when the device is set, unless the design features of the quick-opening device or dry pipe valve make this requirement unnecessary.
- **N 8.2.5.5** To protect the quick-opening device against submergence upon operation, a check valve shall be installed between the quick-opening device and the intermediate chamber of the dry pipe valve, unless the design features of the quick-opening device make this requirement unnecessary.
- **N 8.2.5.6** If the quick-opening device requires pressure feedback from the intermediate chamber, a supervised normally open indicating type valve shall be permitted in place of the check valve in 8.2.5.5.
- **N 8.2.5.7** Unless the quick-opening device has a built-in antiflooding device or is listed or approved for use without an antiflooding device, a listed anti-flooding device shall be installed in the connection between the dry pipe valve and the quickopening device.

N 8.2.6 System Pneumatic Pressure.

- **N 8.2.6.1** System pneumatic pressure shall be maintained in accordance with the instruction sheet furnished with the dry pipe valve, or in the absence of manufactures data system pneumatic pressure 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.
- **N 8.2.6.2** The permitted rate of pressure leakage shall be as specified in 29.2.2.
- **N 8.2.6.3** Each dry pipe valve shall have a low/high supervisory pressure switch that provides a supervisory signal when the pneumatic pressure within the system is out of the ranges specified in 8.2.6.4 and 8.2.6.5.
- **N 8.2.6.4** The low pressure signal shall be set at a minimum of 5 psi (0.3 bar) above the trip pressure of the dry pipe valve or per the manufacturer's instructions.
- **N 8.2.6.5** The high pressure signal shall be set at a minimum of 5 psi (0.3 bar) above the system pneumatic pressure specified in 8.2.6.1 or per the manufacturer's instructions.
- **N 8.2.6.6** When a low or high pneumatic pressure condition is detected, notification shall be by either of the following:
 - (1) An audible signal at a location that will be heard by building maintenance staff
 - (2) Through the fire alarm control unit as a supervisory condition

N 8.2.7* Air Supply.

- **N 8.2.7.1** Air under pressure, as permitted in Section 4.7, shall be maintained on dry pipe systems throughout the year.
- **N 8.2.7.2*** The air shall be supplied from a permanent source available at all times.
- **N 8.2.7.3*** The air supply shall be capable of restoring normal pressure in the system within 30 minutes.
- **N 8.2.7.4** The requirement of 8.2.7.3 shall not apply in refrigerated spaces maintained below 5° F (- 15° C), where the air supply is capable of restoring normal pressure in the system within 60 minutes.

N 8.2.7.5 Compressed Air.

- **N 8.2.7.5.1** Air supply shall be from a dependable plant compressed air system or a dedicated air compressor with an air receiver.
- N 8.2.7.5.2* Where an air compressor is dedicated for the sprinkler system, the air compressor shall be listed for fire protection.
- **N 8.2.7.5.3** Where the air compressor supplying a single dry pipe system has a capacity of less than 5.5 ft³/min (160 L/min) at 10 psi (0.7 bar), the air receiver shall not be required.
- **N 8.2.7.5.4** Where an air compressor is the dedicated air supply, it shall be installed in accordance with *NFPA 70*, Article 430.
- **N 8.2.7.5.5** The disconnecting means for an automatic air compressor shall not be a general use switch or a cord-and-plug connection.

N 8.2.7.6 Compressed Nitrogen.

- **N 8.2.7.6.1** Nitrogen supply shall be from a dependable nitrogen generator or from one or more industrial cylinders or containers.
- **N 8.2.7.6.2** Where a nitrogen generator is the dedicated nitrogen supply, it shall be installed in accordance with *NFPA 70*, Article 430.
- **N 8.2.7.6.3** The disconnecting means for a nitrogen generator shall not be a general use switch or a cord-and-plug connection.
- **N 8.2.7.6.4** Where nitrogen or other approved gas stored in high-pressure industrial cylinders is used, the gas shall be introduced through an approved regulator on the supply side of the pressure maintenance device(s).
- **N** 8.2.7.6.5 A low pressure alarm shall be provided between the regulator in 8.2.7.6.3 and the air maintenance device(s) to notify the need for refilling cylinder(s).
- **N 8.2.7.6.6** Combinations of approved sources of air supplies shall be permitted.

N 8.2.8 Air Maintenance Devices.

- **N 8.2.8.1*** Unless the requirements of 8.2.7.5.2 are met, each dry pipe system shall have a dedicated and listed air maintenance device capable of controlling the required pressure on the system and the maximum flow of air into the system.
- **N 8.2.8.2** Where the air compressor supplying a single dry pipe system has a capacity of less than 5.5 ft³/min (160 L/min) at

10 psi (0.7 bar), an air maintenance device shall not be required.

N 8.2.9 Connections.

- **N 8.2.9.1*** The connection from the air source shall not be less than $\frac{1}{2}$ in. (15 mm) in diameter and shall enter the system above the priming water level of the dry pipe valve, or as otherwise specified by the manufacturer.
- **N 8.2.9.2** A check valve shall be installed in the pneumatic supply connection.
- **N 8.2.9.3** A listed or approved shutoff valve of either the renewable disc or ball valve type shall be installed on the supply side of the check valve in 8.2.9.2.
- **N 8.2.9.4** An approved relief valve shall be provided between the pneumatic supply and shutoff valve required in 8.2.9.3 and shall be set to relieve pressure no less than 10 psi (0.7 bar) in excess of the system pneumatic air pressure provided in 8.8.2.6.1.
- **N 8.2.10*** Nitrogen Supply for Increased *C* Value. Where nitrogen is used to allow for increased *C* value in hydraulic calculations in accordance with Table 28.2.4.8.1, the nitrogen supply shall be in accordance with 8.2.10.1 through 8.2.10.5.
- **N 8.2.10.1** Nitrogen shall be from a listed nitrogen generator permanently installed.
- **N 8.2.10.2** The generator shall be capable of supplying and maintaining at least 98 percent nitrogen concentration throughout the system at a minimum leakage rate of 1.5 psi (0.1 bar) per hour.
- **N 8.2.10.3** A means of verifying nitrogen concentration shall be provided for each system where increased *C* value is used.
- **N 8.2.10.4** The nitrogen generator shall be installed per the manufacturer's instructions.
- **N 8.2.10.5** The nitrogen generator shall be maintained in accordance with Chapter 32.

N 8.2.11 Vapor Corrosion Inhibitor.

- **N 8.2.11.1** The vapor corrosion inhibitor shall be from a listed assembly permanently installed in accordance with the manufacturer's instructions.
- **N 8.2.11.2** The vapor corrosion inhibitor equipment shall be maintained in accordance with Chapter 32 and manufacturer's instructions.
- **N 8.2.11.3** A means of verifying vapor concentration shall be provided for each system.

8.3 Preaction Systems and Deluge Systems.

8.3.1* General.

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

8.3.1.2 Detection. Automatic systems shall be controlled by the operation of fire detection devices in accordance with Section 8.10.

8.3.1.3 Actuator Supervision. Removal or disabling of an electric actuator from the preaction or deluge valve that it controls shall result in an audible and visual indication of system impairment at the system releasing control panel.

N 8.3.1.4 Automatic Water Control Valve. 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.

Δ 8.3.1.5 Pressure Gauges.

- **N 8.3.1.5.1** Approved pressure gauges conforming with Section 16.13 shall be installed as follows:
 - (1) Above and below water control valve on preaction systems
 - (2) Below water control valve on deluge systems
 - (3) On air supply to preaction systems
- **N 8.3.1.5.2** For deluge systems only, a pressure gauge connection shall be installed near the most remote open sprinkler or nozzle.
- **8.3.1.6*** Additional Indicating Control Valve. A separate additional indicating control valve, supervised in accordance with 16.9.3.3, shall be permitted to be installed in the riser assembly above the water control valve on preaction and deluge systems to permit full function trip testing as required by NFPA 25, without flooding the system.

8.3.1.7 Location and Protection of System Water Control Valves.

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

8.3.1.7.2 Valve Rooms.

8.3.1.7.2.1 Valve rooms shall be lighted and heated.

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

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

8.3.2 Preaction Systems.

8.3.2.1 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 noninterlock 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

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

8.3.2.3 Size of Systems — Double Interlock Preaction Systems.

8.3.2.3.1 The system size controlled by a double interlock preaction valve shall be determined by either 8.3.2.3.1.1, 8.3.2.3.1.2, 8.3.2.3.1.3, or 8.3.2.3.1.4.

8.3.2.3.1.1 A system size for double interlock preaction systems of not more than 500 gal (1900 L) shall be permitted and shall not be required to meet any specific water delivery requirement to the trip test connection.

8.3.2.3.1.2 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.

8.3.2.3.1.3 The system size for double interlock preaction systems shall be based on calculating water delivery in accordance with 8.2.4.3, anticipating that the detection system activation and sprinkler operation will be simultaneous.

8.3.2.3.1.4* 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 8.2.4.3.2, starting at the normal air pressure on the system, with the detection system activated and the inspection trip test connection or manifold opened simultaneously.

8.3.2.3.2 A listed quick-opening device shall be permitted to be used to help meet the requirements of 8.3.2.3.1.2, 8.3.2.3.1.3, and 8.3.2.3.1.4.

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

8.3.2.5 Air Pressure Except as provided by 8.3.2.5.1 through 8.3.2.5.3, supervisory air pressure for preaction systems shall be installed in conformance with the dry pipe system air pressure and supply rules of 8.2.6.

8.3.2.5.1 The relief valves required by 8.2.6 shall be permitted to be omitted for the type of preaction system described in 8.3.2.1(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).

8.3.2.5.2 A preaction system type described in 8.3.2.1(2) and 8.3.2.1(3) shall maintain a minimum supervisory air pressure of 7 psi (0.5 bar).

8.3.2.5.3 The air pressure values for the type of preaction system described in 8.3.2.1(1) shall be set in accordance with the manufacturer's installation instructions.

8.3.2.6 Sprinklers. The following sprinkler orientations 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 above freezing
- (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 above freezing, the water supply is potable, and the piping for the preaction system is copper or CPVC specifically listed for dry pipe applications

Δ 8.3.2.7 System Configuration.

- **N 8.3.2.7.1** Double interlock preaction systems shall not be gridded.
- **N 8.3.2.7.2** Single and non-interlock preaction systems protecting high-piled storage occupancies shall not be gridded.

8.3.3* Deluge Systems.

8.3.3.1 The detection devices or systems shall be automatically supervised.

8.3.3.2 Deluge systems shall be hydraulically calculated.

N 8.3.3.3* A sign to identify its function shall be provided at the deluge system manual releasing mechanism.

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

8.4.1 In addition to the requirements of Section 8.4, design and installation requirements for piers, terminals, and wharves shall be in accordance with Section 27.27.

8.4.2* General.

8.4.2.1* 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.

8.4.2.2 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.

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

8.4.2.4 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

8.4.3 Dry Pipe Valves in Combined Systems.

8.4.3.1 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.

8.4.3.2* Where parallel dry pipe valves are required by 8.4.3.1, these valves shall be checked against each other.

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

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

8.4.3.5 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.

8.4.3.6 The check valves between the dry pipe valves and the common feed main shall be equipped with $\frac{1}{2}$ 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.

8.4.3.7 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.

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

8.4.4 Subdivision of System Using Check Valves.

8.4.4.1 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.

8.4.4.2 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.

8.4.4.3 Each section shall have a $1\frac{1}{4}$ in. (32 mm) drain on the system side of each check valve supplemented by a dry pipe system auxiliary drain.

8.4.4. 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.

8.4.5 Time Limitation.

8.4.5.1 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 (120 m) of common feed main from the time the heat-responsive system operates.

8.4.5.2 The maximum time permitted shall not exceed 3 minutes.

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

8.5 Multicycle Systems.

8.5.1 All multicycle systems shall be specifically tested and listed as systems.

8.5.2 All multicycle systems shall be installed in compliance with the manufacturer's installation instructions.

8.6* Antifreeze Systems.

8.6.1* General.

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

8.6.1.2 Antifreeze shall not be used in ESFR systems unless the ESFR sprinkler is listed for use with the antifreeze solution.

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

8.6.1.3.1 The requirements of 8.6.1.3 shall not apply where the system is hydrostatically tested with a listed antifreeze solution.

8.6.1.4 Where antifreeze systems are remote from the system riser, a placard shall be mounted on the system riser that indi-

cates the number and location of all remote antifreeze systems supplied by that riser.

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

8.6.2* Antifreeze Solutions.

8.6.2.1* Except as permitted in 8.6.2.2, antifreeze solutions shall be listed for use in sprinkler systems.

8.6.2.2 Premixed antifreeze solutions of propylene glycol shall be permitted to be used with ESFR sprinklers where the ESFR sprinklers are listed for such use in a specific application.

8.6.3 Arrangement of Supply Piping and Valves.

8.6.3.1 Where the connection between the antifreeze system and the supply piping does not incorporate a backflow prevention device, and the conditions of 8.6.3.5 are not met, piping and valves shall be installed as illustrated in Figure 8.6.3.1.

8.6.3.2* Where the connection between the antifreeze system and the supply piping incorporates a backflow prevention device, and the conditions of 8.6.3.5 are not met, piping and valves shall be installed as illustrated in Figure 8.6.3.3 or Figure 8.6.3.4.

8.6.3.2.1 A means shall be provided to perform a full forward flow test in accordance with 16.14.5.

8.6.3.3* Where the connection between the antifreeze system and supply pipe incorporates a backflow prevention device, and the conditions of 8.6.3.5 are not met, a listed expansion chamber shall be provided to compensate for thermal expansion of the antifreeze solution as illustrated in Figure 8.6.3.3.



Notes:

1. Check valves are permitted to be omitted where sprinklers are below the level of valve A. $% \left({{{\bf{n}}_{\rm{c}}}} \right)$

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 8.6.3.3 Arrangement of Supply Piping with Backflow Device.

8.6.3.3.1 When determining the size of the expansion chamber, the precharge air temperature and precharge air pressure shall be included.

8.6.3.3.2 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.

8.6.3.4 A listed $\frac{1}{2}$ in. (15 mm) relief valve shall be permitted in lieu of the expansion chamber required in 8.6.3.3, and as illustrated in Figure 8.6.3.4, provided the antifreeze system volume does not exceed 40 gal (150 L).



- 1. Check valve can 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.



Shaded text = Revisions. Δ = Text deletions and figure/table revisions. • = Section deletions. N = New material.

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8.6.3.5 The requirements of 8.6.3.1, 8.6.3.2, and 8.6.3.3 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.

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

8.6.3.7 For systems with a capacity larger than 150 gal (570 L), an additional test connection shall be provided for every additional 150 gal (570 L).

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

8.7.1 Applications.

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

8.7.1.2 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.

8.7.2 Water Supply and Control.

8.7.2.1 Unless the requirements of 8.7.2.2 are met, sprinklers installed for protection against exposure fires shall be supplied from a standard water supply as outlined in Chapter 5.

8.7.2.2 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.

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

8.7.3 Control.

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

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

8.7.3.3 Sprinklers shall be of the open or automatic type.

8.7.3.4 Automatic sprinklers in areas subject to freezing shall be on dry pipe systems conforming to Section 8.2 or antifreeze systems conforming to Section 8.6, or be dry sprinklers of an adequate length connected to wet pipe systems located in heated areas.

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

8.7.4 System Components.

8.7.4.1 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.

8.7.4.2 Check Valves.

8.7.4.2.1* 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.

8.7.4.2.2 The intermediate pipe between the two check valves shall be arranged to drain.

8.7.4.2.3* As an alternate solution, an additional sprinkler shall be installed on each system located around the corner from the system involved.

8.7.4.3 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.

8.7.5 Pipe and Fittings. Pipe and fittings installed on the exterior of the building or structure shall be corrosion resistant.

8.7.6 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).

8.7.7 Gauge Connections. A pressure gauge conforming to Section 16.13 shall be installed immediately below the control valve of each system.

8.7.8 Sprinklers.

8.7.8.1 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.

8.7.8.2 Where window sills or similar features result in recesses or projections exceeding 1 in. (25 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.

8.7.8.3 For wall protection systems, sprinklers shall be located 6 in. to 12 in. (150 mm to 300 mm) from the wall surface and within 6 in. (150 mm) of the top of the wall, with maximum spacing of 8 ft (2.4 m) or as indicated in the sprinkler listing for exposure protection use.

8.7.8.4 For protection of window and similar openings, listed window sprinklers shall be positioned within 2 in. (50 mm) of the top of the window sash in accordance with Table 8.7.8.4.

8.7.8.5 Where exposure protection sprinkler systems are installed, listed cornice sprinklers shall be used to protect combustible cornices exceeding 12 in. (300 mm) in depth.

8.7.8.5.1 Cornice sprinklers shall be installed in each bay formed by cornice features and shall be spaced up to a maximum distance of 10 ft (3.0 m) apart, with deflectors 8 in. (200 mm) below the underside of the roof sheathing.

Δ Table 8.7.8.4 Position of Window Sprin

Width of Window	Nominal	K-Factor	Nominal Distance from Window		
(f t)	US	Metric	in.	mm	
Up to 3	2.8	40	7	175	
>3 to 4	2.8	40	8	200	
>4 to 5	2.8	40	9	225	
	5.6	80	12	300	
>5 to 7	11.2	160	12	300	
	Two 2.8	40	7	175	
>7 to 9.5	14.0	200	12	300	
	Two 2.8	40	9	225	
>9.5 to 12	Two 5.6	80	12	300	

For SI units, 1 ft = 0.3048 m.

8.7.8.6 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. (450 mm) above the roof surface.

8.7.8.6.1 Upright sprinklers positioned as ridge pole sprinklers shall be permitted with their deflectors horizontal and minimum 6 in. (150 mm) above the ridge, with their maximum spacing and protection areas determined in the plan view rather than along the slope.

8.7.9* Exposure Protection Sprinkler Systems.

8.7.9.1 Exposure protection sprinkler systems shall be hydraulically calculated using Table 8.7.9.1 based on severity of exposure as indicated by a relative classification of guide number or other approved source.

		\sim Section A – V	Wall and Window Sp	rinklers		
Fynosure	Level of Well or		Minimum	Discharge	Minimum Average Application Rate Over Protected Surface	
Severity	Guide Number	Window Sprinklers	Nominal K-Factor	(K-Factor)	gpm/ft ²	mm/min
Light	1.50 or less	Top 2 levels	2.8 (40)	2.8 (40)	0.20	8.1
0		Next lower 2 levels	1.9 (27)	1.9(27)	0.15	6.1
		Next lower 2 levels	1.4 (20)	1.4 (20)	0.10	4.1
Moderate	1.5-2.20	Top 2 levels	5.6 (80)	5.6 (80)	0.30	12.2
		Next lower 2 levels	4.2 (60)	4.2 (60)	0.25	10.2
		Next lower 2 levels	2.8 (40)	2.8 (40)	0.20	8.2
Severe	>2.20	Top 2 levels	11.2 (161)	11.2 (161)	0.40	16.3
		Next lower 2 levels	8.0 (115)	8.0 (115)	0.35	14.3
		Next lower 2 levels	5.6 (80)	5.6 (80)	0.30	12.2
		Section B	— Cornice Sprinkle	ers		
Guide Number	Cornice Sprinkler Minimal Nominal K-Factor		Application Rate per Lineal Foot (gpm)		Applicatio Line (L	on Rate per al Meter //min)
1.50 or less	2.8 (40)		0.75		9.3	
>1.51-2.20	5.6	6 (80)	1.50		1	8.6
>2 20	11.9(161)		3.00		37 3	

Table 8.7.9.1 Exposure Protection

8.7.9.2 In no case shall compliance with Table 8.7.9.1 result in a sprinkler discharge pressure below 7 psi (0.5 bar).

8.7.9.3 Only half of the flow from upright, pendent, and other nondirectional sprinklers shall be used in determining the minimum average application rate over the protected surface.

8.7.9.4 The water supply shall be capable of simultaneously supplying the total demand of sprinklers along an exposure to a maximum length of 300 ft (91 m). Where systems of open sprinklers are used, the water supply shall be capable of simultaneously flowing all sprinklers that would flow as part of all systems that could be actuated within any 300 ft (91 m) length.

8.7.9.5 The water supply duration for an exposure protection sprinkler system shall be a minimum of 60 minutes.

8.7.9.6 A level of window sprinklers as described in Table 8.7.9.1 shall be defined as a floor level of the building being protected.

8.7.9.7 Window sprinklers shall be permitted to cover more than $25 \text{ ft}^2 (2.3 \text{ m}^2)$ of window area per level.

8.7.9.7.1 The starting pressure shall be calculated based on the application rate over $25 \text{ ft}^2 (2.3 \text{ m}^2)$ of window area as indicated in Table 8.7.9.1.

8.7.9.7.2 The maximum spacing between window sprinklers shall not exceed 8 ft (2.4 m) unless listed for a greater distance.

8.8* Refrigerated Spaces.

8.8.1 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.

8.8.2* Spaces Maintained at Temperatures Below 32°F (0°C).

8.8.2.1 General.

8.8.2.1.1* 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.

8.8.2.1.2 The removable length of pipe required in 8.8.2.1.1 shall be a minimum of 30 in. (750 mm).

8.8.2.2 Low Air Pressure Alarm.

8.8.2.2.1 Unless the requirements of 8.8.2.2.2 are met, a low air pressure alarm to a constantly attended location shall be installed.

8.8.2.2.2 Systems equipped with local low pressure alarms and an automatic air maintenance device shall not be required to alarm to a constantly attended location.

8.8.2.3 Piping Pitch. Piping in refrigerated spaces shall be installed with pitch as outlined in 16.10.3.2.

△ 8.8.2.4* **Air Supply.** Air 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

8.8.2.5* 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.

8.8.2.6* Check Valve.

8.8.2.6.1 Unless the requirements of 8.8.2.6.2 are met, a check valve with a $\frac{3}{32}$ in. (2 mm) diameter hole in the clapper shall be installed in the system riser below the test valve required in 8.8.2.5.

8.8.2.6.2 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.

8.8.2.7 Air or Nitrogen Supply Piping.

△ 8.8.2.7.1* The air supply piping entering the freezer area shall be as stated in 8.8.2.7.1.1 and 8.8.2.7.1.2.

8.8.2.7.1.1 Air Supply. The supply piping shall be equipped with two easily removable supply lines at least 6 ft (1.8 m) long and at least 1 in. (25 mm) in diameter as shown in Figure 8.8.2.7.1.1(a) or Figure 8.8.2.7.1.1(b).

8.8.2.7.1.2 Nitrogen Supply. The supply piping shall be equipped with a single easily removable supply line at least 6 ft (1.8 m) long and at least 1 in. (25 mm) in diameter.

8.8.2.7.2 Each supply line shall be equipped with control valves located in the warm area.

8.8.2.7.3 Only one air supply line shall be open to supply the system air at any one time.

8.8.2.8 Fire Detection for Preaction Release. Systems shall be automatically controlled by the operation of fire detection devices in accordance with 8.10.5.

8.9 Commercial-Type Cooking Equipment and Ventilation.

8.9.1 General. In cooking areas protected by automatic sprinklers, additional sprinklers or automatic spray nozzles shall be provided to protect commercial-type cooking equipment and ventilation systems that are designed to carry away grease-laden vapors unless otherwise protected.

8.9.2* Sprinklers and Automatic Spray Nozzles.

8.9.2.1 Standard spray 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.

8.9.2.2 Unless the requirements of 8.9.2.4 are met, standard spray sprinklers or automatic spray nozzles shall be so located as to provide for the protection of cooking equipment and cooking surfaces.

8.9.2.3 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.

8.9.2.4 Cooking equipment below hoods that contain automatic fire-extinguishing equipment is protected and shall not require protection from the overhead sprinkler system.

8.9.3 Sprinkler and Automatic Spray Nozzle Location — Ducts.

8.9.3.1 Unless the requirements of 8.9.3.2 or 8.9.3.4 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.

8.9.3.2 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).

8.9.3.3 Unless the requirements of 8.9.3.4 are met, horizontal exhaust ducts shall have sprinklers or automatic spray nozzle devices located on 10 ft (3.0 m) centers beginning no more than 5 ft (1.5 m) from the duct entrance.

8.9.3.4 Sprinklers or automatic spray nozzles shall be required in ducts.

8.9.3.4.1 Where ducts do not exceed 75 ft (23 m) in length and the entire exhaust duct is protected in accordance with NFPA 96, sprinkler(s) or automatic spray nozzle(s) shall not be required.

8.9.3.5 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 16.4.1.*)

8.9.4 Sprinkler and Automatic Spray Nozzle Location — Duct Collar.

8.9.4.1 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 300 mm maximum) above the point of duct collar connection in the hood plenum.



1. Check valve with 3/32 in. (2 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 8.8.2.7.1.1(a) Refrigerator Area Sprinkler System Used to Minimize the Chances of Developing Ice Plugs.



Notes:

- 1. Check valve with 3/32 in. (2 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 8.8.2.7.1.1(b) Preaction System Arrangement.

8.9.4.2 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.

8.9.5 Sprinkler and Automatic Spray Nozzle Location — Exhaust Plenum Chambers.

8.9.5.1 Hood exhaust plenum chambers shall have one sprinkler or automatic spray nozzle centered in each chamber not exceeding 10 ft (3.0 m) in length.

8.9.5.2 Plenum chambers greater than 10 ft (3.0 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 (3.0 m).

8.9.6 Sprinkler and Automatic Spray Nozzle Temperature Ratings and K-Factors.

8.9.6.1 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)].

8.9.6.2 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.

8.9.6.3 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).

8.9.7 Sprinkler and Automatic Spray Nozzle. Access shall be provided to all sprinklers or automatic spray nozzles for examination and replacement.

8.9.8 Cooking Equipment.

8.9.8.1 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 8.9.1.

8.9.8.2 Deep Fat Fryers.

8.9.8.2.1 A sprinkler or automatic spray nozzle used for protection of deep fat fryers shall be listed for that application.

8.9.8.2.2 The position, arrangement, location, and water supply for each sprinkler or automatic spray nozzle shall be in accordance with its listing.

8.9.8.3 Fuel and Heat Shutoff.

8.9.8.3.1 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.

8.9.8.3.2 Any gas appliance not requiring protection but located under ventilating equipment shall also be shut off.

8.9.8.3.3 All shutdown devices shall be of the type that requires manual resetting prior to fuel or power being restored.

8.9.9 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.

8.9.10 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).

8.9.11 Test Connection. A system test connection shall be provided to verify proper operation of equipment specified in 8.9.8.3.

N 8.10 Detection and Release System for Preaction and Deluge Systems.

N 8.10.1 General.

- **N 8.10.1.1** The type of detection shall be appropriate for the hazard protected and shall be approved by the authority having jurisdiction.
- **N 8.10.1.2** All components of pneumatic, hydraulic, or electrical systems shall be compatible.
- **N 8.10.1.3** The detection system shall serve all areas that the preaction or deluge system protects.
- **N 8.10.1.4*** The detection system for preaction systems shall be designed to activate prior to sprinkler operation.
- **N 8.10.1.5** Where thermal activation is utilized for preaction systems, the activation temperature of the release system shall be lower than the activation temperature of the sprinklers.
- **N 8.10.1.6** The temperature rating of thermal detection devices shall be selected in accordance with 9.4.2.

- **N 8.10.1.7** 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.
- **N 8.10.1.8** Where two or more adjacent water spray systems in one fire area are controlled by separate detection systems, the detectors on each system shall be spaced independently as if the dividing line between the systems was a wall or draft curtain.
- **N 8.10.2 Electrical Detection.** Electrical detection and release systems shall comply with the requirements of *NFPA 72*.

N 8.10.3 Pilot Line Detection.

- **N 8.10.3.1** Piping for wet and dry pilot line detection shall be permitted to be any type of approved pipe or tube.
- **N 8.10.3.2** Piping for wet and dry pilot line detection shall be considered branch lines for purposes of installation and shall be installed in accordance with the applicable requirements of this standard, except as modified by 8.10.3.2 and 8.10.3.3.
- **N 8.10.3.3** Pipe supplying pilot line detectors shall be permitted to be supported from the same points of hanger attachment as the piping system it serves.
- **N 8.10.3.4** Pipe supplying pilot line detectors shall not be required to meet the requirements of Section 18.5.
- **N 8.10.3.5** Pilot line detectors, spray sprinklers utilized as pilot line detectors, and related components including pipe and fittings shall be corrosion resistant when installed in areas exposed to weather or corrosive conditions.
- **N 8.10.3.6** Where subject to mechanical of physical damage, pilot line detection piping and related detection system components shall be protected.
- **N 8.10.3.7** Where spray sprinklers are used as pilot line detectors, they shall be installed in accordance with the spacing and location rules of Section 10.2, except that the obstruction to water distribution rules shall not be required to be followed.
- **N 8.10.3.7.1** Pilot line detectors shall be permitted to be located more than 22 in. (550 mm) below a ceiling or deck where the maximum spacing between pilot line detectors is 10 ft (3.0 m) or less.
- **N 8.10.3.8** Wet pilot 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.
- **N 8.10.3.9** Pilot line detectors shall be installed in the upright position on dry pilot lines.
- **N 8.10.3.10** Dry pilot lines shall be pitched $\frac{1}{2}$ in. per 10 ft (4 mm/m) for drainage.
- **N 8.10.3.11** The air supply for dry pilot lines shall be arranged to enable maintenance of dry pilot line pressure independent from that of the preaction system.
- **N 8.10.3.12** A row of pilot line detectors shall be located along the open sides of open-sided buildings.
- **N 8.10.3.13** Where pilot line detectors are installed in water cooling tower applications, they shall be in accordance with Section 27.26.

N 8.10.4 Spacing of Detection Devices.

- **N 8.10.4.1** Spacing of detection devices shall be in accordance with their listing and manufacturer's specifications.
- **N 8.10.4.2** Where spray sprinklers are used as pilot line detectors, spacing of detectors shall not exceed that of the sprinkler spacing in the area it serves.
- **N 8.10.4.3** The maximum horizontal distance between pilot line detectors installed indoors shall not exceed 12 ft (3.7 m).
- **N 8.10.4.3.1** Pilot line detectors located in open-sided buildings shall in accordance with 8.10.4.3.
- **N 8.10.4.4** The maximum horizontal distance between pilot line detectors installed outdoors shall not exceed 8 ft (2.4 m).
- **N 8.10.4.4.1** Pilot line detectors required by 8.10.3.11 shall be spaced in accordance with 8.10.4.4.
- **N 8.10.4.5** Where multiple levels of pilot line detectors are present, the horizontal distance between pilot line detectors installed outdoors on a given level shall be permitted to be increased to 10 ft (3.0 m) when all the following conditions are met:
 - (1) The elevation of the first level does not exceed 15 ft (4.6 m).
 - (2) The distance between additional levels does not exceed 12 ft (3.7 m).
 - (3) The pilot line detectors are staggered vertically.
- **N 8.10.4.6** Pilot line detectors located outdoors, such as in open process structures, shall be spaced such that the vertical distance between levels of pilot line detectors does not exceed 17 ft (5.2 m).
- **N 8.10.4.7** Horizontal spacing of pilot line detectors differing from those required in 8.10.4.3 and 8.10.4.4 shall be permitted where installed in accordance with their listing.

N 8.10.5 Detection for Refrigerated Spaces.

- **N 8.10.5.1** Detection devices shall be electric or pneumatic fixed temperature type with temperature ratings less than that of the sprinklers in the protected space.
- **N 8.10.5.2** Detection devices shall not be rate-of-rise type.
- **N 8.10.5.3** Where the system is a double interlock preaction system or single interlock 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* or other approved fire alarm code.

N 8.10.5.4 Detector Location at Ceiling.

- **N 8.10.5.4.1** Under smooth ceilings, detectors shall be spaced not exceeding their listed spacing.
- **N 8.10.5.4.2** For other than smooth ceilings, detector spacing shall not exceed one-half of their listed spacing or full allowable sprinkler spacing in the protected area, whichever is greater.

N 8.10.5.5 Detector Location in Racks.

N 8.10.5.5.1 Unless the conditions in 8.10.5.6 are met, one level of detectors shall be installed for each level of sprinklers.

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- **N 8.10.5.5.2** Detectors shall be installed vertically no further than one storage level away from the rack sprinklers and as follows:
 - (1) Detectors shall be located in the transverse flue in singlerow 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 the system is double interlock preaction type, the ceiling detection system shall operate both the ceiling and in-rack preaction systems.

N 8.10.5.6 Ceiling detection only shall be permitted where all the following conditions are met:

- (1) Maximum storage height is 35 ft (11 m)
- (2) Maximum ceiling height is 40 ft (12 m)
- (3) Maximum hazard of storage class 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 8.10.5.6

N 8.10.6 Devices for Test Purposes and Testing Apparatus.

- **N 8.10.6.1** Where detection devices are located where not accessible for testing, an additional detection device shall be provided on each detection zone for test purposes at an accessible location and shall be connected at a point that will ensure a proper test of each zone.
- **N 8.10.6.2** Any specialized testing apparatus needed to activate the detection devices shall be furnished to the owner of the property with each installation.
- **N 8.10.6.3** Where explosive vapors or material are present, hot water, steam, or other methods of testing not involving an ignition source shall be used.

N 8.11 Vacuum Systems.

N 8.11.1 General.

N 8.11.1.1 Vacuum system equipment shall be listed for fire sprinkler system use.



N FIGURE 8.10.5.6 Valve Arrangement.

- **N 8.11.1.2** Vacuum systems shall be installed in accordance with the manufacturer's installation instructions.
- **N 8.11.1.3** Sprinklers shall be listed for use under vacuum conditions.

N 8.11.2 Vacuum Dry Pipe.

- **N 8.11.2.1** Unless modified by 8.11.2, vacuum dry pipe systems shall meet the requirements of Section 8.2.
- **N 8.11.2.2** The relief valve required by 8.2.9.4 shall be set in accordance with the manufacturer's instructions.

N 8.11.3 Vacuum Preaction.

N 8.11.3.1 Unless modified by 8.11.3, vacuum preaction systems shall meet the requirements of Section 8.3.

N 8.11.3.2 The relief valve required by 8.2.9.4 shall be set in accordance with the manufacturer's instructions.

Chapter 9 Sprinkler Location Requirements

9.1* Basic Requirements.

9.1.1* 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.

9.2 Allowable Sprinkler Omission Locations.

9.2.1* Concealed Spaces Not Requiring Sprinkler Protection.

9.2.1.1* Concealed spaces of noncombustible and limited-combustible construction with minimal combustible loading having no access shall not require sprinkler protection.

9.2.1.1.1 The space shall be considered a concealed space even with small openings such as those used as return air for a plenum.

9.2.1.1.2* Small openings with both of the following limits shall be permitted:

- (1) A combined total area of not more than 20 percent of the ceiling, construction feature, or plane shall be used to determine the boundaries of the concealed space.
- (2) Gaps greater than 4 ft (1.2 m) long shall not be more than 8 in. (200 mm) wide.

9.2.1.2 Concealed spaces of noncombustible and limitedcombustible construction with limited access and not permitting occupancy or storage of combustibles shall not require sprinkler protection.

9.2.1.2.1 The space shall be considered a concealed space even with small openings such as those used as return air for a plenum.

9.2.1.2.2* The space shall be considered a concealed space even with non-fuel-fired equipment and access panels.

9.2.1.3 Concealed spaces formed by studs or joists with less than 6 in. (150 mm) between the inside or near edges of the studs or joists shall not require sprinkler protection. (*See Figure 10.2.7.1.5.1.*)

9.2.1.4 Concealed spaces formed by bar joists with less than 6 in. (150 mm) between the roof or floor deck and ceiling shall not require sprinkler protection.

9.2.1.5* Concealed spaces formed by ceilings attached directly to or within 6 in. (150 mm) of wood joist or similar solid member construction shall not require sprinkler protection.

9.2.1.6* Concealed spaces formed by ceilings attached to composite wood joist construction either directly or onto metal channels not exceeding 1 in. (25 mm) in depth, provided the joist channels as measured from the top of the batt insulation are separated into volumes each not exceeding 160 ft³ (4.5 m³) using materials equivalent to the web construction and at least $3\frac{1}{2}$ in. (90 mm) of batt insulation is installed at the bottom of the joist channels when the ceiling is attached utilizing metal channels, shall not require sprinkler protection.

9.2.1.7 Concealed spaces filled with noncombustible insulation shall not require sprinkler protection.

9.2.1.7.1 A maximum 2 in. (50 mm) air gap at the top of the space shall be permitted.

9.2.1.8 Concealed spaces within wood joist construction having noncombustible insulation filling the space from the ceiling up to the bottom edge of the joist of the roof or floor deck shall not require sprinkler protection.

9.2.1.9 Concealed spaces within composite wood joist construction having noncombustible insulation filling the space from the ceiling up to the bottom edge of the composite wood joist of the roof or floor deck and with the joist channels separated into volumes each not exceeding 160 ft³ (4.5 m³) to the full depth of the composite wood joist, with material equivalent to the web construction, shall not require sprinkler protection.

9.2.1.10 Concealed spaces over isolated small compartments not exceeding 55 ft^2 (5.1 m²) in area shall not require sprinkler protection.

9.2.1.11* Concealed spaces created by soffits of combustible construction below noncombustible or limited combustible ceilings separated into volumes each not exceeding 160 ft^3 (4.5 m³) by noncombustible or limited combustible materials shall not require sprinkler protection.

- △ 9.2.1.12 Concealed spaces where rigid materials are used and the exposed surfaces, in the form in which they are installed, comply with one of the following shall not require sprinkler protection:
 - (1) The surface materials have a flame spread index of 25 or less, and the materials have demonstrated that the flame front does not progress more than 10.5 ft (3.2 m) beyond the centerline of the burners at any time during the 30minute test period, when tested in accordance with ASTM E84, Standard Test Method for Surface Burning Characteristics of Building Materials, or UL 723, Test for Surface Burning Characteristics of Building Materials, extended for an additional 20 minutes.
 - (2) The surface materials comply with the requirements of ASTM E2768, *Standard Test Method for Extended Duration Surface Burning Characteristics of Building Materials (30 min Tunnel Test).*

9.2.1.13* Concealed spaces in which the exposed materials are constructed entirely of fire retardant–treated wood as defined by NFPA 703 shall not require sprinkler protection.

9.2.1.14 Noncombustible concealed spaces having exposed combustible insulation where the heat content of the facing
and substrate of the insulation material does not exceed 1000 Btu/ft² (11,400 kJ/m^2) shall not require sprinkler protection.

9.2.1.15 Concealed spaces below insulation that is laid directly on top of or within wood joists or composite wood joists used as ceiling joists in an otherwise sprinklered concealed space, with the ceiling attached directly to the bottom of the joists, shall not require sprinkler protection.

9.2.1.16 Sprinklers shall not be required in vertical pipe chases under 10 ft^2 (0.9 m²).

9.2.1.16.1 Pipe chases in accordance with 9.2.1.16 shall contain no sources of ignition.

9.2.1.16.2 In buildings having more than a single story, blocking shall be required at pipe penetrations at each floor.

9.2.1.17 Exterior columns under 10 ft^2 (0.9 m²) in area, formed by studs or wood joist supporting exterior canopies that are fully protected with a sprinkler system, shall not require sprinkler protection.

9.2.1.18* Concealed spaces formed by noncombustible or limited-combustible ceilings suspended from the bottom of wood joists, composite wood joists, wood bar joists, or wood trusses that have insulation filling all of the gaps between the bottom of the trusses or joists, and where sprinklers are present in the space above the insulation within the trusses or joists, shall not require sprinkler protection.

9.2.1.18.1 The heat content of the facing, substrate, and support of the insulation material shall not exceed $1000 \text{ Btu/ft}^2 (11,400 \text{ kJ/m}^2)$.

9.2.1.19* Concealed spaces formed by noncombustible or limited-combustible ceilings suspended from the bottom of wood joists and composite wood joists with a maximum nominal chord width of 2 in. (50 mm), where joist spaces are full of noncombustible batt insulation with a maximum 2 in, (50 mm) air space between the decking material and the top of the batt insulation shall not require sprinklers.

9.2.1.19.1 Facing that meets the requirements for noncombustible or limited-combustible material covering the surface of the bottom chord of each joist and secured in place per the manufacturer's recommendations shall not require sprinklers.

9.2.1.20 Exterior Soffits, Eaves, Overhangs, and Decorative Frame Elements.

9.2.1.20.1 Sprinklers shall be permitted to be omitted from within combustible soffits, eaves, overhangs, and decorative frame elements that are constructed in accordance with 9.2.1.20.2 through 9.2.1.20.5.

9.2.1.20.2 Combustible soffits, eaves, overhangs, and decorative frame elements shall not exceed 4 ft 0 in. (1.2 m) in width.

9.2.1.20.3 Combustible soffits, eaves, overhangs, and decorative frame elements shall be draftstopped, with a material equivalent to that of the soffit, into volumes not exceeding 160 ft^3 (4.5 m³).

9.2.1.20.4 Combustible soffits, eaves, overhangs, and decorative frame elements shall be separated from the interior of the building by walls or roofs of noncombustible or limited-combustible construction.

9.2.1.20.5 Combustible soffits, eaves, overhangs, and decorative frame elements shall have no openings or unprotected penetrations directly into the building.

9.2.2 Spaces Under Ground Floors, Exterior Docks, and Exterior Platforms. Sprinklers shall be permitted to be omitted from spaces under ground floors, exterior docks, and exterior platforms where all of the following conditions exist:

- (1) The space is not accessible for storage purposes and is protected against accumulation of wind-borne debris.
- (2) The space contains no equipment such as conveyors or fuel-fired heating units.
- (3) The floor over the space is constructed in such a manner as to prevent the passage of debris into the space below.
- (4) No combustible or flammable liquids or materials that under fire conditions would convert into combustible or flammable liquids are processed, handled, or stored on the floor above the space.

9.2.3* Exterior Projections.

9.2.3.1* Sprinklers shall be permitted to be omitted where the exterior canopies, roofs, porte-cocheres, balconies, decks, and similar projections are constructed with materials that are noncombustible, limited-combustible, or fire retardant–treated wood as defined in NFPA 703, or where the projections are constructed utilizing a noncombustible frame, limited-combustibles, or fire retardant–treated wood with an inherently flame-resistant fabric overlay as demonstrated by Test Method 2 in accordance with NFPA 701.

9.2.3.2 Sprinklers shall be permitted to be omitted from below the exterior projections of combustible construction, provided the exposed finish material on the exterior projections are noncombustible, limited-combustible, or fire retardant–treated wood as defined in NFPA 703, and the exterior projections contain only sprinklered concealed spaces or any of the following unsprinklered combustible concealed spaces:

- (1) Combustible concealed spaces filled entirely with noncombustible insulation
- (2) Light or ordinary hazard occupancies where noncombustible or limited-combustible ceilings are directly attached to the bottom of solid wood joists so as to create enclosed joist spaces 160 ft³ (4.5 m³) or less in volume, including space below insulation that is laid directly on top or within the ceiling joists in an otherwise sprinklered attic [see 19.2.3.1.5.2(4)]
- (3) Concealed spaces over isolated small exterior projections not exceeding 55 ft² (5.1 m²) in area

9.2.3.2.1 Sprinklers shall be required for porte-cocheres that are located directly below floors intended for occupancy.

9.2.3.3 Sprinklers shall be permitted to be omitted from an exterior exit corridor where the exterior wall of the corridor is at least 50 percent open and where the corridor is entirely of noncombustible construction.

9.2.3.4 Sprinklers shall be installed under all exterior projections greater than 4 ft (1.2 m) where combustibles are stored.

9.2.4 Dwelling Units.

9.2.4.1 Bathrooms.

9.2.4.1.1* Unless sprinklers are required by 9.2.4.1.2 or 9.2.4.1.3, sprinklers shall not be required in bathrooms that are located within dwelling units, that do not exceed 55 ft² (5.1 m^2)

in area, and that have walls and ceilings of noncombustible or limited-combustible materials with a 15-minute thermal barrier rating, including the walls and ceilings behind any shower enclosure or tub.

9.2.4.1.1.1 Bathrooms in accordance with 9.2.4.1.1 that are located under stairs that are part of the path of egress shall not be required to be protected provided that the bathroom is separated from the stairs by fire-resistive construction in accordance with the local building code.

9.2.4.1.2 Sprinklers shall be required in bathrooms of limited care facilities and nursing homes, as defined in NFPA *101*.

9.2.4.1.3 Sprinklers shall be required in bathrooms opening directly onto public corridors or exitways.

9.2.5 Closets and Pantries.

9.2.5.1 Sprinklers shall not be required in clothes closets, linen closets, and pantries, with or without doors, within dwelling units in hotels and motels where the area of the space does not exceed 24 ft² (2.2 m²) and the walls and ceilings are surfaced with noncombustible or limited-combustible materials.

9.2.5.2* Hospital Clothes Closets. Sprinklers shall not be required in clothes closets of patient sleeping rooms in hospitals where the area of the closet does not exceed 6 ft² (0.6 m^2), provided the distance from the sprinkler in the patient sleeping room to the back wall of the closet does not exceed the maximum distance permitted by 9.5.3.2.

9.2.5.3 Sprinklers shall not be required in closets and pantries where other governing laws, codes, or standards permit their omission.

9.2.6* Electrical Equipment Rooms. Sprinklers shall not be required in electrical equipment rooms where all of the following conditions are met:

- (1) The room is dedicated to electrical equipment only.
- (2) Only dry-type or liquid-type with listed K-class fluid electrical equipment is used.
- (3) Equipment is installed in a 2-hour fire-rated enclosure including protection for penetrations.
- (4) Storage is not permitted in the room.

9.2.7 Cloud Ceilings.

9.2.7.1* Sprinklers shall be permitted to be omitted above cloud ceilings where all of the following apply:

- (1)* The combined total area of the openings around the cloud are less than or equal to 20 percent of the area of the ceiling, construction feature, or plane used to determine the boundaries of the compartment.
- (2) The width of the gap and the maximum sprinkler protection area are in accordance with Table 9.2.7.1.
- (3) The requirements of 9.2.7.2 are met.
- (4) Spaces above cloud ceilings contain either noncombustible or limited-combustible construction with minimal combustible loading.

9.2.7.2 When sprinklers are omitted from above a cloud ceiling in accordance with 9.2.7.1, the requirements of this section shall apply.

9.2.7.2.1 All sprinklers shall be quick response standard spray or extended coverage pendent or upright sprinklers.

 Table 9.2.7.1 Maximum Sprinkler Protection Area Based on

 Ceiling Cloud Width and Opening Width

Ceiling Cloud — Minimum Width Dimension (ft)	Maximum Area (ft²) — Opening Width ≤0.5 in./ft of Ceiling Height	Maximum Area (ft²) — Opening Width ≤0.75 in./ft of Ceiling Height	Maximum Area (ft²) — Opening Width ≤1 in./ft of Ceiling Height
2-<2.5	175	70	NP
2.5 - 4	225	120	70
>4	225	150	150

9.2.7.2.2 Maximum cloud ceiling height shall not exceed 20 ft (6.1 m).

9.2.7.2.3 Maximum spacing and area of protection shall not exceed the maximum requirements of Table 10.2.4.2.1(a) for light hazard and Table 10.2.4.2.1(b) for ordinary hazard.

9.2.7.2.3.1 Where extended coverage sprinklers are used, the maximum distance between sprinklers shall not exceed 16 ft (4.9 m).

9.2.7.2.4 Cloud ceilings shall be of smooth ceiling construction.

9.2.7.2.5* For irregular shaped ceiling clouds (not rectangular) the minimum width dimension shall be the smallest width dimension of the cloud and for the gap shall be the greatest dimension between clouds or adjacent walls as applicable.

9.2.8 Revolving Doors Enclosures. Sprinkler protection shall not be required within revolving door enclosures.

9.2.9* Furniture and Cabinets.

9.2.9.1 Sprinklers shall not be required to be installed in furniture, cabinets, and similar items not intended for occupancy.

9.2.9.2 This type of feature shall be permitted to be attached to the finished structure.

9.2.9.3 Where sprinklers are omitted from furniture, sprinklers in the surrounding area shall be located based on covering the area to the wall behind the furniture.

9.2.10 Small Temporarily Occupied Enclosures.

9.2.10.1* Sprinklers shall not be required in small isolated temporarily occupied enclosures that do not extend to the ceiling.

9.2.10.2 The maximum area of the small temporarily occupied enclosures shall not exceed 24 ft² (2.2 m²), and storage shall not be permitted.

9.2.11* Equipment Enclosures. Sprinklers shall not be required to be installed within electrical equipment, mechanical equipment, or air handling units not intended for occupancy.

9.2.12 Noncombustible Vertical Shafts. Sprinklers shall not be required at the top of noncombustible or limited-combustible, nonaccessible vertical duct, electric, and mechanical shafts as permitted by 9.3.3.1.1 and 9.3.3.1.2.

9.2.13 Noncombustible Stairways.

9.2.13.1 Sprinklers shall not be required at the bottom of stairwells complying with the provisions of 9.3.4.2.3.1.

9.2.13.2 Sprinklers shall not be required for exterior stair towers complying with the provisions of 9.3.4.2.4.

△ 9.2.14 Elevator Hoistways and Machine Rooms.

- **N 9.2.14.1 Elevators.** Sprinklers shall be permitted to be omitted in elevator machine rooms, machinery spaces, control rooms, control spaces, and hoistways in accordance with 9.2.14 unless required by 9.3.6.
- **N 9.2.14.2 Elevator Pits.** Sprinklers shall not be required in elevator pits.
- **N** 9.2.14.3 Elevator Machine Rooms, Machinery Spaces, Control Rooms, Control Spaces, and Hoistways. Sprinklers shall not be required in elevator machine rooms, machinery spaces, control rooms, control spaces, or top of hoistways of elevators installed in accordance with the applicable provisions in NFPA *101*, or the applicable building code, where all the following conditions are met:
 - (1) The elevator machine rooms, machinery spaces, control rooms, control spaces, or hoistways are dedicated to elevator equipment only.
 - (2) The elevator machinery spaces, control rooms, control spaces, or hoistways are separated from the remainder of the building by walls and floor/ceiling or roof/ceiling assemblies having a fire resistance rating of not less than that specified by the applicable building code.
 - (3) No materials unrelated to elevator equipment are permitted to be stored in elevator machine rooms, machinery spaces, control rooms, control spaces, or hoistways.
 - (4) The elevator machinery is not of the hydraulic type.

N 9.2.14.4 Hydraulic Elevators.

- **N 9.2.14.4.1** Sprinklers shall not be required in the elevator machine rooms, machinery spaces, control rooms, and control spaces where noncombustible hydraulic fluid is used.
- **N 9.2.14.4.2** Sprinklers shall not be required at the top of hoistways of hydraulic elevators.
- **N 9.2.14.5 Suspension Means.** Sprinklers shall not be required in elevator hoistways where the suspension means is in accordance with one of the following:
 - (1) A noncombustible suspension means
 - (2) A combustible suspension means in accordance with the FT-1 test method and tested to the vertical burn test requirements of UL 2556, *Wire and Cable Test Methods*, that does not continue to burn for more than 60 seconds and the indicator flag does not burn more than 25 percent
- **N 9.2.14.6*** Noncombustible and Limited-Combustible Elevators. Sprinklers shall not be required at the top of the hoistway where the hoistway for elevators is noncombustible or limitedcombustible and the car enclosure materials meet the requirements of ASME A17.1/CSA B44, *Safety Code for Elevators and Escalators.*

9.2.15 Duct Protection. Sprinklers shall not be required in vertical duct risers complying with 9.3.9.1.2.

9.2.16 Open-Grid Ceilings. Sprinklers shall not be required below open grid ceiling installations complying with 9.3.10.

9.2.17 Drop-Out Ceilings. Sprinklers shall not be required below drop-out ceilings complying with 9.3.11.

9.2.18 Skylights. Sprinklers shall not be required in skylights complying with 9.3.16.

9.3 Special Situations.

9.3.1 Heat-Producing Devices with Composite Wood Joist Construction. Where heat-producing devices such as furnaces or process equipment are located in the joist channels above a ceiling attached directly to the underside of composite wood joist construction that would not otherwise require sprinkler protection of the spaces, the joist channel containing the heat-producing devices shall be sprinklered by installing sprinklers in each joist channel, on each side, adjacent to the heat-producing device.

△ 9.3.2 Horizontal Combustible Concealed Spaces. Unless the requirements of 9.2.1.19 are met, sprinklers used in horizontal combustible concealed spaces (with a slope not exceeding 2 in 12) with wood truss, wood joist construction, or bar joist construction having a combustible upper surface and where the depth of the space is less than 36 in. (900 mm) from deck to deck, from deck to ceiling, or with double wood joist construction with a maximum of 36 in. (900 mm) between the top of the bottom joist and the bottom of the upper joist shall be listed for such use.

9.3.2.1 Sprinklers specifically listed to provide protection of combustible concealed spaces described in 9.3.2 shall be permitted to be used in accordance with 9.4.1.2 where the space is less than 12 in. (300 mm) from deck to deck or deck to ceiling

9.3.2.2 Sprinklers specifically listed to provide protection of combustible concealed spaces described in 9.3.2 shall be permitted to be used in accordance with 9.4.1.2 throughout the area when a portion of the area exceeds a depth of 36 in. (900 mm).

9.3.2.3 Sprinklers specifically listed to provide protection of combustible concealed spaces described in 9.3.2 shall be permitted to be used in accordance with 9.4.1.2 to protect composite wood joist construction.

9.3.3 Vertical Shafts.

9.3.3.1 General. Unless the requirements of 9.3.3.1.1 or 9.3.3.1.2 are met, one sprinkler shall be installed at the top of shafts.

9.3.3.1.1 Noncombustible or limited-combustible, nonaccessible vertical duct shafts shall not require sprinkler protection.

9.3.3.1.2 Noncombustible or limited-combustible, nonaccessible vertical electrical or mechanical shafts shall not require sprinkler protection.

9.3.3.2* Shafts with Combustible Surfaces.

9.3.3.2.1 Where vertical shafts have combustible surfaces, one sprinkler shall be installed at each alternate floor level.

9.3.3.2.2 Where a shaft having combustible surfaces is trapped, an additional sprinkler shall be installed at the top of each trapped section.

9.3.3.3 Accessible Shafts with Noncombustible Surfaces. Where accessible vertical shafts have noncombustible surfaces, one sprinkler shall be installed near the bottom.

9.3.4 Stair Shafts.

9.3.4.1 Combustible Construction. Sprinklers shall be installed in stair shafts of combustible construction in accordance with 9.3.4.1.1, 9.3.4.1.2, and 9.3.4.1.3.

9.3.4.1.1 Sprinklers shall be installed at the top of combustible stair shafts to protect the entire footprint of the shaft.

9.3.4.1.2* Sprinklers shall be installed under the landings at each floor level.

9.3.4.1.3 Sprinklers shall be installed beneath the lowest intermediate landing.

9.3.4.2 Noncombustible Construction.

9.3.4.2.1 In noncombustible stair shafts having noncombustible stairs with noncombustible or limited-combustible finishes, sprinklers shall be installed at the top of the shaft to protect the entire footprint of the shaft and under the first accessible landing above the bottom of the shaft.

9.3.4.2.2 Where noncombustible stair shafts are divided by walls or doors, sprinklers shall be provided on each side of the separation.

9.3.4.2.3 Sprinklers shall be installed beneath landings or stairways where the area beneath is used for storage.

9.3.4.2.3.1* Sprinklers shall be permitted to be omitted under the first accessible landing above the bottom of the shaft when the space under the stairs at the bottom is blocked off so that storage cannot occur.

9.3.4.2.4 Sprinklers shall be permitted to be omitted from exterior stair towers when the exterior walls of the stair tower are at least 50 percent open and when the stair tower is entirely of noncombustible construction.

9.3.4.3* Stairs Serving Two or More Areas. When stairs have openings to each side of a fire wall(s), sprinklers shall be installed in the stair shaft at each floor landing with multiple openings.

9.3.5* Vertical Openings.

9.3.5.1* General. Unless the requirements of 9.3.5.4 are met, where moving stairways, staircases, or similar floor openings are unenclosed and where sprinkler protection is serving as the alternative to enclosure of the vertical opening, the floor openings involved shall be protected by closely spaced sprinklers in combination with draft curtains in accordance with 9.3.5.2 and 9.3.5.3.

9.3.5.2 Draft Curtains. Draft curtains shall meet all of the following criteria:

- (1) The draft curtains shall be located immediately adjacent to the opening.
- (2) The draft curtains shall be at least 18 in. (450 mm) deep.
- (3) The draft curtains shall be of noncombustible or limitedcombustible material that will stay in place before and during sprinkler operation.

9.3.5.3 Sprinklers.

9.3.5.3.1 Sprinklers shall be spaced not more than 6 ft (1.8 m) apart and placed 6 in. to 12 in. (150 mm to 300 mm) from the draft curtain on the side away from the opening.

9.3.5.3.2 Where sprinklers are closer than 6 ft (1.8 m), cross baffles shall be provided in accordance with 10.2.6.4.2.

9.3.5.4 Large Openings. Closely spaced sprinklers and draft curtains are not required around large openings such as those found in shopping malls, atrium buildings, and similar structures where all adjoining levels and spaces are protected by automatic sprinklers in accordance with this standard and where the openings have all horizontal dimensions between opposite edges of 20 ft (6.1 m) or greater and an area of 1000 ft² (93 m²) or greater.

9.3.6 Elevators.

- **N** 9.3.6.1 Combustible Suspension Means. Sprinklers shall be installed at the top of hoistways where elevators use combustible suspension means that do not meet the requirements of 9.2.14.5(2).
- Δ 9.3.6.2 Machine Rooms, Machinery Spaces, Control Rooms, and Control Spaces. Sprinklers shall be required in elevator machine rooms, machinery spaces, control rooms, and control spaces containing combustible hydraulic fluid.
- **N 9.3.6.3** Where provided, sprinklers in elevator machine rooms, machinery spaces, control rooms, control spaces, or hoistways shall be standard response spray sprinklers.

9.3.7* Library Stack Areas and Record Storage. Where books or records are stored in fixed open book shelves, sprinklers shall be installed in accordance with one of the following:

- (1) Sprinklers shall be permitted to be installed without regard to aisles where clearance between sprinkler deflectors and tops of stacks is 18 in. (450 mm) or more.
- (2) Where the 18 in. (450 mm) clearance between sprinkler deflectors and tops of stacks cannot be maintained, sprinklers shall be installed in every aisle and at every tier of stacks with distance between sprinklers along aisles not to exceed 12 ft (3.7 m) in accordance with Figure 9.3.7(a).
- (3) Where the 18 in. (450 mm) clearance between sprinkler deflectors and tops of stacks cannot be maintained and where vertical shelf dividers are incomplete and allow water distribution to adjacent aisles, sprinklers shall be permitted to be omitted in alternate aisles on each tier, and where ventilation openings are also provided in tier floors, sprinklers shall be staggered vertically in accordance with Figure 9.3.7(b).

9.3.8* Industrial Ovens and Furnaces.

9.3.9 Duct Protection. Duct protection shall be required to meet the requirements of 9.3.9 where required by the authority having jurisdiction or the applicable referenced code or standard.

9.3.9.1 Sprinkler Location.

9.3.9.1.1 Unless the requirements of 9.3.9.1.2 or 9.3.9.1.3 are met, ducts shall have one sprinkler located at the top of each vertical riser and at the midpoint of each offset.

9.3.9.1.2 Sprinklers 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).









9.3.9.1.3 Horizontal exhaust ducts shall have sprinklers located on 10 ft (3.0 m) centers beginning no more than 5 ft (1.5 m) from the duct entrance.

9.3.9.2 Protection Against Freezing. Sprinklers in exhaust ducts subject to freezing shall be properly protected against freezing. (*See 16.4.1.*)

9.3.9.3 Sprinkler Access. Access shall be provided to all sprinklers for inspection, testing, and maintenance.

9.3.9.4 Strainers. A listed line strainer shall be installed in the main water supply preceding sprinklers having nominal K-factors smaller than K-2.8 (40).

9.3.10* Open-Grid Ceilings. Open-grid ceilings shall only be installed beneath sprinklers where one of the following is met:

- (1) Open-grid ceilings in which the openings are ¼ in. (6 mm) or larger in the least dimension, where the thickness or depth of the material does not exceed the least dimension of the opening, and where such openings constitute 70 percent of the area of the ceiling material. The spacing of the sprinklers over the open-grid ceiling shall then comply with the following:
 - (a) In light hazard occupancies where sprinkler spacing (either spray or old-style sprinklers) is less than 10 ft × 10 ft (3 m × 3 m), a minimum clearance of at least 18 in. (450 mm) shall be provided between the sprinkler deflectors and the upper surface of the open-grid ceiling. Where spacing is greater than 10 ft × 10 ft (3 m × 3 m) but less than 10 ft × 12 ft (3 m × 3.7 m), a clearance of at least 24 in. (600 mm) shall be provided from spray sprinklers and at least 36 in. (900 mm) from old-style sprinklers. Where spacing is greater than 10 ft × 12 ft (3 m × 3.7 m), a clearance of at least 48 in. (1.2 m) shall be provided.
 - (b) In ordinary hazard occupancies, open-grid ceilings shall be permitted to be installed beneath spray sprinklers only. Where sprinkler spacing is less than 10 ft × 10 ft (3 m × 3 m), a minimum clearance of at least 24 in. (600 mm) shall be provided between the sprinkler deflectors and the upper surface of the open-grid ceiling. Where spacing is greater than 10 ft × 10 ft (3 m × 3 m), a clearance of at least 36 in. (900 m) shall be provided.

Other types of open-grid ceilings shall be permitted to be installed beneath sprinklers where they are listed for such service and are installed in accordance with instructions contained in each package of ceiling material.

9.3.11 Drop-Out Ceilings and Ceiling Materials.

9.3.11.1* Drop-out ceilings and ceiling materials shall be permitted to be installed beneath sprinklers where the ceiling panels or ceiling materials are listed for that service and are installed in accordance with their listings.

9.3.11.2 Drop-out ceilings and ceiling materials meeting the criteria in 9.3.11.1 shall not be installed below quick-response or extended coverage sprinklers unless specifically listed for that application.

9.3.11.3 Drop-out ceilings and ceiling materials meeting the criteria in 9.3.11.1 shall not be considered ceilings within the context of this standard.

9.3.11.4* Piping installed above drop-out ceilings and ceiling materials meeting the criteria in 9.3.11.1 shall not be considered concealed piping.

9.3.11.5* Sprinklers shall not be installed beneath drop-out ceilings or ceiling materials meeting the criteria in 9.3.11.1.

9.3.12* Fur Storage Vaults. Old-style/conventional sprinklers shall be installed in fur storage vaults.

9.3.13 Stages.

(2)

9.3.13.1 Sprinklers shall be installed under the roof at the ceiling, in spaces under the stage either containing combustible materials or constructed of combustible materials, and in all

adjacent spaces and dressing rooms, storerooms, and work-shops.

9.3.13.2 Where proscenium opening protection is required, a deluge system shall be provided with open sprinklers located not more than 3 ft (900 mm) away from the stage side of the proscenium arch and spaced up to a maximum of 6 ft (1.8 m) on center. (*See Chapter 19 for design criteria.*)

9.3.14 Spaces Above Ceilings.

9.3.14.1 Where spaces have ceilings that are lower than the rest of the area, the space above this lower ceiling shall be sprinklered unless it complies with the rules of 9.2.1 for allowable unsprinklered concealed spaces.

- **\Delta 9.3.14.2** Where the space above a ceiling is sprinklered, the sprinkler system shall conform to the rules of 19.1.2 and Section 20.13.
- Δ 9.3.14.3* Where there is a noncombustible space above a noncombustible or limited-combustible ceiling that is sprinklered because it is open to an adjacent sprinklered space and where there is no possibility for storage above the drop ceiling, the sprinkler system shall be permitted to extend only as far into the space as 0.6 times the square root of the design area of the sprinkler system in the adjacent space.

9.3.14.3.1 The sprinkler system shall extend at least 24 ft (7.3 m) into the space above the ceiling.

9.3.15* Sprinkler-Protected Glazing. Where sprinklers are used in combination with glazing as an alternative to a required fire-rated wall or window assembly, the sprinkler-protected assembly shall comply with the following:

- (1) Sprinklers shall be listed as specific application window sprinklers unless the standard spray sprinklers are specifically permitted by the building code.
- (2) Sprinklers shall be supplied by a wet pipe system.
- (3) Glazing shall be heat-strengthened, tempered, or glass ceramic and shall be fixed.
- (4) Where the assembly is required to be protected from both sides, sprinklers shall be installed on both sides of the glazing.
- (5) The use of sprinkler-protected glazing shall be limited to non-load-bearing walls.
- (6) The glazed assembly shall not have any horizontal members that would interfere with uniform distribution of water over the surface of the glazing, and there shall be no obstructions between sprinklers and glazing that would obstruct water distribution.
- (7) The water supply duration for the design area that includes the window sprinklers shall not be less than the required rating of the assembly

9.3.16 Skylights.

9.3.16.1 Sprinklers shall be permitted to be omitted from skylights not exceeding 32 ft^2 (3.0 m²) in area, regardless of hazard classification, that are separated by at least 10 ft (3.0 m) horizontally from any other unprotected skylight or unprotected ceiling pocket.

9.3.16.1.1 When a sprinkler is installed directly beneath a skylight that does not allow venting and does not exceed 32 ft^2 (3.0 m²), the distance to the ceiling shall be measured to the plane of the ceiling as if the skylight was not present.

N 9.3.16.2* Where skylights do not meet the requirements of 9.3.16.1, the skylight shall be permitted to be protected as a ceiling pocket in accordance with the appropriate sprinkler installation requirements in Chapter 10 through Chapter 14.

9.3.16.3 Skylights not exceeding 32 ft^2 (3.0 m^2) shall be permitted to have a plastic cover.

9.3.16.4 Skylights that allow venting, other than smoke and heat venting per 20.9.5, shall be provided with sprinkler protection installed in the skylight.

9.3.17 Concealed Spaces.

9.3.17.1 Concealed Spaces Requiring Sprinkler Protection. Concealed spaces of exposed combustible construction shall be protected by sprinklers except in concealed spaces where sprinklers are not required to be installed by 9.2.1.1 through 9.2.1.20 and 9.2.2.

9.3.17.1.1* Concealed Space Design Requirements. Sprinklers in concealed spaces having no access for storage or other use shall be installed in accordance with the requirements for light hazard occupancy.

9.3.17.1.2 Localized Protection of Exposed Combustible Construction or Exposed Combustibles. When otherwise noncombustible or limited-combustible concealed spaces that would not require sprinkler protection have localized exposed combustible construction, or contain localized areas of exposed combustibles, the combustibles shall be permitted to be protected as follows:

- If the exposed combustibles are in the vertical partitions or walls around all or a portion of the enclosure, a single row of sprinklers spaced not over 12 ft (3.7 m) apart nor more than 6 ft (1.8 m) from the inside of the partition shall be permitted to protect the surface. The first and last sprinklers in such a row shall not be over 5 ft (1.5 m) from the ends of the partitions.
- (2) If the exposed combustibles are in the horizontal plane, the area of the combustibles shall be permitted to be protected with sprinklers on a light hazard spacing. Additional sprinklers shall be installed no more than 6 ft (1.8 m) outside the outline of the area and not more than 12 ft (3.7 m) on center along the outline. When the outline returns to a wall or other obstruction, the last sprinkler shall not be more than 6 ft (1.8 m) from the wall or obstruction.

9.3.18 Spaces Under Ground Floors, Exterior Docks, and Platforms.

9.3.18.1 Unless the requirements of 9.2.2 are met, sprinklers shall be installed in spaces under all combustible ground floors and combustible exterior docks and platforms.

9.3.19 Exterior Projections.

9.3.19.1* Unless the requirements of 9.2.3.1, 9.2.3.2, or 9.2.3.3 are met, sprinklers shall be installed under exterior projections exceeding 4 ft (1.2 m) in width.

9.3.19.2* Sprinklers shall be installed under all exterior projections greater than 4 ft (1.2 m) where combustibles are stored.

9.3.20* Balconies and Decks Serving Dwelling Units.

9.3.20.1* Where a roof, deck, or balcony greater than 4 ft (1.2 m) wide is provided above, sprinklers shall be installed to protect attached exterior balconies, attached exterior decks, and ground floor patios directly serving dwelling units in buildings of Type V construction.

9.3.20.2 Where sprinklers are installed beneath roofs, overhangs, decks, or balconies, sprinklers shall be permitted to be installed with deflectors positioned in accordance with 9.3.20.3 or 9.3.20.4 or the manufacturer's installation instructions.

9.3.20.3 Sidewall sprinklers shall not be less than 4 in. (100 mm) or more than 6 in. (150 mm) below structural members under a smooth ceiling and not less than 1 in. (25 mm) or more than 6 in. (150 mm) below exposed structural members, provided that the deflector is not more than 14 in. (350 mm) below the underside surface of the deck above the exposed structural members.

9.3.20.4 Pendent sprinklers shall be positioned in accordance with the requirements of NFPA 13 for the sprinkler type installed.

9.3.21 Electrical Equipment.

9.3.21.1 Unless the requirements of 9.2.6 are met, sprinkler protection shall be required in electrical equipment rooms.

9.4 Use of Sprinklers.

9.4.1 General.

9.4.1.1* Sprinklers shall be installed in accordance with their listing.

9.4.1.2 Where no sprinklers are specifically listed for construction features or other special situations that require unusual water distribution, the requirements of 9.4.1.1 shall not apply and listed sprinklers shall be permitted to be installed in positions other than anticipated by their listing to achieve specific results.

9.4.1.3* Upright sprinklers shall be installed with the frame arms parallel to the branch line, unless specifically listed for other orientation.

9.4.1.4 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.

9.4.1.5 Protective Caps and Straps.

9.4.1.5.1* Protective caps and straps shall be removed using means that are in accordance with the manufacturer's installation instructions.

9.4.1.5.2* Protective caps and straps shall be removed from all sprinklers prior to the time when the sprinkler system is placed in service.

9.4.1.5.3 Protective caps and straps on all upright sprinklers or on any sprinklers installed more than 10 ft (3.0 m) above the floor shall be permitted to be removed from sprinklers immediately following their installation.

9.4.2 Temperature Ratings.

9.4.2.1* Unless the requirements of 9.4.2.2, 9.4.2.3, 9.4.2.4, or 9.4.2.5 are met, ordinary or intermediate-temperature sprin-

klers shall be permitted to be used throughout buildings and compartments.

9.4.2.2 Where maximum ceiling temperatures exceed 100° F (38°C), sprinklers with temperature ratings in accordance with the maximum ceiling temperatures of Table 7.2.4.1(a) or Table 7.2.4.1(b) shall be used.

9.4.2.3 High-temperature sprinklers shall be permitted to be used throughout ordinary and extra hazard occupancies, storage occupancies, and as allowed in this standard and other NFPA codes and standards.

9.4.2.4 Sprinklers of intermediate- and high-temperature classifications shall be installed in specific locations as required by 9.4.2.5.

9.4.2.5* 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 9.4.2.5(a), Table 9.4.2.5(b), and Figure 9.4.2.5:

- (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. (300 mm) to one side or 30 in. (750 mm) above an uncovered steam main, heating coil, or radiator shall be of the intermediatetemperature 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 attics (peaked or flat) shall be of the intermediate-temperature classification.
- (6) Sprinklers in enclosed show windows 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 8.9.6.*)
- (8) Sprinklers protecting residential areas installed near specific heat sources identified in Table 9.4.2.5(b) shall be installed in accordance with Table 9.4.2.5(b).
- (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 9.4.2.5(a) or Table 9.4.2.5(b).
- (10) Sprinklers in walk-in type coolers and freezers with automatic defrosting shall be of the intermediatetemperature classification or higher.
- (11) Sprinklers in closets containing ventless clothes dryers shall be of the intermediate-temperature classification or higher.

9.4.2.6 In case of occupancy change involving temperature change, the sprinklers shall be changed accordingly.

9.4.2.7* The minimum temperature rating of ceiling sprinklers in general storage, rack storage, rubber tire storage, roll paper storage, and baled cotton storage applications shall be 150° F (66°C).

Type of Heat Condition	Ordinary-Temperature Rating	Intermediate-Temperature Rating	High-Temperature Rating
Type of Heat ConditionOrdinary-Temperature Rating(1) Heating ducts (a) AboveMore than 2 ft 6 in. (750 mm)(b) Side and belowMore than 1 ft 0 in. (300 mm)(c) DiffuserAny distance except as shown under Intermediate- Temperature Rating column		2 ft 6 in. or less (750 mm) 1 ft 0 in. or less (300 mm) <i>Downward discharge:</i> Cylinder with 1 ft 0 in. (300 mm) radius from edge extending 1 ft 0 in. (300 mm) below and 2 ft 6 in. (750 mm) above <i>Horizontal discharge:</i> Semicylinder or cylinder with 2 ft 6 in. (750 mm) radius from edge in direction of flow extending 1 ft 0 in. (300 mm) below and 2 ft 6 in. (750 mm) above	2025
 (2) Unit heater and radiant heater (a) Horizontal discharge (b) Vertical downward discharge (for sprinklers below unit heater see Figure 		Discharge side: 7 ft 0 in. (2.1 m) to 20 ft 0 in. (6.1 m) radius pie- shaped cylinder (see Figure 9.4.2.5) extending 7 ft 0 in. (2.1 m) above and 2 ft 0 in. (600 mm) below heater; also 7 ft 0 in. (2.1 m) radius cylinder more than 7 ft 0 in. (2.1 m) above unit heater 7 ft 0 in. (2.1 m) radius cylinder extending upward from an elevation 7 ft 0 in. (2.1 m)	 7 ft 0 in. (2.1 m) radius cylinder extending 7 ft 0 in. (2.1 m) above and 2 ft 0 in. (600 mm) below unit heater 7 ft 0 in. (2.1 m) radius cylinder extending from the top of the unit heater
9.4.2.5) (3) Steam mains (uncovered) (a) Above (b) Side and below (c) Blowoff when	More than 2 ft 6 in. (750 mm) More than 1 ft 0 in. (300 mm) More than 7 ft 0 in. (2 1 m)	above unit heater 2 ft 6 in. or less (750 mm) 1 ft 0 in. or less (300 mm)	to an elevation 7 ft 0 in. (2.1 m) above unit heater

Z	Table 9.4.2.5(a)	Temperature	Ratings of	Sprinklers	Based on	Distance from	n Heat Sources

9.4.2.8 Listed residential sprinklers of intermediate temperature rating shall be permitted to be installed throughout areas where residential sprinklers are required or permitted.

9.4.2.9 Listed quick response sprinklers of ordinary and/or intermediate temperature rating shall be permitted to be installed throughout areas where quick response sprinklers are required or permitted.

Δ 9.4.3 Thermal Sensitivity.

▲ 9.4.3.1 Sprinklers in light hazard occupancies shall be one of the following:

- (1) Quick-response type as defined in 3.3.223.4.16
- (2) Residential sprinklers in accordance with the requirements of Chapter 12
- (3) Quick-response CMSA sprinklers
- (4) ESFR sprinklers

9.4.3.2 Where quick-response sprinklers are installed, all sprinklers within a compartment shall be quick-response unless otherwise permitted in 9.4.3.3, 9.4.3.4, or 9.4.3.5.

9.4.3.3 Where there are no listed quick-response sprinklers in the temperature range required, standard-response sprinklers shall be permitted to be used.

9.4.3.4 The provisions of 9.4.3.2 shall not apply to in-rack sprinklers.

9.4.3.5 In other than light hazard occupancies, where a sprinkler carries a listing for both standard-response protection and quick-response protection at different coverage areas, that sprinkler shall be permitted to be installed within a compartment at the spacing for both the quick-response and standard-response listings without any separation between the areas so covered.

9.4.4 Sprinklers with K-Factors Less than K-5.6 (80).

9.4.4.1 Sprinklers shall have a minimum nominal K-factor of 5.6 (80) unless otherwise permitted by 9.4.4.

Δ Table 9.4.2.5(b) Te	emperature Ratings	of Sprinklers in S	specified Residential	Areas
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	Minimum Distance from Edge of Source to Ordinary-Temperature Sprinkler		Minimum Distance from Edge of Source to Intermediate-Temperature Sprinkler	
Heat Source	in.	mm	in.	mm
Side of open or recessed fireplace	36	900	12	300
Front of recessed fireplace	60	1500	36	900
Coal- or wood-burning stove	42	1050	12	300
Kitchen range	18	450	9	225
Wall oven	18	450	9	225
Hot air flues	18	450	9	225
Uninsulated heat ducts	18	450	9	225
Uninsulated hot water pipes	12	300	6	150
Side of ceiling- or wall-mounted hot air diffusers	24	600	12	300
Front of wall-mounted hot air diffusers	36	900	18	450
Hot water heater or furnace	6	150	3	75
Light fixture except LED:				
0 W-250 W	6	150	3	75
250 W-499 W	12	300	6	150



FIGURE 9.4.2.5 High-Temperature and Intermediate-Temperature Zones at Unit Heaters and Radiant Heaters.

9.4.4.2 For light hazard occupancies, sprinklers having a nominal K-factor smaller than K-5.6 (80) shall be permitted, subject to the following restrictions:

- (1) The system shall be hydraulically calculated.
- (2) Sprinklers with nominal K-factors of less than K-5.6 (80) shall be installed only in wet pipe sprinkler systems or in accordance with the limitations of 9.4.4.3 or 9.4.4.4.
- (3) A listed strainer shall be provided on the supply side of sprinklers with nominal K-factors of less than K-2.8 (40).

9.4.4.3 Sprinklers with nominal K-factors of less than K-5.6 (80) shall be permitted to be installed in conformance with 19.3.2 for protection against exposure fires.

9.4.4.4 Sprinklers with nominal K-factors of K-4.2 (57) shall be permitted to be installed on dry pipe and preaction systems protecting light hazard occupancies where piping is corrosion resistant or internally galvanized.

N 9.4.5 Sprinklers in Ordinary Hazard Group 2 Occupancies with Ceilings Over 30 ft (9.1 m). Sprinklers having a nominal K-factor less than K-11.2 (K-160) shall not be permitted for use in Ordinary Hazard Group 2 and higher occupancy hazards where the ceiling height is greater than 30 ft (9.1 m).

9.4.6 Thread Size Limitations. Sprinklers having a K-factor exceeding K-5.6 (80) and having $\frac{1}{2}$ in. (15 mm) National Pipe Thread (NPT) shall not be installed in new sprinkler systems.

9.5 Position, Location, Spacing, and Use of Sprinklers.

9.5.1 General.

9.5.1.1 Sprinklers shall be located, spaced, and positioned in accordance with the requirements of Section 9.5.

9.5.1.2 Sprinklers shall be positioned to provide protection of the area consistent with the overall objectives of this standard by controlling the positioning and allowable area of coverage for each sprinkler.

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9.5.1.3* In light and ordinary hazard occupancies, small areas created by architectural features shall be evaluated as follows:

- (1) Where no additional floor area is created by the architectural features, no additional sprinkler protection is required.
- (2) Where additional floor area is created by an architectural feature, no additional sprinkler protection is required, provided all of the following conditions are met:
 - (a) The floor area does not exceed 18 ft² (1.7 m^2) .
 - (b) The floor area is not greater than 2 ft (0.61 m) in depth at the deepest point of the architectural feature to the plane of the primary wall where measured along the finished floor.
 - (c) The floor area is not greater than 9 ft (2.7 m) in length where measured along the plane of the primary wall.
 - (d) Measurement from the deepest point of the architectural feature shall not exceed the maximum listed spacing of the sprinkler.
- (3) The hydraulic design is not required to consider the area created by the architectural feature.

9.5.1.4 The requirements of 9.5.2 through 9.5.5 shall apply to all sprinkler types unless modified by more restrictive rules in Chapters 10 through 15.

9.5.2 Protection Areas per Sprinkler.

9.5.2.1 Determination of Protection Area of Coverage.

9.5.2.1.1 The protection area of coverage per sprinkler (A_s) shall be determined as follows:

- (1) Along branch lines as follows:
 - (a) Determine distance between sprinklers (or to wall or obstruction in the case of the end sprinkler on the branch line) upstream and downstream
 - (b) Choose the larger of either twice the distance to the wall or the distance to the next sprinkler
 - (c) Define dimension as *S*
- (2) Between branch lines as follows:
 - (a) Determine perpendicular distance to the sprinkler on the adjacent branch line (or to a wall or obstruction in the case of the last branch line) on each side of the branch line on which the subject sprinkler is positioned
 - (b) Choose the larger of either twice the distance to the wall or obstruction or the distance to the next sprinkler
 - (c) Define dimension as L

9.5.2.1.2 The protection area of coverage of the sprinkler shall be established by multiplying the *S* dimension by the *L* dimension, as follows:

$$A_s = S \times L$$

9.5.2.2 Maximum Protection Area of Coverage.

9.5.2.2.1 The maximum allowable protection area of coverage for a sprinkler (A_s) shall be in accordance with the value indicated in the section for each type or style of sprinkler.

9.5.2.2.2 The maximum area of coverage of any sprinkler shall not exceed $400 \text{ ft}^2 (37 \text{ m}^2)$.

9.5.3 Sprinkler Spacing.

9.5.3.1 Maximum Distance Between Sprinklers.

9.5.3.1.1 The maximum distance permitted between sprinklers shall be based on the centerline distance between adjacent sprinklers.

9.5.3.1.2 The maximum distance shall be measured along the slope of the ceiling.

9.5.3.1.3 The maximum distance permitted between sprinklers shall comply with the value indicated in the applicable section for each type or style of sprinkler.

9.5.3.2 Maximum Distance from Walls.

9.5.3.2.1 The distance from sprinklers to walls shall not exceed one-half of the allowable maximum distance between sprinklers.

9.5.3.2.2 The distance from the wall to the sprinkler shall be measured perpendicular to the wall.

9.5.3.2.3* The distance from the wall to the sprinkler shall be measured to the wall behind furniture.

9.5.3.2.4 The distance from the wall to the sprinkler shall be measured to the wall when sprinklers are spaced near windows and no additional floor space is created.

9.5.3.3 Minimum Distance from Walls.

9.5.3.3.1 The minimum distance permitted between a sprinkler and the wall shall comply with the value indicated in the applicable section for each type or style of sprinkler.

9.5.3.3.2 The distance from the wall to the sprinkler shall be measured perpendicular to the wall.

9.5.3.4 Minimum Distance Between Sprinklers.

9.5.3.4.1 A minimum distance shall be maintained between sprinklers to prevent operating sprinklers from wetting adjacent sprinklers and to prevent skipping of sprinklers.

9.5.3.4.2 The minimum distance permitted between sprinklers shall comply with the value indicated in the applicable section for each type or style of sprinkler.

9.5.3.4.3 The minimum distance to be maintained between sprinklers shall not apply when either one of the affected sprinklers is capable of protecting the room or space without the other sprinkler having to operate.

9.5.4 Deflector Position.

9.5.4.1* Distance Below Ceilings.

9.5.4.1.1 The distances between the sprinkler deflector and the ceiling above shall be selected based on the type of sprinkler and the type of construction.

9.5.4.1.2 Corrugated Metal Deck Roofs.

9.5.4.1.2.1 For corrugated metal deck roofs up to 3 in. (75 mm) in depth, the distance shall be measured to the sprinkler from the bottom of the deck.

9.5.4.1.2.2 For decks deeper than 3 in. (75 mm), the distance shall be measured to the highest point on the deck.

[9.5.2.1.2]

9.5.4.1.3 For ceilings that have insulation installed directly against underside of the ceiling or roof structure, the deflector distance shall be measured from the bottom of the insulation and shall be in accordance with 9.5.4.1.3.1, 9.5.4.1.3.2, and 9.5.4.1.3.3.

9.5.4.1.3.1 Insulation used to measure sprinkler deflector distance shall be batt insulation or insulation that withstands 3 lb/ft^2 (0.13 kg/m²) uplift force.

9.5.4.1.3.2 For insulation that is installed directly against the ceiling or roof structure and is installed flat and parallel to the ceiling or roof structure, the deflector distance shall be measured to the underside of the insulation.

9.5.4.1.3.3 For insulation that is installed in a manner that causes it to deflect or sag down from the ceiling or roof structure, the deflector distance shall be measured as half of the distance of the deflection from the insulation high point to the insulation low point.

(A) If the deflection or sag in the insulation exceeds 6 in. (150 mm), the deflector distance shall be measured to the high point of the insulation.

(B) The deflector shall not be positioned above the low point of the insulation.

9.5.4.1.4* Heat collectors shall not be used as a means to assist the activation of a sprinkler.

9.5.4.2 Deflector Orientation. Except as required in 9.5.4.3, deflectors of sprinklers shall be aligned parallel to ceilings, roofs, or the incline of stairs.

N 9.5.4.3 Deflectors of sprinklers shall be oriented as follows:

- (1) Where ceilings have a slope of 2 in 12 or less, deflectors of sprinklers shall be aligned parallel to ceilings, roofs, or the incline of stairs, or parallel to the floor.
- (2) Where ceilings have a slope of more than 2 in 12 and sprinklers protect nonstorage hazards in accordance with Chapter 19, deflectors of sprinklers shall be aligned parallel to ceilings, roofs, or the incline of stairs, or parallel to the floor.
- (3)* Where sprinklers are installed under ceilings with a slope that exceeds 2 in 12 (16.7 percent) and protect storage in accordance with Chapters 20 through 26, deflectors of sprinklers shall be aligned parallel to the floor of the storage area.

9.5.5 Obstructions to Sprinkler Discharge.

 Δ 9.5.5.1* General. Sprinklers shall be arranged in accordance with 9.5.5.2 and 9.5.5.3 to minimize obstructions to discharge, or supplemental sprinklers shall be provided to ensure adequate coverage of the hazard.

$9.5.5.2^*$ Obstructions to Sprinkler Discharge Pattern Development.

9.5.5.2.1 Obstructions, continuous or noncontinuous, individual or grouped, less than or equal to 18 in. (450 mm) below the sprinkler deflector that prevent the pattern from fully developing shall comply with 9.5.5.2.

9.5.5.2.2 Sprinklers shall be positioned in accordance with the minimum distances and special requirements of Section 10.2 through Section 14.2 so that they are located sufficiently away

from obstructions such as truss webs and chords, pipes, columns, and fixtures.

Δ 9.5.5.3 Obstructions that Prevent Sprinkler Discharge from Reaching Hazard.

№ 9.5.5.3.1* Obstructions, continuous or noncontinuous, individual or grouped, that interrupt the water discharge in a horizontal plane more than 18 in. (450 mm) below the sprinkler deflector in a manner to limit the distribution from reaching the protected hazard shall comply with 9.5.5.3.

Δ 9.5.5.3.2 Obstructions Over 4 ft (1.2 m) in Width.

- **N** 9.5.5.3.2.1* Supplemental sprinklers shall be installed below fixed obstructions, including open grate flooring, over 4 ft (1.2 m) in width.
- **N 9.5.5.3.2.2*** Supplemental sprinklers shall not be required below obstructions that are not fixed in place.
- **N 9.5.5.3.2.3** Supplemental sprinklers shall not be required below noncombustible obstructions over 4 ft (1.2 m) wide where the bottom of the obstruction is 24 in. (600 mm) or less above the floor or deck.

N 9.5.5.3.3 Supplemental Sprinklers.

- **N 9.5.5.3.3.1** Supplemental sprinklers shall be quick response, or have a fast-response thermal element, having a nominal ordinary temperature rating unless otherwise required by 7.2.4 or 9.4.2.5.
- **N 9.5.5.3.3.2** Unless the requirements of 9.5.5.3.3.3 are met, supplemental sprinklers shall have the same K-factor value, orientation, and coverage type characteristics as the ceiling sprinklers.
- **N 9.5.5.3.3.3** Supplemental sprinklers shall be permitted to have different K-factor value, orientation, and coverage-type characteristics than those of the ceiling sprinklers when the requirements of Section 19.5 are met.
- **N 9.5.5.3.3.4** Supplemental sprinklers shall be equipped with a water shield or otherwise shielded from the discharge of overhead sprinklers where they are installed for any of the following conditions:
 - (1) Under non-flat obstructions
 - (2) Under non-solid obstructions
 - (3) Beyond the outer edges of the obstructions
 - (4) Under open grating

N 9.5.5.3.4 Position and Spacing of Supplemental Sprinklers.

- **N 9.5.5.3.4.1*** Supplemental sprinklers shall be positioned below obstructions in accordance with one of the following:
 - (1) Installed below the obstruction
 - (2) Installed adjacent to the obstruction not more than 3 in.(75 mm) from the outside edge of the obstruction
- **N 9.5.5.3.4.2** Supplemental sprinklers shall be permitted to be spaced in accordance with unobstructed construction requirements for the hazards they protect, unless otherwise modified elsewhere in this standard.

9.5.5.4 Closets. In all closets and compartments, including those closets housing mechanical equipment, that are not larger than 400 ft³ (11.3 m³) in size, a single sprinkler at the highest ceiling level shall be sufficient without regard to clearance, obstructions, or minimum distance to the wall.

Chapter 10 Installation Requirements for Standard Pendent, Upright, and Sidewall Spray Sprinklers

10.1 General. Standard pendent, upright, and sidewall sprinklers shall be selected for use and installation as indicated in this chapter and shall be positioned and spaced in accordance with Section 9.5.

10.2 Standard Pendent and Upright Spray Sprinklers.

10.2.1 General. All requirements of Section 9.5 shall apply to standard pendent and upright spray sprinklers except as modified in Section 10.2.

10.2.2 Upright and pendent spray sprinklers shall be permitted in all occupancy hazard classifications and building construction types unless the requirements of 9.3.2 apply.

10.2.3 Quick-response sprinklers shall not be permitted for use in extra hazard occupancies under the density/area design method.

10.2.4 Protection Areas per Sprinkler (Standard Pendent and Upright Spray Sprinklers).

10.2.4.1 Determination of Protection Area of Coverage.

10.2.4.1.1 Except as permitted by 10.2.4.1.2, the protection area of coverage per sprinkler (A_s) shall be determined in accordance with 9.5.2.1.

Table 10.2.4.2.1(b)Protection Areas and Maximum Spacing ofStandard Pendent and Upright Spray Sprinklers for OrdinaryHazard

Construction	System	Protecti	on Area	Maxi Spa	imum icing
Туре	Туре	ft ²	m ²	ft	m
All	All	130	12	15	4.6

10.2.4.1.2 The requirements of 10.2.4.1.1 shall not apply in a small room as defined in 3.3.214.

10.2.4.1.2.1 The protection area of coverage for each sprinkler in the small room shall be the area of the room divided by the number of sprinklers in the room.

10.2.4.2 Maximum Protection Area of Coverage.

10.2.4.2.1* The maximum allowable protection area of coverage for a sprinkler (A_s) shall be in accordance with the value indicated in Table 10.2.4.2.1(a) through Table 10.2.4.2.1(d).

10.2.4.2.2 In any case, the maximum area of coverage of a sprinkler shall not exceed 225 ft^2 (20 m²).

Table 10.2.4.2.1(a) Protection Areas and Maximum Spacing of Standard Pendent and Upright Spray Sprinklers for Light Hazard

	10,	Maxi	imum		
		Protect	ion Area	Maximur	n Spacing
Construction Type	System Type	ft²	m ²	ft	m
Noncombustible unobstructed	Hydraulically calculated	225	20	15	4.6
Noncombustible unobstructed	Pipe schedule	200	18	15	4.6
Noncombustible obstructed	Hydraulically calculated	225	20	15	4.6
Noncombustible obstructed	Pipe schedule	200	18	15	4.6
Combustible unobstructed with no exposed members	Hydraulically calculated	225	20	15	4.6
Combustible unobstructed with no exposed members	Pipe schedule	200	18	15	4.6
Combustible unobstructed with exposed members 3 ft (910 mm) or more on center	Hydraulically calculated	225	20	15	4.6
Combustible unobstructed with exposed members 3 ft (910 mm) or more on center	Pipe schedule	200	18	15	4.6
Combustible unobstructed with members less than 3 ft (910 mm) on center	All	130	12	15	4.6
Combustible obstructed with exposed members 3 ft (910 mm) or more on center	All	168	16	15	4.6
Combustible obstructed with members less than 3 ft (910 mm) on center	All	130	12	15	4.6
Combustible concealed spaces in accordance with 10.2.6.1.4	All	120	11	15 parallel to the slope 10 perpendicular to the slope*	4.6 parallel to the slope3.0 perpendicular to the slope*

*See 10.2.6.1.4.4.

Table 10.2.4.2.1(c)Protection Areas and Maximum Spacing ofStandard Pendent and Upright Spray Sprinklers for ExtraHazard

Construction		Prote Au	ection rea	Maxi Spa	imum icing
Туре	System Type	ft ²	m ²	ft	m
All	Pipe schedule	90	8.4	12*	3.7*
All	Hydraulically calculated with density ≥0.25 gpm/ft ² (10.2 mm/min)	100	9	12*	3.7*
All	Hydraulically calculated with density <0.25 gpm/ft ² (10.2 mm/min)	130	12	15	4.6

*In buildings where solid structural members create bays up to 25 ft (7.6 m) wide, maximum spacing between sprinklers is permitted up to 12 ft 6 in. (3.8 m).

Table 10.2.4.2.1(d) Protection Areas and Maximum Spacing of Standard Pendent and Upright Spray Sprinklers for High-Piled Storage

Construction		Prote Ar	ection rea	Maxi Spa	imum icing
Туре	System Type	ft²	m^2	ft	m
All	Hydraulically calculated with density ≥0.25 gpm/ft ² (10.2 mm/min)	100	9	12*	3.7*
All	Hydraulically calculated with density <0.25 gpm/ft ² (10.2 mm/min)	130	12	15	4.6

*In buildings where solid structural members create bays up to 25 ft (7.6 m) wide, maximum spacing between sprinklers is permitted up to 12 ft 6 in. (3.8 m).

N 10.2.5 Sprinklers in Ordinary Hazard Group 2 Occupancies with Ceilings Over 30 ft (9.1 m). Standard-response standardcoverage sprinklers shall not be permitted for use in Ordinary Hazard Group 2 occupancies where the ceiling height is greater than 30 ft (9.1 m).

10.2.6 Sprinkler Spacing (Standard Pendent and Upright Spray Sprinklers).

10.2.6.1 Maximum Distance Between Sprinklers. The maximum distance permitted between sprinklers shall comply with Table 10.2.4.2.1(a) through Table 10.2.4.2.1(d).

10.2.6.2 Maximum Distance from Walls.

10.2.6.2.1 The distance from sprinklers to walls shall not exceed one-half of the allowable distance between sprinklers as indicated in Table 10.2.4.2.1(a) through Table 10.2.4.2.1(d).

10.2.6.2.2* The requirements of 10.2.6.2.1 shall not apply where walls are angled or irregular, and the maximum horizontal distance between a sprinkler and any point of floor area

protected by that sprinkler shall not exceed 0.75 times the allowable distance permitted between sprinklers, provided the maximum perpendicular distance is not exceeded.

10.2.6.2.3* The requirements of 10.2.6.2.1 shall not apply within small rooms as defined in 3.3.214.

10.2.6.2.3.1 Sprinklers shall be permitted to be located not more than 9 ft (2.7 m) from any single wall.

10.2.6.2.3.2 Sprinkler spacing limitations of 10.2.6 and area limitations of Table 10.2.4.2.1(a) shall not be exceeded.

10.2.6.2.4 Under curved surfaces, the horizontal distance shall be measured at the floor level from the wall, or the intersection of the curved surface and the floor to the nearest sprinkler shall not be greater than one-half the allowable distance between sprinklers.

10.2.6.3 Minimum Distances from Walls. Sprinklers shall be located a minimum of 4 in. (100 mm) from a wall.

10.2.6.4 Minimum Distances Between Sprinklers.

10.2.6.4.1 Unless the requirements of 10.2.6.4.2 or 10.2.6.4.4 are met, sprinklers shall be spaced not less than 6 ft (1.8 m) on center.

10.2.6.4.2 Sprinklers shall be permitted to be placed less than 6 ft (1.8 m) on center where the following conditions are satisfied:

- (1) Baffles shall be arranged to protect the actuating elements.
- (2) Baffles shall be of solid and rigid material that will stay in place before and during sprinkler operation.
- (3) Baffles shall be not less than 8 in. (200 mm) long and 6 in. (150 mm) high.
- (4) The tops of baffles shall extend between 2 in. and 3 in. (50 mm and 75 mm) above the deflectors of upright sprinklers.
- (5) The bottoms of baffles shall extend downward to a level at least even with the deflectors of pendent sprinklers.
- **N 10.2.6.4.3** Where sprinklers are installed in every channel formed by solid obstructed construction with the deflectors above the bottom of the structural members, the structural members shall be considered baffles in accordance with 10.2.6.4.2.

10.2.6.4.4 In-rack sprinklers shall be permitted to be placed less than 6 ft (1.8 m) on center.

10.2.7 Deflector Position (Standard Pendent and Upright Spray Sprinklers).

10.2.7.1 Distance Below Ceilings.

10.2.7.1.1 Unobstructed Construction.

10.2.7.1.1.1 Under unobstructed construction, the distance between the sprinkler deflector and the ceiling shall be a minimum of 1 in. (25 mm) and a maximum of 12 in. (300 mm) throughout the area of coverage of the sprinkler.

10.2.7.1.1.2 The requirements of 10.2.7.1.1.1 shall not apply where ceiling-type sprinklers (concealed, recessed, and flush types) have the operating element above the ceiling and the deflector located nearer to the ceiling where installed in accordance with their listing.

10.2.7.1.1.3 The requirements of 10.2.7.1.1.1 shall not apply for light and ordinary hazard occupancies with ceilings of noncombustible or limited-combustible construction where either 10.2.7.1.1.3(A) or 10.2.7.1.1.3(B) applies.

(A) Where a vertical change in ceiling elevation within the area of coverage of the sprinkler creates a distance of more than 36 in. (900 mm) between the upper ceiling and the sprinkler deflector, a vertical plane extending down from the ceiling at the change in elevation shall be considered a wall for the purpose of sprinkler spacing as shown in Figure 10.2.7.1.1.3(A).

(B) Where the distance between the upper ceiling and the sprinkler deflector is less than or equal to 36 in. (900 mm), the sprinklers shall be permitted to be spaced as though the ceiling was flat, provided the obstruction rules are observed as shown in Figure 10.2.7.1.1.3(B).

▲ **10.2.7.1.2 Obstructed Construction.** Under obstructed construction, the sprinkler deflector shall be located in accordance with one of the following arrangements:

(1) Installed with the deflectors within the horizontal planes of 1 in. to 6 in. (25 mm to 150 mm) below the structural





FIGURE 10.2.7.1.1.3(A) Vertical Change in Ceiling Elevation Greater Than 36 in. (900 mm).





members and a maximum distance of 22 in. (550 mm) below the ceiling/roof deck

- (2) Installed with the deflectors at or above the bottom of the structural member to a maximum of 22 in. (550 mm) below the ceiling/roof deck where the sprinkler is installed in conformance with 10.2.7.2
- (3) Installed in each bay of obstructed construction, with the deflectors located a minimum of 1 in. (25 mm) and a maximum of 12 in. (300 mm) below the ceiling
- (4) Installed with the deflectors within the horizontal planes 1 in. to 6 in. (25 mm to 150 mm) below composite wood joists to a maximum distance of 22 in. (550 mm) below the ceiling/roof deck only where joist channels are provided with blocking to the full depth of the joists with material at least equivalent to the web construction so that individual channel areas do not exceed 300 ft² (28 m²)
- (5)* Installed with deflectors of sprinklers under concrete tee construction with stems spaced less than 7 ½ ft (2.3 m) on centers and a maximum depth of the stems of 30 in. (750 mm), located at or above a horizontal plane 1 in. (25 mm) below the bottom of the stems of the tees and complying with Table 10.2.8.2(a) or Table 10.2.8.2(b)

10.2.7.1.3 Peaked Roofs and Ceilings.

10.2.7.1.3.1 Unless the requirements of 10.2.7.1.3.2 or 10.2.7.1.3.3 are met, sprinklers under or near the peak of a roof or ceiling shall have deflectors located not more than 36 in. (900 mm) vertically down from the peak as indicated in Figure 10.2.7.1.3.1 (a) and Figure 10.2.7.1.3.1 (b).

10.2.7.1.3.2* Under saw-toothed roofs, sprinklers at the highest elevation shall not exceed a distance of 36 in. (900 mm) measured down the slope from the peak.

▲ 10.2.7.1.3.3* Under a steeply pitched surface, the distance from the peak to the deflectors shall be permitted to be increased to maintain a horizontal clearance of 24 in. (600 mm) from other structural members as indicated in Figure 10.2.7.1.3.3.

10.2.7.1.4 Sprinklers under a roof or ceiling in combustible concealed spaces of wood joist or wood truss construction with members less than 3 ft (900 mm) on center with a slope having a pitch of 4 in 12 or greater shall be positioned in accordance with Figure 10.2.7.1.4 and the requirements of 10.2.7.1.4.1 through 10.2.7.1.4.6.

10.2.7.1.4.1 Sprinklers shall be quick-response.

10.2.7.1.4.2 Sprinklers shall be installed so that a row of sprinklers is installed within 12 in. (300 mm) horizontally of the peak and between 1 in. and 12 in. (25 mm and 300 mm) down from the bottom of the top chord member.

10.2.7.1.4.3* Sprinklers shall be installed so that the sprinklers installed along the eave are located not less than 5 ft (1.5 m) from the intersection of the upper and lower truss chords or the wood rafters and ceiling joists.

10.2.7.1.4.4* Sprinklers installed where the dimension perpendicular to the slope exceeds 8 ft (2.4 m) shall have a minimum pressure of 20 psi (1.4 bar).

10.2.7.1.4.5* The requirements of 10.2.7.1.4.3 or 10.2.7.1.4.4 shall not apply to sprinklers installed at the corner of the eave of a hip type roof where located directly under the hip line spaced in accordance with 10.2.6.2.2 or located on the slope plane not less than 5 ft (1.5 m) from the intersection of the

upper and lower truss chords or the wood rafters and ceiling joists on the eave and no more than 5 ft (1.5 m) from the hip line.

10.2.7.1.4.6 The special requirements of 10.2.4.2.1 and 10.2.7.1.4 shall not apply when the exposed combustible sheathing in the roof or ceiling space are constructed of pressure impregnated fire retardant–treated wood as defined by NFPA 703.



FIGURE 10.2.7.1.3.1(a) Sprinklers Under Pitched Roof with Sprinkler Directly Under Peak; Branch Lines Run Up Slopes.



10.2.7.1.5.1 Unless the requirements of 10.2.7.1.5.2 are met, where two sets of joists are under a roof or ceiling, and no flooring is over the lower set, sprinklers shall be installed above and below the lower set of joists where a clearance of 6 in. (150 mm) or more is between the top of the lower joist and the bottom of the upper joist as indicated in Figure 10.2.7.1.5.1.

10.2.7.1.5.2 Sprinklers shall be permitted to be omitted from below the lower set of joists where at least 18 in. (450 mm) is maintained between the sprinkler deflector and the top of the lower joist.

10.2.7.2 Deflector Orientation.

10.2.7.2.1 Unless the requirements of 10.2.7.2.2 or 10.2.7.2.3 are met, deflectors of sprinklers shall be aligned parallel to ceilings, roofs, hips, or the incline of stairs.

10.2.7.2.2 Where sprinklers are installed in the peak below a sloped ceiling or roof surface, the sprinkler shall be installed with the deflector parallel to the floor.

10.2.7.2.3 Where roofs having a pitch not exceeding 2 in 12 (16.7 percent) are considered horizontal in the application of 10.2.7.2, and sprinklers are installed under horizontal ceilings, the sprinklers shall be permitted to be installed with deflectors parallel to the floor.

10.2.8 Obstructions to Sprinkler Discharge (Standard Pendent and Upright Spray Sprinklers).

10.2.8.1 General. Sprinklers shall be located so as to minimize obstructions to discharge as defined in 10.2.8, or additional sprinklers shall be provided to ensure adequate coverage of the hazard.



FIGURE 10.2.7.1.3.1(b) Sprinklers at Pitched Roof; Branch Lines Run Up Slopes.



△ FIGURE 10.2.7.1.3.3 Horizontal Clearance for Sprinkler at Peak of Pitched Roof.



FIGURE 10.2.7.1.4 Sprinklers Under Roof or Ceiling in Combustible Concealed Spaces of Wood Joist or Wood Truss Construction with Members Less Than 3 ft (900 mm) on Center with a Slope Having a Pitch of 4 in 12 or Greater.



FIGURE 10.2.7.1.5.1 Arrangement of Sprinklers Under Two Sets of Open Joists — No Sheathing on Lower Joists.

- Δ 10.2.8.2* Obstructions At or Above the Deflector Affecting Sprinkler Discharge Pattern Development. Where the top of the obstruction is level with or above the plane of the deflector, sprinklers shall be arranged to comply with one of the following:
 - (1) Subsection 9.5.5.2, Table 10.2.8.2(a) or Table 10.2.8.2(b), and Figure 10.2.8.2(a) shall be followed.
 - (2) Sprinklers shall be permitted to be spaced on opposite sides of obstructions not exceeding 4 ft (1.2 m) in width, provided the distance from the centerline of the obstruction to the sprinklers does not exceed one-half the allowable distance permitted between sprinklers.
 - (3) Obstructions located against the wall and that are not over 30 in. (750 mm) in width shall be permitted to be protected in accordance with Figure 10.2.8.2(b).
 - (4) Obstructions located against the wall and that are not over 24 in. (600 mm) in width shall be permitted to be protected in accordance with Figure 10.2.8.2(c). The maximum distance between the sprinkler and the wall shall be measured from the sprinkler to the wall behind the obstruction and not to the face of the obstruction.
 - (5) Obstructions no greater than 12 in. (300 mm) in width in hallways up to 6 ft (1.8 m) in width shall be permitted in accordance with Figure 10.2.8.2(d) when the sprinkler is

△ Table 10.2.8.2(a) Positioning of Sprinklers to Avoid Obstructions to Discharge [Standard Spray Upright/Standard Spray Pendent (SSU/SSP)]

Distance from Sprinkler to Side of Obstruction (A) (ft)	Allowable Distance of Deflector Above Bottom of Obstruction (B) (in.)
Less than 1	0
1 or more	$2\frac{1}{2}$ or less
$1\frac{1}{2}$ or more	$3\frac{1}{2}$ or less
2 or more	$5\frac{1}{2}$ or less
$2\frac{1}{2}$ or more	$7\frac{1}{2}$ or less
3 or more	$9\frac{1}{2}$ or less
$3\frac{1}{2}$ or more	12 or less
4 or more	14 or less
$4\frac{1}{2}$ or more	$16\frac{1}{2}$ or less
5 or more	18 or less
$5\frac{1}{2}$ or more	20 or less
6 or more	24 or less
$6\frac{1}{2}$ or more	30 or less
7 or more	35 or less

Note: For *A* and *B*, refer to Figure 10.2.8.2(a).

located within the allowable obstruction zone and the closest edge of the obstruction is a minimum of 12 in. (300 mm) away from the centerline of the sprinkler.

- (6) Sprinklers shall be installed below fixed obstructions over 4 ft (1.2 m) wide.
- (7) Sprinklers shall not be required under obstructions 4 ft. (1.2 m) or less wide when the provisions of Table 10.2.8.2(a) or Table 10.2.8.2(b) and Figure 10.2.8.2(a) are maintained.

Distance from Sprinkler to Side of Obstruction (A) (mm)	Allowable Distance of Deflector Above Bottom of Obstruction (B) (mm)
Less than 300	0
300 or more	65 or less
450 or more	90 or less
600 or more	140 or less
750 or more	190 or less
900 or more	240 or less
1100 or more	300 or less
1200 or more	350 or less
1400 or more	420 or less
1500 or more	450 or less



Side of Obstruction (A) (mm)	Obstruction (B) (mm)
Less than 300	0
300 or more	65 or less
450 or more	90 or less
600 or more	140 or less
750 or more	190 or less
900 or more	240 or less
1100 or more	300 or less
1200 or more	350 or less
1400 or more	420 or less
1500 or more	450 or less
1700 or more	510 or less
1800 or more	600 or less
2000 or more	750 or less
2100 or more	875 or less

Note: For A and B, refer to Figure 10.2.8.2(a).



FIGURE 10.2.8.2(a) Positioning of Sprinkler to Avoid Obstruction to Discharge (SSU/SSP).

10.2.8.3 Obstructions Below the Deflector Affecting Sprinkler Discharge Pattern Development.

10.2.8.3.1 General.

10.2.8.3.1.1 Continuous or noncontinuous obstructions less than or equal to 18 in. (450 mm) below the sprinkler deflector that prevent the pattern from fully developing shall comply with 10.2.8.3.

10.2.8.3.1.2 Regardless of the rules of 10.2.8.3, solid continuous obstructions, where the top of the obstruction is level with or above the plane of the deflector, shall meet the applicable requirements of 10.2.8.2.

N 10.2.8.3.1.3* Clearance Below Sprinklers in Alcoves and Below Soffits. In light hazard occupancies, obstructions below pend-





FIGURE 10.2.8.2(c) Obstructions Against Walls (SSU/SSP).

ent sprinklers in alcove ceilings and under soffits shall not be required to maintain an 18 in. (450 mm) clearance to the sprinkler deflector as long as all of the following conditions are met:

- (1)The height of the alcove ceiling or bottom of the soffit doesn't exceed 10 ft (3 m) above the finished floor.
- (2)The floor area of the alcove or the protection area below the soffit doesn't exceed 50 ft² (4.5 m^2).
- The top of the obstruction is at least 1 in. (25 mm) below (3)the plane of the sprinkler deflector.



FIGURE 10.2.8.2(d) Obstruction in Hallway.

10.2.8.3.1.4* Minimum Distance from Obstructions. Unless the requirements of 10.2.8.3.1.5 through 10.2.8.3.1.10 are met, sprinklers shall be positioned away from obstructions a minimum distance of three times the maximum dimension of the obstruction (e.g., structural members, pipe, columns, and fixtures) in accordance with Figure 10.2.8.3.1.4(a) and Figure 10.2.8.3.1.4(b).

(A) The maximum clear distance required shall be 24 in. (600 mm).

(B) The maximum clear distance shall not be applied to obstructions in the vertical orientation (e.g., columns).

10.2.8.3.1.5 For light and ordinary hazard occupancies, structural members only shall be considered when applying the requirements of 10.2.8.3.1.4.

10.2.8.3.1.6 Sprinklers shall be permitted to be spaced on opposite sides of the obstruction not exceeding 4 ft (1.2 m) in width, where the distance from the centerline of the obstruction to the sprinklers does not exceed one-half the allowable distance between sprinklers.

10.2.8.3.1.7 Sprinklers shall be permitted to be located onehalf the distance between the obstructions where the obstruction consists of open trusses 20 in. (500 mm) or greater apart [24 in. (600 mm) on center], provided that all truss members are not greater than 4 in. (100 mm) (nominal) in width.

10.2.8.3.1.8 Sprinklers shall be permitted to be installed on the centerline of a truss or bar joist or directly above a beam, provided that the truss chord or beam dimension is not more



FIGURE 10.2.8.3.1.4(a) Minimum Distance from an Obstruction in the Vertical Orientation (SSU/SSP).



(Obstruction view of irruss (Obstruction in horizontal orientation) $A \ge 3C \text{ or } 3D$ $A \le 4 \text{ in.}$ (600 mm) (Use dimension *C* or *D*, whichever is greater)

FIGURE 10.2.8.3.1.4(b) Minimum Distance from an Obstruction in the Horizontal Orientation (SSU/SSP).

than 8 in. (200 mm) and the sprinkler deflector is located at least 6 in. (150 mm) above the structural member and where the sprinkler is positioned at a distance three times greater than the maximum dimension of the web members away from the web members.

10.2.8.3.1.9 The requirements of 10.2.8.3.1.4 shall not apply to sprinkler system piping less than 3 in. (80 mm) in diameter.

10.2.8.3.1.10 The requirements of 10.2.8.3.1.4 shall not apply to sprinklers positioned with respect to obstructions in accordance with 10.2.8.2.

10.2.8.3.1.11* Sprinklers shall be permitted to be placed without regard to the blades of ceiling fans less than 60 in. (1.5 m) in diameter, provided the plan view of the fan is at least 50 percent open.

10.2.8.3.2 Suspended or Floor-Mounted Vertical Obstructions.

10.2.8.3.2.1 The distance from sprinklers to privacy curtains, freestanding partitions, room dividers, and similar obstructions in light hazard occupancies shall be in accordance with Table 10.2.8.3.2.1(a) or Table 10.2.8.3.2.1(b) and Figure 10.2.8.3.2.1.

Δ Table 10.2.8.3.2.1(a)	Suspended or Floor-Mounted
Obstructions in Light	Hazard Occupancies Only (SSU/SSP)

Horizontal Distance (A) (in.)	Minimum Vertical Distance Below Deflector (B) (in.)
6 or less	3 or more
9 or less	4 or more
12 or less	6 or more
15 or less	8 or more
18 or less	$9\frac{1}{2}$ or more
24 or less	$12\frac{1}{2}$ or more
30 or less	$15\frac{1}{2}$ or more
More than 30	18 or more

Note: For A and B, refer to Figure 10.2.8.3.2.1.

△ Table 10.2.8.3.2.1(b) Suspended or Floor-Mounted Obstructions in Light Hazard Occupancies Only (SSU/SSP)

Horizontal Distance (A) (mm)	Minimum Vertical Distance Below Deflector (B) (mm)
150 or less	75 or more
225 or less	100 or more
300 or less	150 or more
375 or less	200 or more
450 or less	240 or more
600 or less	315 or more
750 or less	390 or more
More than 750	450 or more

Note: For A and B, refer to Figure 10.2.8.3.2.1.

10.2.8.3.2.2* In light hazard occupancies, privacy curtains, as shown in Figure 10.2.8.3.2.1, shall not be considered obstructions where all of the following are met:

- (1) The curtains are supported by fabric mesh on ceiling track.
- (2) Openings in the mesh are equal to 70 percent or greater.
- (3) The mesh extends a minimum of 20 in. (500 mm) down from the sprinkler deflector.

10.2.8.3.2.3 In ordinary hazard occupancies, where sprinklers are installed above freestanding partitions, room dividers, and similar obstructions, the distance from the sprinkler deflector to the top of the obstruction shall be 18 in. (450 mm) or greater per Figure 10.2.8.3.2.3.

10.2.8.3.2.4 In ordinary hazard occupancies, where sprinklers are installed within 6 in. (150 mm) horizontally of the centerline of freestanding partitions, room dividers, and similar obstructions no greater than 12 in. (300 mm) in width, the distance from the sprinkler deflector to the top of the obstruction shall be permitted to be installed 6 in. (150 mm) or greater vertically per Figure 10.2.8.3.2.4.

10.2.8.4 Obstructions that Prevent Sprinkler Discharge from Reaching Hazard. Continuous or noncontinuous obstructions that interrupt the water discharge in a horizontal plane more than 18 in. (450 mm) below the sprinkler deflector in a manner to limit the distribution from reaching the protected hazard shall comply with 9.5.5.3. (*See A. 9.5.5.3.1.*)



FIGURE 10.2.8.3.2.1 Suspended or Floor-Mounted Obstruction in Light Hazard Occupancies Only (SSU/SSP).

10.2.9 Clearance to Storage (Standard Pendent and Upright Spray Sprinklers).

10.2.9.1* The clearance between the deflector and the top of storage shall be 18 in. (450 mm) or greater.

10.2.9.2 The **18** in. (450 mm) dimension shall not limit the height of shelving on a wall or shelving against a wall in accordance with **10.2.9.1**.



FIGURE 10.2.8.3.2.3 Location of Suspended or Floor-Mounted Obstruction in Ordinary Hazard Occupancies (Sprinkler Located to the Side) (SSU/SSP).



FIGURE 10.2.8.3.2.4 Location of Suspended or Floor-Mounted Obstruction in Ordinary Hazard Occupancies (Sprinkler Located Directly Above) (SSU/SSP).

10.2.9.2.1 Where shelving is installed on a wall and is not directly below sprinklers, the shelves, including storage thereon, shall be permitted to extend above the level of a plane located 18 in. (450 mm) below ceiling sprinkler deflectors.

10.2.9.2.2 Shelving, and any storage thereon, directly below the sprinklers shall not extend above a plane located 18 in. (450 mm) below the ceiling sprinkler deflectors.

10.2.9.3 The clearance between the top of storage to sprinkler deflectors shall not be less than 36 in. (900 mm) where rubber tires are stored.

10.2.9.4 Where other standards specify greater clearance to storage minimums, they shall be followed.

10.2.10 Ceiling Pockets (Standard Pendent and Upright Spray Sprinklers).

10.2.10.1* Except as provided in 10.2.10.2 and 10.2.10.3, sprinklers shall be required in all ceiling pockets.

10.2.10.2 Sprinklers shall not be required in ceiling pockets where all of the following are met:

- (1) The total volume of the unprotected ceiling pocket does not exceed $1000 \text{ ft}^3 (28 \text{ m}^3)$.
- (2) The depth of the unprotected ceiling pocket does not exceed 36 in. (900 mm).
- (3) The entire floor under the unprotected ceiling pocket is protected by sprinklers at the lower ceiling elevation.
- (4)* The total size of all unprotected ceiling pockets in the same compartment within 10 ft (3 m) of each other does not exceed 1000 ft³ (28 m³).

- (5) The unprotected ceiling pocket has noncombustible or limited-combustible finishes.
- (6) Quick-response sprinklers are utilized throughout the compartment.

10.2.10.3 Sprinklers shall not be required in skylights and similar pockets in accordance with 9.3.16.

10.3 Sidewall Standard Spray Sprinklers.

10.3.1 General. All requirements of Section 9.5 shall apply to sidewall standard spray sprinklers except as modified in Section 10.3.

10.3.2 Sidewall Spray Sprinklers. Sidewall sprinklers shall only be installed as follows:

- (1) In light hazard occupancies with smooth, horizontal ceilings
- (2) In light hazard occupancies with sloped, flat ceilings
- (3) In ordinary hazard occupancies with smooth, flat ceilings, where specifically listed for such use, and ceiling height does not exceed 30 ft (9.1 m)
- (4) To protect areas below overhead doors
- (5) At the top and bottom of elevator hoistways
- (6) For the protection of steel building columns
- (7) Under obstructions that require sprinklers
- (8) For the protection of exterior projections and similar structures
- (9)* Under cars in car stackers and car lift systems with cars stacked vertically placed under each level of cars
- **\Delta 10.3.2.1** For purposes of 10.3.2(1) and 10.3.2(3), corrugated metal deck with channel depths up to 4 in. (100 mm) shall be considered as smooth ceilings.

10.3.3 Protection Areas per Sprinkler (Standard Sidewall Spray Sprinklers).

10.3.3.1 Determination of Protection Area of Coverage.

10.3.3.1.1 The protection area of coverage per sprinkler (A_s) shall be determined as follows:

- (1) Along the wall as follows:
 - (a) Determine the distance between sprinklers along the wall (or to the end wall or obstruction in the case of the end sprinkler on the branch line) upstream and downstream
 - (b) Choose the larger of either twice the distance to the end wall or the distance to the next sprinkler(c) Define dimension as *S*
- (c) Define dimension as S(2) Across the room as follows:
 - (a) Determine the distance from the wall on which the sprinkler is installed to the wall opposite the sprinklers or to the midpoint of the room where sprinklers are installed on two opposite walls (*see* 10.3.4.1.5 and 10.3.4.1.6)
 - (b) Define dimension as L

10.3.3.1.2 The protection area of the sprinkler shall be established by multiplying the *S* dimension by the *L* dimension, as follows:

[10.3.3.1.2]

$$A_s = S \times L$$

10.3.3.2 Maximum Protection Area of Coverage.

10.3.3.2.1 The maximum allowable protection area of coverage for a sprinkler (A_i) shall be in accordance with the value indicated in Table 10.3.3.2.1.

10.3.3.2.2 In any case, the maximum area of coverage of a sprinkler shall not exceed 196 ft² (18 m^2).

10.3.4 Sprinkler Spacing (Standard Sidewall Spray Sprinklers).

10.3.4.1 Maximum Distance Between Sprinklers.

10.3.4.1.1 The maximum distance permitted between sidewall spray sprinklers shall be based on the centerline distance between sprinklers on the branch line.

10.3.4.1.2 The maximum distance between sidewall spray sprinklers or to a wall shall be measured along the slope of the ceiling.

10.3.4.1.3 Where sidewall spray sprinklers are installed along the length of a single wall of rooms or bays, they shall be spaced in accordance with the maximum spacing provisions of Table 10.3.3.2.1.

10.3.4.1.4 Sidewall spray sprinklers shall not be installed back-to-back without being separated by a continuous lintel or soffit.

10.3.4.1.4.1 The maximum width of the lintel or soffit shall not exceed 16 in. (400 mm).

10.3.4.1.4.2 The lintel or soffit shall project a minimum of 4 in. (100 mm) below the deflector of the back-to-back horizontal sidewall sprinklers.

10.3.4.1.4.3 The maximum width of the lintel or soffit can exceed 16 in. (400 mm) when a pendent sprinkler is installed under the lintel or soffit.

10.3.4.1.5 Where sidewall spray sprinklers are installed on two opposite walls or sides of bays, the maximum width of the room or bay shall be permitted to be up to 24 ft (7.3 m) for light hazard occupancy or 20 ft (6.1 m) for ordinary hazard occupancy, with spacing as required by Table 10.3.3.2.1.

10.3.4.1.6 Sidewall spray sprinklers shall be permitted to be installed on opposing or adjacent walls, provided no sprinkler is located within the maximum protection area of another sprinkler.

10.3.4.1.7 Where sidewall standard spray sprinklers are installed to protect areas below overhead doors within ordinary hazard occupancy spaces or rooms, protection area and maxi-

mum sprinkler spacing for light hazard as specified in Table 10.3.3.2.1 shall be permitted under the overhead doors.

10.3.4.2 Maximum Distance from Walls. The distance from sprinklers to the end walls shall not exceed one-half of the allowable distance permitted between sprinklers as indicated in Table 10.3.3.2.1.

10.3.4.3 Minimum Distance from Walls.

10.3.4.3.1 Sprinklers shall be located a minimum of 4 in. (100 mm) from an end wall.

10.3.4.4 Minimum Distance Between Sprinklers. Sprinklers shall be spaced not less than 6 ft (1.8 m) on center unless required by 10.3.5.1.3.1 or unless the sprinklers are separated by baffles that comply with the following:

- (1) Baffles shall be arranged to protect the actuating elements.
- (2) Baffles shall be of solid and rigid material that will stay in place before and during sprinkler operation.
- (3) Baffles shall be not less than 8 in. (200 mm) long and 6 in. (150 mm) high.
- (4) The tops of baffles shall extend between 2 in. and 3 in. (50 mm and 75 mm) above the deflectors.
- (5) The bottoms of baffles shall extend downward to a level at least even with the deflectors.

10.3.5 Deflector Position from Ceilings and Walls (Standard Sidewall Spray Sprinklers).

10.3.5.1 Distance Below Ceilings and from Walls.

10.3.5.1.1 Ceilings.

10.3.5.1.1.1 Unless the requirements of 10.3.5.1.1.2 are met, sidewall sprinkler deflectors shall be located not more than 6 in. (150 mm) or less than 4 in. (100 mm) from ceilings.

10.3.5.1.1.2 Horizontal sidewall sprinklers shall be permitted to be located in a zone 6 in. to 12 in. (150 mm to 300 mm) or 12 in. to 18 in. (300 mm to 450 mm) below noncombustible and limited-combustible ceilings where listed for such use.

10.3.5.1.2 Walls.

10.3.5.1.2.1* Vertical sidewall sprinkler deflectors shall be located not more than 6 in. (150 mm) or less than 4 in. (100 mm) from the wall from which they are projecting.

10.3.5.1.2.2 Horizontal sidewall sprinkler deflectors shall be located no more than 6 in. (150 mm), and shall be permitted to be located with their deflectors less than 4 in. (100 mm), from the wall on which they are mounted.

Table 10.3.3.2.1 Protection Areas and Maximum Spacing (Standard Sidewall Spray Sprinkler)

	Light Hazard		Ordinary Hazard	
	Combustible Ceiling Finish	Noncombustible or Limited- Combustible Ceiling Finish	Combustible Ceiling Finish	Noncombustible or Limited- Combustible Ceiling Finish
Maximum distance along the wall (S) (ft) [m]	14 [4.3]	14 [4.3]	10 [3.0]	10 [3.0]
Maximum room width (L) (ft) [m]	12 [3.7]	14 [4.3]	10 [3.0]	10 [3.0]
Maximum protection area (ft ²) [m ²]	120 [11]	196 [18]	80 [7.4]	100 [9.3]

10.3.5.1.3 Lintels and Soffits.

10.3.5.1.3.1 Where soffits used for the installation of sidewall sprinklers exceed 8 in. (200 mm) in width or projection from the wall, additional sprinklers shall be installed below the soffit.

10.3.5.1.3.2* Where soffits used for the installation of sidewall sprinklers are less than or equal to 8 in. (200 mm) in width or projection from the wall, additional sprinklers shall not be required below the soffit when the sidewall sprinkler is installed on the soffit.

10.3.5.1.3.3* A sidewall sprinkler shall be permitted to be installed under a soffit when both the minimum distance from the sprinkler deflector to the bottom of the soffit and maximum distance from the sprinkler deflector to the high ceiling is maintained.

10.3.5.1.4* Soffits and Cabinets. Where soffits are used for the installation of sidewall sprinklers, the sprinklers and soffits shall be installed in accordance with 10.3.5.1.4.1, 10.3.5.1.4.2, or 10.3.5.1.4.3.

10.3.5.1.4.1 Where soffits exceed more than 8 in. (200 mm) in width or projection from the wall, pendent sprinklers shall be installed under the soffit.

10.3.5.1.4.2 Sidewall sprinklers shall be permitted to be installed in the face of a soffit located directly over cabinets, without requiring additional sprinklers below the soffit or cabinets, where the soffit does not project horizontally more than 12 in. (300 mm) from the wall.

10.3.5.1.4.3 Where sidewall sprinklers are more than 36 in. (900 mm) above the top of cabinets, the sprinkler shall be permitted to be installed on the wall above the cabinets where the cabinets are no greater than 12 in. (300 mm) from the wall.

10.3.5.2 Deflector Orientation.

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10.3.5.2.1 Sidewall sprinklers, where installed under a sloped ceiling with a slope exceeding 2 in 12, shall be located at the high point of the slope and positioned to discharge downward along the slope.

10.3.6 Obstructions to Sprinkler Discharge (Standard Sidewall Spray Sprinklers).

10.3.6.1 Performance Objective.

10.3.6.1.1 Sprinklers shall be located so as to minimize obstructions to discharge as defined in 9.5.5.2 and 9.5.5.3, or additional sprinklers shall be provided to ensure adequate coverage of the hazard.

10.3.6.1.2 Sidewall sprinklers shall not be installed less than 4 ft (1.2 m) from light fixtures or similar obstructions unless the requirements of 10.3.6.1.2.1 or 10.3.6.1.2.2 are met.

10.3.6.1.2.1 For obstructions such as light fixtures, where the greatest dimension of the obstruction is less than 2 ft (0.6 m), sidewall sprinklers shall be permitted to be installed at a minimum distance of three times the greatest dimension.

10.3.6.1.2.2 The bottom of light fixtures and similar obstructions located less than 4 ft (1.2 m) from the sprinkler shall be above the plane of the sprinkler deflector.

10.3.6.1.3 The distance between light fixtures or similar obstructions located 4 ft (1.2 m) or greater from the sprinkler

shall be in conformity with Table 10.3.6.1.3(a) or Table 10.3.6.1.3(b) and Figure 10.3.6.1.3.

10.3.6.1.4 Obstructions projecting from the same wall as the one on which the sidewall sprinkler is mounted shall be in accordance with one of the following:

- (1) Sprinklers shall be installed in accordance with Table 10.3.6.1.4(a) or Table 10.3.6.1.4(b) and Figure 10.3.6.1.4(a).
- (2) Sprinklers shall be permitted to be spaced on opposite sides of obstructions less than 4 ft (1.2 m) in width where the distance from the centerline of the obstruction to the sprinklers does not exceed one-half the allowable distance between sprinklers.
- (3) Obstructions located against a wall and that are not over 30 in. (750 mm) in width shall be permitted to be protected in accordance with Figure 10.3.6.1.4(b).
- (4) Obstructions located against a wall and that are not over 24 in. (600 mm) in width shall be permitted to be protected in accordance with Figure 10.3.6.1.4(c). The maximum distance between the sprinkler and the wall shall be measured from the sprinkler to the wall behind the obstruction and not to the face of the obstruction.

Table 10.3.6.1.3(a)	Positioning of Sprinklers to Avoid
Obstructions to Dis	charge (Standard Spray Sidewall)

Distance from Sprinkler to Side of Obstruction (A) (ft)	Allowable Distance of Deflector Above Bottom of Obstruction (B) (in.)
Less than 4	0
4 or more	1 or less
5 or more	2 or less
$5\frac{1}{2}$ or more	3 or less
6 or more	4 or less
$6\frac{1}{2}$ or more	6 or less
7 or more	7 or less
$7\frac{1}{2}$ or more	9 or less
8 or more	11 or less
$8\frac{1}{2}$ or more	14 or less

Note: For A and B, refer to Figure 10.3.6.1.3.

 Table 10.3.6.1.3(b)
 Positioning of Sprinklers to Avoid

 Obstructions to Discharge (Standard Spray Sidewall)

Distance from Sprinkler to Side of Obstruction (A) (mm)	Allowable Distance of Deflector Above Bottom of Obstruction (B) (mm)
Less than 1200	0
1200 or more	25 or less
1500 or more	50 or less
1700 or more	75 or less
1800 or more	100 or less
2000 or more	150 or less
2100 or more	175 or less
2300 or more	225 or less
2400 or more	275 or less
2600 or more	350 or less

Note: For A and B, refer to Figure 10.3.6.1.3.

10.3.6.1.4.1 Isolated obstructions projecting from the same wall as the one on which the sidewall sprinkler is mounted shall be located a minimum of 4 in. (100 mm) from the sidewall sprinkler.

10.3.6.1.5 Sprinklers shall be permitted to be spaced on opposite sides of obstructions less than 4 ft (1.2 m) in width where the distance from the centerline of the obstruction to the sprinklers does not exceed one-half the allowable distance between sprinklers.





Table 10.3.6.1.4(a)	Positioning of Sprinklers to Avoid	
Obstructions Along	Wall (Standard Spray Sidewall Sprinkle	ers)

Distance from Sprinkler to Side of Obstruction (A)	Allowable Distance of Deflector Above Bottom of Obstruction (B) (in.)
Less than 4 in.	0
4 in. or more	1 or less
6 in. or more	2 or less
1 ft or more	3 or less
$1\frac{1}{2}$ ft or more	$4\frac{1}{2}$ or less
2 ft or more 🦯	$5\frac{3}{4}$ or less
$2\frac{1}{2}$ ft or more	7 or less
3 ft or more	8 or less
$3\frac{1}{2}$ ft or more	$9\frac{1}{4}$ or less
4 ft or more	10 or less
$4\frac{1}{2}$ ft or more	$11\frac{1}{2}$ or less
5 ft or more	$12\frac{3}{4}$ or less
$5\frac{1}{2}$ ft or more	14 or less
6 ft or more	15 or less
$6\frac{1}{2}$ ft or more	$16\frac{1}{4}$ or less
7 ft or more	$17\frac{1}{2}$ or less

Note: For A and B, refer to Figure 10.3.6.1.4(a).

Table 10.3.6.1.4(b)Positioning of Sprinklers to AvoidObstructions Along Wall (Standard Spray Sidewall Sprinklers)

Distance from Sprinkler to Side of Obstruction (A) (mm)	Allowable Distance of Deflector Above Bottom of Obstruction (B) (mm)
Less than 100	0
100 or more	25 or less
150 or more	50 or less
300 or more	75 or less
450 or more	115 or less
600 or more	145 or less
750 or more	175 or less
900 or more	200 or less
1100 or more	230 or less
1200 or more	250 or less
1400 or more	290 or less
1500 or more	320 or less
1700 or more 💦 💦 💦	> 350 or less
1800 or more	375 or less
2000 or more	410 or less
2200 or more	440 or less

Note: For A and B, refer to Figure 10.3.6.1.4(a).



FIGURE 10.3.6.1.4(a) Positioning of Sprinkler to Avoid Obstruction Along Wall (Standard Sidewall Spray Sprinklers).

10.3.6.1.6 Obstructions on the wall opposite from the sidewall sprinkler shall be permitted in accordance with Figure 10.3.6.1.6.

10.3.6.1.7 Obstructions up to 12 in. (300 mm) in width in hallways up to 6 ft (1.8 m) in width shall be permitted in accordance with Figure 10.3.6.1.7 when the sprinkler is located in the allowable obstruction zone and the closest edge of the obstruction is a minimum of 12 in. (300 mm) away from the deflector.

10.3.6.2 Obstructions to Sprinkler Discharge Pattern Development.

10.3.6.2.1 General.

10.3.6.2.1.1 Continuous or noncontinuous obstructions less than or equal to 18 in. (450 mm) below the sprinkler deflector that prevent the pattern from fully developing shall comply with this section.







N FIGURE 10.3.6.1.4(c) Obstruction Against Wall (Standard Sidewall Spray Sprinklers).

10.3.6.2.1.2 Regardless of the rules of this section, solid continuous obstructions shall meet the requirements of 10.3.6.1.2 and 10.3.6.1.3.

10.3.6.2.1.3* Unless the requirements of 10.3.6.2.1.4 or 10.3.6.2.1.5 are met, sprinklers shall be positioned away from obstructions a minimum distance of three times the maximum dimension of the obstruction (e.g., truss webs and chords, pipe, columns, and fixtures) in accordance with Figure 10.3.6.2.1.3(a) and Figure 10.3.6.2.1.3(b).





(A) The maximum clear distance required to obstructions in the horizontal orientation (e.g., light fixtures and truss chords) shall be 24 in. (600 mm).

(B) The maximum clear distance shall not be applied to obstructions in the vertical orientation (e.g., columns).

10.3.6.2.1.4 The requirements of 10.3.6.2.1.3 shall not apply to sprinkler system piping less than 3 in. (80 mm) in diameter.

10.3.6.2.1.5 The requirements of 10.3.6.2.1.3 shall not apply where sprinklers are positioned with respect to obstructions in accordance with 10.3.6.1.2, 10.3.6.1.3, and 10.3.6.1.4.

10.3.6.2.1.6* Sprinklers shall be permitted to be placed without regard to the blades of ceiling fans less than 60 in. (1.5 m) in diameter, provided the plan view of the fan is at least 50 percent open.

10.3.6.2.2 Suspended or Floor-Mounted Vertical Obstructions. The distance from sprinklers to privacy curtains, free-standing partitions, room dividers, and similar obstructions in light hazard occupancies shall be in accordance with Table 10.3.6.2.2(a) or Table 10.3.6.2.2(b) and Figure 10.3.6.2.2.

10.3.6.2.2.1* In light hazard occupancies, privacy curtains, as shown in Figure 10.3.6.2.2, shall not be considered obstructions where all of the following are met:

- (1) The curtains are supported by fabric mesh on ceiling track.
- (2) Openings in the mesh are equal to 70 percent or greater.
- (3) The mesh extends a minimum of 20 in. (500 mm) down from the sprinkler deflector.

10.3.6.3 Obstructions that Prevent Sprinkler Discharge from Reaching Hazard. Supplemental sprinklers shall be installed below continuous or noncontinuous fixed obstructions over 4 ft (1.2 m) in width that interrupt the water discharge in a horizontal plane more than 18 in. (450 mm) below the ceiling sprinkler deflector. (*See A. 9.5.5.3.1.*)

10.3.7 Clearance to Storage (Standard Sidewall Spray Sprinklers). (See 10.2.9.4.)

10.3.7.1 The clearance between the deflector and the top of storage shall be 18 in. (450 mm) or greater.

10.3.7.2 The 18 in. (450 mm) dimension shall not limit the height of shelving on a wall or shelving against a wall in accordance with 10.3.7.1.







FIGURE 10.3.6.2.1.3(a) Minimum Distance from an Obstruction in the Vertical Orientation (Standard Sidewall Spray Sprinklers).

10.3.7.2.1 Where shelving is installed on a wall and is not directly below sprinklers, the shelves, including storage thereon, shall be permitted to extend above the level of a plane located 18 in. (450 mm) below ceiling sprinkler deflectors.

10.3.7.2.2 Shelving, and any storage thereon, directly below the sprinklers shall not extend above a plane located 18 in. (450 mm) below the ceiling sprinkler deflectors.

10.3.7.3 Where other standards specify greater clearance to storage minimums, they shall be followed.

 $A \ge 3C \text{ or } 3D$ $A \le 24 \text{ in.}$ (600 mm) (Use dimension *C* or *D*, whichever is greater)

FIGURE 10.3.6.2.1.3(b) Minimum Distance from an Obstruction in the Horizontal Orientation (Standard Sidewall Spray Sprinklers).

 Table 10.3.6.2.2(a)
 Suspended or Floor-Mounted Obstructions

 in Light Hazard Occupancies Only (Standard Spray Sidewalls)

Horizontal Distance (A) (in.)	Minimum Vertical Distance Below Deflector (B) (in.)
6 or less	3 or more
9 or less	4 or more
12 or less	6 or more
15 or less	8 or more
18 or less	$9\frac{1}{2}$ or more
24 or less	$12\frac{1}{2}$ or more
30 or less	$15\frac{1}{2}$ or more
More than 30	18 or more

Note: For A and B, refer to Figure 10.3.6.2.2.

Horizontal Distance (A) (mm)	Minimum Vertical Distance Below Deflector (B) (mm)
150 or less	75 or more
225 or less	100 or more
300 or less	150 or more
375 or less	200 or more
450 or less	240 or more
600 or less	315 or more
750 or less	390 or more
More than 750	450 or more

Table 10.3.6.2.2(b) Suspended or Floor-Mounted Obstructions in Light Hazard Occupancies Only (Standard Spray Sidewalls)

Note: For A and B, refer to Figure 10.3.6.2.2.



Elevation View

FIGURE 10.3.6.2.2 Suspended or Floor-Mounted Obstruction (Standard Sidewall Spray Sprinklers) in Light Hazard Occupancy Only.

Chapter 11 Installation Requirements for Extended Coverage Upright, Pendent, Sidewall Spray Sprinkler

11.1 General. Extended coverage pendent, upright, and sidewall sprinklers shall be selected for use and installation as indicated in this chapter and shall be positioned and spaced in accordance with Section 9.5.

11.2 Extended Coverage Upright and Pendent Spray Sprinklers.

11.2.1 Extended Coverage Sprinklers. Extended coverage sprinklers shall only be installed as follows:

- (1) In unobstructed construction consisting of flat, smooth ceilings with a slope not exceeding a pitch of 1 in 6 (a rise of 2 units in a run of 12 units, a roof slope of 16.7 percent)
- (2) In unobstructed or noncombustible obstructed construction, where specifically listed for such use
- (3) Within trusses or bar joists having web members not greater than 1 in. (25 mm) maximum dimension or where trusses are spaced greater than 7½ ft (2.3 m) on center and where the ceiling slope does not exceed a pitch of 1 in 6 (a rise of 2 units in a run of 12 units, a roof slope of 16.7 percent)
- (4) Extended coverage upright and pendent sprinklers installed under smooth, flat ceilings that have slopes not exceeding a pitch of 1 in 3 (a rise of 4 units in a run of 12 units, a roof slope of 33.3 percent), where specifically listed for such use
- (5) Extended coverage sidewall sprinklers installed in accordance with 11.3.5.2.1 in slopes exceeding a ceiling pitch of 2 in 12
- (6) Extended coverage upright and pendent sprinklers installed in obstructed construction, in accordance with 11.2.4.1
- (7) Extended coverage sprinklers installed to protect areas below a single overhead door(s)
- **N 11.2.1.1** Extended-coverage pendent sprinklers having a nominal K-factor of K-22.4 (K-320) or less shall not be permitted for use in Ordinary Hazard Group 2 and higher occupancy hazards where the ceiling height is greater than 30 ft (9.1 m).

11.2.2 Protection Areas per Sprinkler (Extended Coverage Upright and Pendent Spray Sprinklers).

11.2.2.1* Determination of Protection Area of Coverage.

11.2.2.1.1 The protection area of coverage (A_s) for extended coverage sprinklers shall be not less than that prescribed by the listing.

11.2.2.1.2 Listing dimensions shall be even-numbered square protection areas as shown in Table 11.2.2.1.2.

11.2.2.1.3 Determination of the protection area of coverage and sprinkler spacing for sprinklers listed for extended coverage extra hazard or high-piled storage shall be permitted to be spaced in accordance with the requirements of 9.5.2 and 9.5.3 and shall not exceed 14 ft (4.3 m) maximum spacing and 196 ft² (18 m²) maximum area per sprinkler or 15 ft (4.6 m) maximum spacing and 144 ft² (13 m²) maximum area per sprinkler.

11.2.2.2 Maximum Protection Area of Coverage.

11.2.2.2.1 The maximum allowable area of coverage for a sprinkler (A_s) shall be in accordance with the value indicated in Table 11.2.2.1.2.

11.2.2.2. In any case, the maximum area of coverage of a sprinkler shall not exceed $400 \text{ ft}^2 (37 \text{ m}^2)$.

11.2.3 Sprinkler Spacing (Extended Coverage Upright and Pendent Spray Sprinklers).

11.2.3.1 Maximum Distance Between Sprinklers.

11.2.3.1.1 The maximum distance permitted between sprinklers shall be based on the centerline distance between sprinklers on the branch line or on adjacent branch lines.

11.2.3.1.2 The maximum distance shall be measured along the slope of the ceiling.

11.2.3.1.3 The maximum distance permitted between sprinklers shall comply with Table 11.2.2.1.2.

11.2.3.2 Maximum Distance from Walls.

11.2.3.2.1 The distance from sprinklers to walls shall not exceed one-half of the allowable distance permitted between sprinklers as indicated in Table 11.2.2.1.2.

Table 11.2.2.1.2 Protection Areas and Maximum Spacing (Extended Coverage Upright and Pendent Spray Sprinklers)

	Light Ha	zard	Ordinary H	azard	Extra Haz	ard	High-Piled S	torage
Construction Type	Protection Area [ft ² (m ²)]	Spacing [ft (m)]	Protection Area [ft ² (m ²)]	Spacing [ft (m)]	Protection Area [ft ² (m ²)]	Spacing [ft (m)]	Protection Area [ft ² (m ²)]	Spacing [ft (m)]
Unobstructed	400(37) 324(30)	20 (6.1) 18 (5.5)	400(37) 324(30)	20 (6.1) 18 (5.5)	_	_	_	_
	256 (24)		$256 (24) \\196 (18) \\144 (13)$	$ \begin{array}{c} 16 (4.9) \\ 14 (4.3) \\ 12 (3.7) \end{array} $	196 (18) 144 (13)	14 (4.3) 15 (4.6)	196 (18) 144 (13)	14 (4.3) 15 (4.6)
Obstructed noncombustible (when specifically listed for such use)	400 (37) 324 (30) 256 (24) 	$20 (6.1) \\ 18 (5.5) \\ 16 (4.9) \\$	$\begin{array}{c} 400 \ (37) \\ 324 \ (30) \\ 256 \ (24) \\ 196 \ (18) \\ 144 \ (13) \end{array}$	20 (6.1) 18 (5.5) 16 (4.9) 14 (4.3) 12 (3.7)	 196 (18) 144 (13)	 14 (4.3) 15 (4.6)	 196 (18) 144 (13)	14 (4.3) 15 (4.6)
Obstructed combustible	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

11.2.3.2.3 Where walls are angled or irregular, the maximum horizontal distance between a sprinkler and any point of floor area protected by that sprinkler shall not exceed 0.75 times the allowable distance permitted between sprinklers.

11.2.3.3 Minimum Distance from Walls. Sprinklers shall be located a minimum of 4 in. (100 mm) from a wall unless listed for distances less than 4 in. (100 mm).

11.2.3.4 Minimum Distance Between Sprinklers.

11.2.3.4.1 Unless the requirements of 11.2.3.4.2 are met, sprinklers shall be spaced not less than 8 ft (2.4 m) on center.

11.2.3.4.2 Sprinklers shall be permitted to be placed less than 8 ft (2.4 m) on center where the following conditions are satisfied:

- (1) Baffles shall be arranged to protect the actuating elements.
- (2) Baffles shall be of solid and rigid material that will stay in place before and during sprinkler operation.
- (3) Baffles shall be not less than 8 in. (200 mm) long and 6 in. (150 mm) high.
- (4) The tops of baffles shall extend between 2 in. and 3 in. (50 mm and 75 mm) above the deflectors of upright sprinklers.
- (5) The bottoms of baffles shall extend downward to a level at least even with the deflectors of pendent sprinklers.
- **N 11.2.3.4.3** Where sprinklers are installed in every channel formed by solid obstructed construction with the deflectors above the bottom of the structural members, the structural members shall be considered baffles in accordance with 11.2.3.4.2.

11.2.4 Deflector Position (Extended Coverage Upright and Pendent Spray Sprinklers).

11.2.4.1 Distance Below Ceilings.

11.2.4.1.1 Unobstructed Construction.

11.2.4.1.1.1 Under unobstructed construction, the distance between the sprinkler deflector and the ceiling shall be a minimum of 1 in. (25 mm) and a maximum of 12 in. (300 mm) throughout the area of coverage of the sprinkler.

11.2.4.1.1.2 The requirements of 11.2.4.1.1.1 shall not apply where ceiling-type sprinklers (concealed, recessed, and flush types) have the operating element above the ceiling and the deflector located nearer to the ceiling where installed in accordance with their listing.

11.2.4.1.1.3 The requirements of 11.2.4.1.1.1 shall not apply where sprinklers are listed for use under other ceiling construction features or for different distances where they shall be permitted to be installed in accordance with their listing.

11.2.4.1.1.4 The requirements of 11.2.4.1.1.1 shall not apply for light and ordinary hazard occupancies with ceilings of noncombustible or limited-combustible construction.

 $(A)^*$ Where a vertical change in ceiling elevation within the area of coverage of the sprinkler creates a distance of more than 36 in. (900 mm) between the upper ceiling and the sprinkler deflector, a vertical plane extending down from the ceiling

at the change in elevation shall be considered a wall for the purpose of sprinkler spacing.

(**B**)* Where the distance between the upper ceiling and the sprinkler deflector is less than or equal to 36 in. (900 mm), the sprinklers shall be permitted to be spaced as though the ceiling were flat, provided the obstruction rules are observed.

- △ **11.2.4.1.2 Obstructed Construction.** Under obstructed construction, the sprinkler deflector shall be located in accordance with one of the following arrangements:
 - Installed with the deflectors within the horizontal planes of 1 in. to 6 in. (25 mm to 150 mm) below noncombustible structural members and a maximum distance of 22 in. (550 mm) below the ceiling/roof deck
 - (2) Installed with the deflectors at or above the bottom of noncombustible structural members to a maximum of 22 in. (550 mm) below the noncombustible ceiling/roof deck where the sprinkler is installed in conformance with 11.2.5.1.2
 - (3) Installed in each bay of combustible or noncombustible obstructed construction, with the deflectors located a minimum of 1 in. (25 mm) and a maximum of 12 in. (300 mm) below the ceiling
 - (4) Installed in accordance with their listing where sprinklers are listed for use under other ceiling construction features or for different distances

11.2.4.1.3* Peaked Roofs and Ceilings. Sprinklers under or near the peak of a roof or ceiling shall have deflectors located not more than 3 ft (900 mm) vertically down from the peak in accordance with Figure 10.2.7.1.3.1(a) and Figure 10.2.7.1.3.1(b).

11.2.4.2 Deflector Orientation. Deflectors of sprinklers shall be aligned parallel to ceilings or roofs.

11.2.4.2.1 Roofs and ceilings having a pitch not exceeding 2 in 12 (16.7 percent) are considered horizontal in the application of 11.2.4.2, and sprinklers installed under horizontal ceilings shall be permitted to be installed with deflectors parallel to the floor.

11.2.5 Obstructions to Sprinkler Discharge (Extended Coverage Upright and Pendent Spray Sprinklers).

11.2.5.1 Performance Objective.

11.2.5.1.1 Sprinklers shall be located so as to minimize obstructions to discharge as defined in 11.2.5.2 and 11.2.5.3, or additional sprinklers shall be provided to ensure adequate coverage of the hazard.

11.2.5.1.2* Sprinklers shall be arranged to comply with one of the following arrangements:

- (1) Sprinklers shall be in accordance with 9.5.5.2, Table 11.2.5.1.2(a) or Table 11.2.5.1.2(b), and Figure 11.2.5.1.2(a).
- (2) Sprinklers shall be permitted to be spaced on opposite sides of obstructions not exceeding 4 ft (1.2 m) in width provided the distance from the centerline of the obstruction to the sprinklers does not exceed one-half the allowable distance permitted between sprinklers.
- (3) Obstructions located against the wall and that are not over 30 in. (750 mm) in width shall be permitted to be protected in accordance with Figure 11.2.5.1.2(b).

- (4) Obstructions located against the wall and that are not over 24 in. (600 mm) in width shall be permitted to be protected in accordance with Figure 11.2.5.1.2(c). The maximum distance between the sprinkler and the wall shall be measured from the sprinkler to the wall behind the obstruction and not to the face of the obstruction.
- (5) Obstructions up to 12 in. (300 mm) in width in hallways up to 6 ft (1.8 m) in width shall be permitted in accordance with Figure 11.2.5.1.2(d) when the sprinkler is located in the allowable obstruction zone and the closest edge of the obstruction is a minimum of 12 in. (300 mm) away from the centerline of the sprinkler.

Table 11.2.5.1.2(a) Positioning of Sprinklers to Avoid Obstructions to Discharge (Extended Coverage Upright and Pendent Sprinklers)

Distance from Sprinkler to Side of Obstruction (A) (ft)	Allowable Distance of Deflector Above Bottom of Obstruction (B)(in.)
Less than $1\frac{1}{2}$	0
$1\frac{1}{2}$ or more	1 or less
3 or more	3 or less
4 or more	5 or less
$4\frac{1}{2}$ or more	7 or less
6 or more	9 or less
$6\frac{1}{2}$ or more	11 or less
7 or more	14 or less
8 or more	15 or less
$8\frac{1}{2}$ or more	17 or less
9 or more	19 or less
$9\frac{1}{2}$ or more	21 or less

Note: For *A* and *B*, refer to Figure 11.2.5.1.2(a).

Table11.2.5.1.2(b)PositioningofSprinklerstoAvoidObstructions toDischarge (Extended Coverage Upright andPendent Sprinklers)

Distance from Sprinkler to Side of Obstruction (A) (mm)	Allowable Distance of Deflector Above Bottom of Obstruction (B) (mm)
Less than 450	0
450 or more	25 or less
900 or more	75 or less
1200 or more	125 or less
1400 or more	175 or less
1800 or more	225 or less
2000 or more	275 or less
2100 or more	350 or less
2400 or more	375 or less
2600 or more	425 or less
2700 or more	475 or less
2900 or more	525 or less

Note: For *A* and *B*, refer to Figure 11.2.5.1.2(a).

11.2.5.2 Obstructions to Sprinkler Discharge Pattern Development.

11.2.5.2.1 General.

11.2.5.2.1.1 Continuous or noncontinuous obstructions less than or equal to 18 in. (450 mm) below the sprinkler deflector that prevent the pattern from fully developing shall comply with 11.2.5.2.



FIGURE 11.2.5.1.2(a) Position of Sprinkler to Avoid Obstruction to Discharge (Extended Coverage Upright and Pendent Spray Sprinklers).



FIGURE 11.2.5.1.2(b) Obstructions Against Walls (Extended Coverage Upright and Pendent Spray Sprinklers).

11.2.5.2.1.2 Regardless of the rules of this section, solid continuous obstructions shall meet the applicable requirements of 11.2.5.1.2.

11.2.5.2.1.3* Unless the requirements of 11.2.5.2.1.4 through 11.2.5.2.1.8 are met, sprinklers shall be positioned away from obstructions a minimum distance of four times the maximum dimension of the obstruction (e.g., truss webs and chords, pipe, columns, and fixtures) in accordance with Figure 11.2.5.2.1.3(a) and Figure 11.2.5.2.1.3(b).

(A) The maximum clear distance required to obstructions in the horizontal orientation (e.g., light fixtures and truss chords) shall be 36 in. (900 mm).

(B) The maximum clear distance shall not be applied to obstructions in the vertical orientation (e.g., columns).



FIGURE 11.2.5.1.2(c) Obstructions Against Walls (Extended Coverage Upright and Pendent Spray Sprinklers).











Elevation View of Truss (Obstruction in horizontal orientation) $A \ge 4C \text{ or } 4D$ $A \le 36$ in. (900 mm) (Use dimension C or D, whichever is greater)

FIGURE 11.2.5.2.1.3(b) Minimum Distance from an **Obstruction in the Horizontal Orientation (Extended Coverage** Upright and Pendent Spray Sprinkler).

11.2.5.2.1.4 Sprinklers shall be permitted to be spaced on opposite sides of the obstruction where the distance from the centerline of the obstruction to the sprinklers does not exceed one-half the allowable distance between sprinklers.

11.2.5.2.1.5 Sprinklers shall be permitted to be located onehalf the distance between the obstructions where the obstruction consists of wood bar joists 20 in. (500 mm) or greater apart, provided that the top and bottom chords of the wood bar joist are not greater than 4 in. (100 mm) (nominal) in width and bar members do not exceed 1 in. (25 mm) in width.

11.2.5.2.1.6 Sprinklers shall be permitted to be installed on the centerline of a truss or bar joist or directly above a beam, provided that the truss chord or beam, dimension is not more than 8 in. (200 mm) and the sprinkler deflector is located at least 6 in. (150 mm) above the structural member and where the sprinkler is positioned at a distance four times greater than the maximum dimension of the web members away from the web members.

11.2.5.2.1.7 The requirements of 11.2.5.2.1.3 shall not apply to sprinkler system piping less than 3 in. (80 mm) in diameter.

11.2.5.2.1.8 The requirements of 11.2.5.2.1.3 shall not apply to sprinklers positioned with respect to obstructions in accordance with 11.2.5.1.2.

11.2.5.2.1.9* Sprinklers shall be permitted to be placed without regard to the blades of ceiling fans less than 60 in. (1.5 m) in diameter, provided the plan view of the fan is at least 50 percent open.

11.2.5.2.2 Suspended or Floor-Mounted Vertical Obstructions. The distance from sprinklers to privacy curtains, freestanding partitions, room dividers, and similar obstructions in light hazard occupancies shall be in accordance with Table 11.2.5.2.2(a) or Table 11.2.5.2.2(b) and Figure 11.2.5.2.2.

 Δ Table 11.2.5.2.2(a) Suspended or Floor-Mounted Obstructions in Light Hazard Occupancies Only (Extended Coverage **Upright and Pendent Sprinklers**)

Horizontal Distance (A) (in.)	Minimum Vertical Distance Below Deflector (B) (in.)
6 or less	3 or more
9 or less	4 or more
12 or less	6 or more
15 or less	8 or more
18 or less	$9\frac{1}{2}$ or more
24 or less	$12\frac{1}{2}$ or more
30 or less	$15\frac{1}{2}$ or more
More than 30	18 or more
Note: For A and B, refer to Figure 1	12522

Table 11.2.5.2.2(b) Suspended or Floor-Mounted Obstructions in Light Hazard Occupancies Only (Extended Coverage **Upright and Pendent Sprinklers**)

Horizontal Distance (A) (mm)	Minimum Vertical Distance Below Deflector <i>(B)</i> (mm)
150 or less	75 or more
225 or less	100 or more
300 or less	150 or more
375 or less	200 or more
450 or less	240 or more
600 or less	315 or more
√ 750 or less	390 or more
More than 750	450 or more

Note: For A and B, refer to Figure 11.2.5.2.2.



Elevation View

FIGURE 11.2.5.2.2 Suspended or Floor-Mounted **Obstruction (Extended Coverage Upright and Pendent Spray** Sprinklers) in Light Hazard Occupancy Only.

11.2.5.2.2.1* In light hazard occupancies, privacy curtains, as shown in Figure 11.2.5.2.2, shall not be considered obstructions where all of the following are met:

- (1) The curtains are supported by fabric mesh on ceiling track.
- (2) Openings in the mesh are equal to 70 percent or greater.
- (3) The mesh extends a minimum of 22 in. (550 mm) down from ceiling.

11.2.5.2.2.2 In ordinary hazard occupancies, where sprinklers are installed above freestanding partitions, room dividers, and similar obstructions, the distance from the sprinkler deflector to the top of the obstruction shall be 18 in. (450 mm) or greater per Figure 11.2.5.2.2.2.

11.2.5.2.2.3 In ordinary hazard occupancies, where sprinklers are installed within 6 in. (150 mm) horizontally of the centerline of freestanding partitions, room dividers, and similar obstructions no greater than 12 in. (300 mm) in width, the distance from the sprinkler deflector to the top of the obstruction shall be permitted to be installed 6 in. (150 mm) or greater vertically per Figure 11.2.5.2.2.3.

11.2.5.3 Obstructions that Prevent Sprinkler Discharge from Reaching Hazard. Continuous or noncontinuous obstructions that interrupt the water discharge in a horizontal plane more than 18 in. (450 mm) below the sprinkler deflector in a manner to limit the distribution from reaching the protected hazard shall comply with 9.5.3.3. (*See A.9.5.5.3.1.*)

11.2.6 Clearance to Storage (Extended Coverage Upright and Pendent Spray Sprinklers).

11.2.6.1* The clearance between the deflector and top of storage shall be 18 in. (450 mm) or greater.

11.2.6.2 The 18 in. (450 mm) dimension shall not limit the height of shelving on a wall or shelving against a wall in accordance with 11.2.6.

11.2.6.2.1 Where shelving is installed on a wall and is not directly below sprinklers, the shelves, including storage thereon, shall be permitted to extend above the level of a plane located 18 in. (450 mm) below ceiling sprinkler deflectors.

11.2.6.2.2 Shelving, and any storage thereon, directly below the sprinklers shall not extend above a plane located 18 in. (450 mm) below the ceiling sprinkler deflectors.

11.2.6.3 The clearance from the top of storage to sprinkler deflectors shall not be less than 36 in. (900 mm) where rubber tires are stored.

11.2.6.4 Where other standards specify greater clearance to storage minimums, they shall be followed.

11.2.7 Ceiling Pockets (Extended Coverage Upright and Pendent Spay Sprinklers).

11.2.7.1* Except as allowed in 11.2.7.2 and 11.2.7.3, sprinklers shall be required in all ceiling pockets.

11.2.7.2 Sprinklers shall not be required in ceiling pockets where all of the following are met:

- (1) The total volume of the unprotected ceiling pocket does not exceed $1000 \text{ ft}^3 (28 \text{ m}^3)$.
- (2) The depth of the unprotected ceiling pocket does not exceed 36 in. (900 mm).

- (3) The entire floor under the unprotected ceiling pocket is protected by sprinklers at the lower ceiling elevation.
- (4)* The total size of all unprotected ceiling pockets in the same compartment within 10 ft (3 m) of each other does not exceed 1000 ft³ (28 m³).
- (5) The unprotected ceiling pocket has noncombustible or limited-combustible finishes.
- (6) Quick-response sprinklers are utilized throughout the compartment.

11.2.7.3 Sprinklers shall not be required in skylights and similar pockets in accordance with 9.3.16.

11.3 Extended Coverage Sidewall Spray Sprinklers. (See 10.2.9.2.)

11.3.1 General. All requirements of Section 9.5 shall apply to extended coverage sidewall spray sprinklers except as modified in Section 11.3.

11.3.2 Extended coverage sidewall spray sprinklers shall only be installed as follows:

- (1) Light hazard occupancies with smooth, horizontal or sloped, flat ceilings
- (2) Ordinary hazard occupancies with smooth, flat ceilings where specifically listed for such use
- (3) In unobstructed construction consisting of flat, smooth ceilings with a slope not exceeding a pitch of 1 in 6 (a rise of 2 units in a run of 12 units, a roof slope of 16.7 percent)
- (4) In unobstructed or noncombustible obstructed construction, where specifically listed for such use



△ FIGURE 11.2.5.2.2.2 Location of Suspended or Floor-Mounted Obstruction in Ordinary Hazard Occupancies (Sprinkler Located to the Side) (ECU/ECP).

- (5) Within trusses or bar joists having web members not greater than 1 in. (25 mm) maximum dimension or where trusses are spaced greater than $7\frac{1}{2}$ ft (2.3 m) on center and where the ceiling slope does not exceed a pitch of 1 in 6 (a rise of 2 units in a run of 12 units, a roof slope of 16.7 percent)
- (6) Extended coverage sidewall sprinklers installed in accordance with 11.3.6.2.2 in slopes exceeding a ceiling pitch of 2 in 12
- (7) In each bay of obstructed construction consisting of solid structural members that extend below the deflector of the sprinkler
- (8) Extended coverage sprinklers installed to protect areas below a single overhead door(s)
- (9) For the protection of exterior projections and similar structures
- (10) Under cars in car stackers and car lift systems with cars stacked vertically placed under each level of cars [see A.10.3.2(9)]



▲ FIGURE 11.2.5.2.2.3 Location of Suspended or Floor-Mounted Obstruction in Ordinary Hazard Occupancies (Sprinkler Located Directly Above) (ECU/ECP).

11.3.3 Protection Areas per Sprinkler (Extended Coverage Sidewall Spray Sprinklers).

11.3.3.1* Determination of Protection Area of Coverage.

11.3.3.1.1 The protection area of coverage per sprinkler (A_s) for extended coverage sidewall sprinklers shall be not less than that prescribed by the listing.

11.3.3.1.2 Listing dimensions shall be in 2 ft (600 mm) increments up to 28 ft (8.5 m).

11.3.3.2 Maximum Protection Area of Coverage.

11.3.3.2.1 The maximum allowable protection area of coverage for a sprinkler (A_i) shall be in accordance with the value indicated in Table 11.3.3.2.1.

11.3.3.2.2 In any case, the maximum area of coverage of a sprinkler shall not exceed 400 ft² (37 m^2) .

11.3.4 Sprinkler Spacing (Extended Coverage Sidewall Spray Sprinklers).

11.3.4.1 Maximum Distance Between Sprinklers.

11.3.4.1.1 The maximum distance permitted between sprinklers shall be based on the centerline distance between sprinklers on the branch line along the wall.

11.3.4.1.2 Where sprinklers are installed along the length of a single wall of rooms or bays, they shall be spaced in accordance with the maximum spacing provisions of Table 11.3.3.2.1.

11.3.4.1.3 Sidewall sprinklers shall not be installed back-to-back without being separated by a continuous lintel, soffit, or baffle.

11.3.4.1.4 Where sidewall extended spray sprinklers are installed to protect areas below overhead doors within ordinary hazard occupancy spaces or rooms, listed light hazard sidewall extended coverage spray sprinklers shall be permitted and the protection area and maximum sprinkler spacing for light hazard as specified in Table 11.3.3.2.1 shall be permitted.

11.3.4.2 Maximum Distance from Walls. The distance from sprinklers to the end walls shall not exceed one-half of the allowable distance permitted between sprinklers as indicated in Table 11.3.3.2.1.

11.3.4.3 Minimum Distance from Walls.

11.3.4.3.1 Sprinklers shall be located a minimum of 4 in. (100 mm) from an end wall.

11.3.4.3.2 The distance from the wall to the sprinkler shall be measured perpendicular to the wall.

Table 11.3.3.2.1 Protection Area and Maximum Spacing for Extended Coverage Sidewall Spray Sprinklers

	Light Hazard			Ordinary Hazard				
	Protection Area Spacing		Protection Area		Spacing			
Construction Type	ft ²	m ²	ft	m	ft ²	m ²	ft	m
Unobstructed, smooth, flat	400	37	28	8.5	400	37	24	7.3

11.3.4.4 Minimum Distance Between Sprinklers.

11.3.4.4.1 Sidewall sprinklers shall be permitted to be installed on opposing or adjacent walls, provided no sprinkler is located within 12 ft (3.7 m) of the opposing sprinkler.

- △ 11.3.4.4.2 Sprinklers installed on the same wall shall be not located within 8 ft (2.4 m) of any other sprinkler unless the listing of the sprinkler requires a greater distance, or unless required by 11.3.5.1.4.1, or separated by baffles that comply with the following:
 - (1) Baffles shall be arranged to protect the actuating elements.
 - (2) Baffles shall be of solid and rigid material that will stay in place before and during sprinkler operation.
 - (3) Baffles shall be not less than 8 in. (200 mm) long and 6 in. (150 mm) high.
 - (4) The tops of baffles shall extend between 2 in. and 3 in. (50 mm and 75 mm) above the deflectors.
 - (5) The bottoms of baffles shall extend downward to a level at least even with the deflectors.

11.3.5 Deflector Position from Ceilings and Walls (Extended Coverage Sidewall Spray Sprinklers).

11.3.5.1 Distance Below Ceilings and from Walls to Which Sprinklers Are Mounted.

11.3.5.1.1 Ceilings.

11.3.5.1.1.1 Unless the requirements of 11.3.5.1.1.2 are met, sidewall sprinkler deflectors shall be located not more than 6 in. (150 mm) nor less than 4 in. (100 mm) from ceilings.

11.3.5.1.1.2 Horizontal sidewall sprinklers shall be permitted to be located in a zone 6 in. to 12 in. (150 mm to 300 mm) or 12 in. to 18 in. (300 mm to 450 mm) below noncombustible or limited-combustible ceilings where listed for such use.

11.3.5.1.2 Walls.

11.3.5.1.2.1 Sidewall sprinkler deflectors shall be located not more than 6 in. (150 mm) or less than 4 in. (100 mm) from walls on which they are mounted. (*See A.10.3.5.1.2.1.*)

11.3.5.1.2.2 Horizontal sidewall sprinklers shall be permitted to be located with their deflectors less than 4 in. (100 mm) from the wall on which they are mounted.

11.3.5.1.3 Lintels and Soffits.

11.3.5.1.3.1* Where soffits used for the installation of sidewall sprinklers are less than or equal to 8 in. (200 mm) in width or projection from the wall, additional sprinklers shall not be required below the soffit.

11.3.5.1.3.2* A sidewall sprinkler shall be permitted to be installed under a soffit when both the minimum distance from the sprinkler deflector to the bottom of the soffit and the maximum distance from the sprinkler deflector to the high ceiling are maintained.

11.3.5.1.4* Soffits and Cabinets in Residential Areas/Occupancies. Where soffits are used for the installation of sidewall sprinklers, the sprinklers and soffits shall be installed in accordance with 11.3.5.1.4.1, 11.3.5.1.4.2, or 11.3.5.1.4.3.

11.3.5.1.4.1 Where soffits exceed more than 8 in. (200 mm) in width or projection from the wall, pendent sprinklers shall be installed under the soffit.

11.3.5.1.4.2 Sidewall sprinklers shall be permitted to be installed in the face of a soffit located directly over cabinets, without requiring additional sprinklers below the soffit or cabinets, where the soffit does not project horizontally more than 12 in. (300 mm) from the wall.

11.3.5.1.4.3 Where sidewall sprinklers are more than 3 ft (900 mm) above the top of cabinets, the sprinkler shall be permitted to be installed on the wall above the cabinets where the cabinets are no greater than 12 in. (300 mm) from the wall.

11.3.5.2 Deflector Orientation.

11.3.5.2.1 Sidewall sprinklers, where installed under a sloped ceiling with a slope exceeding 2 in 12, shall be located at the high point of the slope and positioned to discharge downward along the slope.

11.3.5.2.2 Sidewall sprinklers specifically listed for other ceiling configurations shall be permitted to be installed in accordance with the listing requirements.

11.3.6 Obstructions to Sprinkler Discharge (Extended Coverage Sidewall Spray Sprinklers).

11.3.6.1 Performance Objective.

11.3.6.1.1 Sprinklers shall be located so as to minimize obstructions to discharge as defined in 9.5.5.2 and 9.5.5.3, or additional sprinklers shall be provided to ensure adequate coverage of the hazard.

11.3.6.1.2 Sidewall sprinklers shall not be installed less than 8 ft (2.4 m) from light fixtures or similar obstructions unless the requirements of 11.3.6.1.2.1 or 11.3.6.1.2.2 are met.

11.3.6.1.2.1 For obstructions such as light fixtures, where the greatest dimension of the obstruction is less than 2 ft (0.6 m), sidewall sprinklers shall be permitted to be installed at a minimum distance of four times the greatest dimension.

11.3.6.1.2.2 For obstructions located 4 in. or greater above the plane of the sprinkler deflector the sprinkler shall be permitted to be located less than 8 ft (2.4 m) from the obstruction.

11.3.6.1.3 The distance between light fixtures or similar obstructions located 8 ft (2.4 m) or greater from the sprinkler shall be in conformance with Table 11.3.6.1.3(a) or Table 11.3.6.1.3(b) and Figure 11.3.6.1.3.

 Table
 11.3.6.1.3(a)
 Positioning
 of
 Sprinklers
 to
 Avoid

 Obstructions to Discharge (Extended Coverage Sidewall)
 Image: Coverage Sidewall
 Image: Coverage Sidewall

Distance from Sprinkler to Side of Obstruction (A) (ft)	Allowable Distance of Deflector Above Bottom of Obstruction (B) (in.)
Less than 8	0
8 or more	1 or less
10 or more	2 or less
11 or more	3 or less
12 or more	4 or less
13 or more	6 or less
14 or more	7 or less
15 or more	9 or less
16 or more	11 or less
17 or more	14 or less

Note: For *A* and *B*, refer to Figure 11.3.6.1.3.

11.3.6.1.4 Continuous obstructions projecting from the same wall as the one on which the sidewall sprinkler is mounted shall be in accordance with one of the following arrangements:

- (1) Sprinklers shall be installed in accordance with Table 11.3.6.1.4(a) or Table 11.3.6.1.4(b) and Figure 11.3.6.1.4(a).
- (2) Sprinklers shall be permitted to be spaced on opposite sides of obstructions less than 4 ft (1.2 m) in width where the distance from the centerline of the obstruction to the sprinklers does not exceed one-half the allowable distance between sprinklers.
- (3) Obstructions located against the wall and that are not over 30 in. (750 mm) in width shall be permitted to be protected in accordance with Figure 11.3.6.1.4(b).
- (4) Obstructions located against the wall and that are not over 24 in. (600 mm) in width shall be permitted to be protected in accordance with Figure 11.3.6.1.4(c). The maximum distance between the sprinkler and the wall shall be measured from the sprinkler to the wall behind the obstruction and not to the face of the obstruction.
- (5) Obstructions with a maximum width of 12 in. (300 mm) in hallways up to 6 ft (1.8 m) in width shall be permitted

Table 11.3.6.1.3(b) Positioning of Sprinklers to Avoid Obstructions to Discharge (Extended Coverage Sidewall)

Distance from Sprinkler to Side of Obstruction (A) (mm)	Allowable Distance of Deflector Above Bottom of Obstruction (B) (mm)
Less than 2400	0
2400 or more	25 or less
3000 or more	50 or less
3400 or more	75 or less
3700 or more	100 or less 🛛 🔨
4000 or more	150 or less 🛛 🔨 🕹
4300 or more	175 or less
4600 or more	225 or less
4900 or more	275 or less
5200 or more	350 or less

Note: For *A* and *B*, refer to Figure 11.3.6.1.3.





in accordance with Figure 11.3.6.1.4(d) when the sprinkler is located in the allowable obstruction zone and the closest edge of the obstruction is a minimum of 12 in. (300 mm) away from the deflector.

11.3.6.1.5 Isolated Obstructions. Isolated obstructions projecting from the same wall as the one on which the extended coverage sidewall sprinkler is mounted shall be located a minimum of 6 in. (150 mm) from the sidewall sprinkler.

Table 11.3.6.1.4(a)	Positioning of Sprinklers to Avoid	
Obstructions Along	Wall (Extended Coverage Sidewall)

Distance from Sprinkler to Side of Obstruction (A) (ft)	Allowable Distance of Deflector Above Bottom of Obstruction (B) (in.)
Less than $1\frac{1}{2}$	0
$1\frac{1}{2}$ or more	1 or less
3 ft or more	3 or less
4 ft or more	5 or less
$4\frac{1}{2}$ or more	7 or less
6 ft or more	9 or less
$6\frac{1}{2}$ or more	11 or less
7 or more	14 or less

Note: For *A* and *B*, refer to Figure 11.3.6.1.4(a).

 Table 11.3.6.1.4(b)
 Positioning of Sprinklers to Avoid

 Obstructions Along Wall (Extended Coverage Sidewall)

Distance from Sprinkler to Side of Obstruction (A) (mm)	Allowable Distance of Deflector Above Bottom of Obstruction (B) (mm)
Less than 450	0
450 or more	25 or less
900 or more	75 or less
1200 or more	125 or less
1400 or more	175 or less
1800 or more	225 or less
2000 or more	275 or less
2100 or more	350 or less

Note: For *A* and *B*, refer to Figure 11.3.6.1.4(a).



Elevation View

FIGURE 11.3.6.1.4(a) Positioning of Sprinkler to Avoid Obstruction Along Wall (Extended Coverage Sidewall Spray Sprinklers).



where: $D \le 30$ in. (750 mm)

Elevation View

FIGURE 11.3.6.1.4(b) Obstruction Against Wall (Extended **Coverage Sidewall Spray Sprinklers).**



FIGURE 11.3.6.1.4(c) **Obstruction Against Wall (Extended** Coverage Sidewall Spray Sprinklers).

11.3.6.1.6 Obstructions on the wall opposite from the sidewall sprinkler shall be permitted in accordance with Figure 11.3.6.1.6.

11.3.6.2 Obstructions to Sprinkler Discharge Pattern Development.

11.3.6.2.1 General.

11.3.6.2.1.1 Continuous or noncontinuous obstructions less than or equal to 18 in. (450 mm) below the sprinkler deflector that prevent the pattern from fully developing shall comply with this section.

11.3.6.2.1.2 Regardless of the rules of this section, solid continuous obstructions shall meet the requirements of 11.3.6.1.2 and 11.3.6.1.3.

11.3.6.2.1.3* Unless the requirements of 11.3.6.2.1.4 and 11.3.6.2.1.5 are met, sprinklers shall be positioned away from obstructions a minimum distance of four times the maximum dimension of the obstruction (e.g., truss webs and chords, pipe, columns, and fixtures) in accordance with Figure 11.3.6.2.1.3(a) and Figure 11.3.6.2.1.3(b).

(A) The maximum clear distance required to obstructions in the horizontal orientation (e.g., light fixtures and truss chords) shall be 36 in. (900 mm).

(B) The maximum clear distance shall not be applied to obstructions in the vertical orientation (e.g., columns).

11.3.6.2.1.4 The requirements of **11.3.6.2.1.3** and **11.3.6.2.1.4** shall not apply where sprinklers are positioned with respect to obstructions in accordance with 11.3.6.1.2 and 11.3.6.1.3.

11.3.6.2.1.5 The requirements of 11.3.6.2.1.3 shall not apply to sprinkler system piping less than 3 in. (80 mm) in diameter.

11.3.6.2.1.6* Sprinklers shall be permitted to be placed without regard to the blades of ceiling fans less than 60 in. (1.5 m) in diameter, provided the plan view of the fan is at least 50 percent open.

11.3.6.2.2 Suspended or Floor-Mounted Vertical Obstructions. The distance from sprinklers to privacy curtains, freestanding partitions, room dividers, and similar obstructions in light hazard occupancies shall be in accordance with Table 11.3.6.2.2(a) or Table 11.3.6.2.2(b) and Figure 11.3.6.2.2.

11.3.6.2.2.1* In light hazard occupancies, privacy curtains, as shown in Figure 11.3.6.2.2, shall not be considered obstructions where all of the following are met:

- The curtains are supported by fabric mesh on ceiling (1)track.
- Openings in the mesh are equal to 70 percent or greater. (2)
- (3)The mesh extends a minimum of 22 in. (550 mm) down from ceiling.

11.3.6.3* Obstructions that Prevent Sprinkler Discharge from Reaching Hazard. Continuous or noncontinuous obstructions that interrupt the water discharge in a horizontal plane more than 18 in. (450 mm) below the sprinkler deflector in a manner to limit the distribution from reaching the protected hazard shall comply with 9.5.5.3.

11.3.7 Clearance to Storage (Extended Coverage Sidewall Spray Sprinklers). The clearance between the deflector and the top of storage shall be 18 in. (450 mm) or greater.

11.3.7.1 The 18 in. (450 mm) dimension shall not limit the height of shelving on a wall in accordance with 11.3.7.1.1.

11.3.7.1.1 Where shelving is installed on a wall and is not directly below the sprinklers, the shelves, including storage thereon, shall be permitted to extend above the level of a plane located 18 in. (450 mm) below the sprinkler deflectors.

11.3.7.1.2 Shelving, and any storage thereon, directly below the sprinklers shall not extend above a plane located 18 in. (450 mm) below the ceiling sprinkler deflectors.

11.3.7.2 Where other standards specify greater clearance to storage minimums, they shall be followed.








FIGURE 11.3.6.2.1.3(a) Minimum Distance from an **Obstruction in the Vertical Orientation (Extended Coverage** Sidewall).



(Obstruction in horizontal orientation) $A \ge 4C \text{ or } 4D$ $A \le 36$ in. (900 mm) (Use dimension *C* or *D*, whichever is greater)

FIGURE 11.3.6.2.1.3(b) Minimum Distance from an **Obstruction in the Horizontal Orientation (Extended Coverage** Sidewall).

Table 11.3.6.2.2(a) Suspended or Floor-Mounted Obstructions in Light Hazard Occupancies Only (Extended Coverage Sidewall Sprinklers)

Horizontal Distance (A) (in.)	Minimum Vertical Distance Below Deflector (B) (in.)
6 or less	3 or more
9 or less	4 or more
12 or less	6 or more
15 or less	8 or more
18 or less	$9\frac{1}{2}$ or more
24 or less	$12\frac{1}{2}$ or more
30 or less	$15\frac{1}{2}$ or more
More than 30	18 or more

Note: For A and B, refer to Figure 11.3.6.2.2.

Table 11.3.6.2.2(b)	Suspended or Floor-Mounted Obstructions
in Light Hazard Occ	cupancies Only (Extended Coverage
Sidewall Sprinklers)	

Horizontal Distance (A) (mm)	Minimum Vertical Distance Below Deflector (B) (mm)
150 or less	75 or more
225 or less	100 or more
300 or less	150 or more
375 or less	200 or more
450 or less	240 or more
600 or less	315 or more
750 or less	390 or more
More than 750	450 or more

Note: For A and B, refer to Figure 11.3.6.2.2.





Chapter 12 Installation Requirements for Residential Sprinklers

12.1 General. Residential sprinklers shall be selected for use and installation as indicated in this chapter and shall be positioned and spaced in accordance with Section 9.5.

12.1.1* Residential sprinklers shall be permitted in dwelling units and their adjoining corridors, provided they are installed in conformance with their listing and when installed under the following conditions:

- (1) A flat, smooth, horizontal ceiling with no beams up to a maximum of 24 ft (7.3 m) above the floor.
- (2) A flat, horizontal, beamed ceiling, with a maximum ceiling height of 24 ft (7.3 m), with beams up to 14 in. (355 mm) deep with pendent sprinklers under the beams. The compartment containing the beamed ceiling shall be a maximum of 600 ft² (56 m²) in area. The highest sprinkler in the compartment shall be above all openings from the compartment into any communicating spaces.
- (3) A smooth, flat, sloped ceiling with no beams up to a maximum slope of 8 in 12. The highest portion of the ceiling shall not be more than 24 ft (7.3 m) above the floor. The highest sprinkler in the sloped portion of the ceiling shall be above all openings from the compartment containing the sloped ceiling into any communicating spaces.
- (4) A sloped ceiling with beams up to 14 in. (350 mm) deep with pendent sprinklers under the beams. The compartment containing the sloped, beamed ceiling shall be a maximum of 600 ft² (56 m²) in area. The slope of the ceiling shall be between 2 in 12 and 8 in 12. The highest portion of the ceiling shall not be more than 24 ft (7.3 m) above the floor. The highest sprinkler in the sloped portion of the ceiling shall be above all openings from the compartment containing the sloped ceiling into any communicating spaces.
- (5) A sloped ceiling with beams of any depth with sidewall or pendent sprinklers in each pocket formed by the beams. The compartment containing the sloped, beamed ceiling shall be a maximum of 600 ft² (56 m²) in area. The slope of the ceiling shall be between 2 in 12 and 8 in 12. The highest portion of the ceiling shall not be more than 24 ft (7.3 m) above the floor.

12.1.2 Where construction features or other special conditions exist that are outside the scope of sprinkler listings, listed sprinklers shall be permitted to be installed beyond their listing limitations when acceptable to the authority having jurisdiction.

12.1.3 Residential sprinklers shall be used only in wet systems unless specifically listed for use in dry systems or preaction systems.

12.1.4 Where residential sprinklers are installed in a compartment as defined in 3.3.43, all sprinklers within the compartment shall be residential sprinklers.

12.1.4.1 Residential sprinklers shall be permitted to be installed in corridors of residential occupancies that are adjacent to areas protected by quick-response sprinklers.

12.1.5 Reserved.

12.1.6* Listings.

12.1.6.1 Areas of coverage shall be in accordance with the manufacturer's listing.

12.1.7 Distances Between Sprinklers.

12.1.7.1 Maximum distances between sprinklers shall be in accordance with the manufacturer's listing.

12.1.7.2 The distance between the sprinkler and the wall shall not exceed half the maximum allowable distance between sprinklers per the manufacturer's listing.

12.1.7.3 The minimum distance between sprinklers within a compartment shall be 8 ft (2.4 m), unless the listing of the sprinkler requires a greater distance, unless required by 12.1.11.1.5.1, or unless separated by baffles that comply with the following:

- (1) Baffles shall be arranged to protect the actuating elements.
- (2) Baffles shall be of solid and rigid material that will stay in place before and during sprinkler operation.
- (3) Baffles shall be not less than 8 in. (200 mm) long and 6 in. (150 mm) high.
- (4) The tops of baffles shall extend between 2 in. and 3 in. (50 mm and 75 mm) above the deflectors of upright sprinklers.
- (5) The bottoms of baffles shall extend downward to a level at least even with the deflectors of pendent sprinklers.

12.1.7.4 Residential sidewall sprinklers shall be permitted to be installed on opposing or adjacent walls, provided no sprinkler is located within the maximum protection area of another sprinkler or unless separated by baffles that comply with the following:

- (1) Baffles shall be arranged to protect the actuating elements.
- (2) Baffles shall be of solid and rigid material that will stay in place before and during sprinkler operation.
- (3) Baffles shall be not less than 8 in. (200 mm) long and 6 in. (150 mm) high.
- (4) The tops of baffles shall extend between 2 in. and 3 in.(50 mm and 75 mm) above the deflectors.
- (5) The bottoms of baffles shall extend downward to a level at least even with the deflectors.
- ▲ 12.1.7.5 The maximum distance shall be measured along the slope of the ceiling as shown in Figure 12.1.7.5, and the maximum vertical distance from the peak shall be no more than 3 ft (900 mm).
- △ 12.1.7.6 Where sprinklers are installed along sloped ceilings, a sprinkler shall be installed within 3 ft (900 mm) of the peak and the sprinklers shall maintain the minimum listed spacing, but no less than 8 ft (2.4 m), measured in the plan view from one sprinkler to another as shown in Figure 12.1.7.5 unless separated by baffles that comply with the following:
 - (1) Baffles shall be arranged to protect the actuating elements.
 - (2) Baffles shall be of solid and rigid material that will stay in place before and during sprinkler operation.
 - (3) Baffles shall be not less than 8 in. (200 mm) long and 6 in. (150 mm) high.



- (4) The tops of baffles shall extend between 2 in. (50 mm) and 3 in. (75 mm) above the deflectors of upright sprinklers.
- (5) The bottoms of baffles shall extend downward to a level at least even with the deflectors of pendent sprinklers.

12.1.8 Deflector Position from Ceilings and Walls.

12.1.8.1 Pendent and upright sprinklers shall be positioned so that the deflectors are 1 in. to 4 in. (25 mm to 100 mm) from the ceiling unless the listing allows a greater distance.

12.1.8.1.1 Pendent and upright sprinklers installed under beamed or beamed and sloped ceilings shall be permitted to be installed where all of the following apply:

- (1) Maximum beam depth of 14 in. (350 mm)
- (2) Maximum ceiling height of 24 ft (7.3 m)
- (3) Maximum ceiling slope of 8 in 12
- (4) Maximum compartment size of $600 \text{ ft}^2 (56 \text{ m}^2)$

△ 12.1.8.1.2 Pendent-type residential sprinklers located under or adjacent to beams shall be installed in accordance with one of the following:

- Pendent, recessed pendent, concealed, and flush-type pendent sprinklers shall be permitted to be installed directly under a beam having a maximum depth of 14 in. (350 mm) with the sprinkler deflector 1 in. to 2 in. (25 mm to 50 mm) below the beam, or in accordance with the manufacturer's instructions for recessed or flush sprinklers if the deflector is less than 1 in. (25 mm) below the beam, as shown in Figure 12.1.8.1.2(a).
- (2) Pendent sprinklers shall be permitted to be installed adjacent to beams where the vertical centerline of the sprinkler is no greater than 2 in. (50 mm) from the edge of the beam and with the sprinkler deflector 1 in. to 2 in. (25 mm to 50 mm) below the beam, or in accordance

with the manufacturer's instructions for flush sprinklers if the deflector is less than 1 in. (25 mm) below the beam, as shown in Figure 12.1.8.1.2(b).

12.1.8.1.3 The highest sprinkler in the compartment shall be above all openings from the compartment into any communicated spaces.

12.1.8.2 Sidewall sprinklers shall be positioned so that the deflectors are within 4 in. to 6 in. (100 mm to 150 mm) from the ceiling unless the listing allows greater distances.

12.1.8.3 Where soffits used for the installation of sidewall sprinklers exceed 8 in. (200 mm) in width or projection from the wall, additional sprinklers shall be installed below the soffit.

12.1.8.4 Residential horizontal sidewall sprinkler deflectors shall be located no more than 6 in. (150 mm) from the wall on which they are mounted unless listed for greater distances.

12.1.8.5 The distance from sprinklers to the end walls shall not exceed one-half of the allowable distance permitted between sprinklers as indicated in the sprinkler listing.

Δ 12.1.8.6 Minimum Distance from Walls.

12.1.8.6.1 Sprinklers shall be located a minimum of 4 in. (100 mm) from an end wall.

△ 12.1.8.7 Deflector Orientation (Residential Upright and Pendent).

12.1.8.7.1 Unless the requirements of 12.1.8.7.2 or 12.1.8.7.3 are met, deflectors of upright and pendent sprinklers shall be aligned parallel to ceilings, roofs, or the incline of stairs.

12.1.8.7.2 Where upright or pendent sprinklers are installed at the peak below a sloped ceiling or roof surface, the sprinkler shall be installed with the deflector parallel to floor.



N FIGURE 12.1.8.1.2(a) Position of Sprinkler Under Beam.



FIGURE 12.1.8.1.2(b) Position of Sprinkler Adjacent to Beam.

12.1.8.7.3 Roofs and ceilings having a pitch not exceeding 2 in 12 (16.7 percent) are considered horizontal in the application of 12.1.8.7, and upright and pendent sprinklers installed under horizontal ceilings shall be permitted to be installed with deflectors parallel to floor.

- **N 12.1.8.8 Deflector Orientation (Residential Sidewall Sprinklers).** Residential sidewall sprinklers, where installed under a sloped ceiling with a slope exceeding 2 in 12, shall be located in accordance with one of the following:
 - At the high point of the slope and positioned to discharge downward along the slope as shown in Figure 12.1.8.8(a)
 - (2) Along slopes not exceeding 8 in 12 with the deflector installed parallel to the slope and positioned to discharge across the slope as shown in Figure 12.1.8.8(b)

12.1.9 Residential sprinklers installed in conformance with this standard shall follow the sprinkler obstruction rules of 12.1.10 or 12.1.11 as appropriate for their installation orientation (upright, pendent, or sidewall) and the obstruction criteria specified in the manufacturer's installation instructions.



- N FIGURE 12.1.8.8(a) Sidewall Deflector Orientation with Discharge Parallel to the Slope.
- **Δ** 12.1.10 Obstructions to Sprinkler Discharge (Residential Upright and Pendent Sprinklers).
 - 12.1.10.1 Performance Objective.

12.1.10.1.1 Sprinklers shall be located so as to minimize obstructions to discharge as defined in 12.1.10.2 and 12.1.10.3, or additional sprinklers shall be provided to ensure adequate coverage of the hazard.

12.1.10.1.2 Sprinklers shall be arranged to comply with one of the following arrangements:

- Sprinklers shall be in accordance with 9.5.5.2, Table 12.1.10.1.2(a) or Table 12.1.10.1.2(b), and Figure 12.1.10.1.2(a).
- (2) Sprinklers shall be permitted to be spaced on opposite sides of obstructions not exceeding 4 ft (1.2 m) in width, provided the distance from the centerline of the obstruction to the sprinklers does not exceed one-half the allowable distance permitted between sprinklers.
- (3) Obstructions located against the wall and that are not over 30 in. (750 mm) in width shall be permitted to be protected in accordance with Figure 12.1.10.1.2(b).



B – Maximum:	The maximum sprinkler coverage area length for the coverage area being hydraulically calculated
Minimum:	8 ft 0 in. (2.4 m)
C – Maximum:	3 ft 0 in. (0.9 m)

D - Slope: >2 in 12 to 8 in 12

N FIGURE 12.1.8.8(b) Sidewall Deflector Orientation with Discharge Perpendicular to the Slope.

- (4) Obstructions that are located against the wall and that are not over 24 in. (600 mm) in width shall be permitted to be protected in accordance with Figure 12.1.10.1.2(c). The maximum distance between the sprinkler and the wall shall be measured from the sprinkler to the wall behind the obstruction and not to the face of the obstruction.
- (5) Obstructions 12 in. (300 mm) in width in hallways up to 6 ft (1.8 m) in width shall be permitted in accordance with Figure 12.1.10.1.2(d) when the sprinkler is located in the allowable obstruction zone and the closest edge of the obstruction is a minimum of 12 in. (300 mm) away from the centerline of the sprinkler.

12.1.10.2 Obstructions to Sprinkler Discharge Pattern Development.

12.1.10.2.1 General.

12.1.10.2.1.1 Continuous or noncontinuous obstructions less than or equal to 18 in. (450 mm) below the sprinkler deflector that prevent the pattern from fully developing shall comply with 12.1.10.2.

12.1.10.2.1.2 Regardless of the rules of this section, solid continuous obstructions shall meet the applicable requirements of 12.1.10.1.2.

12.1.10.2.1.3* Unless the requirements of 12.1.10.2.1.4 through 12.1.10.2.1.8 are met, sprinklers shall be positioned away from obstructions a minimum distance of four times the maximum dimension of the obstruction (e.g., truss webs and chords, pipe, columns, and fixtures) in accordance with Figure 12.1.10.2.1.3(a) and Figure 12.1.10.2.1.3(b).

(A) The maximum clear distance required to obstructions in the horizontal orientation (e.g., light fixture and truss chords) shall be 36 in. (900 mm).

(B) The maximum clear distance shall not be applied to obstructions in the vertical orientation (e.g., columns).

12.1.10.2.1.4 Sprinklers shall be permitted to be spaced on opposite sides of the obstruction where the distance from the centerline of the obstruction to the sprinklers does not exceed one-half the allowable distance between sprinklers.

12.1.10.2.1.5 Sprinklers shall be permitted to be located onehalf the distance between the obstructions where the obstruction consists of open trusses 20 in. (500 mm) or greater apart [24 in. (600 mm) on center], provided that all truss members are not greater than 4 in. (100 mm) (nominal) in width and web members do not exceed 1 in. (25 mm) in width.

12.1.10.2.1.6 Sprinklers shall be permitted to be installed on the centerline of a truss or bar joist or directly above a beam provided that the truss chord or beam dimension is not more than 8 in. (200 mm) and the sprinkler deflector is located at least 6 in. (150 mm) above the structural member and where the sprinkler is positioned at a distance four times greater than the maximum dimension of the web members away from the web members.

Table 12.1.10.1.2(a) Positioning of Sprinklers to Avoid		
Obstructions to Discharge (Residential Upright and Pendent		
Sprinklers)		

Distance from Sprinkler to Side of Obstruction (A) (ft)	Allowable Distance of Deflector Above Bottom of Obstruction (B) (in.)
Less than $1\frac{1}{2}$	0
$1\frac{1}{2}$ or more	1 or less
3 or more	3 or less
4 or more	5 or less
$4\frac{1}{2}$ or more	7 or less
6 or more	9 or less
$6\frac{1}{2}$ or more	11 or less
7 or more	14 or less
8 or more	15 or less
$8\frac{1}{2}$ or more	17 or less
9 or more	19 or less

Note: For A and B, refer to Figure 12.1.10.1.2(a).

Table 12.1.10.1.2(b) Positioning of Sprinklers to Avoid Obstructions to Discharge (Residential Upright and Pendent Sprinklers)

Distance from Sprinkler to Side of Obstruction (A) (mm)	Allowable Distance of Deflector Above Bottom of Obstruction (B) (mm)
Less than 450	0
450 or more	25 or less
900 or more	75 or less
1200 or more	125 or less
1400 or more	175 or less
1800 or more	225 or less
2000 or more	275 or less
2100 or more	350 or less
2400 or more	375 or less
2600 or more	425 or less
2700 or more	475 or less

Note: For A and B, refer to Figure 12.1.10.1.2(a).

12.1.10.2.1.7 The requirements of 12.1.10.2.1.3 shall not apply to sprinkler system piping less than 3 in. (80 mm) in diameter.

12.1.10.2.1.8 The requirements of 12.1.10.2.1.3 shall not apply to sprinklers positioned with respect to obstructions in accordance with 12.1.10.1.2.

12.1.10.2.1.9* Sprinklers shall be permitted to be placed without regard to the blades of a ceiling fan, provided the plan view of the fan is at least 50 percent open.



Elevation View

△ FIGURE 12.1.10.1.2(a) Positioning of Sprinkler to Avoid Obstruction to Discharge (Residential Upright and Pendent Sprinklers).









12.1.10.2.2 Suspended or Floor-Mounted Vertical Obstructions. The distance from sprinklers to privacy curtains, freestanding partitions, room dividers, and similar obstructions shall be in accordance with Table 12.1.10.2.2(a) or Table 12.1.10.2.2(b) and Figure 12.1.10.2.2.

12.1.10.2.3* Shadow Areas. Shadow areas created by walls and partitions shall be permitted in the protection area of a sprinkler as long as the cumulative areas do not exceed 15 ft² (1.4 m²) per sprinkler. *[See A.9.1.1(3), Figure A.9.1.1(3)(a), and Figure A.9.1.1(3)(b).]*

12.1.10.3 Obstructions that Prevent Sprinkler Discharge from Reaching Hazard. Continuous or noncontinuous obstructions that interrupt the water discharge in a horizontal plane more than 18 in. (450 mm) below the sprinkler deflector in a manner to limit the distribution from reaching the protected hazard shall comply with 9.5.5.3. (*See A.9.5.5.3.1.*)

△ 12.1.11 Obstructions to Sprinkler Discharge (Residential Sidewall Sprinklers).

12.1.11.1 Performance Objective.

12.1.11.1.1 Sprinklers shall be located so as to minimize obstructions to discharge as defined in 9.5.5.2 and 9.5.5.3, or additional sprinklers shall be provided to ensure adequate coverage of the hazard.







Plan View of Column(Obstruction in vertical orientation) $A \ge 4C$ or 4D(Use dimension C or D, whichever is greater)

△ FIGURE 12.1.10.2.1.3(a) Minimum Distance from an Obstruction in the Vertical Orientation (Residential Upright and Pendent Sprinkler).

12.1.11.1.2 Sidewall sprinklers shall not be installed less than 8 ft (2.4 m) from light fixtures or similar obstructions unless the requirements of 12.1.11.1.2.1 or 12.1.11.1.2.2 are met.

12.1.11.1.2.1 For obstructions such as light fixtures, where the greatest dimension of the obstruction is less than 2 ft (0.6 m), sidewall sprinklers shall be permitted to be installed at a minimum distance of four times the greatest dimension.

12.1.11.1.2.2 For obstructions located at least 4 in. (100 mm) above the plane of the sprinkler deflector, the sprinkler shall be permitted to be located less than 8 ft (2.4 m) from the obstruction.

12.1.11.1.3 The distance between light fixtures or similar obstructions located 8 ft (2.4 m) or greater from the sprinkler shall be in conformance with Table 12.1.11.1.3(a) or Table 12.1.11.1.3(b) and Figure 12.1.11.1.3.



Elevation View of Truss (Obstruction in horizontal orientation)

 $A \ge 4C$ or 4D $A \le 36$ in. (900 mm) (Use dimension *C* or *D*, whichever is greater)

△ FIGURE 12.1.10.2.1.3(b) Minimum Distance from an Obstruction in the Horizontal Orientation (Residential Upright and Pendent Sprinkler).

Table 12.1.10.2.2(a) Suspended or Floor-Mounted Obstructions in Light Hazard Occupancies Only (Residential Upright and Pendent Sprinklers)

Horizontal Distance (A) (in.)	Minimum Vertical Distance Below Deflector (B) (in.)
6 or less	3 or more
9 or less	4 or more
12 or less	6 or more
15 or less	8 or more
18 or less	$9\frac{1}{2}$ or more
24 or less	$12\frac{1}{2}$ or more
30 or less	$15\frac{1}{2}$ or more
More than 30	18 or more

Note: For A and B, refer to Figure 12.1.10.2.2.

Table 12.1.10.2.2(b) Suspended or Floor-Mounted Obstructions in Light Hazard Occupancies Only (Residential Upright and Pendent Sprinklers)

Horizontal Distance (A) (mm)	Minimum Vertical Distance Below Deflector (B)(mm)
150 or less	75 or more
225 or less	100 or more
300 or less	150 or more
375 or less	200 or more
450 or less	240 or more
600 or less	315 or more
750 or less	390 or more
More than 750	450 or more

Note: For *A* and *B*, refer to Figure 12.1.10.2.2.





Table 12.1.11.1.3(a) Positioning of Sprinklers to Avoid Obstructions to Discharge (Residential Sidewall)

Distance from Sprinkler to Side of Obstruction (A) (ft)	Allowable Distance of Deflector Above Bottom of Obstruction (<i>B</i>) (in.)
Less than 8	0
8 or more	1 or less
10 or more	2 or less
11 or more	3 or less
12 or more	4 or less
13 or more	6 or less
14 or more	7 or less
15 or more	9 or less
16 or more	11 or less
17 or more	14 or less

Note: For A and B, refer to Figure 12.1.11.1.3.

 Table 12.1.11.1.3(b)
 Positioning of Sprinklers to Avoid

 Obstructions to Discharge (Residential Sidewall)

Distance from Sprinkler to Side of Obstruction (A) (mm)	Allowable Distance of Deflector Above Bottom of Obstruction(<i>B</i>) (mm)
Less than 2400	0
2400 or more	1 or less
3000 or more	50 or less
3400 or more	75 or less
3700 or more	100 or less
4000 or more	150 or less
4300 or more	175 or less
4600 or more	225 or less
4900 or more	275 or less
5200 or more	350 or less

Note: For A and B, refer to Figure 12.1.11.1.3.



△ FIGURE 12.1.11.1.3 Positioning of Sprinkler to Avoid Obstruction (Residential Sidewall Sprinklers).

12.1.11.1.4 Continuous obstructions projecting from the same wall as the one on which the sidewall sprinkler is mounted shall be in accordance with one of the following arrangements:

- (1) Sprinklers shall be in accordance with Table 12.1.11.1.4(a) or Table 12.1.11.1.4(b) and Figure 12.1.11.1.4(a).
- (2) Sprinklers shall be permitted to be spaced on opposite sides of obstructions less than 4 ft (1.2 m) in width where the distance from the centerline of the obstruction to the sprinklers does not exceed one-half the allowable distance between sprinklers.
- (3) Obstructions located against the wall and that are not over 30 in. (750 mm) in width shall be permitted to be protected in accordance with Figure 12.1.11.1.4(b).
- (4) Obstructions located against the wall and that are not over 24 in. (600 mm) in width shall be permitted to be protected in accordance with Figure 12.1.11.1.4(c). The maximum distance between the sprinkler and the wall shall be measured from the sprinkler to the wall behind the obstruction and not to the face of the obstruction.

(5) Obstructions 12 in. (300 mm) in width in hallways up to 6 ft (1.8 m) in width shall be permitted in accordance with Figure 12.1.11.4(d) when the sprinkler is located in the allowable obstruction zone and the closest edge of the obstruction is a minimum of 12 in. (300 mm) away from the deflector.

12.1.11.1.5* Soffits and Wall Cabinets. Where soffits are used for the installation of sidewall sprinklers, the sprinklers and soffits shall be installed in accordance with 12.1.11.1.5.1, 12.1.11.1.5.2, or 12.1.11.1.5.3.

12.1.11.1.5.1 Where soffits exceed more than 8 in. (200 mm) in width or projection from the wall, pendent sprinklers shall be installed under the soffit.

12.1.11.1.5.2 Sidewall sprinklers shall be permitted to be installed in the face of a soffit located directly over cabinets, without requiring additional sprinklers below the soffit or cabinets, where the soffit does not project horizontally more than 12 in. (300 mm) from the wall.

12.1.11.1.5.3 Where sidewall sprinklers are more than 3 ft (900 mm) above the top of cabinets, the sprinkler shall be permitted to be installed on the wall above the cabinets where the cabinets are no greater than 12 in. (300 mm) from the wall.

12.1.11.1.6 Obstructions on the wall opposite from the side-wall sprinkler shall be permitted in accordance with Figure 12.1.11.1.6.

12.1.11.2 Obstructions to Sprinkler Discharge Pattern Development.

12.1.11.2.1 General.

12.1.11.2.1.1 Continuous or noncontinuous obstructions less than or equal to 18 in. (450 mm) below the sprinkler deflector that prevent the pattern from fully developing shall comply with this section.

12.1.11.2.1.2 Regardless of the rules of this section, solid continuous obstructions shall meet the requirements of 12.1.11.1.2 and 12.1.11.1.3.

12.1.11.2.1.3* Unless the requirements of 12.1.11.2.1.4 through 12.1.11.2.1.7 are met, sprinklers shall be positioned away from obstructions a minimum distance of four times the maximum dimension of the obstruction (e.g., truss webs and chords, pipe, columns, and fixtures).

(A) The maximum clear distance required from obstructions in the horizontal orientation (e.g., light fixtures and truss chords) shall be 36 in. (900 mm).

(B) The maximum clear distance shall not be applied to obstructions in the vertical orientation (e.g., columns).

12.1.11.2.1.4 Sidewall sprinklers shall be positioned in accordance with Figure 12.1.11.2.1.4(a) and Figure 12.1.11.2.1.4(b) when obstructions are present.

12.1.11.2.1.5 The requirements of 12.1.11.2.1.3 and 12.1.11.2.1.4 shall not apply where sprinklers are positioned with respect to obstructions in accordance with 12.1.11.1.2 and 12.1.11.1.3.

12.1.11.2.1.6 The requirements of 12.1.11.2.1.3 shall not apply to sprinkler system piping less than 3 in. (80 mm) in diameter.

12.1.11.2.1.7* Sprinklers shall be permitted to be placed without regard to the blades of a ceiling fan, provided the plan view of the fan is at least 50 percent open.

12.1.11.2.2* Suspended or Floor-Mounted Vertical Obstructions. The distance from sprinklers to privacy curtains, freestanding partitions, room dividers, and similar obstructions shall be in accordance with Table 12.1.11.2.2(a) or Table 12.1.11.2.2(b), Figure 12.1.11.2.2(a), and Figure 12.1.11.2.2(b).

Table 12.1.11.1.4(a) Positioning of Sprinklers to Avoid Obstructions Along Wall (Residential Sidewall)

Distance from Sprinkler to Side of Obstruction (A) (ft)	Allowable Distance of Deflector Above Bottom of Obstruction (B) (in.)
Less than $1\frac{1}{2}$	0
$1\frac{1}{2}$ or more	1 or less
3 or more	3 or less
4 or more	5 or less
$4\frac{1}{2}$ or more	7 or less
6 or more	9 or less
$6\frac{1}{2}$ or more	11 or less
7 or more	14 or less

Note: For *A* and *B*, refer to Figure 12.1.11.1.4(a).

Table 12.1.11.1.4(b)Positioning of Sprinklers to AvoidObstructions Along Wall (Residential Sidewall)

Distance from Sprinkler to Side of Obstruction (A) (mm)	Allowable Distance of Deflector Above Bottom of Obstruction (B) (mm)
Less than 450	0
450 or more	25 or less
900 or more	75 or less
1200 or more	125 or less
1400 or more	175 or less
1800 or more	225 or less
2000 or more	275 or less
2100 or more	350 or less

Note: For A and B, refer to Figure 12.1.11.4(a).



FIGURE 12.1.11.4(a) Positioning of Sprinkler to Avoid Obstruction Along Wall (Residential Sidewall Sprinklers).