



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.

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 ft² (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 ft² (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.

Table 4.3.1.7.1 Discharge Criteria for Miscellaneous Storage

Commodity	Type of Storage	Storage Height		Maximum Ceiling Height		Design from 19.2.3.1.1	In-Rack Sprinklers Required	Inside Hose		Total Combined Inside and Outside Hose		Duration (minutes)
		ft	m	ft	m			gpm	L/min	gpm	L/min	
Class I to Class IV												
Class I	Solid-piled, palletized, bin box, shelf, single-, double-, or multiple-row rack, and back-to-back shelf storage	≤12	≤3.7	—	—	OH1	No	0, 50, 100	0, 190, 380	250	950	90
Class II		≤10	≤3.0	—	—	OH1	No	0, 50, 100	0, 190, 380	250	950	90
Class II		>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

Commodity	Type of Storage	Storage Height		Maximum Ceiling Height		Design from 19.2.3.1.1	In-Rack Sprinklers Required	Inside Hose		Total Combined Inside and Outside Hose		Duration (minutes)
		ft	m	ft	m			gpm	L/min	gpm	L/min	
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

Group A Plastic Storage

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	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

Commodity		Type of Storage	Storage Height		Maximum Ceiling Height		Design from 19.2.3.1.1	In-Rack Sprinklers Required	Inside Hose		Total Combined Inside and Outside Hose		Duration (minutes)
			ft	m	ft	m			gpm	L/min	gpm	L/min	
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

Commodity		Type of Storage	Storage Height		Maximum Ceiling Height		Design from 19.2.3.1.1	In-Rack Sprinklers Required	Inside Hose		Total Combined Inside and Outside Hose		Duration (minutes)
			ft	m	ft	m			gpm	L/min	gpm	L/min	
	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
		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

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

Rolled Paper Storage

Heavyweight and mediumweight	On end	≤10	≤3.0	30	9.1	OH2	N/A	0, 50, 100	0, 190, 380	250	950	90
------------------------------	--------	-----	------	----	-----	-----	-----	------------	-------------	-----	-----	----

Commodity	Type of Storage	Storage Height		Maximum Ceiling Height		Design from 19.2.3.1.1	In-Rack Sprinklers Required	Inside Hose		Total Combined Inside and Outside Hose		Duration (minutes)
		ft	m	ft	m			gpm	L/min	gpm	L/min	
Tissue and lightweight	On end	≤10	≤3.0	30	9.1	EH1	N/A	0, 50, 100	0, 190, 380	250	950	120

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.

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.

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.

Table 4.3.1.7.4 Discharge Criteria for Low-Piled Storage

Commodity	Type of Storage	Storage Height		Maximum Ceiling Height		Design from 19.2.3.1.1	In-Rack Sprinklers Required	Inside Hose		Total Combined Inside and Outside Hose		Duration (minutes)
		ft	m	ft	m			gpm	L/min	gpm	L/min	
Class I to Class IV												
Class I	Solid-piled, palletized, bin box, shelf, single-, double-, or multiple-row rack, and back-to-back shelf storage	≤12	≤3.7	—	—	OH1	No, unless solid shelf	0, 50, 100	0, 190, 380	250	950	90
Class II		≤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

Commodity	Type of Storage	Storage Height		Maximum Ceiling Height		Design from 19.2.3.1.1	In-Rack Sprinklers Required	Inside Hose		Total Combined Inside and Outside Hose		Duration (minutes)
		ft	m	ft	m			gpm	L/min	gpm	L/min	
	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
Group A Plastic 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	—	—	OH2	No, unless solid shelf	0, 50, 100	0, 190, 380	250	950	90

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.

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.

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 ft² (280 m²).

4.3.1.7.9

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

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 in-rack sprinklers shall follow Chapter 25 for their installation and design requirements.

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)

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 ft² (4830 m²)
- (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 ft² (3720 m²)

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]

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

4.9.2.2

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/m² for longer than 10 seconds.
- (2) The total heat released shall not exceed 8 MJ/m².

[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]