



25.1 General Requirements for Ceiling and In-Rack Sprinklers Protecting Rack Storage.

25.1.1 Scope.

25.1.1.1 *

This chapter shall apply to the storage of Class I through Class IV and Group A plastic commodities as well as rubber tires representing the broad range of combustibles stored in racks that will be protected by in-rack sprinklers.

25.1.1.2

The requirements of Chapter 20 shall apply unless modified by this chapter. (See Section C.9).

25.1.2 Chapter Organization.

This chapter shall be organized as follows:

- (1) Section 25.1 contains general requirements for the entire chapter.
- (2) Section 25.2 contains requirements for the protection of miscellaneous and low-piled rack storage using in-rack sprinklers.
- (3) Section 25.3 contains requirements for in-rack sprinkler protection with solid shelves.
- (4) Section 25.4 contains requirements for in-rack sprinkler protection in combination with CMDA ceiling-level sprinklers.
- (5) Section 25.5 contains requirements for in-rack sprinkler protection in combination with CMSA ceiling-level sprinklers.
- (6) Section 25.6 contains requirements for in-rack sprinkler protection in combination with ESFR ceiling-level sprinklers.
- (7) Section 25.7 contains requirements for in-rack sprinkler protection independent of ceiling-level sprinklers.

25.1.3 Building Steel Protection.

Where in-rack sprinklers are installed in accordance with this chapter, building steel shall not require special protection.

25.1.4 In-Rack Sprinkler System.

25.1.4.1 In-Rack Sprinkler System Size.

An area protected by a single in-rack sprinkler system shall not exceed 40,000 ft² (3,720 m²) of floor area occupied by the racks, including aisles, regardless of the number of in-rack sprinkler levels.

25.1.4.2 * In-Rack Sprinkler System Control Valves.

25.1.4.2.1

Unless the requirements of 25.1.4.2.2 or 25.1.4.2.3 are met, separate indicating control valves and drains shall be provided and arranged so that ceiling and in-rack sprinkler systems can be controlled independently.

25.1.4.2.2

A separate indicating control valve shall not be required where 20 or fewer in-rack sprinklers are supplied by any one ceiling sprinkler system.

25.1.4.2.3

The separate indicating valves shall be permitted to be arranged as sectional control valves supplied from the ceiling sprinkler system where in-rack sprinklers are required and the racks, including the adjacent aisles, occupy 8000 ft² (745 m²) or less of the area protected by the ceiling sprinklers.

25.1.4.3 In-Rack Sprinkler Waterflow Alarm. (Reserved) (See A.16.11.2 and Section C.4.)

25.1.5 * Open Rack Storage.

The in-rack sprinkler arrangements as well as the ceiling and in-rack sprinkler design criteria for rack storage in this chapter shall be based on open rack configurations as defined in 3.3.154 unless indicated otherwise.

25.1.6 In-Rack Sprinkler Characteristics.

25.1.6.1

In-rack sprinklers shall be pendent or upright, standard- or quick-response, ordinary-temperature-rated and have a minimum nominal K-factor of K-5.6 (80) unless indicated otherwise.

25.1.6.2

In-rack sprinklers with intermediate- and high-temperature ratings shall be used near heat sources as required by 9.4.2.

25.1.6.3

In-rack sprinklers shall be permitted to have a different RTI rating from the ceiling sprinklers under which they are installed.

25.1.6.4

Where in-rack sprinklers are not shielded by horizontal barriers, either water shields shall be provided above the sprinklers or listed intermediate level/rack storage sprinklers shall be used. (See Section C.3.)

25.1.7 Horizontal Location of In-Rack Sprinklers.**25.1.7.1**

The horizontal location and spacing of in-rack sprinklers shall be as shown in the figures of the applicable section of this chapter, and as follows:

- (1) The rack plan view shall be considered in determining the maximum area covered by each sprinkler when protecting multiple-row racks.
- (2) The aisles shall not be included in the area calculations.

25.1.7.2

In-rack sprinklers shall not be required to meet the obstruction criteria and clearance from storage requirements of Section 9.5.

25.1.7.3 *

Where in-rack sprinklers are installed in longitudinal flues, they shall be located at an intersection of transverse and longitudinal flues while not exceeding the maximum horizontal spacing rules.

25.1.7.4

Where horizontal distances between transverse flues exceed the maximum allowable horizontal linear spacing for in-rack sprinklers, in-rack sprinklers shall be installed at the intersection of the transverse and longitudinal flues, and additional in-rack sprinklers shall be installed between transverse flues to meet the maximum allowable horizontal linear spacing rules for in-rack sprinklers.

25.1.7.5

In-rack sprinklers shall be permitted to be installed horizontally less than 6 ft (1.8 m) apart.

25.1.7.6 Higher-Hazard Commodities.**25.1.7.6.1**

Where in-rack sprinklers are installed to protect a higher-hazard commodity that occupies only a portion of the length of a rack, in-rack sprinklers shall be extended a minimum of 8 ft (2.4 m) or one bay, whichever is greater, in each direction along the rack on either side of the higher hazard.

25.1.7.6.2

In-rack sprinklers protecting a higher-hazard commodity shall not be required to extend across the aisle.

25.1.7.7

In-rack sprinklers shall be a minimum 3 in. (75 mm) radially from the side of rack uprights. (See Section C.17.)

25.1.7.8

Face sprinklers shall be located within the rack a minimum 3 in. (75 mm) from rack uprights and no more than 18 in. (450 mm) from the aisle face of storage.

25.1.7.9 In-Rack Sprinklers for Single-Row Racks.**25.1.7.9.1**

Unless indicated otherwise, in-rack sprinklers protecting single-row racks shall be installed in the transverse flue space at any point between the load faces.

25.1.7.9.2 *

Where the horizontal distance between a single-row rack and an adjacent full-height wall does not exceed 2 ft (0.6 m), in-rack sprinklers shall be permitted to be installed within this space as if it were a longitudinal flue of a double-row rack.

25.1.8 Vertical Location of In-Rack Sprinklers.

25.1.8.1 *

Where one level of in-rack sprinklers is required by the guidelines of this chapter and the vertical location of the in-rack sprinklers is not indicated in an applicable figure, in-rack sprinklers shall be installed at the first tier level at or above one-half of the highest expected storage height.

25.1.8.2

Where two levels of in-rack sprinklers are required by the guidelines of this chapter and the vertical location of the in-rack sprinklers is not indicated in an applicable figure, in-rack sprinklers shall be installed at the first tier level at or above one-third and two-thirds of the highest expected storage height.

25.1.8.3 Vertical Clear Space Between Top of Storage and In-Rack Sprinkler Deflectors.

25.1.8.3.1 *

A minimum 6 in. (150 mm) vertical clear space shall be maintained between in-rack sprinkler deflectors and the top of storage located below them.

25.1.8.3.2 *

Where in-rack sprinklers are being installed within single- and double-row racks of Class I through Class IV commodities up to and including 20 ft (6.1 m) in height, the vertical clear space of in-rack sprinkler deflectors with respect to the top of storage located below them shall be permitted to be less than 6 in. (150 mm). (See Section C.16.)

25.1.8.4

In-rack sprinklers shall not be required to meet the obstruction criteria and clearance from storage requirements of Section 9.5.

25.1.8.5

In-rack sprinkler discharge shall not be obstructed by horizontal rack members.

25.1.8.6

All in-rack sprinkler vertical spacings shown in the applicable figures start from the floor.

25.1.9 Horizontal Barriers in Combination with In-Rack Sprinklers.

25.1.9.1 *

Where required by sections of this chapter, horizontal barriers used in combination with in-rack sprinklers to impede vertical fire development shall be constructed of sheet metal, wood, or similar material and shall extend the full length and depth of the rack.

25.1.9.2

Barriers shall be fitted within 3 in. (75 mm) horizontally around rack uprights.

25.1.10 Design Criteria for In-Rack Sprinklers in Combination with Ceiling-Level Sprinklers.

25.1.10.1

The design pressure for the most remote in-rack sprinkler shall not be less than 7 psi (0.5 bar).

25.1.10.2

In-rack sprinkler design criteria for Group A plastic commodities shall be permitted for the protection of the same storage height and configuration of Class I, Class II, Class III, and Class IV commodities.

25.1.10.3

Pipe sizing of an in-rack sprinkler system shall be permitted to be based on hydraulic calculations and not restricted by any pipe schedule.

25.1.10.4

Where in-rack sprinklers are being installed to protect a storage rack and, due to the length of the rack, fewer in-rack sprinklers will be installed than the number of in-rack sprinklers specified in the design, the in-rack sprinkler design shall be based on only those in-rack sprinklers installed within the protected rack.

25.1.10.5

Where in-rack sprinkler arrangements have been installed in accordance with this chapter, except for those specified in Section 25.7, the flow and pressure requirements of both the ceiling and in-rack sprinkler systems over the same protected area shall be hydraulically balanced together to the higher sprinkler system pressure requirement at their point of connection.

25.1.11 Aisle Width for Group A Plastic Commodities.**25.1.11.1**

Unless indicated otherwise in this chapter, ceiling-level sprinkler design criteria for single- and double-row rack storage of Group A plastic commodities shall be applicable where aisles are 3.5 ft (1.1 m) or greater in width.

25.1.11.2

Unless indicated otherwise in this chapter, ceiling-level sprinkler design criteria for rack storage of Group A plastic commodities shall be protected as multiple-row racks where aisles are less than 3.5 ft (1.1 m) in width.

25.1.12 * Group A Plastic Commodity Protection for Class I, Class II, Class III, or Class IV Commodities.

Ceiling-level sprinkler design criteria as well as in-rack sprinkler design criteria for Group A plastic commodities in this chapter shall be permitted for the protection of the same storage height and configuration of Class I, Class II, Class III, or Class IV commodities.

25.1.13 Water Supply Requirements.

Unless indicated otherwise in this chapter, the minimum water supply requirements for a hydraulically designed ceiling and in-rack sprinkler system shall be determined by adding the hose stream allowance from Table 20.15.2.6 to the water demand for sprinklers.

25.2 Protection of Miscellaneous and Low-Piled Rack Storage Using In-Rack Sprinklers.**25.2.1 Miscellaneous Rack Storage.****25.2.1.1 Scope.**

This section shall apply to miscellaneous rack storage up to and including 12 ft (3.7 m) in height of Class I through Class IV commodities, Group A plastic commodities, and rubber tires.

25.2.1.2 In-Rack Sprinkler Design for Miscellaneous Storage.

Where in-rack sprinklers are installed in accordance with this section to protect miscellaneous rack storage of Class I through Class IV commodities, Group A plastic commodities, and rubber tires up to and including 12 ft (3.7 m) in height, the in-rack sprinkler design shall be based on the hydraulically most demanding four adjacent in-rack sprinklers using a minimum flow of 22 gpm (83 L/min) from the hydraulically most remote in-rack sprinkler.

25.2.1.3 Horizontal Spacing of In-Rack Sprinklers for Miscellaneous Storage.

The maximum allowable horizontal spacing of in-rack sprinklers is 10 ft (3.0 m).

25.2.1.4 Ceiling Sprinkler Design in Combination with In-Rack Sprinklers for Miscellaneous Storage.**25.2.1.4.1**

Where in-rack sprinklers are installed in accordance with this chapter to protect miscellaneous rack storage of Class I through Class IV commodities, Group A plastic commodities, and rubber tires up to and including 12 ft (3.7 m) in height under a maximum 32 ft (9.8 m) high ceiling, the ceiling-level sprinkler design criteria shall be a 0.20 gpm/ft² (8.2 mm/min) density over a 1500 ft² (140 m²) area of ceiling-level sprinkler operation.

25.2.1.4.2

Installation criteria as permitted by this standard and design criteria and modifiers as permitted by the density/area method of Section 19.1 for ordinary hazard Group 2 occupancies shall be applicable.

25.2.1.4.3

The sprinkler system criteria specified in this chapter for miscellaneous storage shall be permitted for both horizontal and sloped ceilings.

25.2.1.5 Hose Connections.

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

25.2.2 Low-Piled Rack Storage.

25.2.2.1 Scope.

This section shall apply to any of the following situations:

- (1) Rack storage of Class I through Class IV commodities up to and including 12 ft (3.7 m) in height
- (2)* Rack storage of Group A plastic commodities up to and including 5 ft (1.5 m) in height

25.2.2.2 In-Rack Sprinkler Design for Low-Piled Storage.

Where in-rack sprinklers are installed in accordance with this section to protect low-piled rack storage of Class I through Class IV commodities up to and including 12 ft (3.7 m) in height and low-piled rack storage of Group A plastic commodities up to and including 5 ft (1.5 m) in height, the in-rack sprinkler design shall be based on the hydraulically most demanding four adjacent in-rack sprinklers using a minimum flow of 22 gpm (83 L/min) from the hydraulically most remote in-rack sprinkler.

25.2.2.3 Horizontal Spacing of In-Rack Sprinklers for Low-Piled Storage.

The maximum allowable horizontal spacing of in-rack sprinklers is 10 ft (3.0 m).

25.2.2.4 Ceiling Sprinkler Design in Combination with In-Rack Sprinklers for Low-Piled Storage.

25.2.2.4.1

Where in-rack sprinklers are installed in accordance with this section to protect low-piled rack storage of Class I through Class IV and Group A plastic commodities that do not meet the definition of *miscellaneous storage*, the ceiling-level design shall be a 0.20 gpm/ft² (8.2 mm/min) density over a 1500 ft² (140 m²) area of ceiling-level sprinkler operation.

25.2.2.4.2

The sprinkler system criteria specified in this chapter for low-piled storage shall be permitted for both horizontal and sloped ceilings.

25.3 Protection of Racks with Solid Shelves.

25.3.1 General.

The requirements in this chapter for the installation of in-rack sprinklers shall apply to racks with solid shelves except as modified in this section.

25.3.2 Open Racks Combined with In-Rack Sprinklers.

Ceiling-level sprinkler design criteria for CMDA, CMSA, and ESFR sprinklers shall be an applicable option for open racks combined with in-rack sprinklers installed in accordance with the criteria for solid shelving.

25.3.3 Vertical Spacing and Location of In-Rack Sprinklers in Racks with Solid Shelves.

25.3.3.1

Where CMDA sprinklers are at ceiling level protecting racks with solid shelving that exceeds 20 ft² (1.9 m²) but not 64 ft² (5.9 m²) in area, in-rack sprinklers shall not be required below every shelf but shall be installed below shelves at intermediate levels not more than 6 ft (1.8 m) apart vertically. (See Section C.11.)

25.3.3.2

Where CMDA sprinklers are at ceiling level protecting racks with solid shelving that exceeds 64 ft² (5.9 m²) in area or where the levels of storage exceed 6 ft (1.8 m), in-rack sprinklers shall be installed below each level of shelving.

25.3.3.3

Where CMSA sprinklers are at ceiling level and protect racks with solid shelving, in-rack sprinklers shall be installed beneath all tiers under the highest solid shelf.

25.3.3.4

Where ESFR sprinklers are at ceiling level and protect racks with solid shelving, in-rack sprinklers shall be installed beneath all tiers under the highest solid shelf.

25.3.3.5

Where racks with solid shelves obstruct only a portion of an open rack, in-rack sprinklers shall be installed vertically as follows:

- (1) In accordance with 25.3.3.1 and 25.3.3.2 where CMDA sprinklers are installed at ceiling level
- (2) In accordance with 25.3.3.3 where CMSA sprinklers are installed at ceiling level
- (3) In accordance with 25.3.3.4 where ESFR sprinklers are installed at ceiling level

25.3.4 Horizontal Location and Spacing of In-Rack Sprinklers in Racks with Solid Shelves.

25.3.4.1

Where racks with solid shelves contain storage of Class I through Class IV commodities, the maximum allowable horizontal spacing of in-rack sprinklers shall be 10 ft (3.0 m).

25.3.4.2

Where racks with solid shelves contain storage of Group A plastic commodities, the maximum allowable horizontal spacing of in-rack sprinklers shall be 5 ft (1.5 m).

25.3.4.3

Where racks with solid shelves obstruct only a portion of an open rack, in-rack sprinklers shall be extended beyond the end of the solid shelf a minimum of 4 ft (1.2 m) to the nearest flue space intersection.

25.4 In-Rack Sprinkler Protection in Combination with CMDA Ceiling-Level Sprinklers.

25.4.1 General.

25.4.1.1 In-Rack Sprinkler Design Criteria in Combination with CMDA Ceiling-Level Sprinklers.

The in-rack sprinkler system design, in terms of the number of operating sprinklers at a minimum flow from the most remote in-rack sprinkler, in combination with CMDA ceiling-level sprinklers shall be in accordance with Table 25.4.1.1. (See Sections C.18 and C.19.)

Table 25.4.1.1 Design Criteria for In-Rack Sprinklers in Combination with CMDA Ceiling-Level Sprinklers for Storage Not Meeting the Definition of Miscellaneous

Commodity Classification	Rack Type	Storage Height ft (m)	No. of IRAS Levels	IRAS Design, No. of IRAS @ gpm (L/min)
Class I, Class II or Class III	Open	Up to 25 (7.6)	1	6 @ 22 (83)
			More than 1	10 (5 in-rack sprinklers on top 2 in-rack sprinkler levels) @ 22 (83)
		Over 25 (7.6)	1	6 @ 30 (114)
			More than 1	10 (5 in-rack sprinklers on top 2 in-rack sprinkler levels) @ 30 (114)
	Solid shelves	Up to 25 (7.6)	1	6 @ 30 (114)
			More than 1	10 (5 in-rack sprinklers on top 2 in-rack sprinkler levels) @ 30 (114)
		Over 25 (7.6)	1	6 @ 30 (114)
			More than 1	10 (5 in-rack sprinklers on top 2 in-rack sprinkler levels) @ 30 (114)

Commodity Classification	Rack Type	Storage Height ft (m)	No. of IRAS Levels	IRAS Design, No. of IRAS @ gpm (L/min)
Class IV	Open	Up to 25 (7.6)	1	8 @ 22 (83)
			More than 1	10 (5 in-rack sprinklers on top 2 in-rack sprinkler levels) @ 22 (83)
		Over 25 (7.6)	1	8 @ 30 (114)
			More than 1	10 (5 in-rack sprinklers on top 2 in-rack sprinkler levels) @ 30 (114)
	Solid shelves	Up to 25 (7.6)	1	8 @ 30 (114)
			More than 1	14 (7 in-rack sprinklers on top 2 in-rack sprinkler levels) @ 30 (114)
		Over 25 (7.6)	1	8 @ 30 (114)
			More than 1	14 (7 in-rack sprinklers on top 2 in-rack sprinkler levels) @ 30 (114)
Group A plastics	Open	Up to 25 (7.6)	1	8 @ 22 (83)
			More than 1	14 (7 in-rack sprinklers on top 2 in-rack sprinkler levels) @ 22 (83)
		Over 25 (7.6)	1	8 @ 30 (114)
			More than 1	14 (7 in-rack sprinklers on top 2 in-rack sprinkler levels) @ 30 (114)
	Solid shelves	Up to 25 (7.6)	1	8 @ 30 (114)
			More than 1	14 (7 in-rack sprinklers on top 2 in-rack sprinkler levels) @ 30 (114)
		Over 25 (7.6)	1	8 @ 30 (114)
			More than 1	14 (7 in-rack sprinklers on top 2 in-rack sprinkler levels) @ 30 (114)
Rubber tires	Open	Up to 20 (6.1)	1	12 @ 30 (114)

25.4.1.2 CMDA Ceiling-Level Sprinkler Design Criteria in Combination with In-Rack Sprinklers.

25.4.1.2.1

CMDA Ceiling-level sprinkler design criteria, in combination with in-rack sprinklers, for rack storage over 12 ft (3.7 m) and up to and including 25 ft (7.6 m) in height of Class I through Class IV commodities and rubber tires shall be in accordance with the following:

- (1) For the storage of exposed nonencapsulated Class I through Class IV commodities, see 25.4.2.1.2
- (2) For the storage of exposed encapsulated, or cartoned (nonencapsulated or encapsulated) Class I through Class IV commodities, see 25.4.2.2.2
- (3) For the storage of rubber tires see 25.4.2.5.2

25.4.1.2.2

CMDA Ceiling-level sprinkler design criteria, in combination with in-rack sprinklers, for rack storage over 5 ft (1.5 m) and up to and including 25 ft (7.6 m) in height of Group A plastic commodities shall be in accordance with the following:

- (1) For the storage of cartoned Group A plastic commodities, see 25.4.2.3.2
- (2) For the storage of exposed nonexpanded Group A plastic commodities, see 25.4.2.4.2

25.4.1.2.3

CMDA Ceiling-level sprinkler design criteria, in combination with in-rack sprinklers, for rack storage over 25 ft (7.6 m) in height of Class I through Class IV and Group A plastic commodities shall be in accordance with the following:

- (1) For the storage of exposed nonencapsulated Class I through Class IV commodities, see 25.4.3.1.2

- (2) For the storage of exposed encapsulated, or cartoned (nonencapsulated or encapsulated) Class I through Class IV commodities, see 25.4.3.2.2
- (3) For the storage of cartoned Group A plastic commodities, see 25.4.3.3.2
- (4) For the storage of exposed nonexpanded Group A plastic commodities, see 25.4.3.4

25.4.1.2.4

The water supply for CMDA ceiling-level sprinklers in combination with in-rack sprinklers shall be determined from the CMDA ceiling-level sprinkler design requirements of Section 25.4.

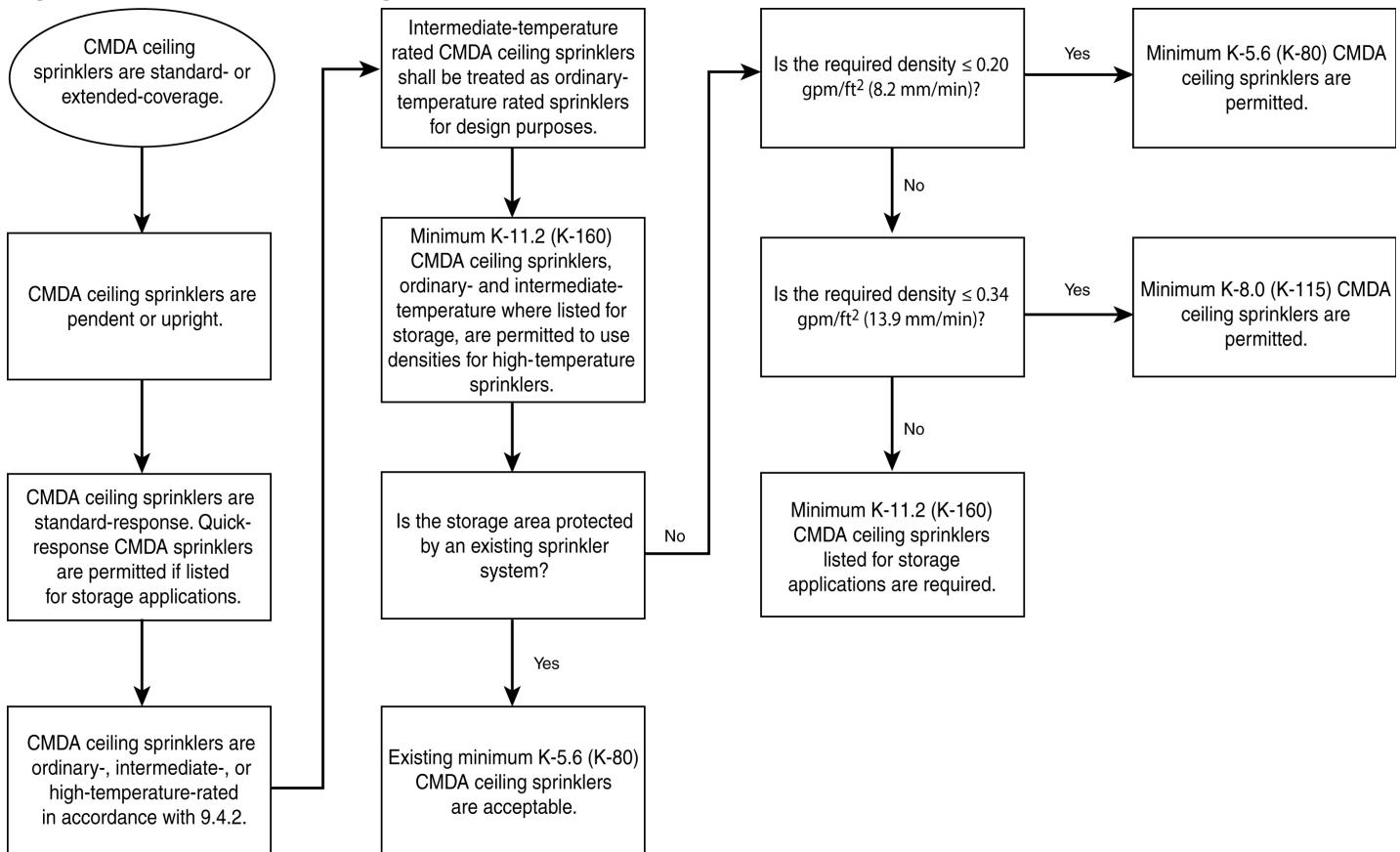
25.4.1.2.5

The ceiling-level sprinkler system design area shall meet the requirements of 28.2.4.2.1.

25.4.1.3 CMDA Ceiling-Level Sprinkler Characteristics.

CMDA Ceiling-level sprinkler characteristics in combination with in-rack sprinklers shall be in accordance with Figure 25.4.1.3.

Figure 25.4.1.3 CMDA Ceiling-Level Sprinkler Characteristics in Combination with In-Rack Sprinklers.



25.4.2 Ceiling and In-Rack Sprinkler Protection for Rack Storage Heights Up to and Including 25 ft (7.6 m).

25.4.2.1 Exposed Nonencapsulated Class I, Class II, Class III, or Class IV Commodities.

25.4.2.1.1 * In-Rack Sprinkler Arrangements and Designs for Exposed Nonencapsulated Class I, Class II, Class III, or Class IV Commodities Stored Up to and Including 25 ft (7.6 m) in Height.

25.4.2.1.1.1

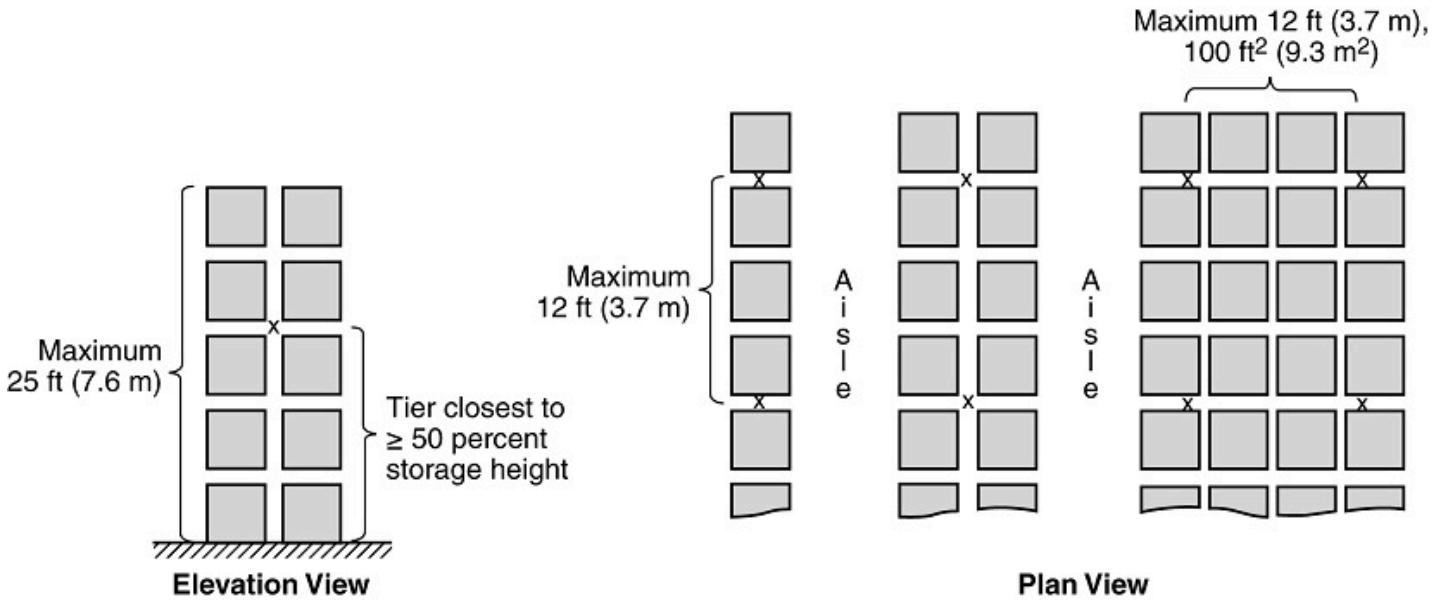
Where rack storage of exposed nonencapsulated Class I through Class IV commodities stored over 12 ft (3.7 m) and up to and including 25 ft (7.6 m) in height will be protected by in-rack sprinklers, the following levels of in-rack sprinklers shall be required:

- (1) One level of in-rack sprinklers where Class I through Class IV commodities are stored in single- or double-row racks up to and including 25 ft (7.6 m)
- (2) One level of in-rack sprinklers where Class IV commodities are stored in multiple-row racks up to and including 20 ft (6.1 m)
- (3) Two levels of in-rack sprinklers where Class IV commodities are stored in multiple-row racks over 20 ft (6.1 m) and up to and including 25 ft (7.6 m)

25.4.2.1.1.2

Where rack storage of exposed nonencapsulated Class I or Class II commodities stored over 12 ft (3.7 m) and up to and including 25 ft (7.6 m) in height will be protected by in-rack sprinklers, in-rack sprinkler arrangements and designs shall be selected from Figure 25.4.2.1.1.2(a) through Figure 25.4.2.1.1.2(c). (See Section 25.3 for racks with solid shelving.)

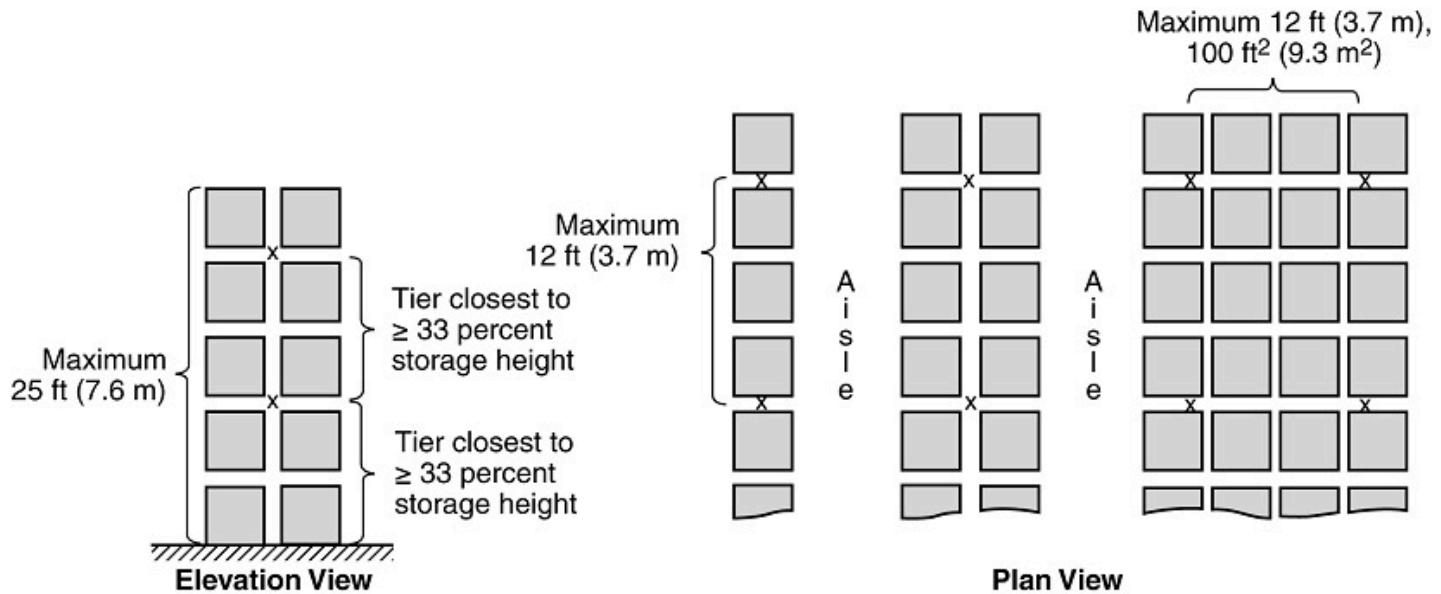
Figure 25.4.2.1.1.2(a) In-Rack Sprinkler Arrangements for Exposed Nonencapsulated Class I or Class II Commodities Stored to a Maximum Height of 25 ft (7.6 m) with One Level of In-Rack Sprinklers.



Notes:

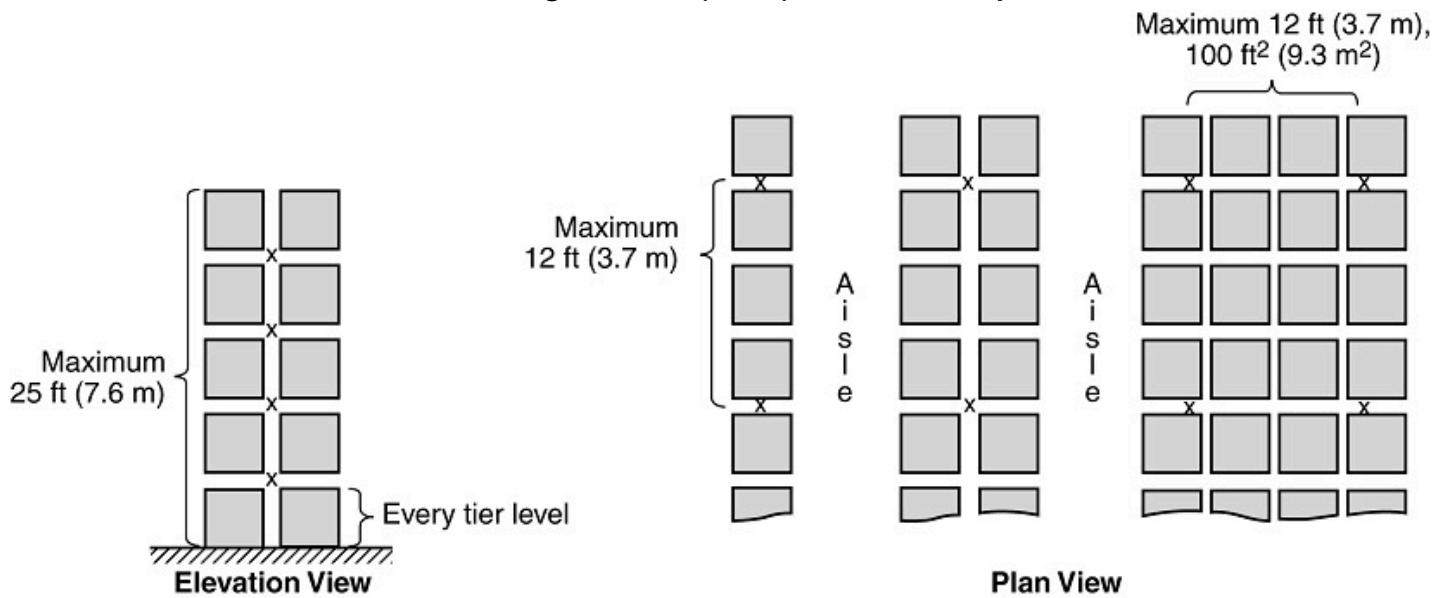
- (1) See 25.4.2.1.2 for the ceiling-level sprinkler design.
- (2) In-rack sprinklers are ordinary-temperature-rated, quick-or standard-response, pendent or upright, minimum K-5.6 (K-80), and designed for a minimum of six (6) in-rack sprinklers operating at 22 gpm (83 L/min).
- (3) The symbol X represents in-rack sprinklers.
- (4) Each square represents a storage cube measuring 4 ft to 5 ft (1.2 m to 1.5 m) on a side.

Figure 25.4.2.1.1.2(b) In-Rack Sprinkler Arrangements for Exposed Nonencapsulated Class I or Class II Commodities Stored to a Maximum Height of 25 ft (7.6 m) with More Than One Level of In-Rack Sprinklers (Not at Each Tier Level).

**Notes:**

- (1) See 25.4.2.1.2 for the ceiling-level sprinkler design.
- (2) In-rack sprinklers are ordinary-temperature-rated, quick-or standard-response, pendent or upright, minimum K-5.6 (K-80), and designed for a minimum of ten (10) in-rack sprinklers [five (5) in-rack sprinklers on top two levels] operating at 22 gpm (83 L/min).
- (3) The symbol X represents in-rack sprinklers.
- (4) Each square represents a storage cube measuring 4 ft to 5 ft (1.2 m to 1.5 m) on a side.

Figure 25.4.2.1.1.2(c) In-Rack Sprinkler Arrangements for Exposed Nonencapsulated Class I or Class II Commodities Stored to a Maximum Height of 25 ft (7.6 m) with In-Rack Sprinklers at Each Tier Level.

**Notes:**

- (1) See 25.4.2.1.2 for the ceiling-level sprinkler design.
- (2) In-rack sprinklers are ordinary-temperature-rated, quick-or standard-response, pendent or upright, minimum K-5.6 (K-80), and designed for a minimum of ten (10) in-rack sprinklers [five (5) in-rack sprinklers on top two levels] operating at 22 gpm (83 L/min).
- (3) The symbol X represents in-rack sprinklers.
- (4) Each square represents a storage cube measuring 4 ft to 5 ft (1.2 m to 1.5 m) on a side.

25.4.2.1.1.3

Where rack storage of exposed nonencapsulated Class III commodities stored over 12 ft (3.7 m) and up to and including 25 ft (7.6 m) in height will be protected by in-rack sprinklers, in-rack sprinkler arrangements and designs shall be selected from Figure 25.4.2.1.1.3(a) through Figure 25.4.2.1.1.3(c). (See Section 25.3 for racks with solid shelving.)

Figure 25.4.2.1.1.3(a) In-Rack Sprinkler Arrangements for Exposed Nonencapsulated Class III Commodities Stored to a Maximum Height of 25 ft (7.6 m) with One Level of In-Rack Sprinklers.

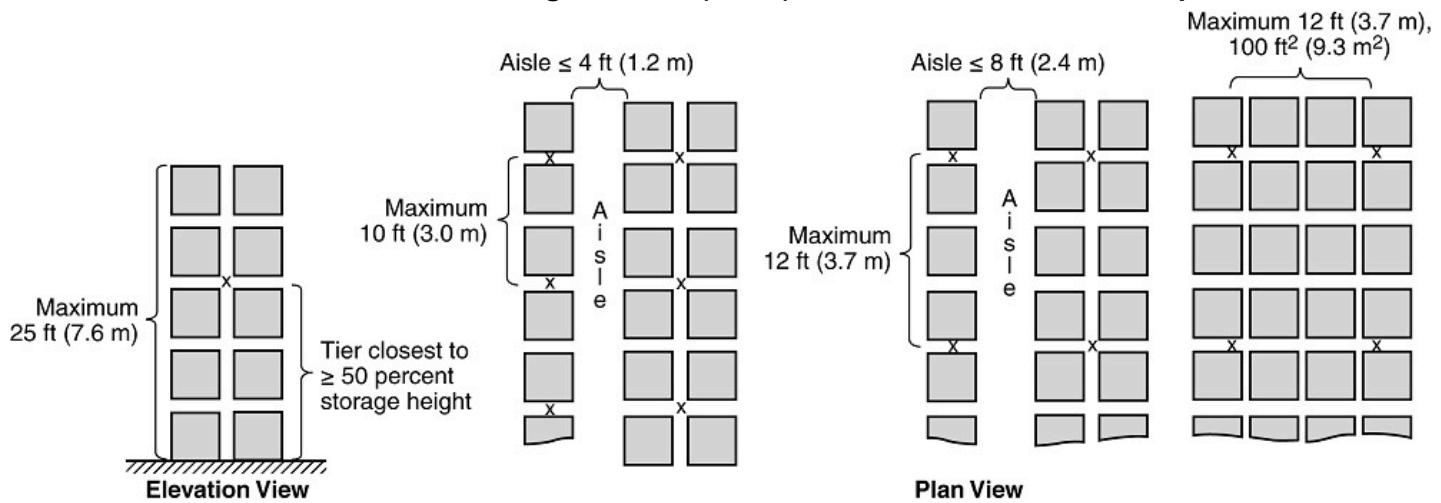


Figure 25.4.2.1.1.3(b) In-Rack Sprinkler Arrangements for Exposed Nonencapsulated Class III Commodities Stored to a Maximum Height of 25 ft (7.6 m) with More Than One Level of In-Rack Sprinklers (Not at Each Tier Level).

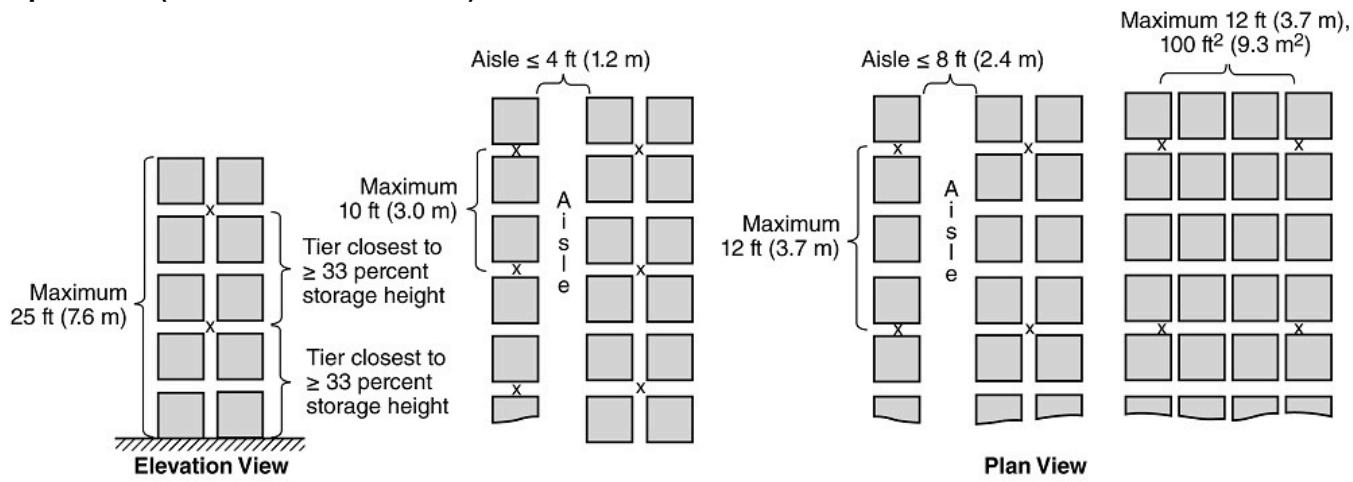
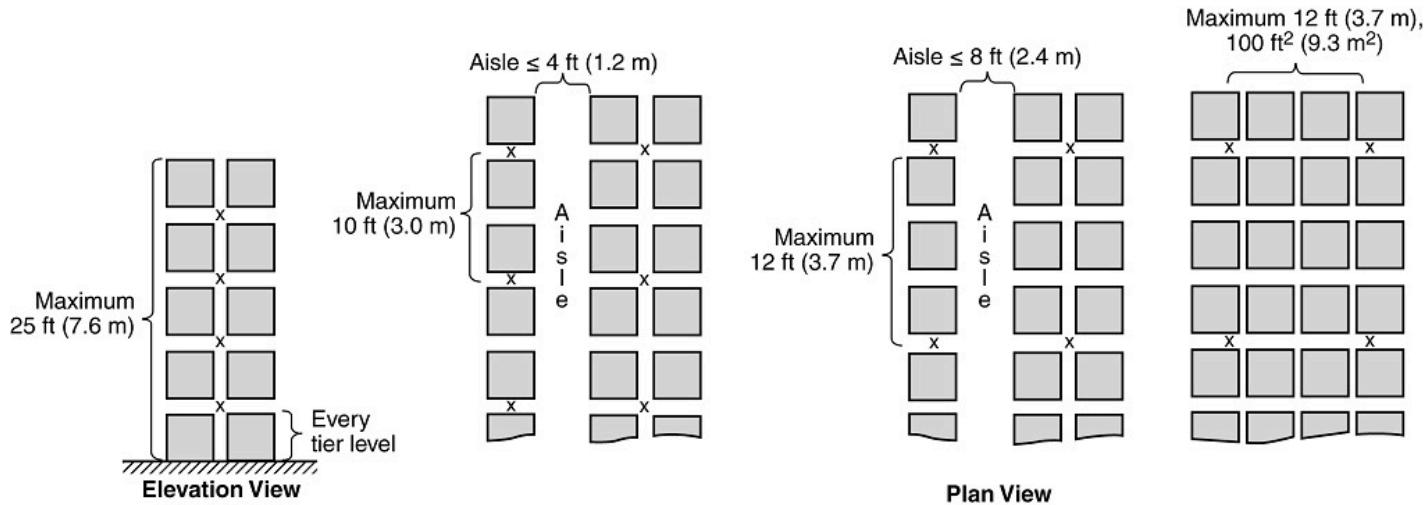


Figure 25.4.2.1.1.3(c) In-Rack Sprinkler Arrangements for Exposed Nonencapsulated Class III Commodities Stored to a Maximum Height of 25 ft (7.6 m) with In-Rack Sprinklers at Each Tier Level.

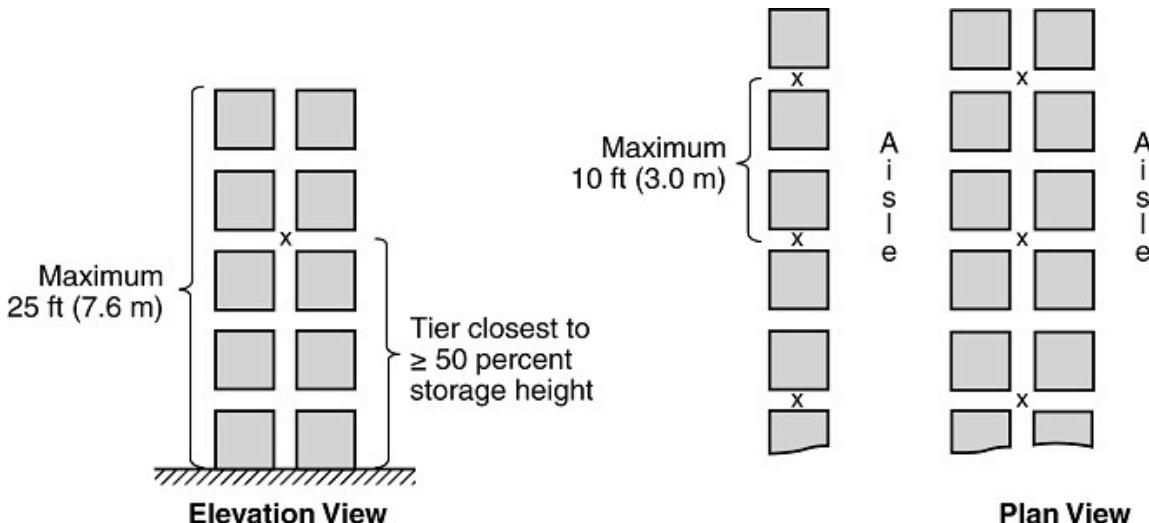
**Notes:**

- (1) See 25.4.2.1.2 for the ceiling-level sprinkler design.
- (2) In-rack sprinklers are ordinary-temperature-rated, quick-or standard-response, pendent or upright, minimum K-5.6 (K-80), and designed for a minimum of ten (10) in-rack sprinklers [five (5) in-rack sprinklers on top two levels] operating at 22 gpm (83 L/min).
- (3) The symbol X represents in-rack sprinklers.
- (4) Each square represents a storage cube measuring 4 ft to 5 ft (1.2 m to 1.5 m) on a side.

25.4.2.1.1.4

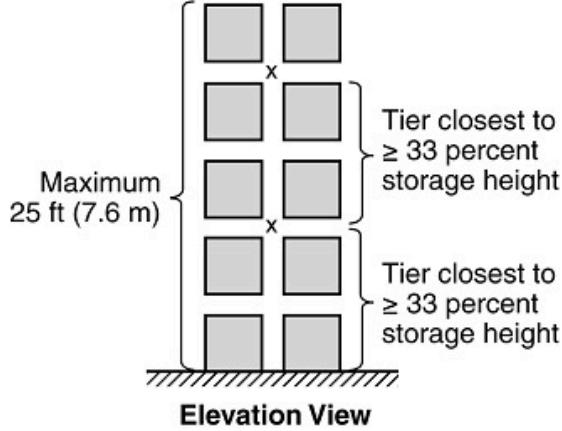
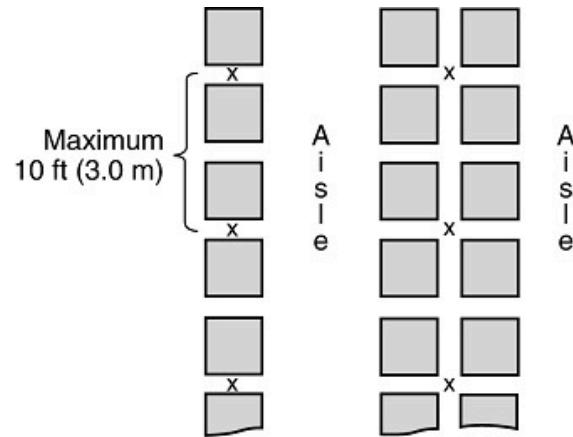
Where rack storage of exposed nonencapsulated Class IV commodities stored over 12 ft (3.7 m) and up to and including 25 ft (7.6 m) in height in single- and double-row racks will be protected by in-rack sprinklers, in-rack sprinkler arrangements and designs shall be selected from Figure 25.4.2.1.1.4(a) through Figure 25.4.2.1.1.4(c). (See Section 25.3 for racks with solid shelving.)

Figure 25.4.2.1.1.4(a) In-Rack Sprinkler Arrangements for Exposed Nonencapsulated Class IV Commodities Stored to a Maximum Height of 25 ft (7.6 m) in Single- and Double-Row Racks with One Level of In-Rack Sprinklers.

**Notes:**

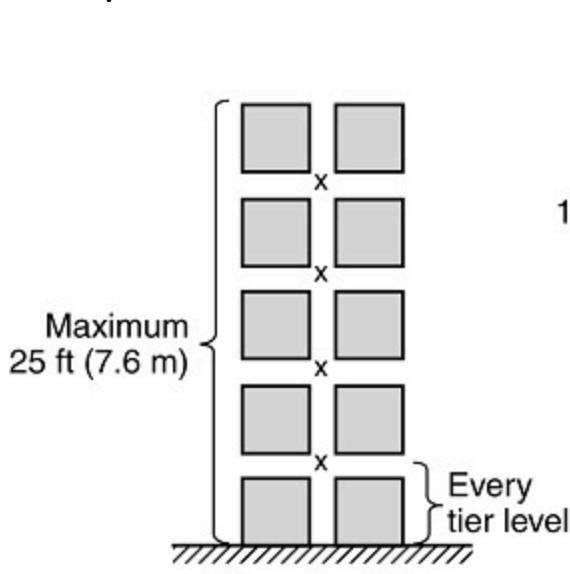
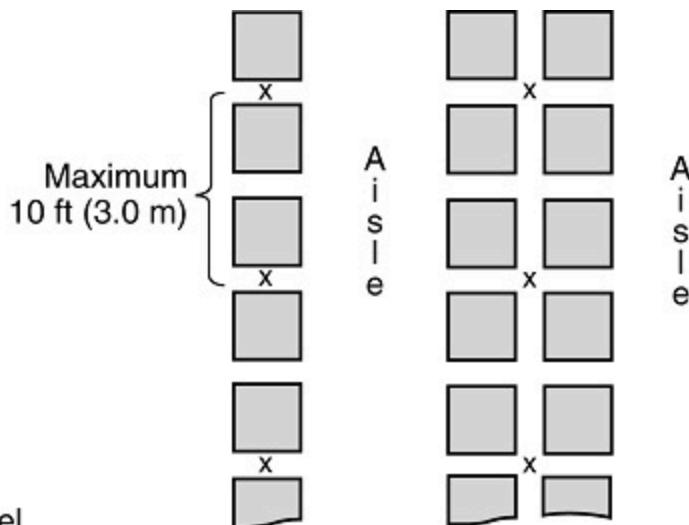
- (1) See 25.4.2.1.2 for the ceiling-level sprinkler design.
- (2) In-rack sprinklers are ordinary-temperature-rated, quick-or standard-response, pendent or upright, minimum K-5.6 (K-80), and designed for a minimum of eight (8) in-rack sprinklers operating at 22 gpm (83 L/min).
- (3) The symbol X represents in-rack sprinklers.
- (4) Each square represents a storage cube measuring 4 ft to 5 ft (1.2 m to 1.5 m) on a side.

Figure 25.4.2.1.1.4(b) In-Rack Sprinkler Arrangements for Exposed Nonencapsulated Class IV Commodities Stored to a Maximum Height of 25 ft (7.6 m) in Single- and Double-Row Racks with More Than One Level of In-Rack Sprinklers (Not at Each Tier Level).

**Elevation View****Plan View****Notes:**

- (1) See 25.4.2.1.2 for the ceiling-level sprinkler design.
- (2) In-rack sprinklers are ordinary-temperature-rated, quick-or standard-response, pendent or upright, minimum K-5.6 (K-80), and designed for a minimum of 14 in-rack sprinklers [seven (7) in-rack sprinklers on top two levels] operating at 22 gpm (83 L/min).
- (3) The symbol X represents in-rack sprinklers.
- (4) Each square represents a storage cube measuring 4 ft to 5 ft (1.2 m to 1.5 m) on a side.

Figure 25.4.2.1.1.4(c) In-Rack Sprinkler Arrangements for Exposed Nonencapsulated Class IV Commodities Stored to a Maximum Height of 25 ft (7.6 m) in Single- and Double-Row Racks with In-Rack Sprinklers at Each Tier Level.

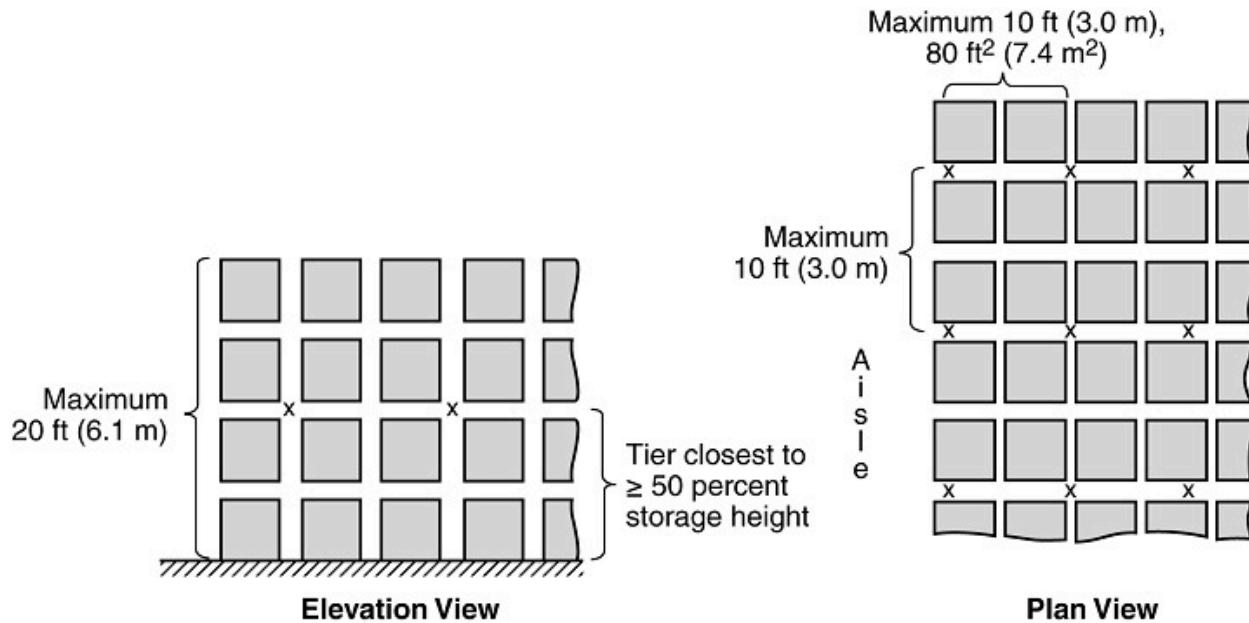
**Elevation View****Plan View****Notes:**

- (1) See 25.4.2.1.2 for the ceiling-level sprinkler design.
- (2) In-rack sprinklers are ordinary-temperature-rated, quick-or standard-response, pendent or upright, minimum K-5.6 (K-80), and designed for a minimum of 14 in-rack sprinklers [seven (7) in-rack sprinklers on top two levels] operating at 22 gpm (83 L/min).
- (3) The symbol X represents in-rack sprinklers.
- (4) Each square represents a storage cube measuring 4 ft to 5 ft (1.2 m to 1.5 m) on a side.

25.4.2.1.1.5

Where rack storage of exposed nonencapsulated Class IV commodities stored over 12 ft (3.7 m) and up to and including 20 ft (6.1 m) in height in multiple-row racks will be protected by in-rack sprinklers, in-rack sprinkler arrangements and designs shall be selected from Figure 25.4.2.1.1.5(a) through Figure 25.4.2.1.1.5(c). (See Section 25.3 for racks with solid shelving.)

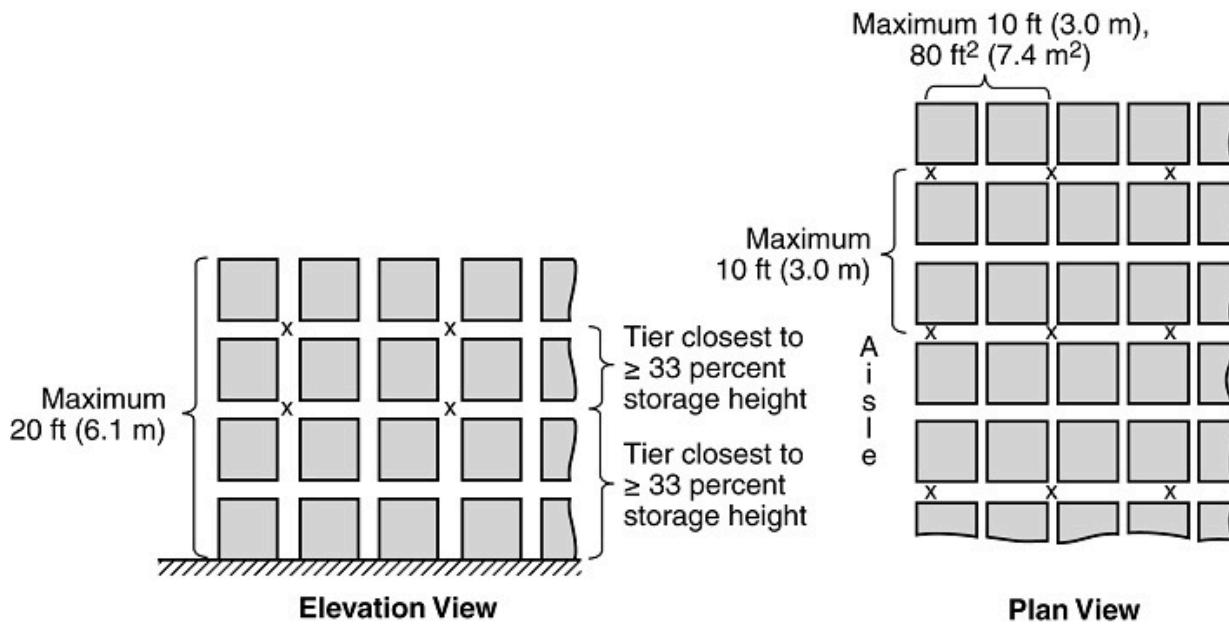
Figure 25.4.2.1.1.5(a) In-Rack Sprinkler Arrangements for Exposed Nonencapsulated Class IV Commodities Stored to a Maximum Height of 20 ft (6.1 m) in Multiple-Row Racks with One Level of In-Rack Sprinklers.



Notes:

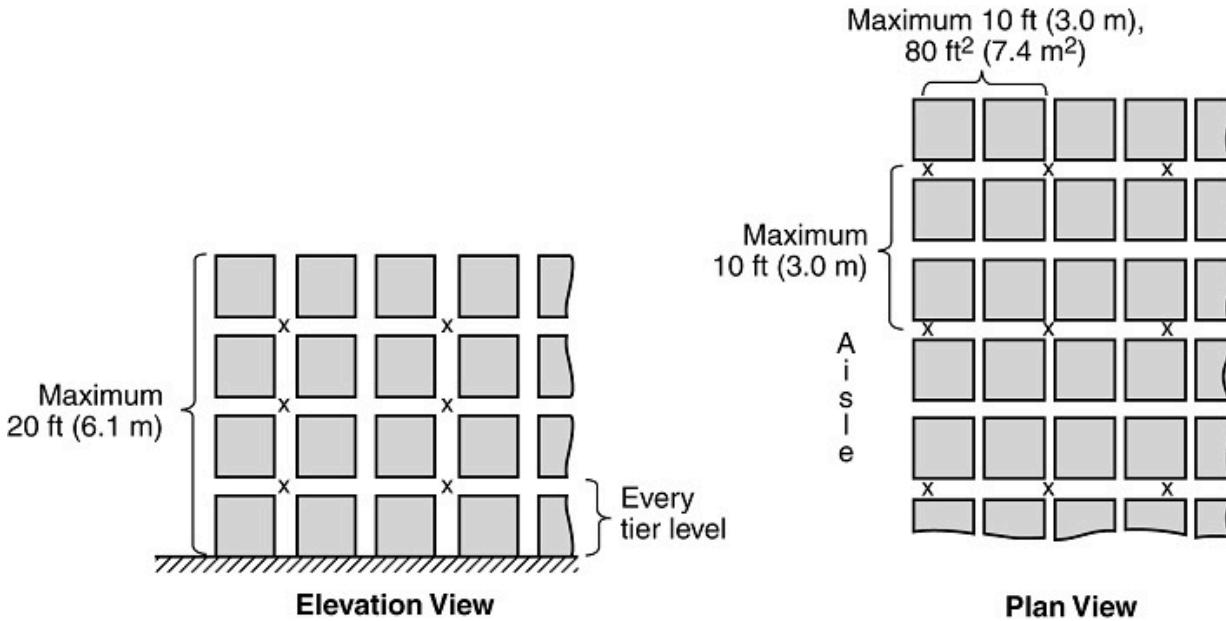
- (1) See 25.4.2.1.2 for the ceiling-level sprinkler design.
- (2) In-rack sprinklers are ordinary-temperature-rated, quick-or standard-response, pendent or upright, minimum K-5.6 (K-80), and designed for a minimum of eight (8) in-rack sprinklers operating at 22 gpm (83 L/min).
- (3) The symbol X represents in-rack sprinklers.
- (4) Each square represents a storage cube measuring 4 ft to 5 ft (1.2 m to 1.5 m) on a side.

Figure 25.4.2.1.1.5(b) In-Rack Sprinkler Arrangements for Exposed Nonencapsulated Class IV Commodities Stored to a Maximum Height of 20 ft (6.1 m) in Multiple-Row Racks with More Than One Level of In-Rack Sprinklers.

**Notes:**

- (1) See 25.4.2.1.2 for the ceiling-level sprinkler design.
- (2) In-rack sprinklers are ordinary-temperature-rated, quick-or standard-response, pendent or upright, minimum K-5.6 (K-80), and designed for a minimum of 14 in-rack sprinklers [seven (7) in-rack sprinklers on top two levels] operating at 22 gpm (83 L/min).
- (3) The symbol X represents in-rack sprinklers.
- (4) Each square represents a storage cube measuring 4 ft to 5 ft (1.2 m to 1.5 m) on a side.

Figure 25.4.2.1.1.5(c) In-Rack Sprinkler Arrangements for Exposed Nonencapsulated Class IV Commodities Stored to a Maximum Height of 20 ft (6.1 m) in Multiple-Row Racks with In-Rack Sprinklers at Each Tier Level.

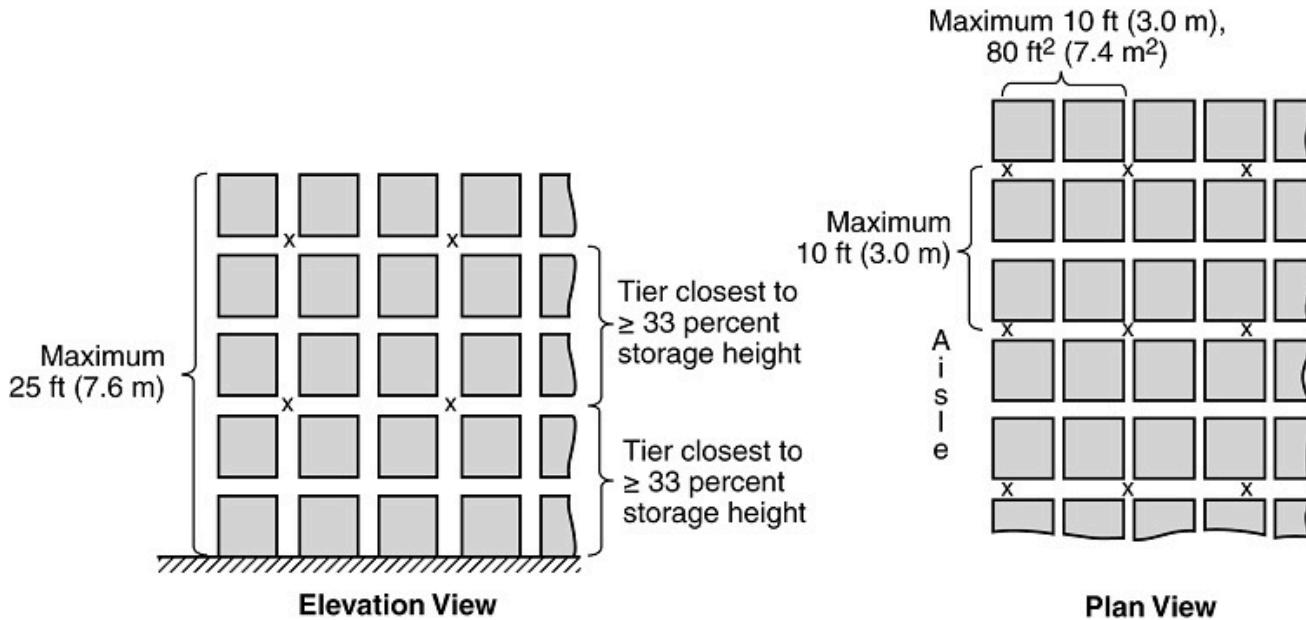
**Notes:**

- (1) See 25.4.2.1.2 for the ceiling-level sprinkler design.
- (2) In-rack sprinklers are ordinary-temperature-rated, quick-or standard-response, pendent or upright, minimum K-5.6 (K-80), and designed for a minimum of 14 in-rack sprinklers [seven (7) in-rack sprinklers on top two levels] operating at 22 gpm (83 L/min).
- (3) The symbol X represents in-rack sprinklers.
- (4) Each square represents a storage cube measuring 4 ft to 5 ft (1.2 m to 1.5 m) on a side.

25.4.2.1.6

Where rack storage of exposed nonencapsulated Class IV commodities stored over 20 ft (6.1 m) and up to and including 25 ft (7.6 m) in height in multiple-row racks will be protected by in-rack sprinklers, in-rack sprinkler arrangements and designs shall be selected from Figure 25.4.2.1.1.6(a) or Figure 25.4.2.1.1.6(b). (See Section 25.3 for racks with solid shelving.)

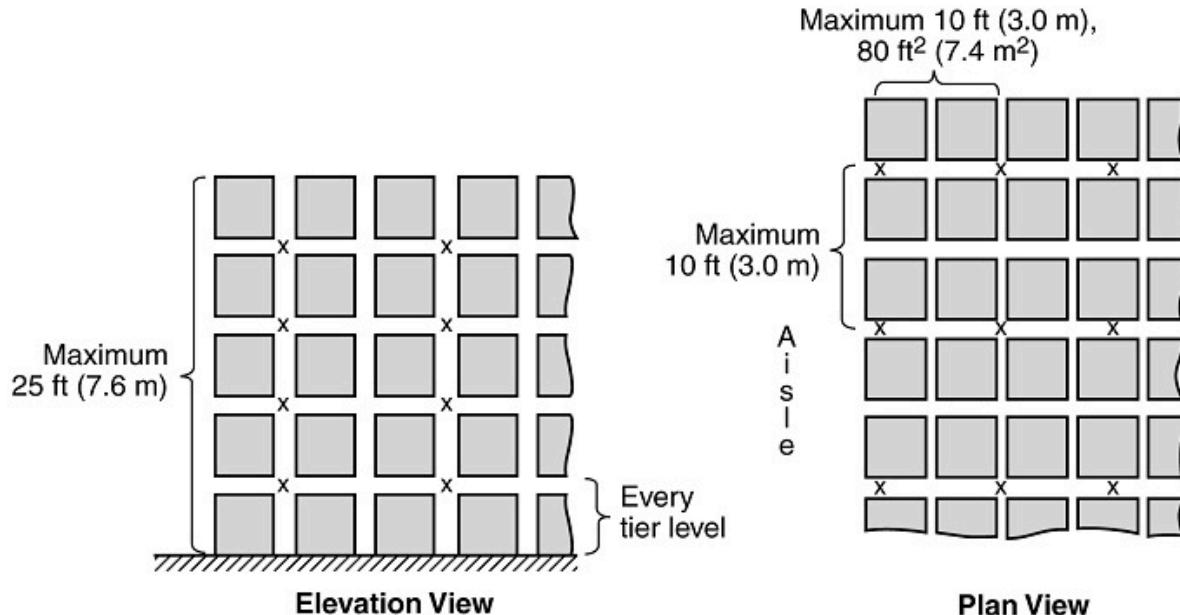
Figure 25.4.2.1.1.6(a) In-Rack Sprinkler Arrangements for Exposed Nonencapsulated Class IV Commodities Stored Over 20 ft (6.1 m) and up to a Maximum Height of 25 ft (7.6 m) in Multiple-Row Racks with Two Levels of In-Rack Sprinklers.



Notes:

- (1) See 25.4.2.1.2 for the ceiling-level sprinkler design.
- (2) In-rack sprinklers are ordinary-temperature-rated, quick-or standard-response, pendent or upright, minimum K-5.6 (K-80), and designed for a minimum of 14 in-rack sprinklers [seven (7) in-rack sprinklers on top two levels] operating at 22 gpm (83 L/min).
- (3) The symbol X represents in-rack sprinklers.
- (4) Each square represents a storage cube measuring 4 ft to 5 ft (1.2 m to 1.5 m) on a side.

Figure 25.4.2.1.1.6(b) In-Rack Sprinkler Arrangements for Exposed Nonencapsulated Class IV Commodities Stored Over 20 ft (6.1 m) and up to a Maximum Height of 25 ft (7.6 m) in Multiple-Row Racks with In-Rack Sprinklers at Each Tier Level.

**Notes:**

- (1) See 25.4.2.1.2 for the ceiling-level sprinkler design.
- (2) In-rack sprinklers are ordinary-temperature-rated, quick-or standard-response, pendent or upright, minimum K-5.6 (K-80), and designed for a minimum of 14 in-rack sprinklers [seven (7) in-rack sprinklers on top two levels] operating at 22 gpm (83 L/min).
- (3) The symbol X represents in-rack sprinklers.
- (4) Each square represents a storage cube measuring 4 ft to 5 ft (1.2 m to 1.5 m) on a side.

25.4.2.1.2 CMDA Ceiling-Level Sprinkler Designs for Exposed Nonencapsulated Class I, Class II, Class III, or Class IV Commodities Stored Up to and Including 25 ft (7.6 m) in Height in Combination with In-Rack Sprinklers.

25.4.2.1.2.1 * Single-, Double-, and Multiple-Row Rack Storage of Exposed Nonencapsulated Class I Through Class IV Commodities.

(A)

For single-, double-, and multiple-row rack storage of exposed nonencapsulated Class I through Class IV commodities stored over 12 ft (3.7 m) and up to and including 25 ft (7.6 m) in height, the ceiling-level sprinkler design in terms of density [gpm/ft² (mm/min)] over a 2000 ft² (186 m²) area of ceiling-level sprinkler operation, with the provision of in-rack sprinklers, shall be in accordance with the following:

- (1) For exposed nonencapsulated Class I commodities, see Table 25.4.2.1.2.1(A)(a)
- (2) For exposed nonencapsulated Class II commodities, see Table 25.4.2.1.2.1(A)(b)
- (3) For exposed nonencapsulated Class III commodities, see Table 25.4.2.1.2.1(A)(c)
- (4) For exposed nonencapsulated Class IV commodities, see Table 25.4.2.1.2.1(A)(d)

Table 25.4.2.1.2.1(A)(a) CMDA Ceiling-Level Sprinkler Design Requirements for Exposed Nonencapsulated Class I Commodities Stored Over 12 ft (3.7 m) and Up to 25 ft (7.6 m) in Height Supplemented with In-Rack Sprinklers

Maximum Storage Height ft (m)	Maximum Ceiling Height ft (m)	Storage Arrangement	Aisle Width ft (m)	No. of In-Rack Sprinkler Levels Installed	Ceiling Sprinkler System Design [gpm/ft ² /2000 ft ² (mm/min/185 m ²)]	
					High-Temperature-Rated Sprinklers	Ordinary- or Intermediate-Temperature-Rated Sprinklers
25	25	4x7	1.2	7	1.2	1.2

Maximum Storage Height ft (m)	Maximum Ceiling Height ft (m)	Storage Arrangement	Aisle Width ft (m)	No. of In-Rack Sprinkler Levels Installed	Ceiling Sprinkler System Design [gpm/ft²/2000 ft² (mm/min/185 m²)]	
					High-Temperature-Rated Sprinklers	Ordinary- or Intermediate-Temperature-Rated Sprinklers
15 (4.6)	35 (10.7)	Single- and double-row racks	8 (2.4)	1	0.15 (6.1)	0.15 (6.1)
				More than 1 but not every tier level	0.15 (6.1)	0.15 (6.1)
				Every tier level	0.15 (6.1)	0.15 (6.1)
			4 (1.2)	1	0.15 (6.1)	0.15 (6.1)
				More than 1 but not every tier level	0.15 (6.1)	0.15 (6.1)
		Multiple-row racks	Any	Every tier level	0.15 (6.1)	0.15 (6.1)
				1	0.15 (6.1)	0.15 (6.1)
				More than 1 but not every tier level	0.15 (6.1)	0.15 (6.1)
				Every tier level	0.15 (6.1)	0.15 (6.1)
				1	0.16 (6.5)	0.18 (7.3)
18 (5.5)	38 (11.6)	Single- and double-row racks	8 (2.4)	More than 1 but not every tier level	0.15 (6.1)	0.15 (6.1)
				Every tier level	0.15 (6.1)	0.15 (6.1)
			4 (1.2)	1	0.20 (8.2)	0.22 (9.0)
				More than 1 but not every tier level	0.16 (6.5)	0.17 (6.9)
				Every tier level	0.15 (6.1)	0.15 (6.1)
		Multiple-row racks	Any	1	0.20 (8.2)	0.22 (9.0)
				More than 1 but not every tier level	0.16 (6.5)	0.18 (7.3)
				Every tier level	0.15 (6.1)	0.15 (6.1)

Maximum Storage Height ft (m)	Maximum Ceiling Height ft (m)	Storage Arrangement	Aisle Width ft (m)	No. of In-Rack Sprinkler Levels Installed	Ceiling Sprinkler System Design [gpm/ft ² /2000 ft ² (mm/min/185 m ²)]	
					High-Temperature-Rated Sprinklers	Ordinary- or Intermediate-Temperature-Rated Sprinklers
25 (7.6)	45 (13.7)	Single- and double-row racks	8 (2.4)	1	0.19 (7.7)	0.22 (9.0)
				More than 1 but not every tier level	0.15 (6.1)	0.17 (6.9)
				Every tier level	0.15 (6.1)	0.15 (6.1)
			4 (1.2)	1	0.23 (9.4)	0.26 (10.6)
				More than 1 but not every tier level	0.18 (7.3)	0.20 (8.2)
		Multiple-row racks	Any	Every tier level	0.15 (6.1)	0.15 (6.1)
				1	0.23 (9.4)	0.26 (10.6)
				More than 1 but not every tier level	0.18 (7.3)	0.20 (8.2)
				Every tier level	0.15 (6.1)	0.15 (6.1)

Table 25.4.2.1.2.1(A)(b) CMDA Ceiling-Level Sprinkler Design Requirements for Exposed Nonencapsulated Class II Commodities Stored Over 12 ft (3.7 m) and Up to 25 ft (7.6 m) in Height Supplemented with In-Rack Sprinklers

Maximum Storage Height ft (m)	Maximum Ceiling Height ft (m)	Storage Arrangement	Aisle Width ft (m)	No. of In-Rack Sprinkler Levels Installed	Ceiling Sprinkler System Design [gpm/ft ² /2000 ft ² (mm/min/185 m ²)]	
					High-Temperature-Rated Sprinklers	Ordinary- or Intermediate-Temperature-Rated Sprinklers

Maximum Storage Height ft (m)	Maximum Ceiling Height ft (m)	Storage Arrangement	Aisle Width ft (m)	No. of In-Rack Sprinkler Levels Installed	Ceiling Sprinkler System Design [gpm/ft²/2000 ft² (mm/min/185 m²)]	
					High-Temperature-Rated Sprinklers	Ordinary- or Intermediate-Temperature-Rated Sprinklers
15 (4.6)	35 (10.7)	Single- and double-row racks	8 (2.4)	1	0.15 (6.1)	0.15 (6.1)
				More than 1 but not every tier level	0.15 (6.1)	0.15 (6.1)
				Every tier level	0.15 (6.1)	0.15 (6.1)
			4 (1.2)	1	0.15 (6.1)	0.18 (7.3)
				More than 1 but not every tier level	0.15 (6.1)	0.15 (6.1)
		Multiple-row racks	Any	Every tier level	0.15 (6.1)	0.15 (6.1)
				1	0.15 (6.1)	0.18 (7.3)
				More than 1 but not every tier level	0.15 (6.1)	0.15 (6.1)
				Every tier level	0.15 (6.1)	0.15 (6.1)
				1	0.18 (7.3)	0.20 (8.2)
18 (5.5)	38 (11.6)	Single- and double-row racks	8 (2.4)	More than 1 but not every tier level	0.15 (6.1)	0.16 (6.5)
				Every tier level	0.15 (6.1)	0.15 (6.1)
			4 (1.2)	1	0.21 (8.6)	0.26 (10.6)
				More than 1 but not every tier level	0.17 (6.9)	0.20 (8.2)
				Every tier level	0.15 (6.1)	0.15 (6.1)
		Multiple-row racks	Any	1	0.21 (8.6)	0.26 (10.6)
				More than 1 but not every tier level	0.17 (6.9)	0.20 (8.2)
				Every tier level	0.15 (6.1)	0.15 (6.1)

Maximum Storage Height ft (m)	Maximum Ceiling Height ft (m)	Storage Arrangement	Aisle Width ft (m)	No. of In-Rack Sprinkler Levels Installed	Ceiling Sprinkler System Design [gpm/ft ² /2000 ft ² (mm/min/185 m ²)]	
					High-Temperature-Rated Sprinklers	Ordinary- or Intermediate-Temperature-Rated Sprinklers
25 (7.6)	45 (13.7)	Single- and double-row racks	8 (2.4)	1	0.21 (8.6)	0.24 (9.8)
				More than 1 but not every tier level	0.17 (6.9)	0.19 (7.7)
				Every tier level	0.15 (6.1)	0.15 (6.1)
			4 (1.2)	1	0.25 (10.2)	0.30 (12.2)
				More than 1 but not every tier level	0.20 (8.2)	0.24 (9.8)
		Multiple-row racks	Any	Every tier level	0.15 (6.1)	0.18 (7.3)
				1	0.25 (10.2)	0.30 (12.2)
				More than 1 but not every tier level	0.20 (8.2)	0.24 (9.8)
				Every tier level	0.15 (6.1)	0.18 (7.3)

Table 25.4.2.1.2.1(A)(c) CMDA Ceiling-Level Sprinkler Design Requirements for Exposed Nonencapsulated Class III Commodities Stored Over 12 ft (3.7 m) and Up to 25 ft (7.6 m) in Height Supplemented with In-Rack Sprinklers

Maximum Storage Height ft (m)	Maximum Ceiling Height ft (m)	Storage Arrangement	Aisle Width ft (m)	No. of In-Rack Sprinkler Levels Installed	Ceiling Sprinkler System Design [gpm/ft ² /2000 ft ² (mm/min/185 m ²)]	
					High-Temperature-Rated Sprinklers	Ordinary- or Intermediate-Temperature-Rated Sprinklers
25 (7.6)	45 (13.7)	Single- and double-row racks	8 (2.4)	1	0.21 (8.6)	0.24 (9.8)

Maximum Storage Height ft (m)	Maximum Ceiling Height ft (m)	Storage Arrangement	Aisle Width ft (m)	No. of In-Rack Sprinkler Levels Installed	Ceiling Sprinkler System Design [gpm/ft²/2000 ft² (mm/min/185 m²)]	
					High-Temperature-Rated Sprinklers	Ordinary- or Intermediate-Temperature-Rated Sprinklers
15 (4.6)	35 (10.7)	Single- and double-row racks	8 (2.4)	1	0.15 (6.1)	0.17 (6.9)
				More than 1 but not every tier level	0.15 (6.1)	0.15 (6.1)
				Every tier level	0.15 (6.1)	0.15 (6.1)
			4 (1.2)	1	0.17 (6.9)	0.20 (8.2)
				More than 1 but not every tier level	0.15 (6.1)	0.16 (6.5)
		Multiple-row racks	Any	Every tier level	0.15 (6.1)	0.15 (6.1)
				1	0.17 (6.9)	0.20 (8.2)
				More than 1 but not every tier level	0.15 (6.1)	0.16 (6.5)
				Every tier level	0.15 (6.1)	0.15 (6.1)
				1	0.21 (8.6)	0.23 (9.4)
18 (5.5)	38 (11.6)	Single- and double-row racks	8 (2.4)	More than 1 but not every tier level	0.17 (6.9)	0.19 (7.7)
				Every tier level	0.15 (6.1)	0.15 (6.1)
			4 (1.2)	1	0.24 (9.8)	0.28 (11.4)
				More than 1 but not every tier level	0.19 (7.7)	0.22 (9.0)
				Every tier level	0.15 (6.1)	0.17 (6.9)
		Multiple-row racks	Any	1	0.24 (9.8)	0.28 (11.4)
				More than 1 but not every tier level	0.19 (7.7)	0.22 (9.0)
				Every tier level	0.15 (6.1)	0.17 (6.9)

Maximum Storage Height ft (m)	Maximum Ceiling Height ft (m)	Storage Arrangement	Aisle Width ft (m)	No. of In-Rack Sprinkler Levels Installed	Ceiling Sprinkler System Design [gpm/ft ² /2000 ft ² (mm/min/185 m ²)]	
					High-Temperature-Rated Sprinklers	Ordinary- or Intermediate-Temperature-Rated Sprinklers
25 (7.6)	45 (13.7)	Single- and double-row racks	8 (2.4)	1	0.25 (10.2)	0.28 (11.4)
				More than 1 but not every tier level	0.20 (8.2)	0.22 (9.0)
				Every tier level	0.15 (6.1)	0.17 (6.9)
			4 (1.2)	1	0.29 (11.8)	0.33 (13.4)
				More than 1 but not every tier level	0.23 (9.4)	0.26 (10.6)
		Multiple-row racks	Any	Every tier level	0.17 (6.9)	0.20 (8.2)
				1	0.29 (11.8)	0.33 (13.4)
				More than 1 but not every tier level	0.23 (9.4)	0.26 (10.6)
				Every tier level	0.17 (6.9)	0.20 (8.2)

Table 25.4.2.1.2.1(A)(d) CMDA Ceiling-Level Sprinkler Design Requirements for Exposed Nonencapsulated Class IV Commodities Stored Over 12 ft (3.7 m) and Up to 25 ft (7.6 m) in Height Supplemented with In-Rack Sprinklers

Maximum Storage Height ft (m)	Maximum Ceiling Height ft (m)	Storage Arrangement	Aisle Width ft (m)	No. of In-Rack Sprinkler Levels Installed	Ceiling Sprinkler System Design [gpm/ft ² /2000 ft ² (mm/min/185 m ²)]	
					High-Temperature-Rated Sprinklers	Ordinary- or Intermediate-Temperature-Rated Sprinklers
25 (7.6)	45 (13.7)	Single- and double-row racks	8 (2.4)	1	0.25 (10.2)	0.28 (11.4)

Maximum Storage Height ft (m)	Maximum Ceiling Height ft (m)	Storage Arrangement	Aisle Width ft (m)	No. of In-Rack Sprinkler Levels Installed	Ceiling Sprinkler System Design [gpm/ft ² /2000 ft ² (mm/min/185 m ²)]	
					High-Temperature-Rated Sprinklers	Ordinary- or Intermediate-Temperature-Rated Sprinklers
15 (4.6)	35 (10.7)	Single- and double-row racks	8 (2.4)	1	0.19 (7.7)	0.22 (9.0)
				More than 1 but not every tier level	0.15 (6.1)	0.18 (7.3)
				Every tier level	0.15 (6.1)	0.15 (6.1)
			4 (1.2)	1	0.23 (9.4)	0.27 (11.0)
				More than 1 but not every tier level	0.18 (7.3)	0.21 (8.6)
		Multiple-row racks	Any	Every tier level	0.15 (6.1)	0.16 (6.5)
				1	0.23 (9.4)	0.27 (11.0)
				More than 1 but not every tier level	0.18 (7.3)	0.21 (8.6)
				Every tier level	0.15 (6.1)	0.16 (6.5)
				1	0.27 (11.0)	0.31 (12.6)
18 (5.5)	38 (11.6)	Single- and double-row racks	8 (2.4)	More than 1 but not every tier level	0.22 (9.0)	0.25 (10.2)
				Every tier level	0.16 (6.5)	0.19 (7.7)
			4 (1.2)	1	0.33 (13.4)	0.38 (15.5)
				More than 1 but not every tier level	0.26 (10.6)	0.30 (12.2)
				Every tier level	0.20 (8.2)	0.23 (9.4)
		Multiple-row racks	Any	1	0.33 (13.4)	0.38 (15.5)
				More than 1 but not every tier level	0.26 (10.6)	0.30 (12.2)
				Every tier level	0.20 (8.2)	0.23 (9.4)

Maximum Storage Height ft (m)	Maximum Ceiling Height ft (m)	Storage Arrangement	Aisle Width ft (m)	No. of In-Rack Sprinkler Levels Installed	Ceiling Sprinkler System Design [gpm/ft ² /2000 ft ² (mm/min/185 m ²)]	
					High-Temperature-Rated Sprinklers	Ordinary- or Intermediate-Temperature-Rated Sprinklers
25 (7.6)	45 (13.7)	Single- and double-row racks	8 (2.4)	1	0.32 (13.0)	0.37 (15.1)
				More than 1 but not every tier level	0.26 (10.6)	0.30 (12.2)
				Every tier level	0.19 (7.7)	0.22 (9.0)
			4 (1.2)	1	0.39 (15.9)	0.45 (18.3)
				More than 1 but not every tier level	0.31 (12.6)	0.36 (14.7)
		Multiple-row racks	Any	Every tier level	0.23 (9.4)	0.27 (11.0)
				2	0.39 (15.9)	0.45 (18.3)
				More than 2 but not every tier level	0.31 (12.6)	0.36 (14.7)
				Every tier level	0.23 (9.4)	0.27 (11.0)

(B) *

Design densities obtained from Table 25.4.2.1.2.1(A)(a) through Table 25.4.2.1.2.1(A)(d) for single- and double-row racks shall be selected to correspond to aisle width (see Section C.15):

- (1) The density given for 8 ft (2.4 m) wide aisles shall be applied to aisles wider than 8 ft (2.4 m).
- (2) For aisle widths between 4 ft (1.2 m) and 8 ft (2.4 m), the rules for 4 ft (1.2 m) aisle width shall be used or direct linear interpolation between the densities shall be permitted.
- (3) The density given for 4 ft (1.2 m) wide aisles shall be applied to aisles narrower than 4 ft (1.2 m) down to 3½ ft (1.1 m).
- (4) Where aisles narrower than 3½ ft (1.1 m), racks shall be considered to be multiple-row racks.

25.4.2.1.2.2 Clearance.**(A)**

The ceiling-level sprinkler design obtained from Table 25.4.2.1.2.1(A)(a) through Table 25.4.2.1.2.1(A)(d) shall be based on a maximum clearance from top of storage to ceiling of 20 ft (6.1 m).

(B)

Where the clearance for 25.4.2.1.2.2(A) exceeds 20 ft (6.1 m), one of the following two options shall be implemented:

- (1) The ceiling design shall be determined from Table 25.4.2.1.2.1(A)(a) through Table 25.4.2.1.2.1(A)(d) using a theoretical storage height that does not exceed 25 ft (7.6 m) and results in a clearance to ceiling of 20 ft (6.1 m).
- (2) If not already provided, the in-rack sprinkler arrangement shall be supplemented with one level of quick-response in-rack sprinklers located directly below the top tier level of storage and at every flue space intersection.

25.4.2.2 Exposed Encapsulated, or Cartoned (Nonencapsulated or Encapsulated) Class I, Class II, Class III, or Class IV Commodities.**25.4.2.2.1 * In-Rack Sprinkler Arrangements and Designs for Exposed Encapsulated, or Cartoned (Nonencapsulated or Encapsulated) Class I, Class II, Class III, or Class IV Commodities Stored Up to and Including 25 ft (7.6 m) in Height.**

25.4.2.2.1.1

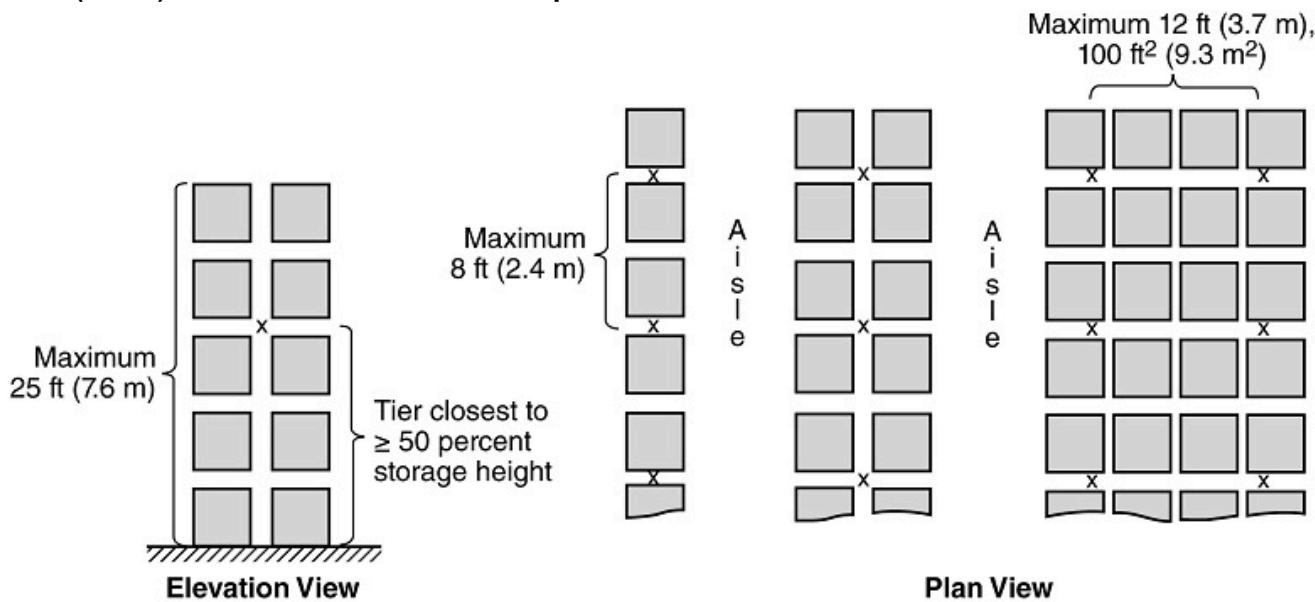
Where rack storage of exposed encapsulated, or cartoned (nonencapsulated or encapsulated) Class I through Class IV commodities stored over 12 ft (3.7 m) and up to and including 25 ft (7.6 m) in height will be protected by in-rack sprinklers, the following levels of in-rack sprinklers shall be required:

- (1) One level of in-rack sprinklers where Class I through Class IV commodities are stored in single- or double-row racks up to and including 25 ft (7.6 m)
- (2) One level of in-rack sprinklers where Class IV commodities are stored in multiple-row racks up to and including 20 ft (6.1 m)
- (3) Two levels of in-rack sprinklers where Class IV commodities are stored in multiple-row racks over 20 ft (6.1 m) and up to and including 25 ft (7.6 m)

25.4.2.2.1.2

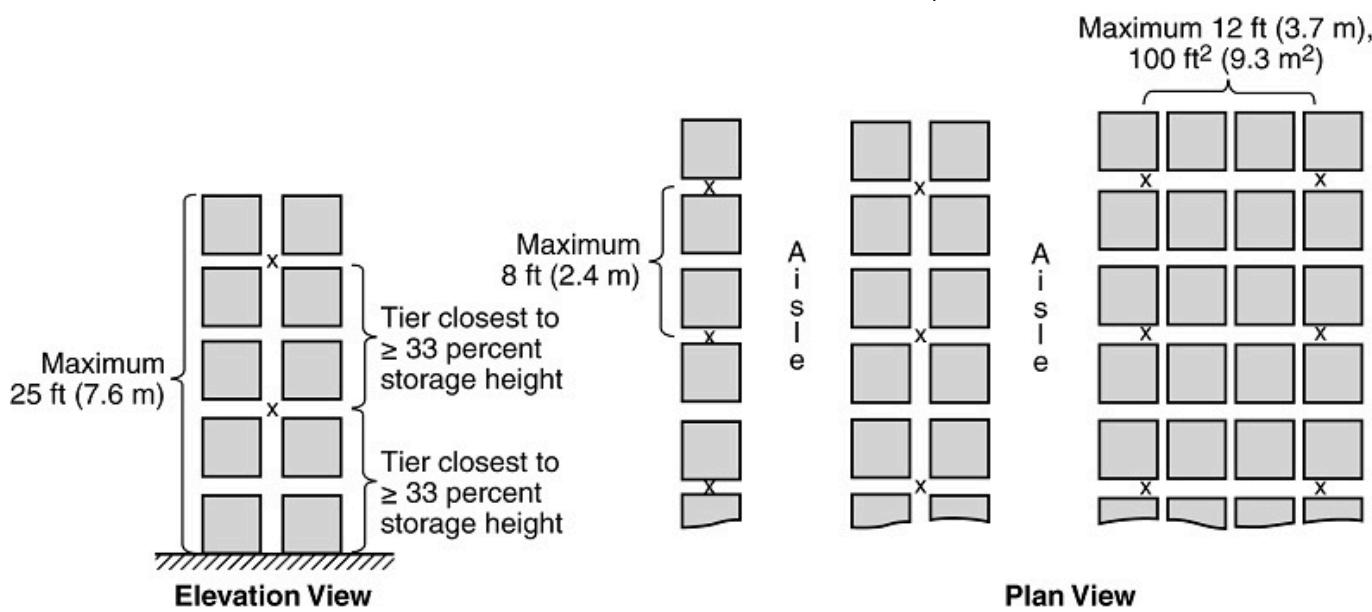
Where rack storage of exposed encapsulated, or cartoned (nonencapsulated or encapsulated) Class I or Class II commodities stored over 12 ft (3.7 m) and up to and including 25 ft (7.6 m) in height will be protected by in-rack sprinklers, in-rack sprinkler arrangements and designs shall be selected from Figure 25.4.2.2.1.2(a) through Figure 25.4.2.2.1.2(c). (See Section 25.3 for racks with solid shelving.)

Figure 25.4.2.2.1.2(a) In-Rack Sprinkler Arrangements for Exposed Encapsulated, or Cartoned (Nonencapsulated or Encapsulated) Class I or Class II Commodities Stored to a Maximum Height of 25 ft (7.6 m) with One Level of In-Rack Sprinklers.

**Notes:**

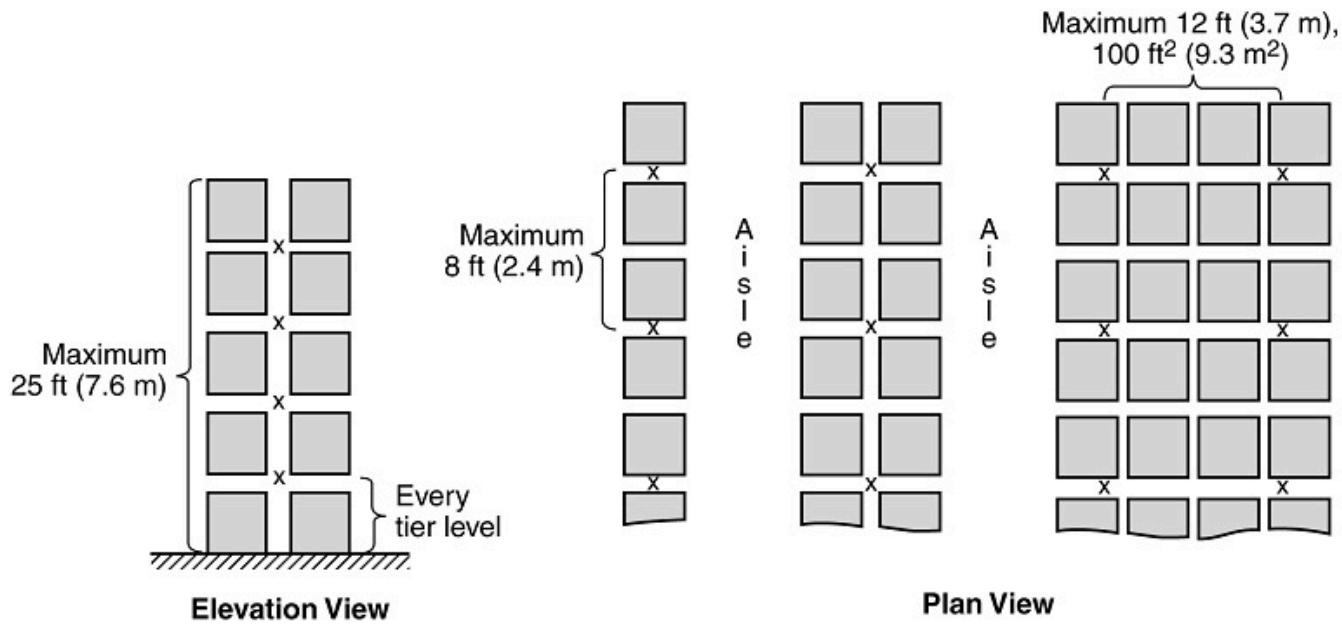
- (1) See 25.4.2.2 for the ceiling-level sprinkler design.
- (2) In-rack sprinklers are ordinary-temperature-rated, quick-or standard-response, pendent or upright, minimum K-5.6 (K-80), and designed for a minimum of six (6) in-rack sprinklers operating at 22 gpm (83 L/min).
- (3) The symbol X represents in-rack sprinklers.
- (4) Each square represents a storage cube measuring 4 ft to 5 ft (1.2 m to 1.5 m) on a side.

Figure 25.4.2.2.1.2(b) In-Rack Sprinkler Arrangements for Exposed Encapsulated, or Cartoned (Nonencapsulated or Encapsulated) Class I or Class II Commodities Stored to a Maximum Height of 25 ft (7.6 m) with More Than One Level of In-Rack Sprinklers (Not at Each Tier Level).

**Notes:**

- (1) See 25.4.2.2.2 for the ceiling-level sprinkler design.
- (2) In-rack sprinklers are ordinary-temperature-rated, quick-or standard-response, pendent or upright, minimum K-5.6 (K-80), and designed for a minimum of ten (10) in-rack sprinklers [five (5) in rack sprinklers on top two levels] operating at 22 gpm (83 L/min).
- (3) The symbol X represents in-rack sprinklers.
- (4) Each square represents a storage cube measuring 4 ft to 5 ft (1.2 m to 1.5 m) on a side.

Figure 25.4.2.2.1(c) In-Rack Sprinkler Arrangements for Exposed Encapsulated, or Cartoned (Nonencapsulated or Encapsulated) Class I or Class II Commodities Stored to a Maximum Height of 25 ft (7.6 m) with In-Rack Sprinklers at Each Tier Level.

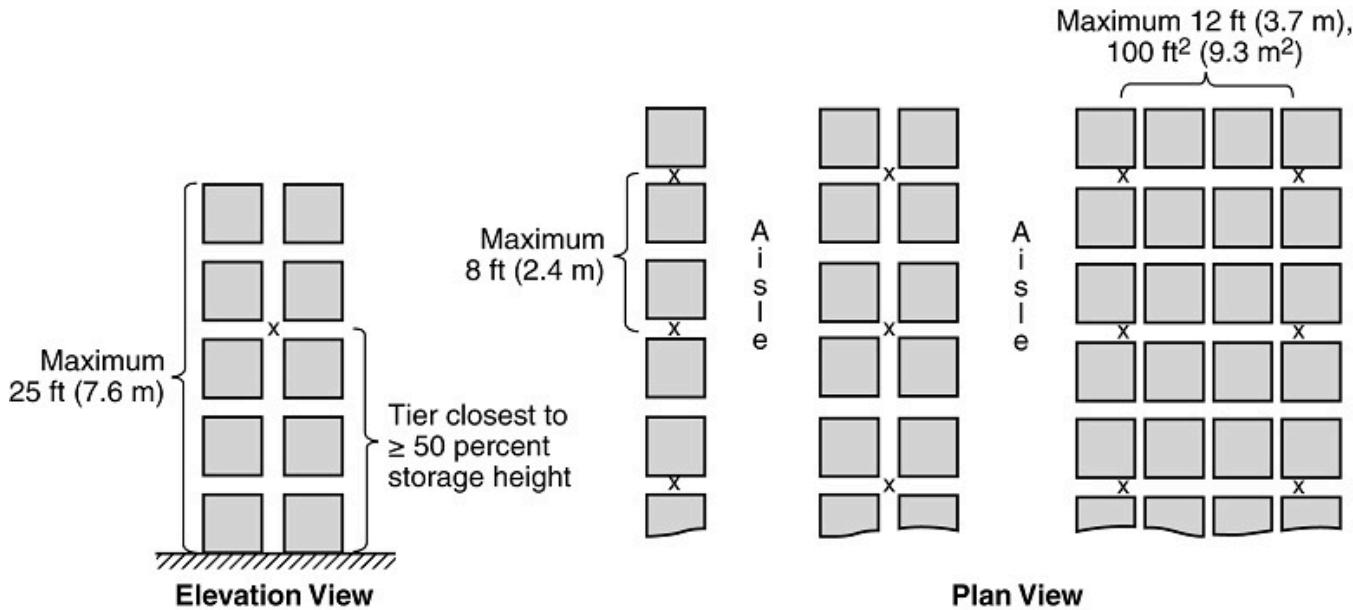
**Notes:**

- (1) See 25.4.2.2.2 for the ceiling-level sprinkler design.
- (2) In-rack sprinklers are ordinary-temperature-rated, quick-or standard-response, pendent or upright, minimum K-5.6 (K-80), and designed for a minimum of 10 in-rack sprinklers [five (5) in-rack sprinklers on top two levels] operating at 22 gpm (83 L/min).
- (3) The symbol X represents in-rack sprinklers.
- (4) Each square represents a storage cube measuring 4 ft to 5 ft (1.2 m to 1.5 m) on a side.

25.4.2.2.1.3

Where rack storage of exposed encapsulated, or cartoned (nonencapsulated or encapsulated) Class III commodities stored over 12 ft (3.7 m) and up to and including 25 ft (7.6 m) in height will be protected by in-rack sprinklers, in-rack sprinkler arrangements and designs shall be selected from Figure 25.4.2.2.1.3(a) through Figure 25.4.2.2.1.3(c). (See Section 25.3 for racks with solid shelving.)

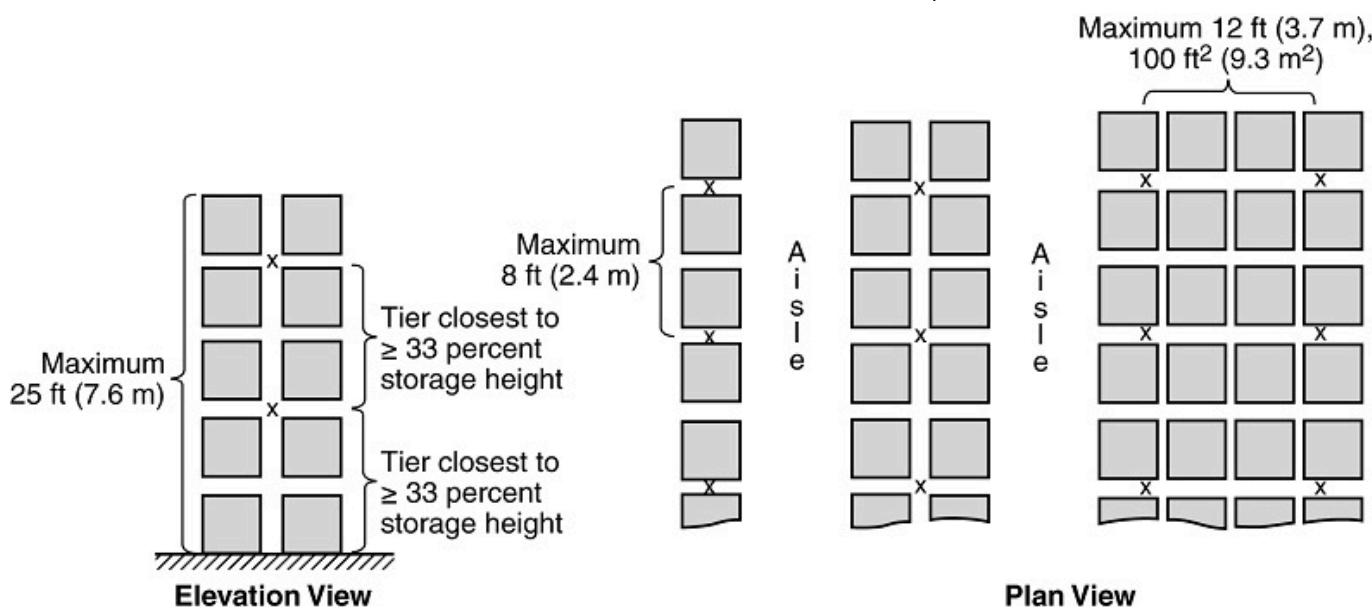
Figure 25.4.2.2.1.3(a) In-Rack Sprinkler Arrangements for Exposed Encapsulated, or Cartoned (Nonencapsulated or Encapsulated) Class III Commodities Stored to a Maximum Height of 25 ft (7.6 m) with One Level of In-Rack Sprinklers.



Notes:

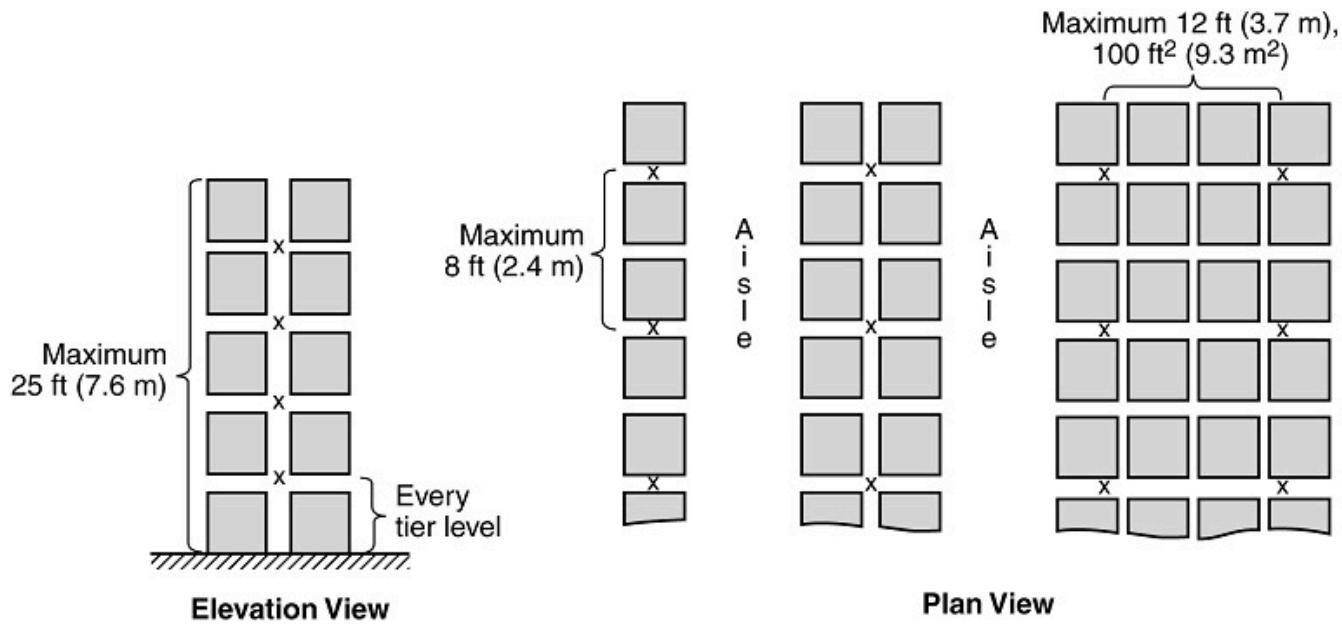
- (1) See 25.4.2.2 for the ceiling-level sprinkler design.
- (2) In-rack sprinklers are ordinary-temperature-rated, quick-or standard-response, pendent or upright, minimum K-5.6 (K-80), and designed for a minimum of six (6) in-rack sprinklers operating at 22 gpm (83 L/min).
- (3) The symbol X represents in-rack sprinklers.
- (4) Each square represents a storage cube measuring 4 ft to 5 ft (1.2 m to 1.5 m) on a side.

Figure 25.4.2.2.1.3(b) In-Rack Sprinkler Arrangements for Exposed Encapsulated, or Cartoned (Nonencapsulated or Encapsulated) Class III Commodities Stored to a Maximum Height of 25 ft (7.6 m) with More Than One Level of In-Rack Sprinklers (Not at Each Tier Level).

**Notes:**

- (1) See 25.4.2.2.2 for the ceiling-level sprinkler design.
- (2) In-rack sprinklers are ordinary-temperature-rated, quick-or standard-response, pendent or upright, minimum K-5.6 (K-80), and designed for a minimum of ten (10) in-rack sprinklers [five (5) in rack sprinklers on top two levels] operating at 22 gpm (83 L/min).
- (3) The symbol X represents in-rack sprinklers.
- (4) Each square represents a storage cube measuring 4 ft to 5 ft (1.2 m to 1.5 m) on a side.

Figure 25.4.2.2.1.3(c) In-Rack Sprinkler Arrangements for Exposed Encapsulated, or Cartoned (Nonencapsulated or Encapsulated) Class III Commodities Stored to a Maximum Height of 25 ft (7.6 m) with In-Rack Sprinklers at Each Tier Level.

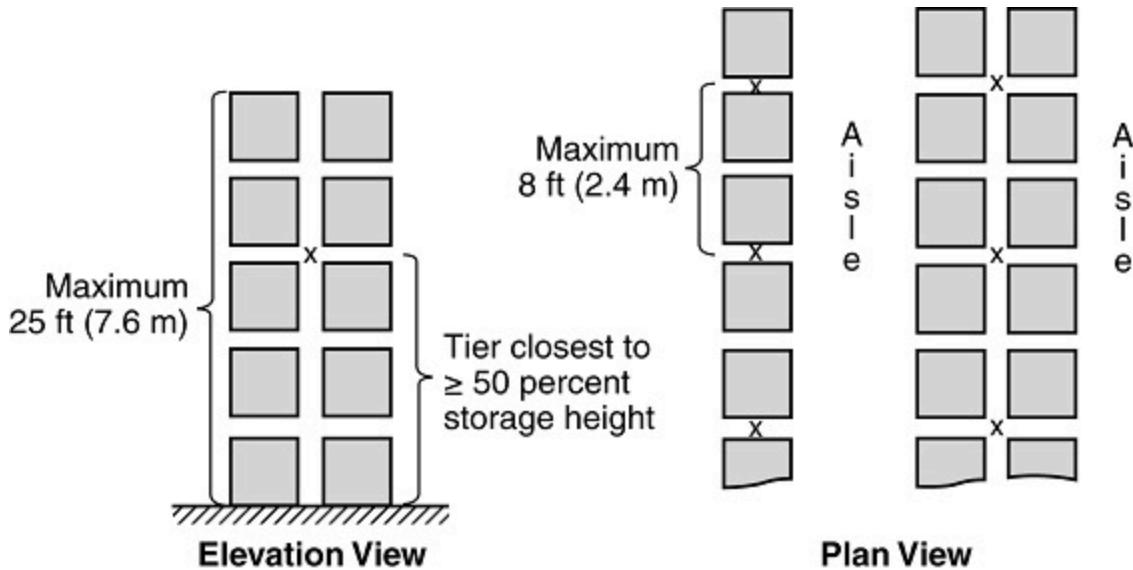
**Notes:**

- (1) See 25.4.2.2.2 for the ceiling-level sprinkler design.
- (2) In-rack sprinklers are ordinary-temperature-rated, quick-or standard-response, pendent or upright, minimum K-5.6 (K-80), and designed for a minimum of 10 in-rack sprinklers [five (5) in-rack sprinklers on top two levels] operating at 22 gpm (83 L/min).
- (3) The symbol X represents in-rack sprinklers.
- (4) Each square represents a storage cube measuring 4 ft to 5 ft (1.2 m to 1.5 m) on a side.

25.4.2.2.1.4

Where rack storage of exposed encapsulated, or cartoned (nonencapsulated or encapsulated) Class IV commodities stored over 12 ft (3.7 m) and up to and including 25 ft (7.6 m) in height in single- and double-row racks will be protected by in-rack sprinklers, in-rack sprinkler arrangements and designs shall be selected from Figure 25.4.2.2.1.4(a) through Figure 25.4.2.2.1.4(c). (See Section 25.3 for racks with solid shelving.)

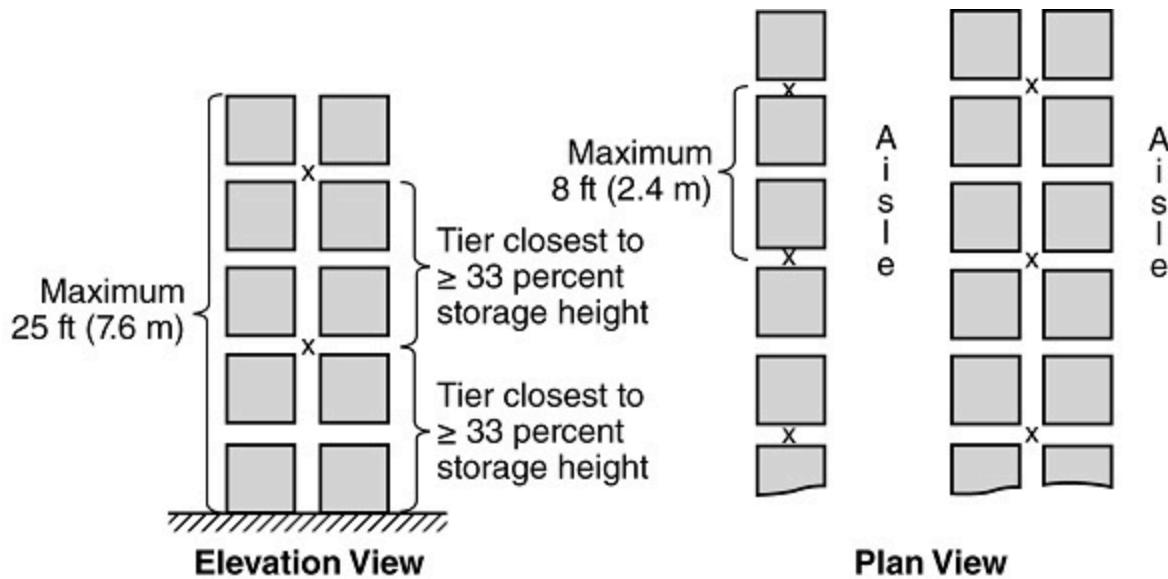
Figure 25.4.2.2.1.4(a) In-Rack Sprinkler Arrangements for Exposed Encapsulated or Cartoned (Nonencapsulated or Encapsulated) Class IV Commodities Stored to a Maximum Height of 25 ft (7.6 m) in Single- and Double-Row Racks with One Level of In-Rack Sprinklers.



Notes:

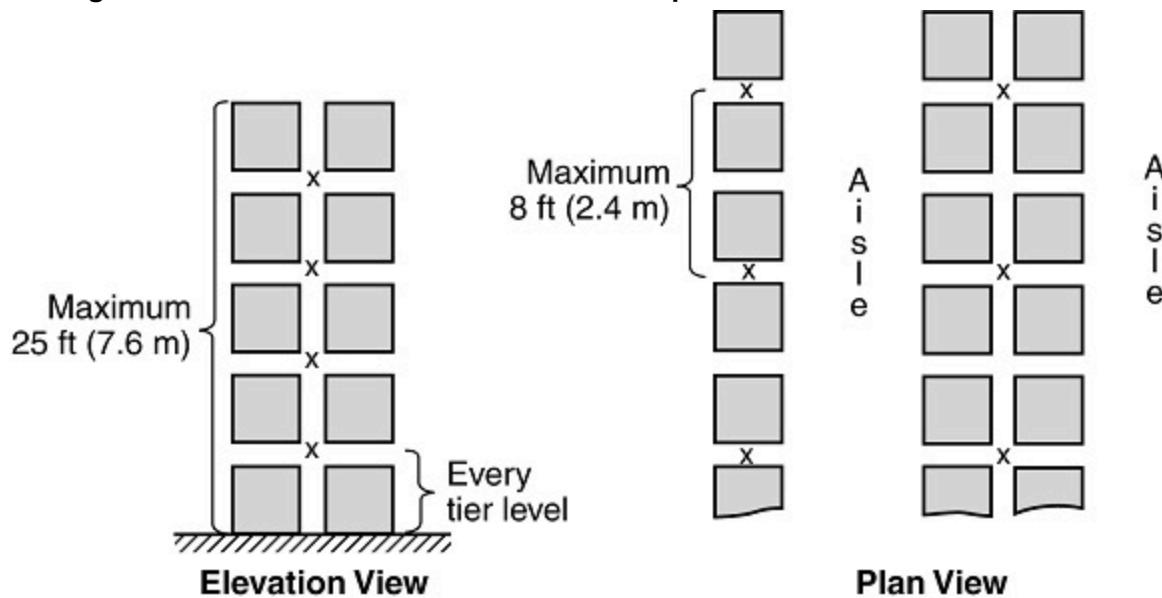
- (1) See 25.4.2.2 for the ceiling-level sprinkler design.
- (2) In-rack sprinklers are ordinary-temperature-rated, quick-or standard-response, pendent or upright, minimum K-5.6 (K-80), and designed for a minimum of eight (8) in-rack sprinklers operating at 22 gpm (83 L/min).
- (3) The symbol X represents in-rack sprinklers.
- (4) Each square represents a storage cube measuring 4 ft to 5 ft (1.2 m to 1.5 m) on a side.

Figure 25.4.2.2.1.4(b) In-Rack Sprinkler Arrangements for Exposed Encapsulated or Cartoned (Nonencapsulated or Encapsulated) Class IV Commodities Stored to a Maximum Height of 25 ft (7.6 m) in Single- and Double-Row Racks with More Than One Level of In-Rack Sprinklers (Not at Each Tier Level).

**Notes:**

- (1) See 25.4.2.2.2 for the ceiling-level sprinkler design.
- (2) In-rack sprinklers are ordinary-temperature-rated, quick-or standard-response, pendent or upright, minimum K-5.6 (K-80), and designed for a minimum of 14 in-rack sprinklers [seven (7) in-rack sprinklers on top two levels] operating at 22 gpm (83 L/min).
- (3) The symbol X represents in-rack sprinklers.
- (4) Each square represents a storage cube measuring 4 ft to 5 ft (1.2 m to 1.5 m) on a side.

Figure 25.4.2.2.1.4(c) In-Rack Sprinkler Arrangements for Exposed Encapsulated or Cartoned (Nonencapsulated or Encapsulated) Class IV Commodities Stored to a Maximum Height of 25 ft (7.6 m) in Single- and Double-Row Racks with In-Rack Sprinklers at Each Tier Level.

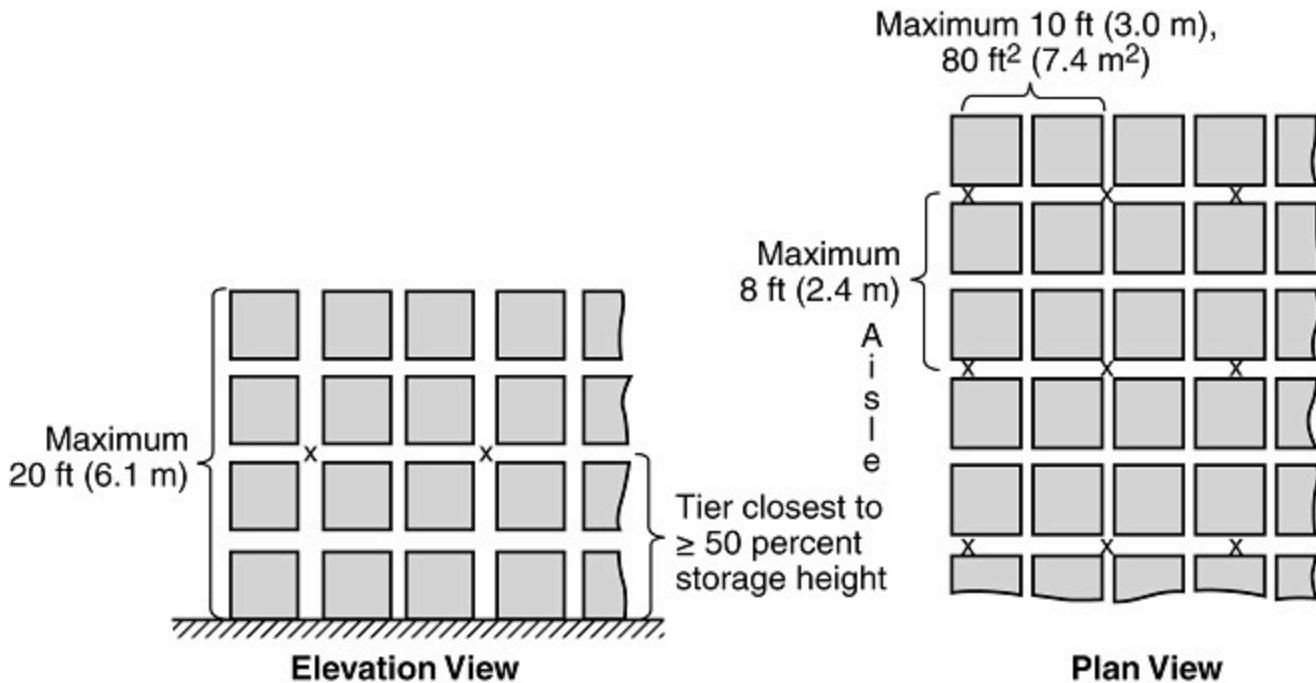
**Notes:**

- (1) See 25.4.2.2.2 for the ceiling-level sprinkler design.
- (2) In-rack sprinklers are ordinary-temperature-rated, quick-or standard-response, pendent or upright, minimum K-5.6 (K-80), and designed for a minimum of 14 in-rack sprinklers [seven (7) in-rack sprinklers on top two levels] operating at 22 gpm (83 L/min).
- (3) The symbol X represents in-rack sprinklers.
- (4) Each square represents a storage cube measuring 4 ft to 5 ft (1.2 m to 1.5 m) on a side.

25.4.2.2.1.5

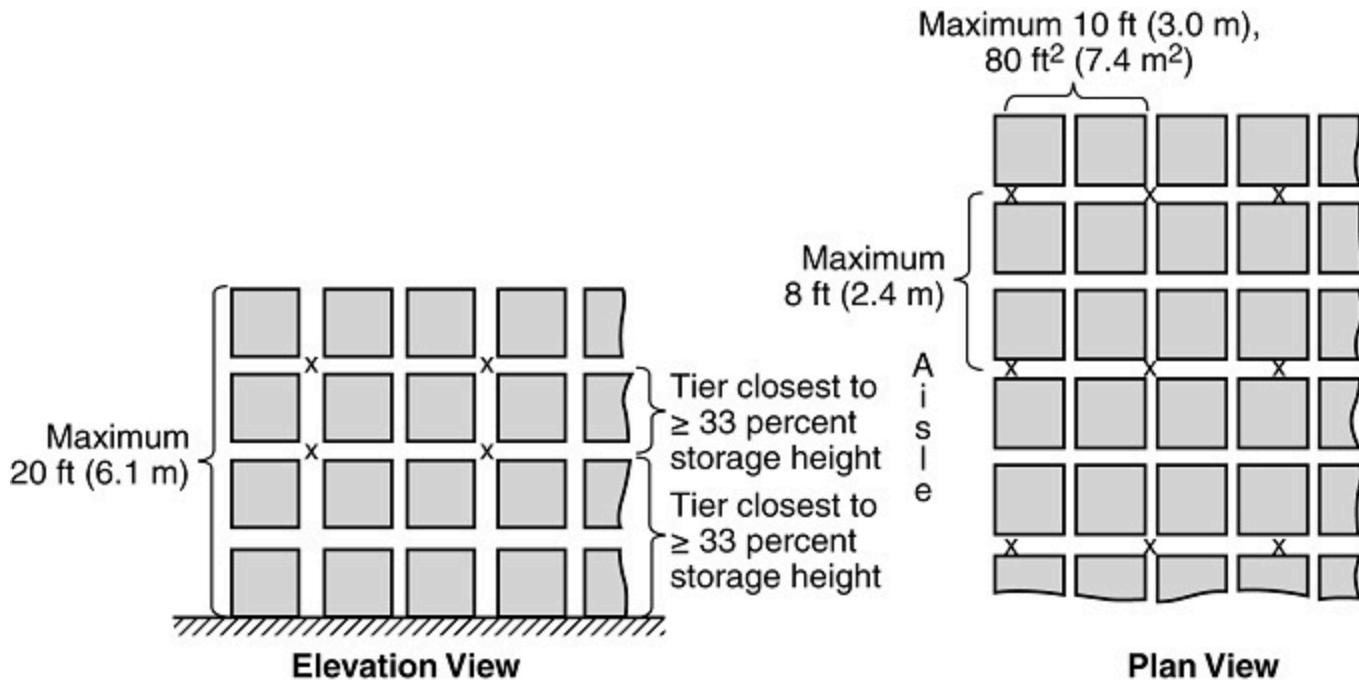
Where rack storage of exposed encapsulated, or cartoned (nonencapsulated or encapsulated) Class IV commodities stored over 12 ft (3.7 m) and up to and including 20 ft (6.1 m) in height in multiple-row racks will be protected by in-rack sprinklers, in-rack sprinkler arrangements and designs shall be selected from Figure 25.4.2.2.1.5(a) through Figure 25.4.2.2.1.5(c). (See Section 25.3 for racks with solid shelving.)

Figure 25.4.2.2.1.5(a) In-Rack Sprinkler Arrangements for Exposed Encapsulated or Cartoned (Nonencapsulated or Encapsulated) Class IV Commodities Stored to a Maximum Height of 20 ft (6.1 m) in Multiple-Row Racks with One Level of In-Rack Sprinklers.

**Notes:**

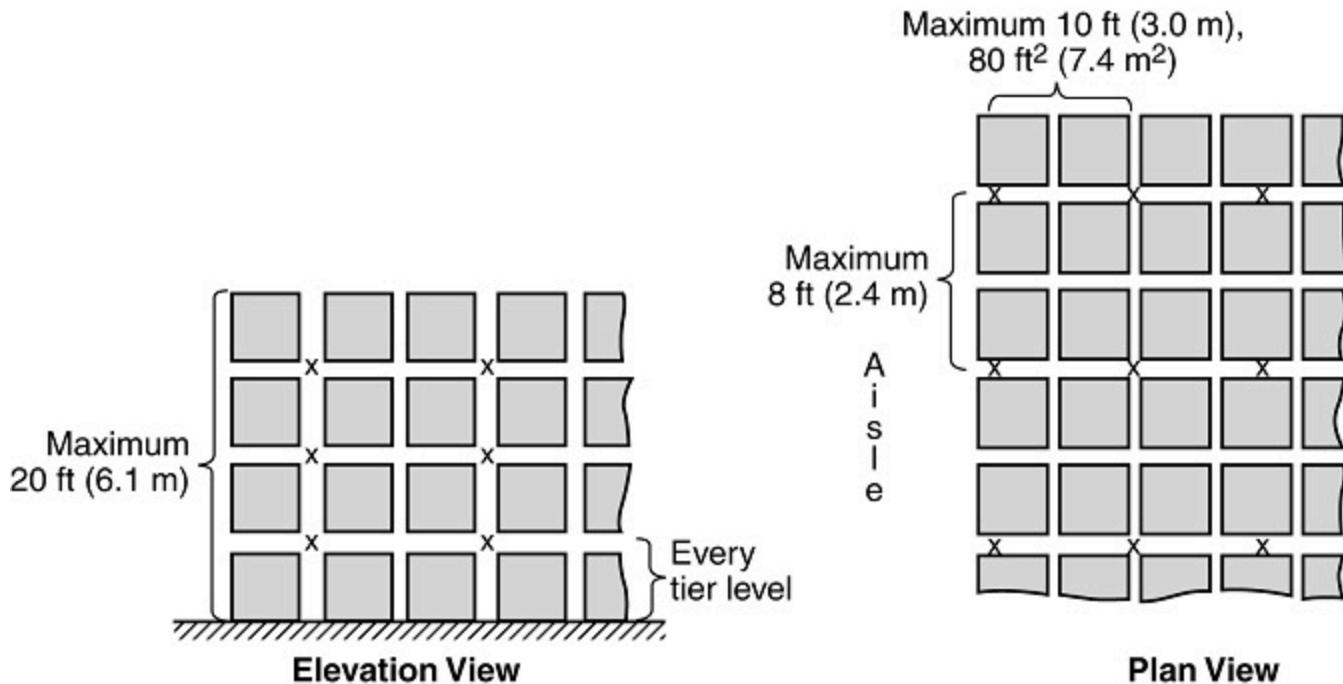
- (1) See 25.4.2.2 for the ceiling-level sprinkler design.
- (2) In-rack sprinklers are ordinary-temperature-rated, quick-or standard-response, pendent or upright, minimum K-5.6 (K-80), and designed for a minimum of eight (8) in-rack sprinklers operating at 22 gpm (83 L/min).
- (3) The symbol X represents in-rack sprinklers.
- (4) Each square represents a storage cube measuring 4 ft to 5 ft (1.2 m to 1.5 m) on a side.

Figure 25.4.2.2.1.5(b) In-Rack Sprinkler Arrangements for Exposed Encapsulated or Cartoned (Nonencapsulated or Encapsulated) Class IV Commodities Stored to a Maximum Height of 20 ft (6.1 m) in Multiple-Row Racks with More Than One Level of In-Rack Sprinklers.

**Notes:**

- (1) See 25.4.2.2.2 for the ceiling-level sprinkler design.
- (2) In-rack sprinklers are ordinary-temperature-rated, quick-or standard-response, pendent or upright, minimum K-5.6 (K-80), and designed for a minimum of 14 in-rack sprinklers [seven (7) in-rack sprinklers on top two levels] operating at 22 gpm (83 L/min).
- (3) The symbol X represents in-rack sprinklers.
- (4) Each square represents a storage cube measuring 4 ft to 5 ft (1.2 m to 1.5 m) on a side.

Figure 25.4.2.2.1.5(c) In-Rack Sprinkler Arrangements for Exposed Encapsulated or Cartoned (Nonencapsulated or Encapsulated) Class IV Commodities Stored to a Maximum Height of 20 ft (6.1 m) in Multiple-Row Racks with In-Rack Sprinklers at Each Tier Level.

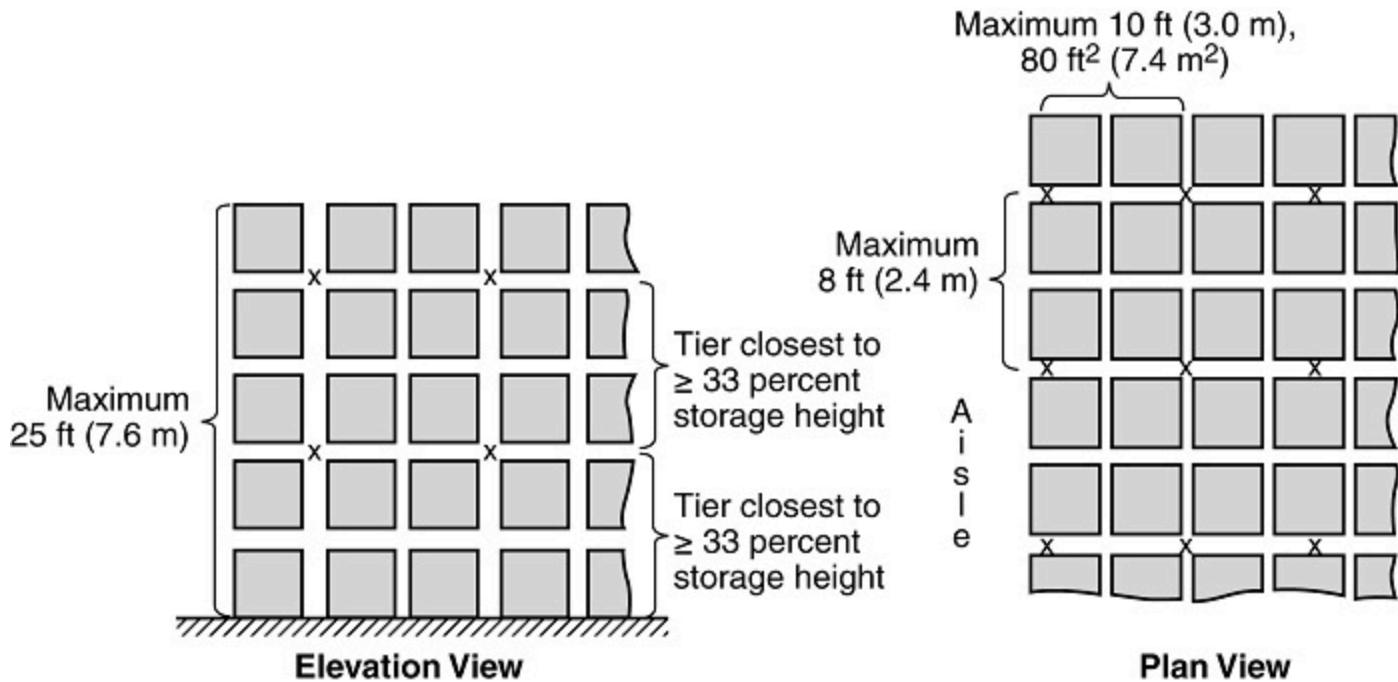
**Notes:**

- (1) See 25.4.2.2.2 for the ceiling-level sprinkler design.
- (2) In-rack sprinklers are ordinary-temperature-rated, quick-or standard-response, pendent or upright, minimum K-5.6 (K-80), and designed for a minimum of 14 in-rack sprinklers [seven (7) in-rack sprinklers on top two levels] operating at 22 gpm (83 L/min).
- (3) The symbol X represents in-rack sprinklers.
- (4) Each square represents a storage cube measuring 4 ft to 5 ft (1.2 m to 1.5 m) on a side.

25.4.2.2.1.6

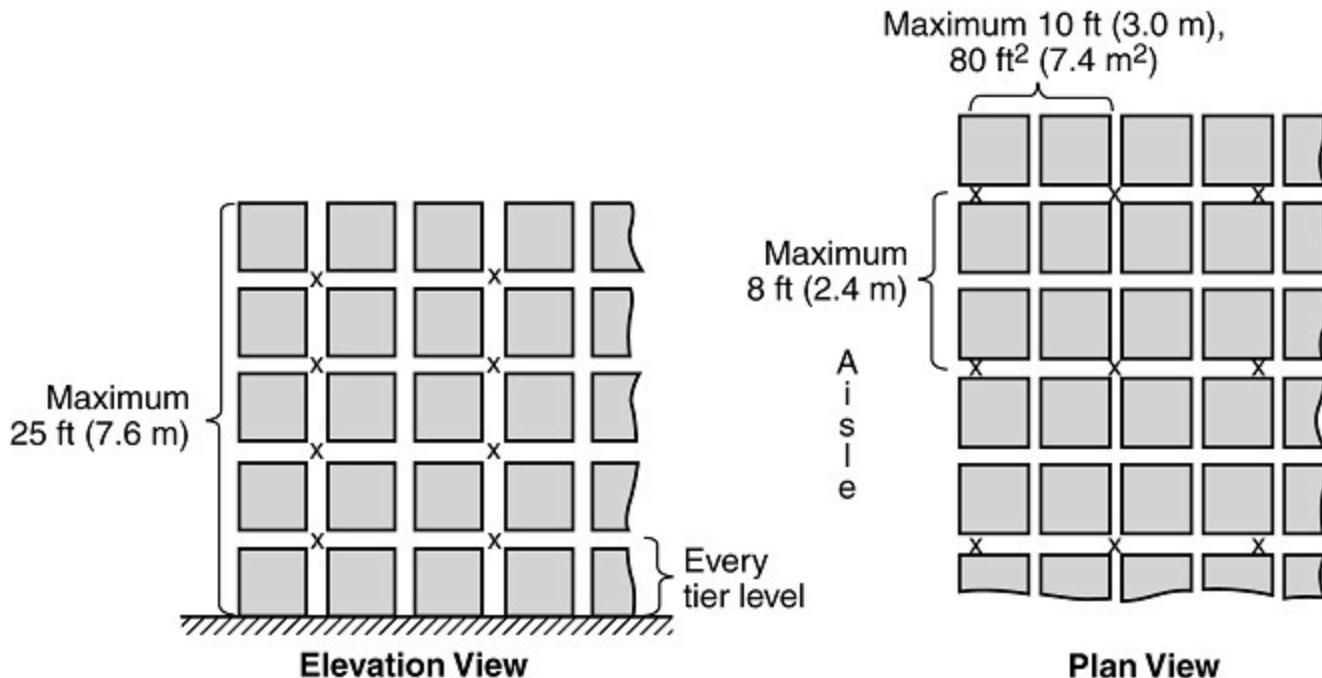
Where rack storage of exposed encapsulated, or cartoned (nonencapsulated or encapsulated) Class IV commodities stored over 20 ft (6.1 m) and up to and including 25 ft (7.6 m) in height in multiple-row racks will be protected by in-rack sprinklers, in-rack sprinkler arrangements and designs shall be selected from Figure 25.4.2.2.1.6(a) or Figure 25.4.2.2.1.6(b). (See Section 25.3 for racks with solid shelving.)

Figure 25.4.2.2.1.6(a) In-Rack Sprinkler Arrangements for Exposed Encapsulated or Cartoned (Nonencapsulated or Encapsulated) Class IV Commodities Stored Over 20 ft (6.1 m) and Up to a Maximum Height of 25 ft (7.6 m) in Multiple-Row Racks with Two Levels of In-Rack Sprinklers.

**Notes:**

- (1) See 25.4.2.2.2 for the ceiling-level sprinkler design.
- (2) In-rack sprinklers are ordinary-temperature-rated, quick-or standard-response, 14 in-rack sprinklers [seven (7) in-rack sprinklers on top two levels] operating at 22 gpm (83 L/min).
- (3) The symbol X represents in-rack sprinklers.
- (4) Each square represents a storage cube measuring 4 ft to 5 ft (1.2 m to 1.5 m) on a side.

Figure 25.4.2.2.1.6(b) In-Rack Sprinkler Arrangements for Exposed Encapsulated or Cartoned (Nonencapsulated or Encapsulated) Class IV Commodities Stored Over 20 ft (6.1 m) and Up to a Maximum Height of 25 ft (7.6 m) in Multiple-Row Racks with In-Rack Sprinklers at Each Tier Level.

**Notes:**

- (1) See 25.4.2.2.2 for the ceiling-level sprinkler design.
- (2) In-rack sprinklers are ordinary-temperature-rated, quick-or standard-response, pendant or upright, minimum K-5.6 (K-80), and designed for a minimum of 14 in-rack sprinklers [seven (7) in-rack sprinklers on top two levels] operating at 22 gpm (83 L/min).
- (3) The symbol X represents in-rack sprinklers.
- (4) Each square represents a storage cube measuring 4 ft to 5 ft (1.2 m to 1.5 m) on a side.

25.4.2.2.2 CMDA Ceiling-Level Sprinkler Designs for Exposed Encapsulated, or Cartoned (Nonencapsulated or Encapsulated) Class I through Class IV Commodities Stored Up to and Including 25 ft (7.6 m) in Height in Combination with In-Rack Sprinklers.

25.4.2.2.2.1 * Single-, Double-, and Multiple-Row Rack Storage of Exposed Encapsulated, or Cartoned (Nonencapsulated or Encapsulated) Class I Through Class IV Commodities.

(A)

For single-, double-, and multiple-row rack storage of exposed encapsulated, or cartoned (nonencapsulated or encapsulated) Class I, Class II, Class III, or Class IV commodities stored over 12 ft (3.7 m) and up to and including 25 ft (7.6 m) in height, the ceiling-level sprinkler design in terms of density [gpm/ft² (mm/min)] over a 2000 ft² (185 m²) area of ceiling-level sprinkler operation, with the provision of in-rack sprinklers, shall be in accordance with the following:

- (1) For exposed encapsulated, or cartoned (nonencapsulated or encapsulated) Class I commodities, see Table 25.4.2.2.2.1(A)(a)
- (2) For exposed encapsulated, or cartoned (nonencapsulated or encapsulated) Class II commodities, see Table 25.4.2.2.2.1(A)(b)
- (3) For exposed encapsulated, or cartoned (nonencapsulated or encapsulated) Class III commodities, see Table 25.4.2.2.2.1(A)(c)
- (4) For exposed encapsulated, or cartoned (nonencapsulated or encapsulated) Class IV commodities, see Table 25.4.2.2.2.1(A)(d)

Table 25.4.2.2.2.1(A)(a) CMDA Ceiling-Level Sprinkler Design Requirements for Exposed Encapsulated, or Cartoned (Nonencapsulated or Encapsulated) Class I Commodities Stored Over 12 ft (3.7 m) and Up to and Including 25 ft (7.6 m) in Height Supplemented with In-Rack Sprinklers

Maximum Storage Height ft (m)	Maximum Ceiling Height ft (m)	Storage Arrangement	Aisle Width ft (m)	No. of In-Rack Sprinkler Levels Installed	Ceiling Sprinkler System Design [gpm/ft²/2000 ft² (mm/min/185 m²)]	
					High-Temperature-Rated Sprinklers	Ordinary- or Intermediate-Temperature-Rated Sprinklers
15 (4.6)	35 (10.7)	Single- and double-row racks	8 (2.4)	1	0.15 (6.1)	0.17 (7.0)
				More than 1 but not every tier level	0.15 (6.1)	0.15 (6.1)
				Every tier level	0.15 (6.1)	0.15 (6.1)
			4 (1.2)	1	0.18 (7.3)	0.21 (8.6)
				More than 1 but not every tier level	0.15 (6.1)	0.17 (7.0)
		Multiple-row racks	Any	Every tier level	0.15 (6.1)	0.15 (6.1)
				1	0.17 (7.0)	0.20 (8.2)
				More than 1 but not every tier level	0.15 (6.1)	0.16 (6.5)
				Every tier level	0.15 (6.1)	0.15 (6.1)
				1	0.21 (8.6)	0.23 (9.3)
18 (5.5)	38 (11.6)	Single- and double-row racks	8 (2.4)	More than 1 but not every tier level	0.17 (7.0)	0.19 (7.7)
				Every tier level	0.15 (6.1)	0.15 (6.1)
			4 (1.2)	1	0.26 (10.6)	0.30 (12.2)
				More than 1 but not every tier level	0.20 (8.2)	0.24 (9.8)
				Every tier level	0.15 (6.1)	0.18 (7.3)
		Multiple-row racks	Any	1	0.24 (9.8)	0.28 (11.4)
				More than 1 but not every tier level	0.20 (8.2)	0.22 (9.0)
				Every tier level	0.15 (6.1)	0.17 (7.0)

Maximum Storage Height ft (m)	Maximum Ceiling Height ft (m)	Storage Arrangement	Aisle Width ft (m)	No. of In-Rack Sprinkler Levels Installed	Ceiling Sprinkler System Design [gpm/ft ² /2000 ft ² (mm/min/185 m ²)]	
					High-Temperature-Rated Sprinklers	Ordinary- or Intermediate-Temperature-Rated Sprinklers
25 (7.6)	45 (13.7)	Single- and double-row racks	8 (2.4)	1	0.25 (10.2)	0.28 (11.4)
				More than 1 but not every tier level	0.20 (8.2)	0.22 (9.0)
				Every tier level	0.15 (6.1)	0.17 (7.0)
			4 (1.2)	1	0.30 (12.2)	0.35 (14.3)
				More than 1 but not every tier level	0.24 (9.8)	0.28 (11.4)
		Multiple-row racks	Any	Every tier level	0.18 (7.3)	0.21 (8.6)
				1	0.29 (11.8)	0.33 (13.4)
				More than 1 but not every tier level	0.23 (9.3)	0.26 (10.6)
				Every tier level	0.17 (7.0)	0.20 (8.2)

Table 25.4.2.2.2.1(A)(b) CMDA Ceiling-Level Sprinkler Design Requirements for Exposed Encapsulated, or Cartoned (Nonencapsulated or Encapsulated) Class II Commodities Stored Over 12 ft (3.7 m) and Up to and Including 25 ft (7.6 m) in Height Supplemented with In-Rack Sprinklers

Maximum Storage Height ft (m)	Maximum Ceiling Height ft (m)	Storage Arrangement	Aisle Width ft (m)	No. of In-Rack Sprinkler Levels Installed	Ceiling Sprinkler System Design [gpm/ft ² /2000 ft ² (mm/min/185 m ²)]	
					High-Temperature-Rated Sprinklers	Ordinary- or Intermediate-Temperature-Rated Sprinklers

Maximum Storage Height ft (m)	Maximum Ceiling Height ft (m)	Storage Arrangement	Aisle Width ft (m)	No. of In-Rack Sprinkler Levels Installed	Ceiling Sprinkler System Design [gpm/ft ² /2000 ft ² (mm/min/185 m ²)]	
					High-Temperature-Rated Sprinklers	Ordinary- or Intermediate-Temperature-Rated Sprinklers
15 (4.6)	35 (10.7)	Single- and double-row racks	8 (2.4)	1	0.15 (6.1)	0.17 (7.0)
				More than 1 but not every tier level	0.15 (6.1)	0.15 (6.1)
				Every tier level	0.15 (6.1)	0.15 (6.1)
			4 (1.2)	1	0.18 (7.3)	0.21 (8.6)
				More than 1 but not every tier level	0.15 (6.1)	0.17 (7.0)
		Multiple-row racks	Any	Every tier level	0.15 (6.1)	0.15 (6.1)
				1	0.19 (7.7)	0.23 (9.3)
				More than 1 but not every tier level	0.15 (6.1)	0.18 (7.3)
				Every tier level	0.15 (6.1)	0.15 (6.1)
				1	0.21 (8.6)	0.23 (9.3)
18 (5.5)	38 (11.6)	Single- and double-row racks	8 (2.4)	More than 1 but not every tier level	0.17 (7.0)	0.19 (7.7)
				Every tier level	0.15 (6.1)	0.15 (6.1)
			4 (1.2)	1	0.26 (10.6)	0.30 (12.2)
				More than 1 but not every tier level	0.20 (8.2)	0.24 (9.8)
				Every tier level	0.15 (6.1)	0.18 (7.3)
		Multiple-row racks	Any	1	0.27 (11.0)	0.32 (13.0)
				More than 1 but not every tier level	0.21 (8.6)	0.26 (10.6)
				Every tier level	0.16 (6.5)	0.19 (7.7)

Maximum Storage Height ft (m)	Maximum Ceiling Height ft (m)	Storage Arrangement	Aisle Width ft (m)	No. of In-Rack Sprinkler Levels Installed	Ceiling Sprinkler System Design [gpm/ft ² /2000 ft ² (mm/min/185 m ²)]	
					High-Temperature-Rated Sprinklers	Ordinary- or Intermediate-Temperature-Rated Sprinklers
25 (7.6)	45 (13.7)	Single- and double-row racks	8 (2.4)	1	0.25 (10.2)	0.28 (11.4)
				More than 1 but not every tier level	0.20 (8.2)	0.22 (9.0)
				Every tier level	0.15 (6.1)	0.17 (7.0)
			4 (1.2)	1	0.30 (12.2)	0.35 (14.3)
				More than 1 but not every tier level	0.24 (9.8)	0.28 (11.4)
		Multiple-row racks	Any	Every tier level	0.18 (7.3)	0.21 (8.6)
				1	0.31 (12.6)	0.38 (15.5)
				More than 1 but not every tier level	0.25 (10.2)	0.30 (12.2)
				Every tier level	0.19 (7.7)	0.23 (9.3)

Table 25.4.2.2.2.1(A)(c) CMDA Ceiling-Level Sprinkler Design Requirements for Exposed Encapsulated, or Cartoned (Nonencapsulated or Encapsulated) Class III Commodities Stored Over 12 ft (3.7 m) and Up to and Including 25 ft (7.6 m) in Height Supplemented with In-Rack Sprinklers

Maximum Storage Height ft (m)	Maximum Ceiling Height ft (m)	Storage Arrangement	Aisle Width ft (m)	No. of In-Rack Sprinkler Levels Installed	Ceiling Sprinkler System Design [gpm/ft ² /2000 ft ² (mm/min/185 m ²)]	
					High-Temperature-Rated Sprinklers	Ordinary- or Intermediate-Temperature-Rated Sprinklers

Maximum Storage Height ft (m)	Maximum Ceiling Height ft (m)	Storage Arrangement	Aisle Width ft (m)	No. of In-Rack Sprinkler Levels Installed	Ceiling Sprinkler System Design [gpm/ft ² /2000 ft ² (mm/min/185 m ²)]	
					High-Temperature-Rated Sprinklers	Ordinary- or Intermediate-Temperature-Rated Sprinklers
15 (4.6)	35 (10.7)	Single- and double-row racks	8 (2.4)	1	0.17 (7.0)	0.19 (7.7)
				More than 1 but not every tier level	0.15 (6.1)	0.15 (6.1)
				Every tier level	0.15 (6.1)	0.15 (6.1)
			4 (1.2)	1	0.21 (8.6)	0.23 (9.3)
				More than 1 but not every tier level	0.17 (7.0)	0.19 (7.7)
		Multiple-row racks	Any	Every tier level	0.15 (6.1)	0.15 (6.1)
				1	0.22 (9.0)	0.25 (10.2)
				More than 1 but not every tier level	0.17 (7.0)	0.20 (8.2)
				Every tier level	0.15 (6.1)	0.15 (6.1)
				1	0.24 (9.8)	0.27 (11.0)
18 (5.5)	38 (11.6)	Single- and double-row racks	8 (2.4)	More than 1 but not every tier level	0.19 (7.7)	0.22 (9.0)
				Every tier level	0.15 (6.1)	0.16 (6.5)
			4 (1.2)	1	0.29 (11.8)	0.33 (13.4)
				More than 1 but not every tier level	0.23 (9.3)	0.27 (11.0)
				Every tier level	0.18 (7.3)	0.20 (8.2)
		Multiple-row racks	Any	1	0.31 (12.6)	0.35 (14.3)
				More than 1 but not every tier level	0.25 (10.2)	0.28 (11.4)
				Every tier level	0.18 (7.3)	0.21 (8.6)

Maximum Storage Height ft (m)	Maximum Ceiling Height ft (m)	Storage Arrangement	Aisle Width ft (m)	No. of In-Rack Sprinkler Levels Installed	Ceiling Sprinkler System Design [gpm/ft ² /2000 ft ² (mm/min/185 m ²)]	
					High-Temperature-Rated Sprinklers	Ordinary- or Intermediate-Temperature-Rated Sprinklers
25 (7.6)	45 (13.7)	Single- and double-row racks	8 (2.4)	1	0.28 (11.4)	0.32 (13.0)
				More than 1 but not every tier level	0.22 (9.0)	0.26 (10.6)
				Every tier level	0.17 (7.0)	0.19 (7.7)
			4 (1.2)	1	0.35 (14.3)	0.39 (15.9)
				More than 1 but not every tier level	0.28 (11.4)	0.31 (12.6)
		Multiple-row racks	Any	Every tier level	0.21 (8.6)	0.23 (9.3)
				1	0.36 (14.7)	0.41 (16.7)
				More than 1 but not every tier level	0.29 (11.8)	0.33 (13.4)
				Every tier level	0.22 (9.0)	0.25 (10.2)

Table 25.4.2.2.2.1(A)(d) CMDA Ceiling-Level Sprinkler Design Requirements for Exposed Encapsulated, or Cartoned (Nonencapsulated or Encapsulated) Class IV Commodities Stored Over 12 ft (3.7 m) and Up to and Including 25 ft (7.6 m) in Height Supplemented with In-Rack Sprinklers

Maximum Storage Height ft (m)	Maximum Ceiling Height ft (m)	Storage Arrangement	Aisle Width ft (m)	No. of In-Rack Sprinkler Levels Installed	Ceiling Sprinkler System Design [gpm/ft ² /2000 ft ² (mm/min/185 m ²)]	
					High-Temperature-Rated Sprinklers	Ordinary- or Intermediate-Temperature-Rated Sprinklers
25 (7.6)	45 (13.7)	Single- and double-row racks	8 (2.4)	1	0.28 (11.4)	0.32 (13.0)

Maximum Storage Height ft (m)	Maximum Ceiling Height ft (m)	Storage Arrangement	Aisle Width ft (m)	No. of In-Rack Sprinkler Levels Installed	Ceiling Sprinkler System Design [gpm/ft ² /2000 ft ² (mm/min/185 m ²)]	
					High-Temperature-Rated Sprinklers	Ordinary- or Intermediate-Temperature-Rated Sprinklers
15 (4.6)	35 (10.7)	Single- and double-row racks	8 (2.4)	1	0.23 (9.3)	0.27 (11.0)
				More than 1 but not every tier level	0.19 (7.7)	0.22 (9.0)
				Every tier level	0.15 (6.1)	0.16 (6.5)
			4 (1.2)	1	0.29 (11.8)	0.33 (13.4)
				More than 1 but not every tier level	0.23 (9.3)	0.26 (10.6)
				Every tier level	0.17 (7.0)	0.20 (8.2)
		Multiple-row racks	$\geq 8 (\geq 2.4)$	1	0.29 (11.8)	0.33 (13.4)
				More than 1 but not every tier level	0.23 (9.3)	0.27 (11.0)
				Every tier level	0.17 (7.0)	0.20 (8.1)
			<8 (<2.4)	1	0.35 (14.3)	0.40 (16.3)
				More than 1 but not every tier level	0.28 (11.4)	0.32 (13.0)
				Every tier level	0.21 (8.6)	0.24 (9.8)
18 (5.5)	38 (11.6)	Single- and double-row racks	8 (2.4)	1	0.33 (13.4)	0.39 (15.9)
				More than 1 but not every tier level	0.27 (11.0)	0.31 (12.6)
				Every tier level	0.20 (8.2)	0.23 (9.3)
			4 (1.2)	1	0.40 (16.3)	0.47 (19.1)
				More than 1 but not every tier level	0.32 (13.0)	0.37 (15.1)
				Every tier level	0.24 (9.8)	0.28 (11.4)
		Multiple-row racks	$\geq 8 (\geq 2.4)$	1	0.41 (16.7)	0.47 (19.1)
				More than 1 but not every tier level	0.33 (13.4)	0.38 (15.5)
				Every tier level	0.24 (9.8)	0.28 (11.4)
			<8 (<2.4)	1	0.50 (20.4)	0.56 (22.8)
				More than 1 but not every tier level	0.40 (16.3)	0.45 (18.3)
				Every tier level	0.30 (12.2)	0.34 (13.9)

Maximum Storage Height ft (m)	Maximum Ceiling Height ft (m)	Storage Arrangement	Aisle Width ft (m)	No. of In-Rack Sprinkler Levels Installed	Ceiling Sprinkler System Design [gpm/ft ² /2000 ft ² (mm/min/185 m ²)]	
					High-Temperature-Rated Sprinklers	Ordinary- or Intermediate-Temperature-Rated Sprinklers
25 (7.6)	45 (13.7)	Single- and double-row racks	8 (2.4)	1	0.39 (15.9)	0.46 (18.7)
				More than 1 but not every tier level	0.31 (12.6)	0.36 (14.7)
				Every tier level	0.23 (9.3)	0.27 (11.0)
			4 (1.2)	1	0.48 (19.6)	0.55 (22.4)
				More than 1 but not every tier level	0.38 (15.5)	0.44 (17.9)
		Multiple-row racks	≥8 (≥2.4)	Every tier level	0.29 (11.8)	0.33 (13.4)
				2	0.48 (19.5)	0.56 (22.8)
				More than 2 but not every tier level	0.38 (15.5)	0.44 (17.9)
				Every tier level	0.29 (11.8)	0.33 (13.4)
			<8 (<2.4)	2	0.59 (24.1)	0.66 (26.9)
				More than 2 but not every tier level	0.47 (19.1)	0.53(21.6)
				Every tier level	0.35 (14.3)	0.40 (16.3)

(B) *

Design densities obtained from Table 25.4.2.2.1(A)(a) through Table 25.4.2.2.1(A)(d) for single- and double-row racks shall be selected to correspond to aisle width as follows (See Section C.15):

- (1) For aisle widths between 4 ft (1.2 m) and 8 ft (2.4 m), the rules for 4 ft (1.2 m) aisle width shall be used or direct linear interpolation between the densities shall be permitted.
- (2) The density given for 8 ft (2.4 m) wide aisles shall be applied to aisles wider than 8 ft (2.4 m).
- (3) The density given for 4 ft (1.2 m) wide aisles shall be applied to aisles narrower than 4 ft (1.2 m) down to 3½ ft (1.1 m).
- (4) Where aisles are narrower than 3½ ft (1.1 m), racks shall be considered to be multiple-row racks.

25.4.2.2.2 Clearance.**(A)**

The ceiling-level sprinkler design obtained from Table 25.4.2.2.1(A)(a) through Table 25.4.2.2.1(A)(d) shall be based on a maximum clearance from top of storage to ceiling of 20 ft (6.1 m).

(B)

Where the clearance for 25.4.2.2.2(A) exceeds 20 ft (6.1 m), one of the following two options shall be implemented:

- (1) The ceiling design shall be determined from Table 25.4.2.2.1(A)(a) through Table 25.4.2.2.1(A)(d) using a theoretical storage height that does not exceed 25 ft (7.6 m) and results in a clearance to ceiling of 20 ft (6.1 m).
- (2) If not already provided, the in-rack sprinkler arrangement shall be supplemented with one level of quick-response in-rack sprinklers located directly below the top tier level of storage and at every flue space intersection.

25.4.2.3 Cartoned Group A Plastic Commodities.

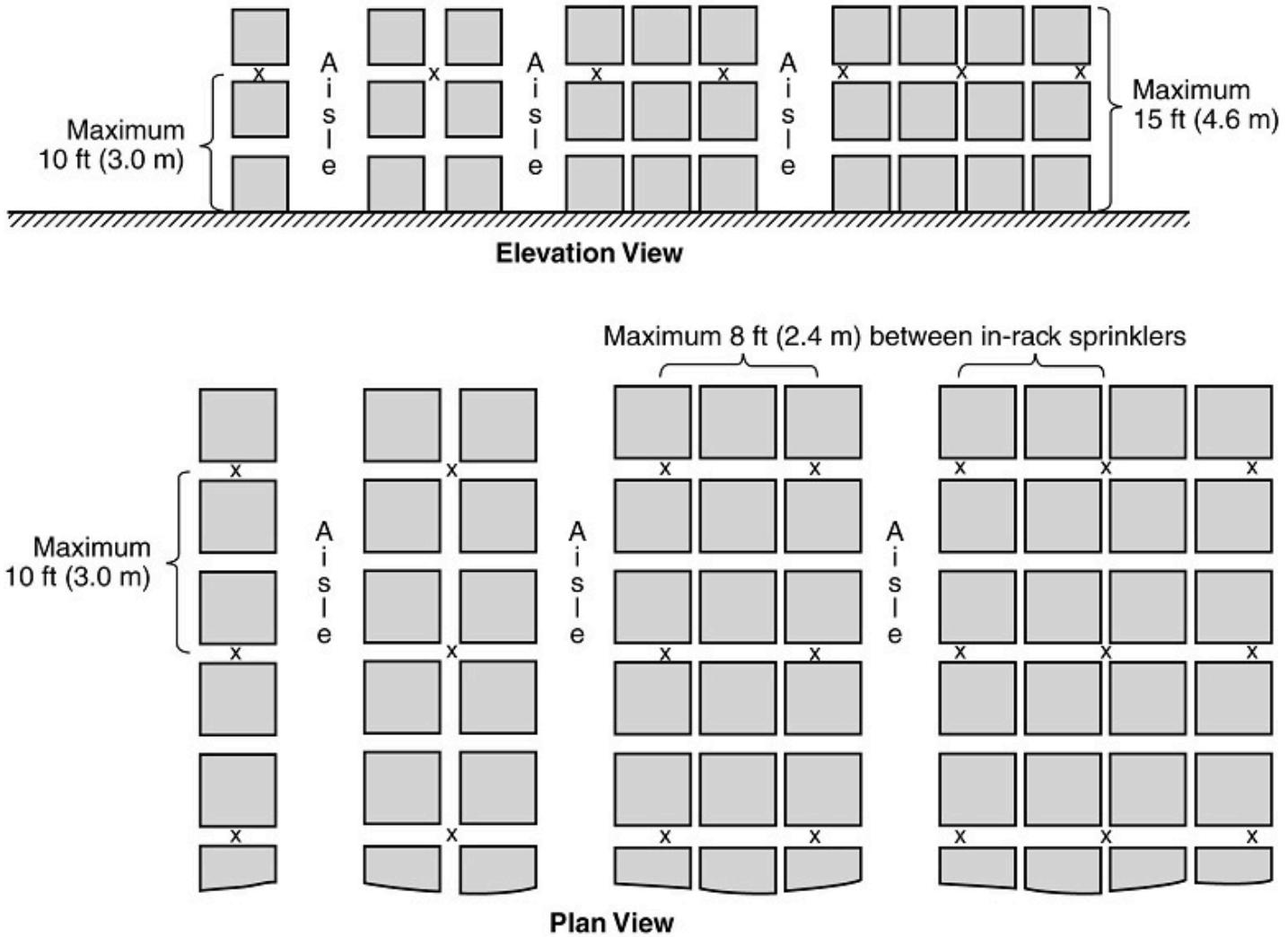
25.4.2.3.1 In-Rack Sprinkler Arrangements and Designs for Cartoned Group A Plastic Commodities Stored Up to and Including 25 ft (7.6 m) in Height.**25.4.2.3.1.1**

Where rack storage of cartoned Group A plastic commodities, encapsulated or nonencapsulated, stored over 5 ft (1.5 m) and up to and including 25 ft (7.6 m) in height will be protected by in-rack sprinklers, in-rack sprinkler arrangements and designs shall be selected from Figure 25.4.2.3.1.1(a) through Figure 25.4.2.3.1.1(g). (See Section 25.3 for racks with solid shelving.)

Figure 25.4.2.3.1.1(a) Ceiling Design Criteria and In-Rack Sprinkler Arrangement and Design Criteria for Cartoned Group A Plastic Commodities Stored to a Maximum Height of 15 ft (4.6 m) Under a Maximum 25 ft (7.6 m) Ceiling in Open Racks.

Ceiling — maximum 25 ft (7.6 m)

0.30 gpm/ft² per 2000 ft²
(12.2 mm/min per 185 m²)

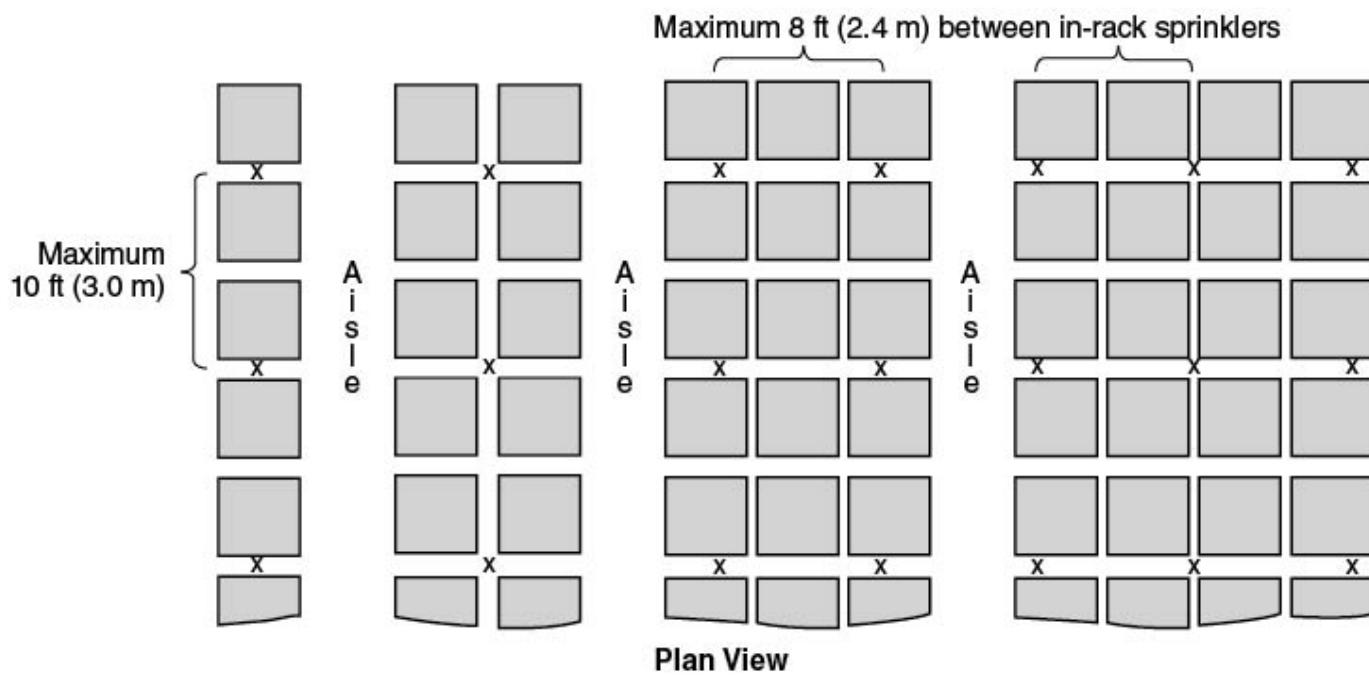
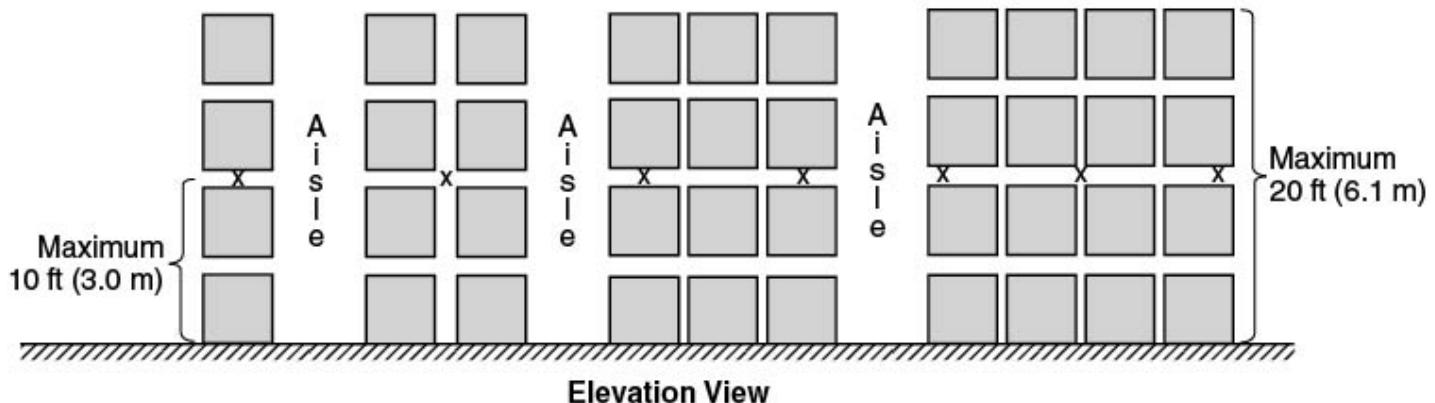
**Notes:**

- (1) In-rack sprinklers are ordinary-temperature-rated, quick-or standard-response, pendant or upright, minimum K-5.6 (K-80), and designed for a minimum of eight (8) in-rack sprinklers operating at 22 gpm (83 L/min).
- (2) The storage height above the top level of in-rack sprinklers is limited to a maximum of 5 ft (1.5 m).
- (3) The symbol X represents in-rack sprinklers.
- (4) Each square represents a storage cube measuring 4 ft to 5 ft (1.2 m to 1.5 m) on a side. Actual load heights can vary from approximately 18 in. (450 mm) to 10 ft (3.0 m). Therefore, there could be as few as one load or as many as six loads between in-rack sprinklers that are spaced 10 ft (3.0 m) apart vertically.

Figure 25.4.2.3.1.1(b) Ceiling Design Criteria and In-Rack Sprinkler Arrangement and Design Criteria for Cartoned Group A Plastic Commodities Stored to a Maximum Height of 20 ft (6.1 m) Under a Maximum 30 ft (9.1 m) Ceiling in Open Racks — Option 1.

Ceiling — maximum 30 ft (9.1 m)

**0.45 gpm/ft² per 2000 ft²
(18.3 mm/min per 185 m²)**

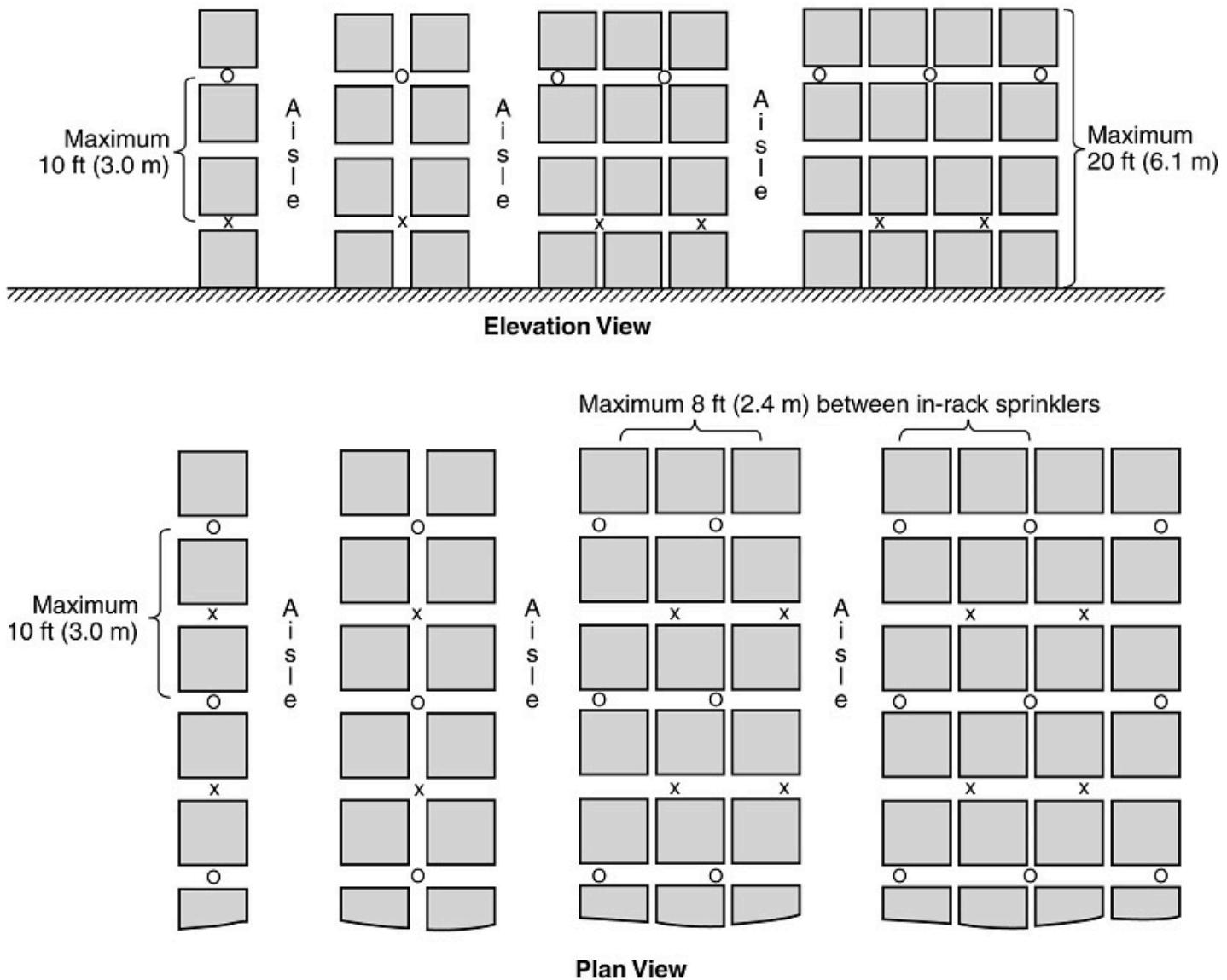
**Notes:**

- (1) In-rack sprinklers are ordinary-temperature-rated, quick-or standard-response, pendent or upright, minimum K-5.6 (K-80), and designed for a minimum of eight (8) in-rack sprinklers operating at 22 gpm (83 L/min).
- (2) The storage height above the top level of in-rack sprinklers is limited to a maximum of 10 ft (3.0 m).
- (3) The symbol X represents in-rack sprinklers.
- (4) Each square represents a storage cube measuring 4 ft to 5 ft (1.2 m to 1.5 m) on a side. Actual load heights can vary from approximately 18 in. (450 mm) to 10 ft (3.0 m). Therefore, there could be as few as one load or as many as six loads between in-rack sprinklers that are spaced 10 ft (3.0 m) apart vertically.

Figure 25.4.2.3.1.1(c) Ceiling Design Criteria and In-Rack Sprinkler Arrangement and Design Criteria for Cartoned Group A Plastic Commodities Stored to a Maximum Height of 20 ft (6.1 m) Under a Maximum 30 ft (9.1 m) Ceiling in Open Racks — Option 2.

Ceiling — maximum 30 ft (9.1 m)

0.30 gpm/ft² per 2000 ft²
(12.2 mm/min per 185 m²)

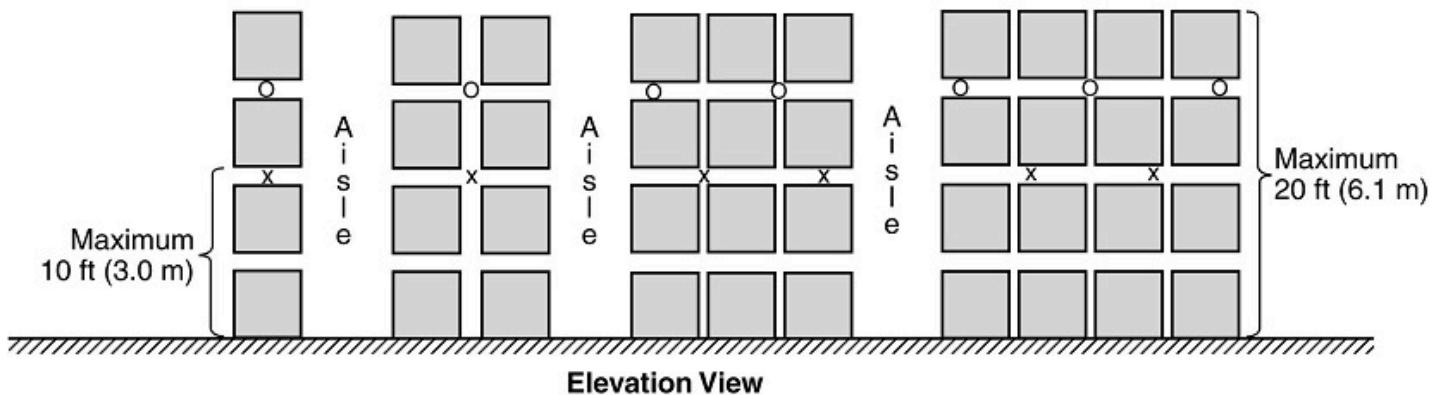
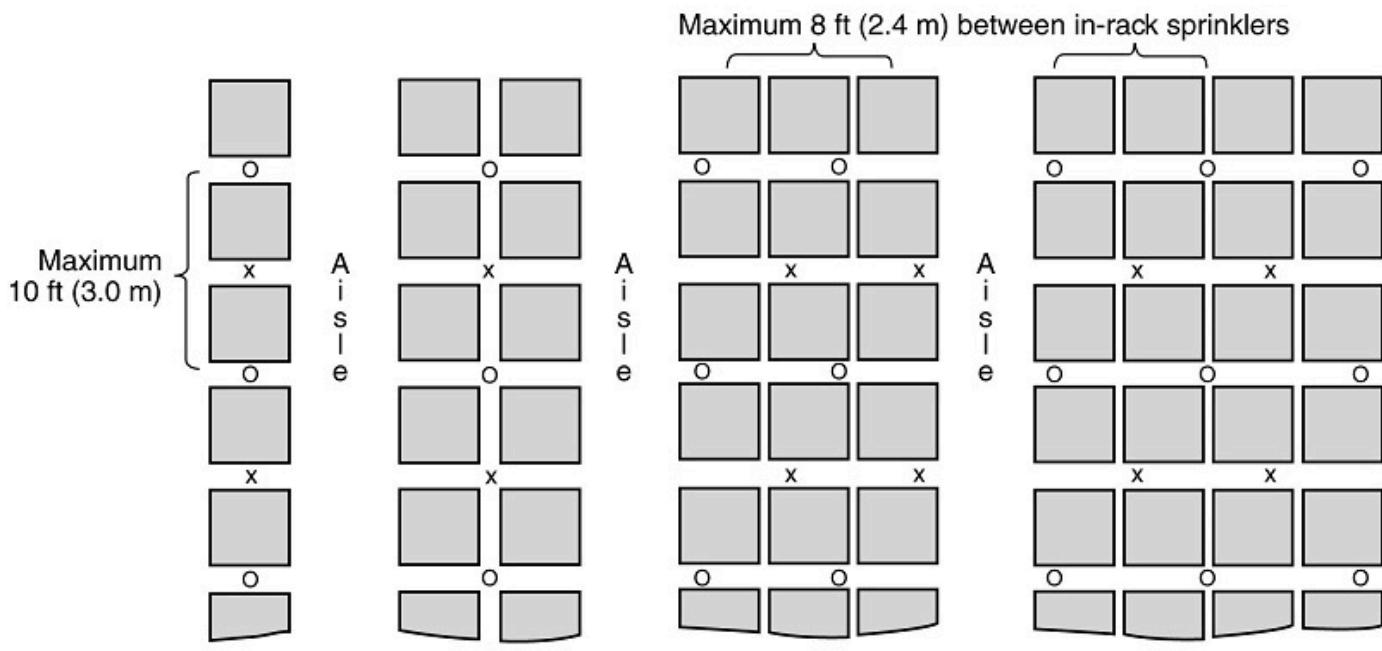
**Notes:**

- (1) In-rack sprinklers are ordinary-temperature-rated, quick-or standard-response, pendent or upright, minimum K-5.6 (K-80), and designed for a minimum of 14 in-rack sprinklers [seven (7) in-rack sprinklers on each level] operating at 22 gpm (83 L/min).
- (2) The storage height above the top level of in-rack sprinklers is limited to a maximum of 5 ft (1.5 m).
- (3) The symbols X and O represent in-rack sprinklers that are staggered both horizontally and vertically.
- (4) Each square represents a storage cube measuring 4 ft to 5 ft (1.2 m to 1.5 m) on a side. Actual load heights can vary from approximately 18 in. (450 mm) to 10 ft (3.0 m). Therefore, there could be as few as one load or as many as six loads between in-rack sprinklers that are spaced 10 ft (3.0 m) apart vertically.

Figure 25.4.2.3.1.1(d) Ceiling Design Criteria and In-Rack Sprinkler Arrangement and Design Criteria for Cartoned Group A Plastic Commodities Stored to a Maximum Height of 20 ft (6.1 m) Under a Maximum 30 ft (9.1 m) Ceiling in Open Racks — Option 3.

Ceiling — maximum 30 ft (9.1 m)

0.30 gpm/ft² per 2000 ft²
(12.2 mm/min per 185 m²)

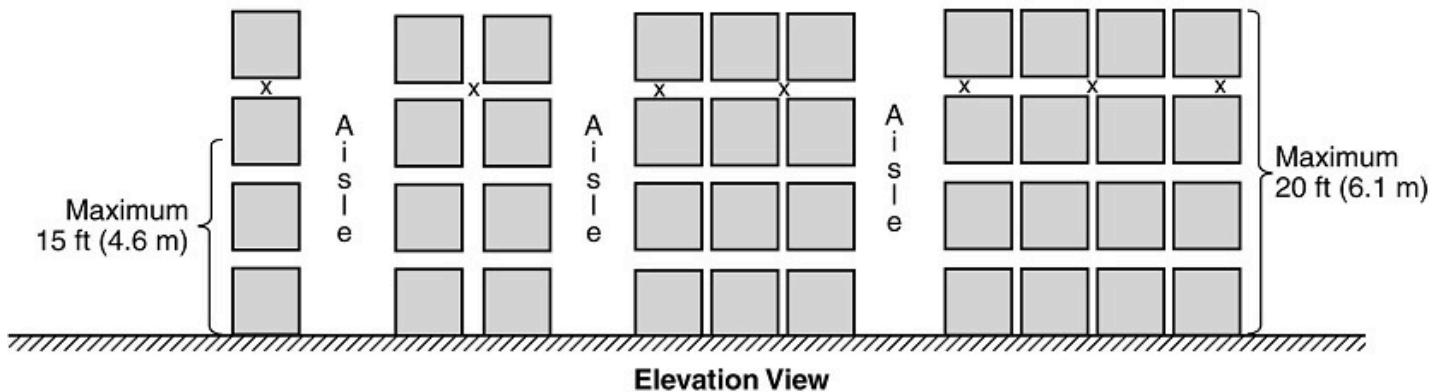
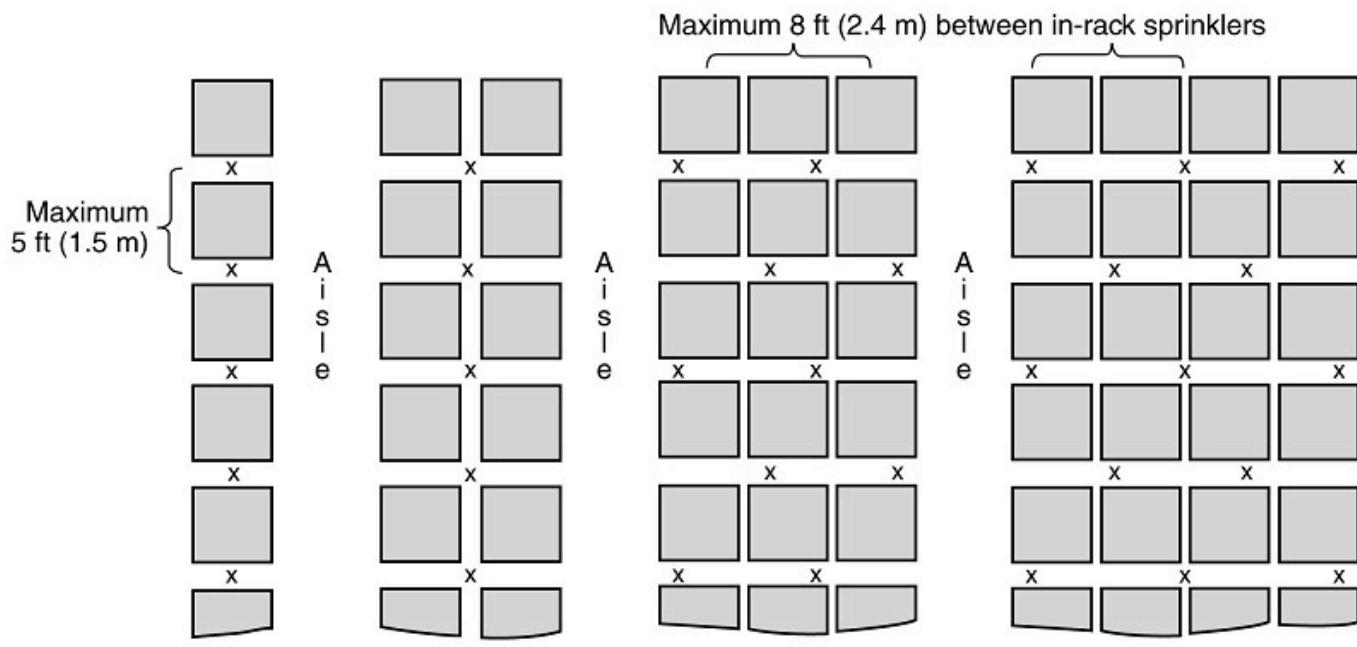
**Elevation View****Plan View****Notes:**

- (1) In-rack sprinklers are ordinary-temperature-rated, quick-or standard-response, pendent or upright, minimum K-5.6 (K-80), and designed for a minimum of 14 in-rack sprinklers [seven (7) in-rack sprinklers on each level] operating at 22 gpm (83 L/min).
- (2) The storage height above the top level of in-rack sprinklers is limited to a maximum of 5 ft (1.5 m).
- (3) The symbols X and O represent in-rack sprinklers that are staggered both horizontally and vertically.
- (4) Each square represents a storage cube measuring 4 ft to 5 ft (1.2 m to 1.5 m) on a side. Actual load heights can vary from approximately 18 in. (450 mm) to 10 ft (3.0 m). Therefore, there could be as few as one load or as many as six loads between in-rack sprinklers that are spaced 10 ft (3.0 m) apart vertically.

Figure 25.4.2.3.1.1(e) Ceiling Design Criteria and In-Rack Sprinkler Arrangement and Design Criteria for Cartoned Group A Plastic Commodities Stored to a Maximum Height of 20 ft (6.1 m) Under a Maximum 30 ft (9.1 m) Ceiling in Open Racks — Option 4.

Ceiling — maximum 30 ft (9.1 m)

0.30 gpm/ft² per 2000 ft²
(12.2 mm/min per 185 m²)

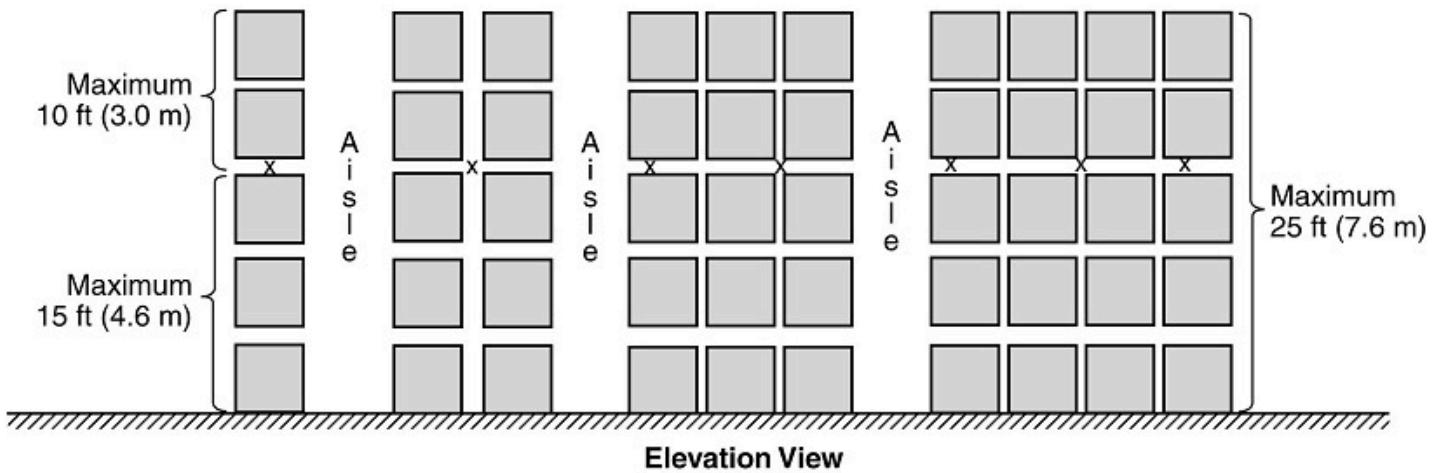
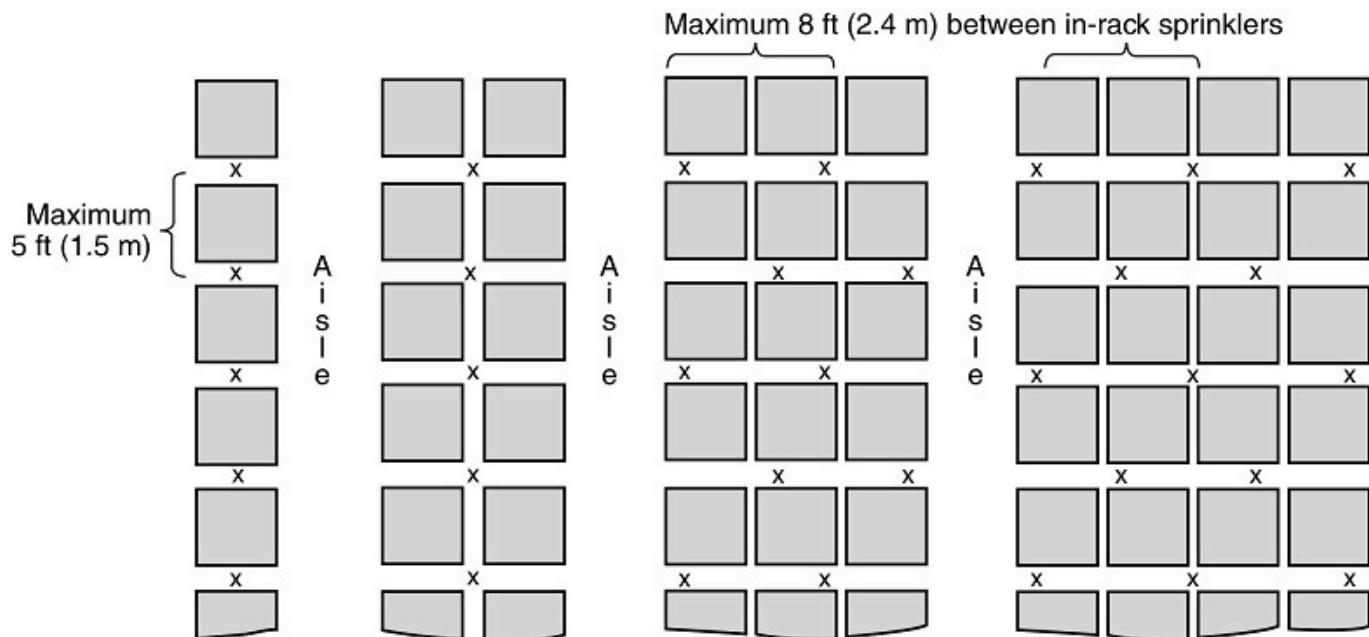
**Elevation View****Plan View****Notes:**

- (1) In-rack sprinklers are ordinary-temperature-rated, quick-or standard-response, pendent or upright, minimum K-5.6 (K-80), and designed for a minimum of eight (8) in-rack sprinklers operating at 30 gpm (114 L/min).
- (2) The storage height above the top level of in-rack sprinklers is limited to a maximum of 5 ft (1.5 m).
- (3) The symbol X represents in-rack sprinklers.
- (4) Each square represents a storage cube measuring 4 ft to 5 ft (1.2 m to 1.5 m) on a side. Actual load heights can vary from approximately 18 in. (450 mm) to 10 ft (3.0 m). Therefore, there could be as few as one load or as many as ten loads between in-rack sprinklers that are spaced 15 ft (4.5 m) apart vertically.

Figure 25.4.2.3.1.1(f) Ceiling Design Criteria and In-Rack Sprinkler Arrangement and Design Criteria for Cartoned Group A Plastic Commodities Stored to a Maximum Height of 25 ft (7.6 m) Under a Maximum 35 ft (10.7 m) Ceiling in Open Racks — Option 1.

Ceiling — maximum 35 ft (10.7 m)

0.45 gpm/ft² per 2000 ft²
(18.3 mm/min per 185 m²)

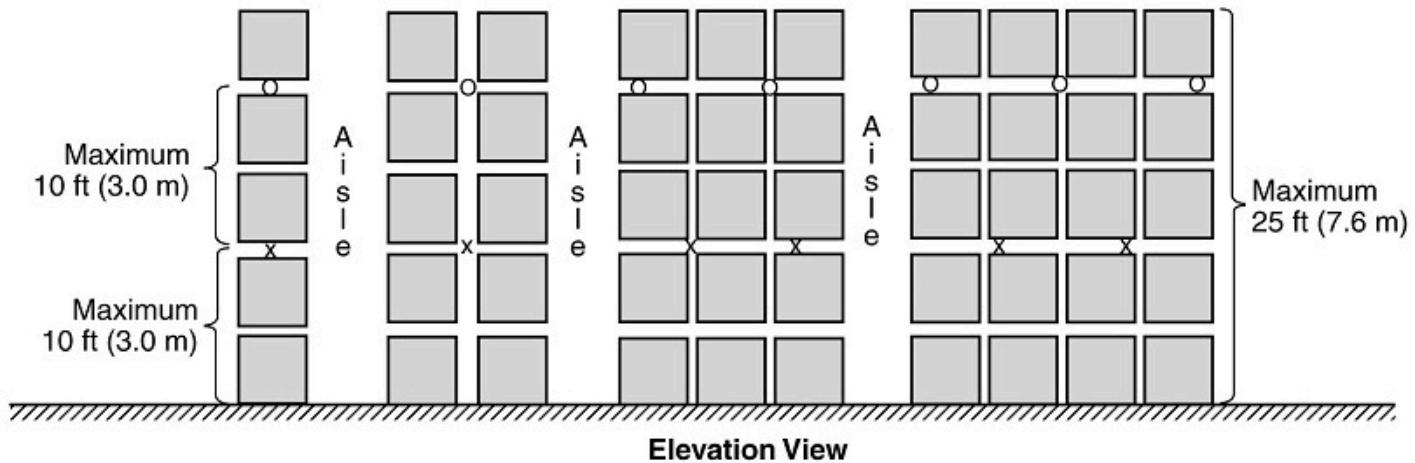
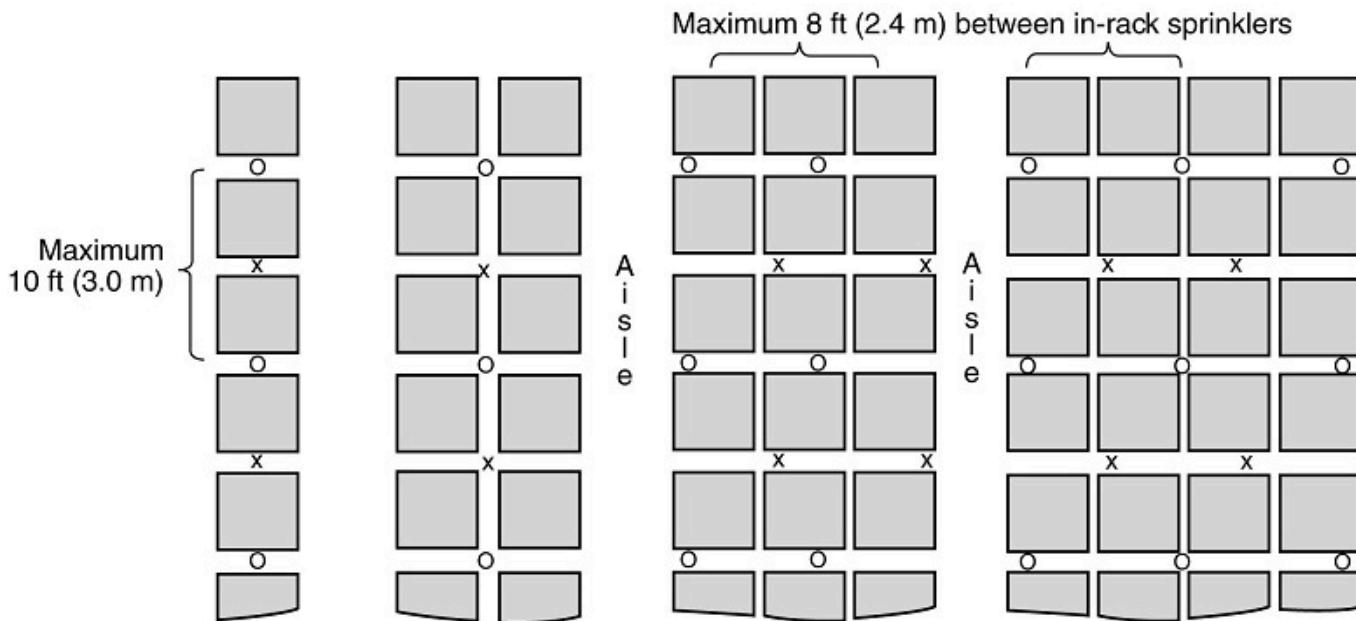
**Elevation View****Plan View****Notes:**

- (1) In-rack sprinklers are ordinary-temperature-rated, quick-or standard-response, pendent or upright, minimum K-5.6 (K-80), and designed for a minimum of eight (8) in-rack sprinklers operating at 30 gpm (114 L/min).
- (2) The storage height above the top level of in-rack sprinklers is limited to a maximum of 10 ft (3.0 m).
- (3) The symbol X represents in-rack sprinklers.
- (4) Each square represents a storage cube measuring 4 ft to 5 ft (1.2 m to 1.5 m) on a side. Actual load heights can vary from approximately 18 in. (450 mm) to 10 ft (3.0 m). Therefore, there could be as few as one load or as many as ten loads between in-rack sprinklers that are spaced 15 ft (4.6 m) apart vertically.

Figure 25.4.2.3.1.1(g) Ceiling Design Criteria and In-Rack Sprinkler Arrangement and Design Criteria for Cartoned Group A Plastic Commodities Stored to a Maximum Height of 25 ft (7.6 m) Under a Maximum 35 ft (10.7 m) Ceiling in Open Racks — Option 2.

Ceiling — maximum 35 ft (10.7 m)

0.30 gpm/ft² per 2000 ft²
(12.2 mm/min per 185 m²)

**Elevation View****Plan View****Notes:**

- (1) In-rack sprinklers are ordinary-temperature-rated, quick-or standard-response, pendent or upright, minimum K-5.6 (K-80), and designed for a minimum of 14 in-rack sprinklers [seven (7) in-rack sprinklers on each level] operating at 22 gpm (83 L/min).
- (2) The storage height above the top level of in-rack sprinklers is limited to a maximum of 5 ft (1.5 m).
- (3) The symbols X and O represent in-rack sprinklers that are staggered both horizontally and vertically.
- (4) Each square represents a storage cube measuring 4 ft to 5 ft (1.2 m to 1.5 m) on a side. Actual load heights can vary from approximately 18 in. (450 mm) to 10 ft (3.0 m). Therefore, there could be as few as one load or as many as six loads between in-rack sprinklers that are spaced 10 ft (3.0 m) apart vertically.

25.4.2.3.1.2 *

Any notes provided in Figure 25.4.2.3.1(a) through Figure 25.4.2.3.1(g) shall be permitted to clarify options.

25.4.2.3.2 CMDA Ceiling-Level Sprinkler Designs for Cartoned Group A Plastic Commodities Stored Up to and Including 25 ft (7.6 m) in Height in Combination with In-Rack Sprinklers.

25.4.2.3.2.1

For single-, double-, and multiple-row rack storage of cartoned Group A plastic commodities, encapsulated or nonencapsulated, stored over 5 ft (1.5 m) and up to and including 25 ft (7.6 m) in height, the ceiling-level sprinkler design in terms of density [gpm/ft² (mm/min)] and area of sprinkler operation [ft² (m²) of ceiling or roof sprinklers] with the provision of in-rack sprinklers shall be in accordance with Figure 25.4.2.3.1.1(a) through Figure 25.4.2.3.1.1(g).

25.4.2.3.2.2

Linear interpolation of design densities and areas shall be permitted between storage heights with the same ceiling height.

25.4.2.3.2.3

No interpolation between ceiling heights shall be permitted.

25.4.2.3.2.4 Clearance.**(A)**

The ceiling-level sprinkler design obtained from Figure 25.4.2.3.1.1(a) through Figure 25.4.2.3.1.1(g) shall be based on a maximum clearance from top of storage to ceiling of 10 ft (3.0 m).

(B)

Where the clearance of 25.4.2.3.2.4(A) exceeds 10 ft (3.0 m), one of the following two options shall be implemented:

- (1) The ceiling design shall be determined from Figure 25.4.2.3.1.1(a) through Figure 25.4.2.3.1.1(g) using a theoretical storage height that results in a clearance to ceiling of 10 ft (3.0 m).
- (2) If not already provided, the in-rack sprinkler arrangement shall be supplemented with one level of quick-response in-rack sprinklers located directly below the top tier level of storage and at every flue space intersection.

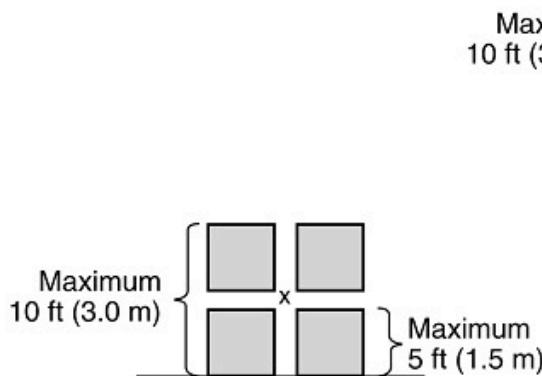
25.4.2.4 Exposed Nonexpanded Group A Plastic Commodities.**25.4.2.4.1 * In-Rack Sprinkler Arrangements and Designs for Exposed Nonexpanded Group A Plastic Commodities Stored Up to and Including 25 ft (7.6 m) in Height.**

Where rack storage of exposed nonexpanded Group A plastic commodities, encapsulated or nonencapsulated, stored over 5 ft (1.5 m) and up to and including 25 ft (7.6 m) in height will be protected by in-rack sprinklers, in-rack sprinkler arrangements and designs shall be selected from Figure 25.4.2.4.1(a) through Figure 25.4.2.4.1(e). (See Section 25.3 for racks with solid shelving.)

Figure 25.4.2.4.1(a) In-Rack Sprinkler Arrangement and Design, Exposed Nonexpanded Group A Plastic Commodities Up to 10 ft (3.0 m) in Height in Up to a 20 ft (6.1 m) High Building.

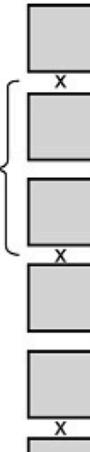
Option 1: Ceiling — maximum 20 ft (6.1 m)

0.45 gpm/ft² over 2000 ft²
(18.3 mm/min over 185 m²)

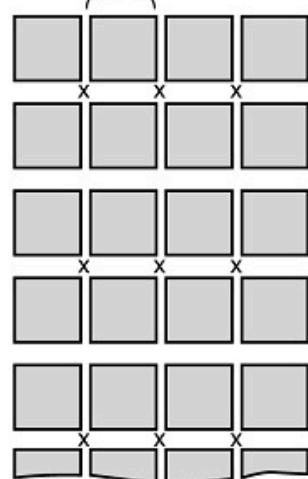
**Elevation View**

Maximum
10 ft (3.0 m)

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**Plan View**

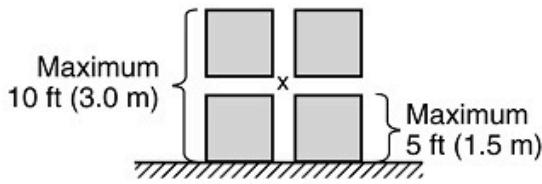
Maximum 5 ft (1.5 m)
50 ft² (4.6 m²)

**Notes:**

- (1) In-rack sprinklers are ordinary-temperature-rated, quick- or standard-response, pendent or upright, minimum K-5.6 (K-80), and designed for a minimum of eight in-rack sprinklers operating at 30 gpm (114 L/min).
- (2) The symbol X represents in-rack sprinklers.
- (3) Each square represents a storage cube measuring 4 ft to 5 ft (1.2 m to 1.5 m) on a side. Actual load heights can vary from approximately 18 in. to 5 ft (450 mm to 1.5 m). Therefore, there could be as few as one load or as many as three loads between in-rack sprinklers that are spaced 5 ft (1.5 m) apart vertically.

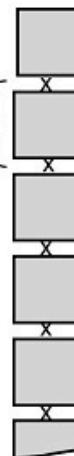
Option 2: Ceiling — maximum 20 ft (6.1 m)

0.30 gpm/ft² over 2000 ft²
(12.2 mm/min over 185 m²)

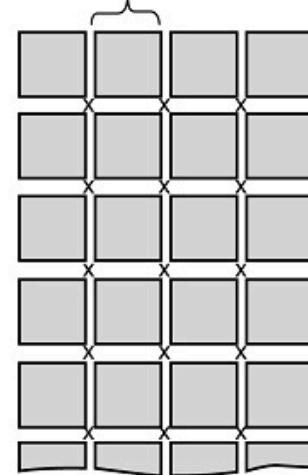
**Elevation View**

Maximum
5 ft (1.5 m)

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**Plan View**

Maximum 5 ft (1.5 m)
25 ft² (2.3 m²)

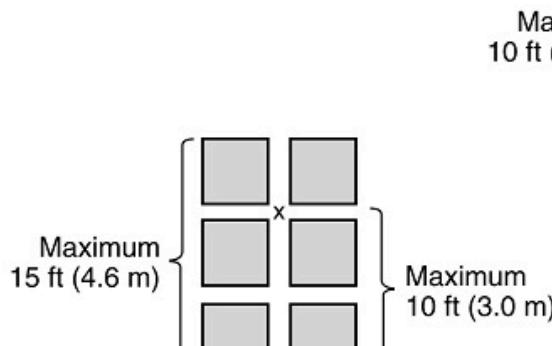
**Notes:**

- (1) In-rack sprinklers are ordinary-temperature-rated, quick- or standard-response, pendent or upright, minimum K-5.6 (K-80), and designed for a minimum of eight in-rack sprinklers operating at 30 gpm (114 L/min).
- (2) The symbol X represents in-rack sprinklers.
- (3) Each square represents a storage cube measuring 4 ft to 5 ft (1.2 m to 1.5 m) on a side. Actual load heights can vary from approximately 18 in. to 5 ft (450 mm to 1.5 m). Therefore, there could be as few as one load or as many as three loads between in-rack sprinklers that are spaced 5 ft (1.5 m) apart vertically.

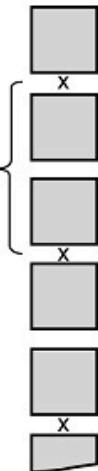
Figure 25.4.2.4.1(b) In-Rack Sprinkler Arrangement and Design, Exposed Nonexpanded Group A Plastic Commodities Up to 15 ft (4.6 m) in Height in Up to a 25 ft (7.6 m) High Building.

Option 1: Ceiling — maximum 25 ft (7.6 m)

0.45 gpm/ft² over 2000 ft²
(18.3 mm/min over 185 m²)

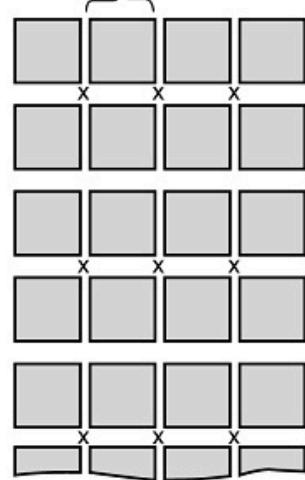
**Elevation View**

Maximum
10 ft (3.0 m)



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Maximum 5 ft (1.5 m)
50 ft² (4.6 m²)



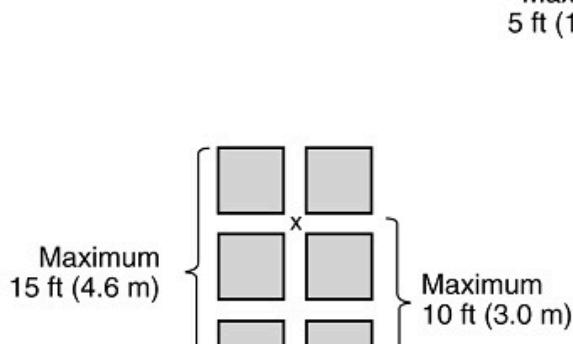
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Plan View**Notes:**

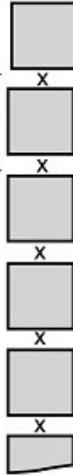
- (1) In-rack sprinklers are ordinary-temperature-rated, quick- or standard-response, pendent or upright, minimum K-5.6 (K-80), and designed for a minimum of eight in-rack sprinklers operating at 30 gpm (114 L/min).
- (2) The symbol X represents in-rack sprinklers.
- (3) Each square represents a storage cube measuring 4 ft to 5 ft (1.2 m to 1.5 m) on a side. Actual load heights can vary from approximately 18 in. to 10 ft (450 mm to 3.0 m). Therefore, there could be as few as one load or as many as six loads between in-rack sprinklers that are spaced 10 ft (3.0 m) apart vertically.

Option 2: Ceiling — maximum 25 ft (7.6 m)

0.30 gpm/ft² over 2000 ft²
(12.2 mm/min over 185 m²)

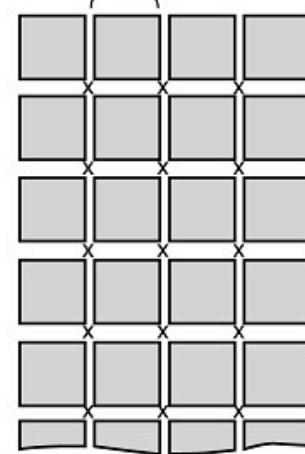
**Elevation View**

Maximum
5 ft (1.5 m)



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Maximum 5 ft (1.5 m)
25 ft² (2.3 m²)



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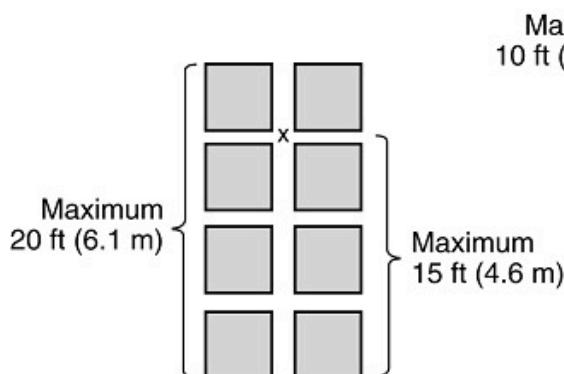
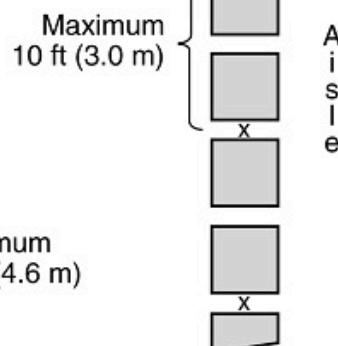
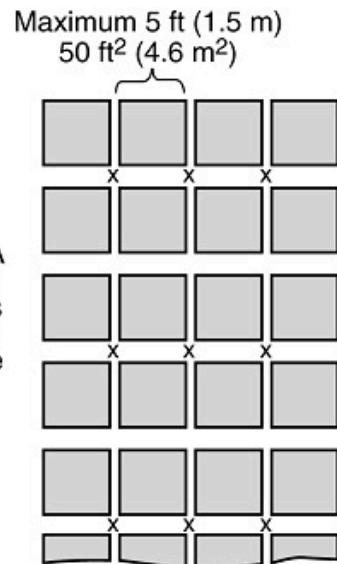
Plan View**Notes:**

- (1) In-rack sprinklers are ordinary-temperature-rated, quick- or standard-response, pendent or upright, minimum K-5.6 (K-80), and designed for a minimum of eight in-rack sprinklers operating at 30 gpm (114 L/min).
- (2) The symbol X represents in-rack sprinklers.
- (3) Each square represents a storage cube measuring 4 ft to 5 ft (1.2 m to 1.5 m) on a side. Actual load heights can vary from approximately 18 in. to 10 ft (450 mm to 3.0 m). Therefore, there could be as few as one load or as many as six loads between in-rack sprinklers that are spaced 10 ft (3.0 m) apart vertically.

Figure 25.4.2.4.1(c) In-Rack Sprinkler Arrangement and Design, Exposed Nonexpanded Group A Plastic Commodities Up to 20 ft (6.1 m) in Height in Up to a 25 ft (7.6 m) High Building.

Option 1: Ceiling — maximum 25 ft (7.6 m)

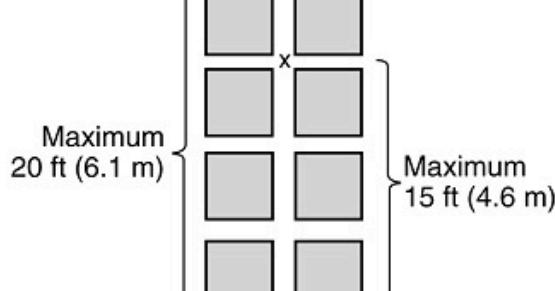
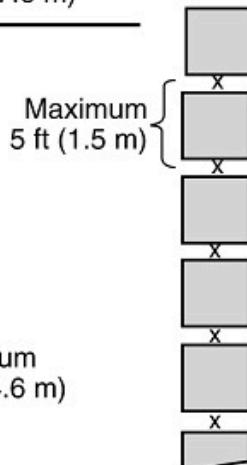
0.60 gpm/ft² over 2000 ft²
(24.5 mm/min over 185 m²)

**Elevation View****Plan View****Notes:**

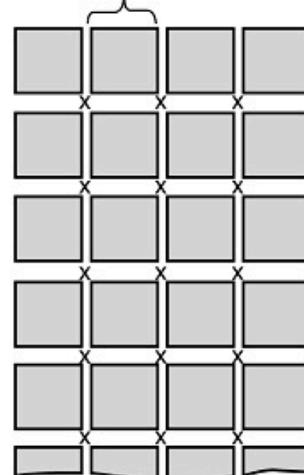
- (1) In-rack sprinklers are ordinary-temperature-rated, quick- or standard-response, pendent or upright, minimum K-5.6 (K-80), and designed for a minimum of eight in-rack sprinklers operating at 30 gpm (114 L/min).
- (2) The symbol X represents in-rack sprinklers.
- (3) Each square represents a storage cube measuring 4 ft to 5 ft (1.2 m to 1.5 m) on a side. Actual load heights can vary from approximately 18 in. to 10 ft (450 mm to 3.0 m). Therefore, there could be as few as one load or as many as 10 loads between in-rack sprinklers that are spaced 15 ft (4.6 m) apart vertically.

Option 2: Ceiling — maximum 25 ft (7.6 m)

0.45 gpm/ft² over 2000 ft²
(18.3 mm/min over 185 m²)

**Elevation View****Plan View**

Maximum 5 ft (1.5 m)
25 ft² (2.3 m²)

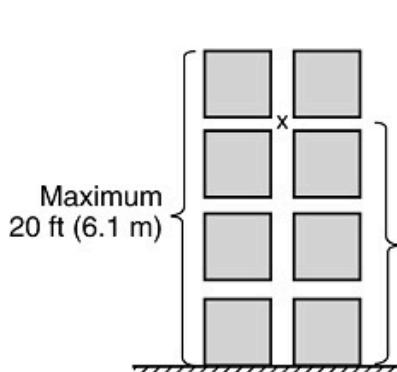
**Notes:**

- (1) In-rack sprinklers are ordinary-temperature-rated, quick- or standard-response, pendent or upright, minimum K-5.6 (K-80), and designed for a minimum of eight in-rack sprinklers operating at 30 gpm (114 L/min).
- (2) The symbol X represents in-rack sprinklers.
- (3) Each square represents a storage cube measuring 4 ft to 5 ft (1.2 m to 1.5 m) on a side. Actual load heights can vary from approximately 18 in. to 10 ft (450 mm to 3.0 m). Therefore, there could be as few as one load or as many as 10 loads between in-rack sprinklers that are spaced 15 ft (4.6 m) apart vertically.

Figure 25.4.2.4.1(d) In-Rack Sprinkler Arrangement and Design, Exposed Nonexpanded Group A Plastic Commodities Up to 20 ft (6.1 m) in Height in Up to a 30 ft (9.1 m) High Building.

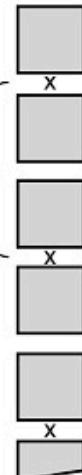
Option 1: Ceiling — maximum 30 ft (9.1 m)

0.80 gpm/ft² over 1500 ft²
(32.6 mm/min over 140 m²)

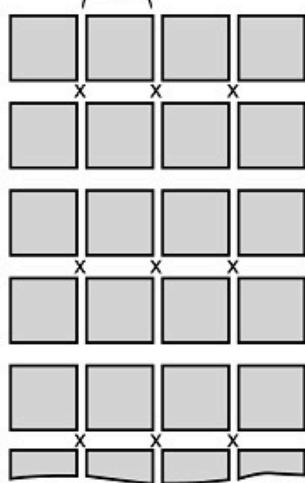
**Elevation View**

Maximum
10 ft (3.0 m)

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**Plan View**

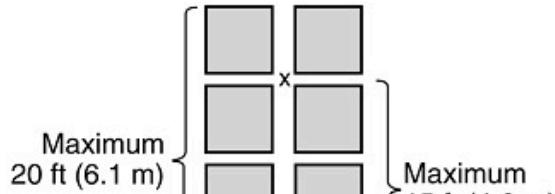
Maximum 5 ft (1.5 m)
50 ft² (4.6 m²)

**Notes:**

- (1) In-rack sprinklers are ordinary-temperature-rated, quick- or standard-response, pendent or upright, minimum K-5.6 (K-80), and designed for a minimum of eight in-rack sprinklers operating at 30 gpm (114 L/min) when one level of in-rack sprinklers is installed or a minimum of 14 in-rack sprinklers (seven in-rack sprinklers on each level) operating at 30 gpm (114 L/min) when more than one level of in-rack sprinklers are installed.
- (2) The symbol X represents in-rack sprinklers.
- (3) Each square represents a storage cube measuring 4 ft to 5 ft (1.2 m to 1.5 m) on a side. Actual load heights can vary from approximately 18 in. to 10 ft (450 mm to 3.0 m). Therefore, there could be as few as one load or as many as 10 loads between in-rack sprinklers that are spaced 15 ft (4.6 m) apart vertically.

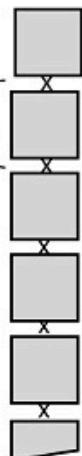
Option 2: Ceiling — maximum 30 ft (9.1 m)

0.60 gpm/ft² over 1500 ft²
(24.5 mm/min over 140 m²)

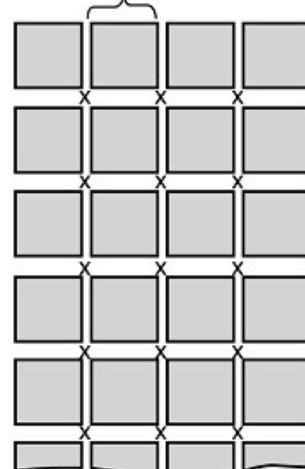
**Elevation View**

Maximum
5 ft (1.5 m)

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**Plan View**

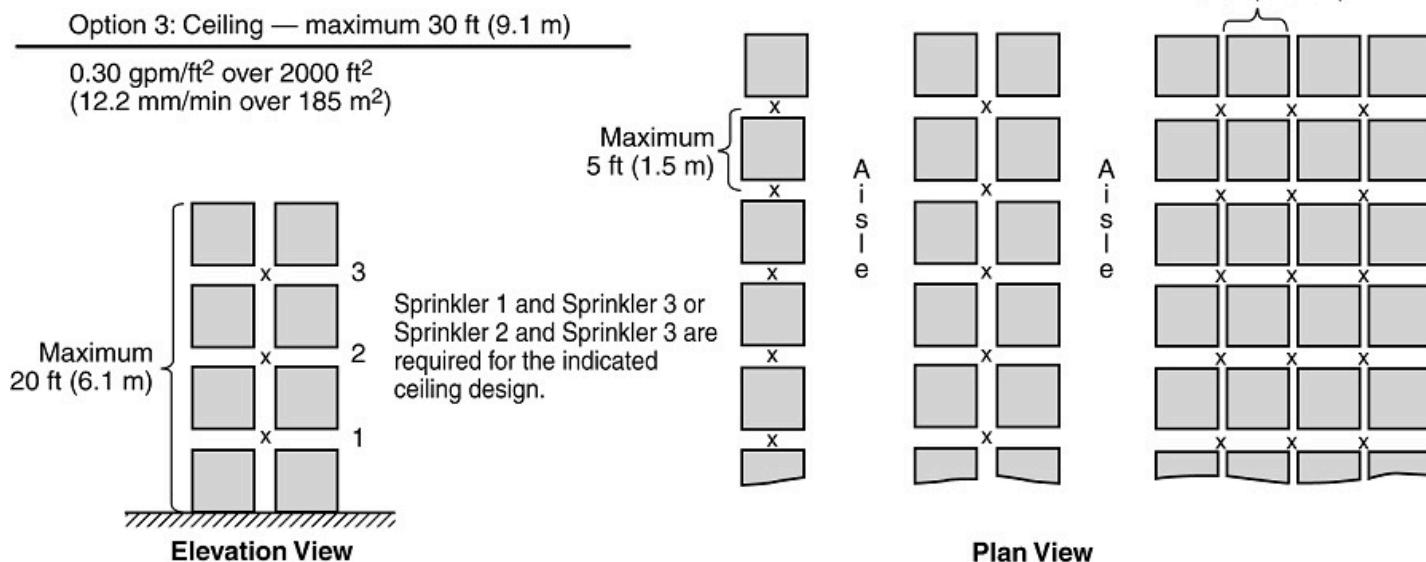
Maximum 5 ft (1.5 m)
25 ft² (2.3 m²)

**Notes:**

- (1) In-rack sprinklers are ordinary-temperature-rated, quick- or standard-response, pendent or upright, minimum K-5.6 (K-80), and designed for a minimum of eight in-rack sprinklers operating at 30 gpm (114 L/min) when one level of in-rack sprinklers is installed or a minimum of 14 in-rack sprinklers (seven in-rack sprinklers on each level) operating at 30 gpm (114 L/min) when more than one level of in-rack sprinklers is installed.
- (2) The symbol X represents in-rack sprinklers.
- (3) Each square represents a storage cube measuring 4 ft to 5 ft (1.2 m to 1.5 m) on a side. Actual load heights can vary from approximately 18 in. to 10 ft (450 mm to 3.0 m). Therefore, there could be as few as one load or as many as 10 loads between in-rack sprinklers that are spaced 15 ft (4.6 m) apart vertically.

heights can vary from approximately 18 in. to 10 ft (450 mm to 3.0 m). Therefore, there could be as few as one load or as many as 10 loads between in-rack sprinklers that are spaced 15 ft (4.6 m) apart vertically.

Maximum 5 ft (1.5 m)
25 ft² (2.3 m²)



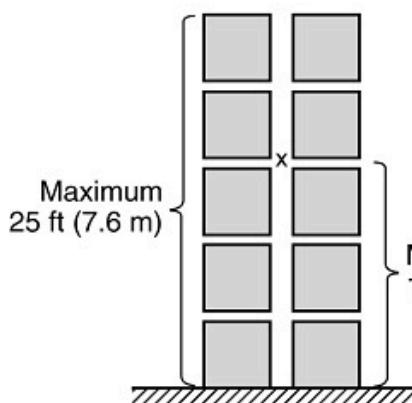
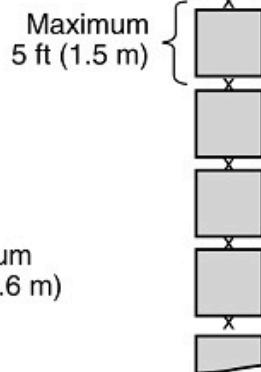
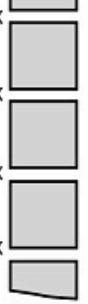
Notes:

- (1) In-rack sprinklers are ordinary-temperature-rated, quick- or standard-response, pendent or upright, minimum K-5.6 (K-80), and designed for a minimum of eight in-rack sprinklers operating at 30 gpm (114 L/min) when one level of in-rack sprinklers is installed or a minimum of 14 in-rack sprinklers (seven in-rack sprinklers on each level) operating at 30 gpm (114 L/min) when more than one level of in-rack sprinklers are installed.
- (2) The symbol X represents in-rack sprinklers.
- (3) Each square represents a storage cube measuring 4 ft to 5 ft (1.2 m to 1.5 m) on a side. Actual load heights can vary from approximately 18 in. to 10 ft (450 mm to 3.0 m). Therefore, there could be as few as one load or as many as 10 loads between in-rack sprinklers that are spaced 15 ft (4.6 m) apart vertically.

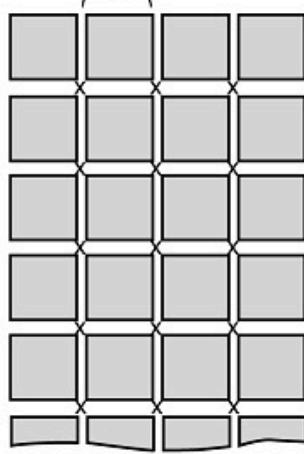
Figure 25.4.2.4.1(e) In-Rack Sprinkler Arrangement and Design, Exposed Nonexpanded Group A Plastic Commodities Up to 25 ft (7.6 m) in Height in Up to a 35 ft (10.7 m) High Building.

Option 1: Ceiling — maximum 35 ft (10.7 m)

0.80 gpm/ft² over 1500 ft²
(32.6 mm/min over 140 m²)

**Elevation View****A
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Maximum 5 ft (1.5 m)
25 ft² (2.3 m²)

**A
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e****Plan View****Notes:**

- (1) In-rack sprinklers are ordinary-temperature-rated, quick- or standard-response, pendent or upright, minimum K-5.6 (K-80), and designed for a minimum of eight in-rack sprinklers operating at 30 gpm (114 L/min) when one level of in-rack sprinklers is installed.
- (2) The symbol X represents in-rack sprinklers.
- (3) Each square represents a storage cube measuring 4 ft to 5 ft (1.2 m to 1.5 m) on a side. Actual load heights can vary from approximately 18 in. to 10 ft (450 mm to 3.0 m). Therefore, there could be as few as one load or as many as 10 loads between in-rack sprinklers that are spaced 15 ft (4.6 m) apart vertically.

Option 2: Ceiling — maximum 35 ft (10.7 m)

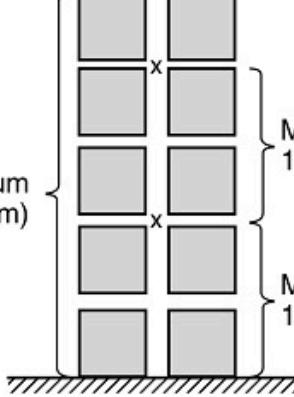
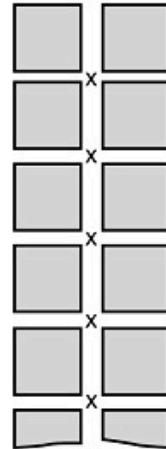
0.30 gpm/ft² over 2000 ft²
(12.2 mm/min over 185 m²)

Maximum 25 ft (7.6 m)

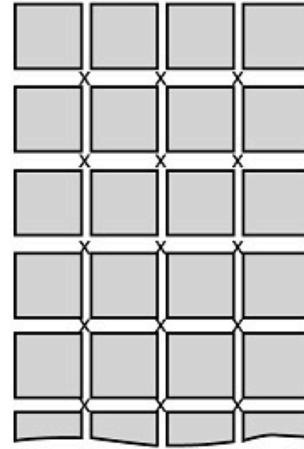
Maximum 5 ft (1.5 m)

Maximum 10 ft (3.0 m)

Maximum 10 ft (3.0 m)

**Elevation View****A
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Maximum 5 ft (1.5 m)
25 ft² (2.3 m²)

**A
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s
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e****Plan View****Notes:**

- (1) In-rack sprinklers are ordinary-temperature-rated, quick- or standard-response, pendent or upright, minimum K-5.6 (K-80), and designed for a minimum of 14 in-rack sprinklers (seven in-rack sprinklers on each level) operating at 30 gpm (114 L/min) when one level of in-rack sprinklers is installed.
- (2) The symbol X represents in-rack sprinklers.
- (3) Each square represents a storage cube measuring 4 ft to 5 ft (1.2 m to 1.5 m) on a side. Actual load heights can vary from approximately 18 in. to 10 ft (450 mm to 3.0 m). Therefore, there could be as few as one load or as many as six loads between in-rack sprinklers that are spaced 10 ft (3.0 m) apart vertically.

25.4.2.4.2 CMDA Ceiling-Level Sprinkler Designs for Exposed Nonexpanded Group A Plastic Commodities Stored Up to and Including 25 ft (7.6 m) in Height in Combination with In-Rack Sprinklers.**25.4.2.4.2.1**

For single-, double-, and multiple-row rack storage of exposed nonexpanded Group A plastic commodities, encapsulated or nonencapsulated, stored over 5 ft (1.5 m) and up to and including 25 ft (7.6 m) in height, the ceiling-level sprinkler design in terms of density [gpm/ft² (mm/min)] and area of sprinkler operation [ft² (m²) of ceiling or roof sprinklers] with the provision of in-rack sprinklers shall be in accordance with Figure 25.4.2.4.1(a) through Figure 25.4.2.4.1(e).

25.4.2.4.2.2 Clearance.**(A)**

The ceiling-level sprinkler design obtained from Figure 25.4.2.4.1(a) through Figure 25.4.2.4.1(e) shall be based on a maximum clearance from top of storage to ceiling of 10 ft (3.0 m).

(B)

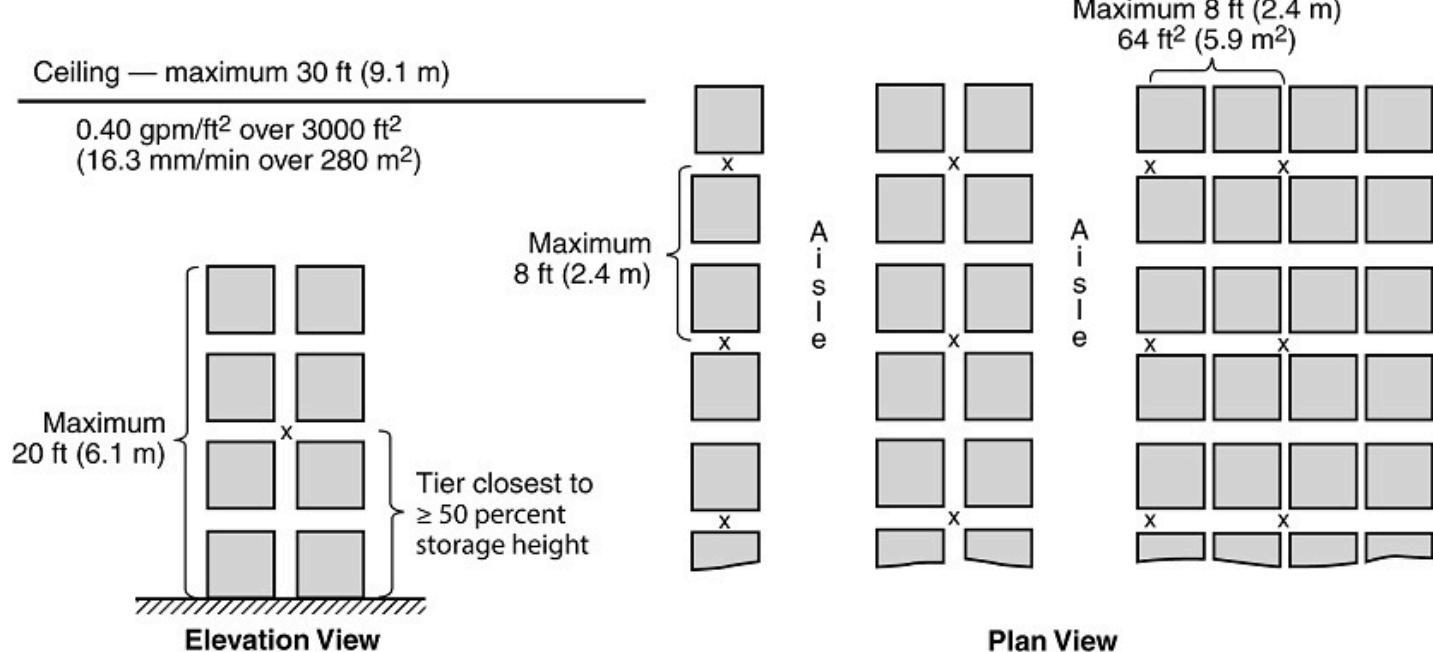
Where the clearance of 25.4.2.4.2.2(A) exceeds 10 ft (3.0 m), one of the following two options shall be implemented:

- (1) The ceiling design shall be determined from Figure 25.4.2.4.1(a) through Figure 25.4.2.4.1(e) using a theoretical storage height that results in a clearance to ceiling of 10 ft (3.0 m).
- (2) If not already provided, the in-rack sprinkler arrangement shall be supplemented with one level of quick-response in-rack sprinklers located directly below the top tier level of storage and at every flue space intersection.

25.4.2.5 Rubber Tire Commodities.**25.4.2.5.1 In-Rack Sprinkler Arrangements for Rubber Tire Commodities Stored Up to and Including 20 ft (6.1 m) in Height.**

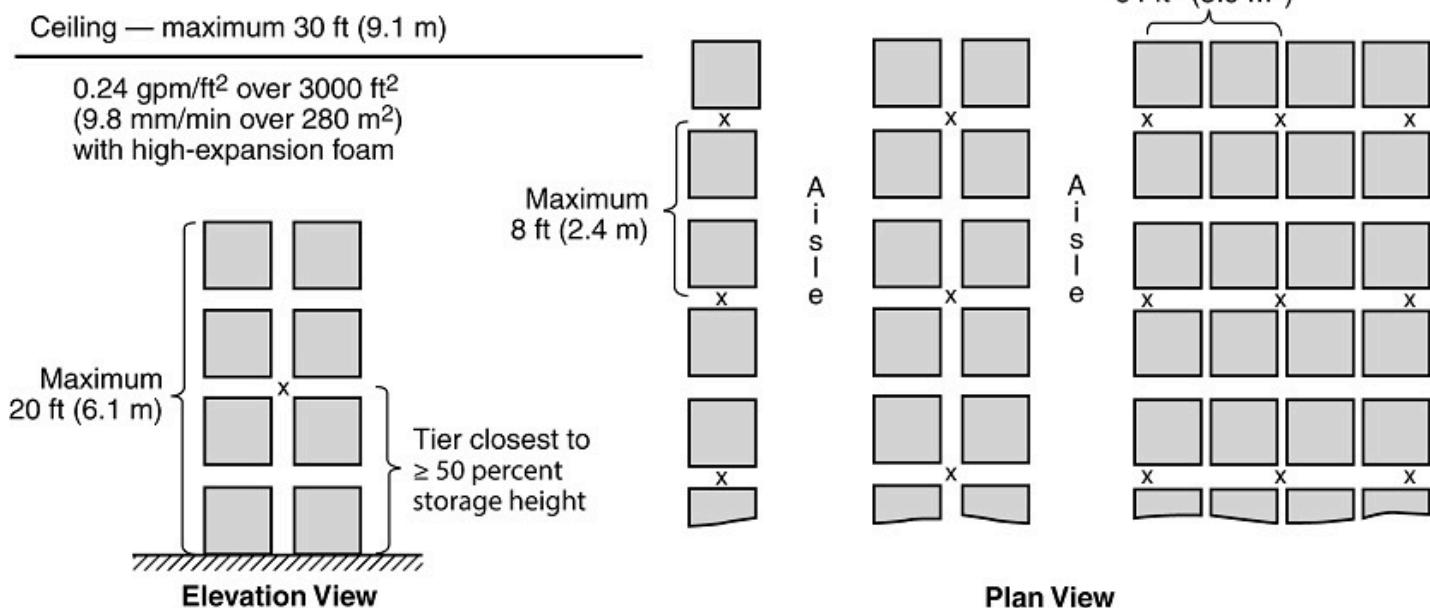
Where rack storage of rubber tires stored over 12 ft (3.7 m) and up to and including 20 ft (6.1 m) in height will be protected by in-rack sprinklers, in-rack sprinkler arrangements and designs shall be selected from Figure 25.4.2.5.1(a) and Figure 25.4.2.5.1(b). (See Section 25.3 for racks with solid shelving.)

Figure 25.4.2.5.1(a) In-Rack Sprinkler Arrangement and Design, Rubber Tires on Pallets, Either On-Side or On-Tread, Up to 20 ft (6.1 m) in Height in Up to a 30 ft (9.1 m) High Building.

**Notes:**

- (1) In-rack sprinklers are ordinary-temperature-rated, quick- or standard-response, pendent or upright, minimum K-5.6 (K-80), and designed for a minimum of 12 in-rack sprinklers operating at 30 gpm (114 L/min).
- (2) The symbol X represents in-rack sprinklers.
- (3) Each square represents a storage cube measuring 4 ft to 5 ft (1.2 m to 1.5 m) on a side.

Figure 25.4.2.5.1(b) In-Rack Sprinkler Arrangement and Design Supplemented with High-Expansion Foam, Rubber Tires on Pallets, Either On-Side or On-Tread, Up to 20 ft (6.1 m) in Height in Up to a 30 ft (9.1 m) High Building.

**Notes:**

- (1) In-rack sprinklers are ordinary-temperature-rated, quick- or standard-response, pendent or upright, minimum K-5.6 (K-80), and designed for a minimum of 12 in-rack sprinklers operating at 30 gpm (114 L/min).
- (2) The symbol X represents in-rack sprinklers.
- (3) Each square represents a storage cube measuring 4 ft to 5 ft (1.2 m to 1.5 m) on a side.

25.4.2.5.2 CMDA Ceiling-Level Sprinkler Designs for Rubber Tire Commodities Stored Up to and Including 20 ft (6.1 m) in Height in Combination with In-Rack Sprinklers.**25.4.2.5.2.1**

For single-, double-, and multiple-row rack storage of rubber tires stored over 12 ft (3.7 m) and up to and including 20 ft (6.1 m) in height, the ceiling-level sprinkler design in terms of density [gpm/ft² (mm/min)] and area of sprinkler operation [ft² (m²) of ceiling or roof sprinklers] with the provision of in-rack sprinklers shall be in accordance with Figure 25.4.2.5.1(a) and Figure 25.4.2.5.1(b). (See A.21.7.)

25.4.2.5.2.2 Clearance.**(A)**

The ceiling-level sprinkler design obtained from Figure 25.4.2.5.1(a) and Figure 25.4.2.5.1(b) shall be based on a maximum clearance from top of storage to ceiling of 10 ft (3.0 m).

(B)

Where the clearance of 25.4.2.5.2.2(A) exceeds 10 ft (3.0 m), one of the following two options shall be implemented.

- (1) The ceiling design shall be determined from Figure 25.4.2.5.1(a) and Figure 25.4.2.5.1(b) using a theoretical storage height that results in a clearance to ceiling of 10 ft (3.0 m).
- (2) If not already provided, the in-rack sprinkler arrangement shall be supplemented with one level of quick-response in-rack sprinklers located directly below the top tier level of storage and at every flue space intersection.

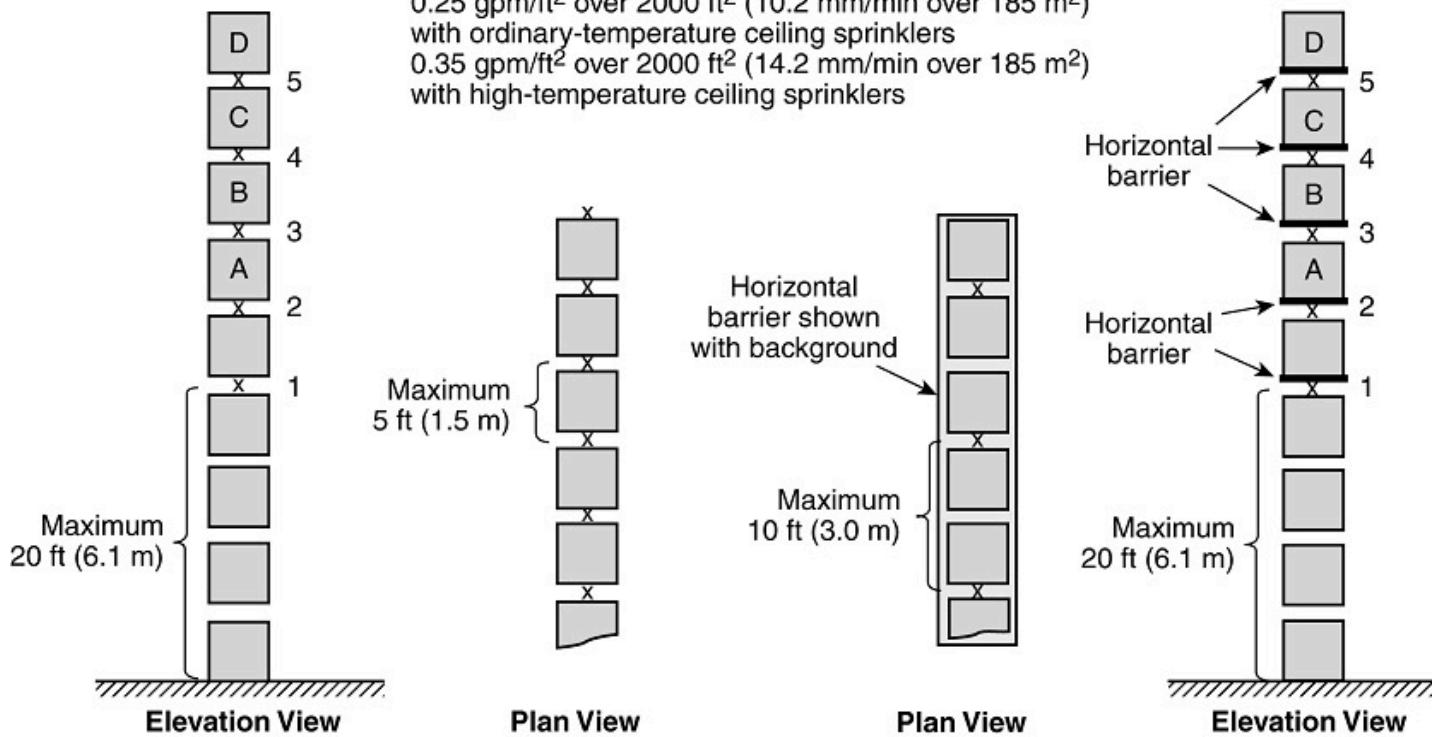
25.4.2.5.2.3

The minimum water supply requirements for a hydraulically designed ceiling and in-rack sprinkler system, including foam systems (if provided), shall be determined by adding the hose stream allowance from Table 20.15.2.6 to the water demand for sprinklers.

25.4.3 Rack Storage Arrangements with Storage Heights Over 25 ft (7.6 m).**25.4.3.1 Exposed Nonencapsulated Class I, Class II, Class III, or Class IV Commodities.****25.4.3.1.1 In-Rack Sprinkler Arrangements and Designs for Exposed Nonencapsulated Class I, Class II, Class III, or Class IV Commodities Stored Over 25 ft (7.6 m) in Height.****25.4.3.1.1.1**

Where rack storage of exposed nonencapsulated Class I commodities stored over 25 ft (7.6 m) in height will be protected by in-rack sprinklers, in-rack sprinkler arrangements and designs shall be selected from Figure 25.4.3.1.1.1(a) through Figure 25.4.3.1.1.1(f). (See Section 25.3 for racks with solid shelving. See also Section C.23.)

Figure 25.4.3.1.1.1(a) In-Rack Sprinkler Arrangements for Exposed Nonencapsulated Class I Commodities Stored Over 25 ft (7.6 m) in Height in Single-Row Racks.

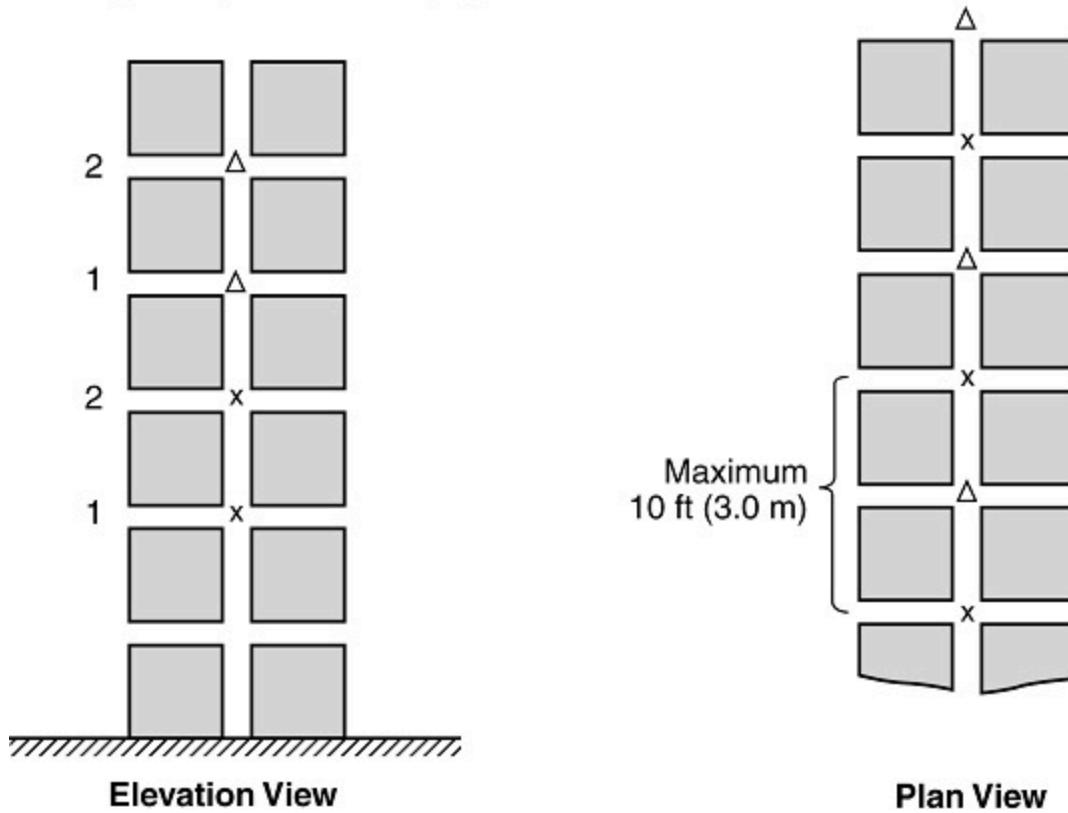
Ceiling Design: Exposed Nonencapsulated Class I Commodities**Notes:**

- (1) In-rack sprinklers are ordinary-temperature-rated, quick- or standard-response, pendent or upright, minimum K-5.6 (K-80), and designed for a minimum of six in-rack sprinklers operating at 30 gpm (114 L/min) when only one level of in-rack sprinklers is installed or a minimum of 10 in-rack sprinklers (five in-rack sprinklers on the top two levels) operating at 30 gpm (114 L/min) when more than one level is installed.
- (2) Sprinkler 1 or Sprinkler 1 and Sprinkler 2 are required when Load A represents the top of storage.
- (3) Sprinkler 1 and Sprinkler 2 or Sprinkler 1 and Sprinkler 3 are required when Load B represents the top of storage.
- (4) Sprinkler 1 and Sprinkler 3 or Sprinkler 1 and Sprinkler 4 are required when Load C represents the top of storage.
- (5) Sprinkler 1 and Sprinkler 4 or Sprinkler 1 and Sprinkler 5 are required when Load D represents the top of storage.
- (6) For storage higher than represented by Load D, the cycle defined by Note 2 through Note 5 above is repeated.
- (7) The storage height above the top level of in-rack sprinklers is limited to a maximum of 10 ft (3.0 m).
- (8) In-rack sprinklers in the transverse flue space are permitted to be at any point between load faces.
- (9) The symbol X represents in-rack sprinklers.
- (10) Each square represents a storage cube measuring 4 ft to 5 ft (1.2 m to 1.5 m) on a side. Actual load heights can vary from approximately 18 in. to 10 ft (450 mm to 3.0 m). Therefore, there could be as few as two loads or as many as 13 loads between in-rack sprinklers that are spaced 20 ft (6.1 m) apart vertically.

Figure 25.4.3.1.1(b) In-Rack Sprinkler Arrangements for Exposed Nonencapsulated Class I Commodities Stored Over 25 ft (7.6 m) and Up to 30 ft (9.1 m) in Height in Double-Row Racks — Option 1.

Ceiling Design: Exposed Nonencapsulated Class I Commodities

0.25 gpm/ft² over 2000 ft² (10.2 mm/min over 185 m²)
 with ordinary-temperature ceiling sprinklers
 0.35 gpm/ft² over 2000 ft² (14.2 mm/min over 185 m²)
 with high-temperature ceiling sprinklers



Notes:

- (1) In-rack sprinklers are ordinary-temperature-rated, quick- or standard-response, pendent or upright, minimum K-5.6 (K-80), and designed for a minimum of 10 in-rack sprinklers (five in-rack sprinklers on two levels) operating at 30 gpm (114 L/min).
- (2) Sprinkler 1 or Sprinkler 2 is required where the maximum storage height is 30 ft (9.1 m).
- (3) The storage height above the top level of in-rack sprinklers is limited to a maximum of 10 ft (3.0 m).
- (4) The symbols X and Δ represent in-rack sprinklers that are to be staggered both horizontally and vertically.
- (5) Each square represents a storage cube measuring 4 ft to 5 ft (1.2 m to 1.5 m) on a side. Actual load heights can vary from approximately 18 in. to 10 ft (450 mm to 3.0 m). Therefore, there could be as few as one load or as many as six loads between in-rack sprinklers that are spaced 10 ft (3.0 m) apart vertically.

Figure 25.4.3.1.1(c) In-Rack Sprinkler Arrangements for Exposed Nonencapsulated Class I Commodities Stored Over 25 ft (7.6 m) and Up to 30 ft (9.1 m) in Height in Double-Row Racks — Option 2.

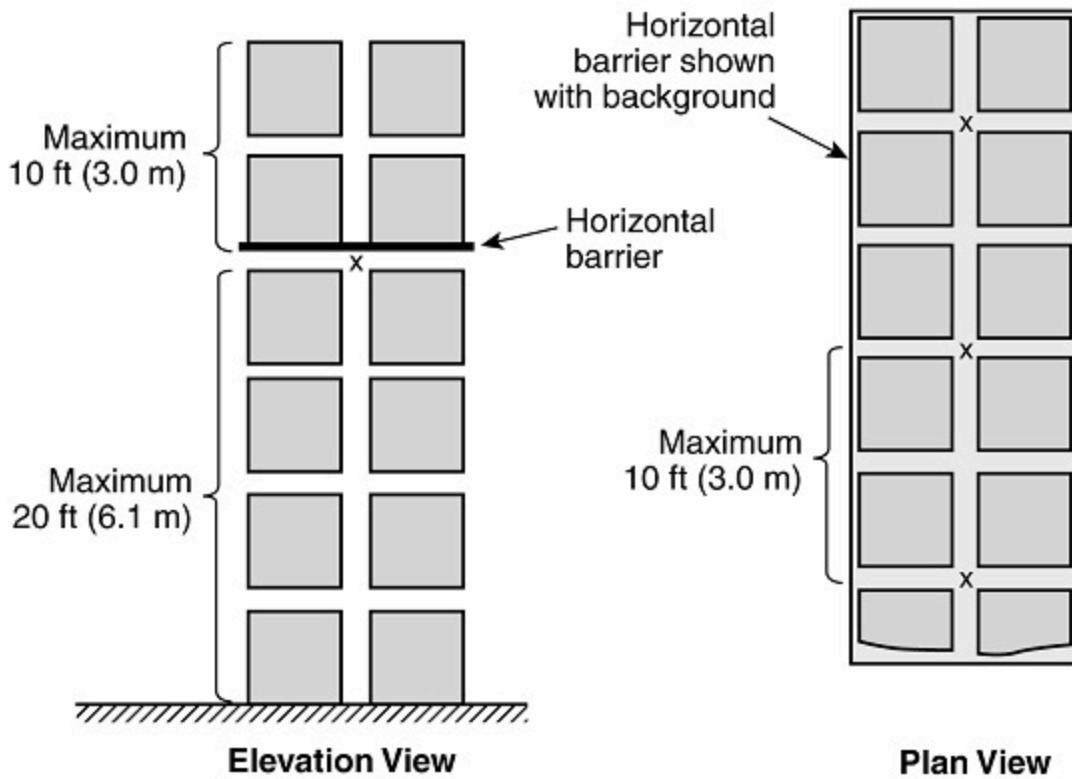
Ceiling Design: Exposed Nonencapsulated Class I Commodities

0.25 gpm/ft² over 2000 ft² (10.2 mm/min over 185 m²)

with ordinary-temperature ceiling sprinklers

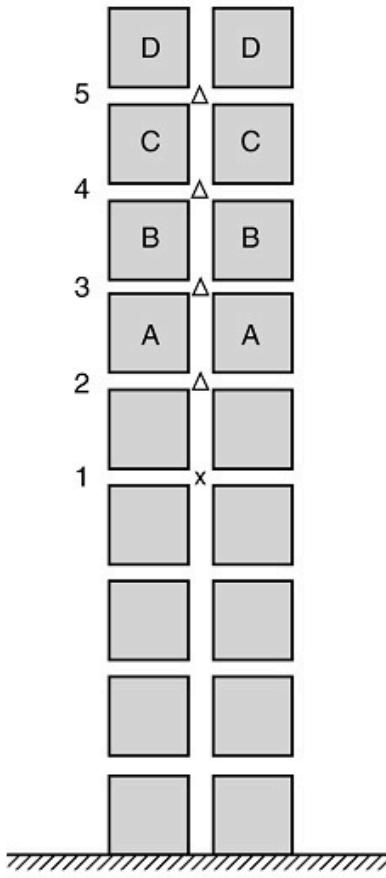
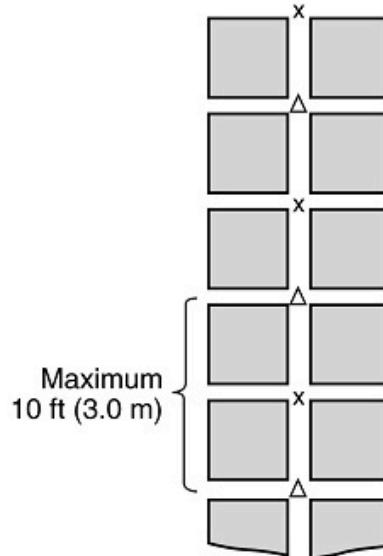
0.35 gpm/ft² over 2000 ft² (14.3 mm/min over 185 m²)

with high-temperature ceiling sprinklers

**Notes:**

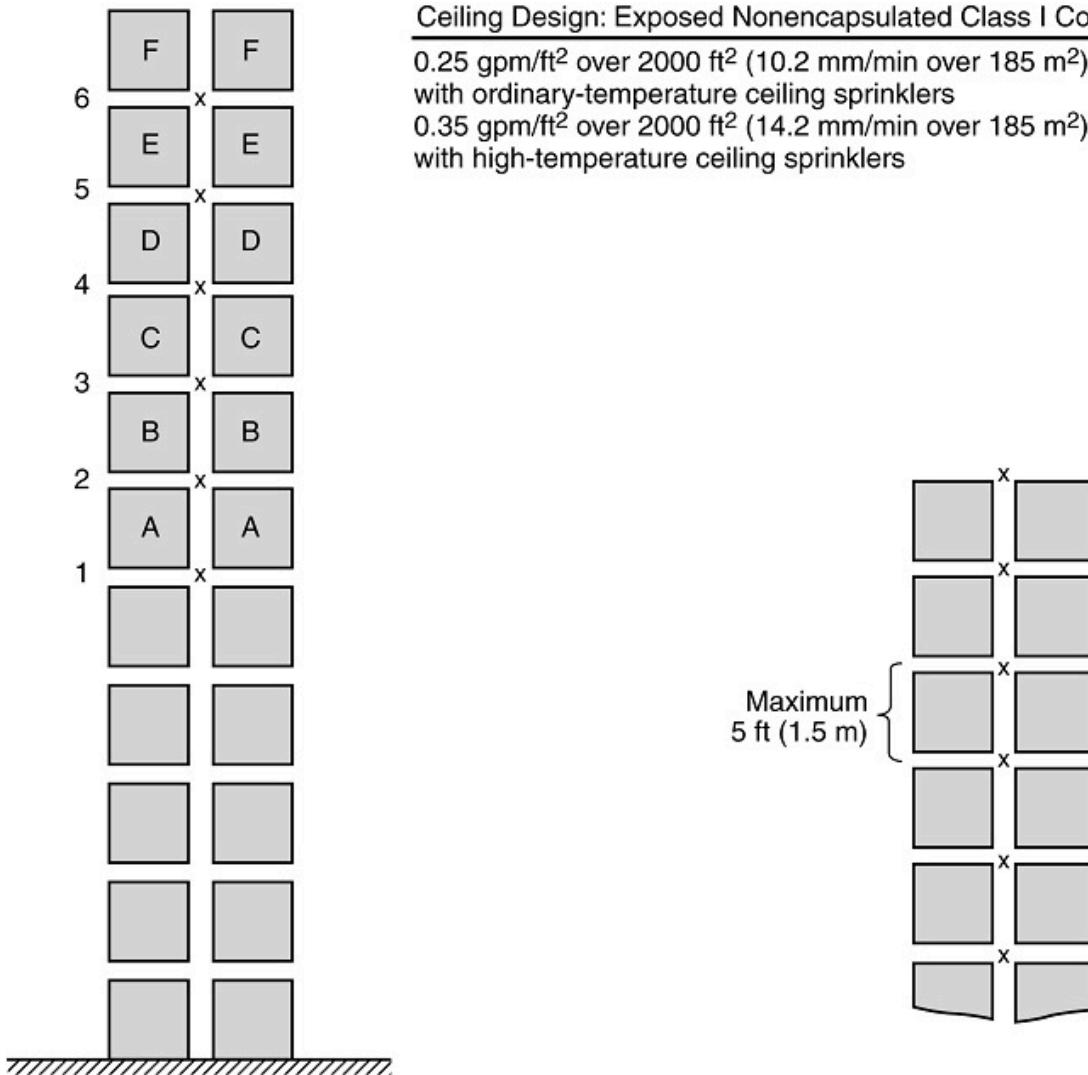
- (1) In-rack sprinklers are ordinary-temperature-rated, quick- or standard-response, pendent or upright, minimum K-5.6 (K-80), and designed for a minimum of six in-rack sprinklers operating at 30 gpm (114 L/min).
- (2) The storage height above the top level of in-rack sprinklers is limited to a maximum of 10 ft (3.0 m).
- (3) The symbol X represents in-rack sprinklers.
- (4) Each square represents a storage cube measuring 4 ft to 5 ft (1.2 m to 1.5 m) on a side. Actual load heights can vary from approximately 18 in. to 10 ft (450 mm to 3.0 m). Therefore, there could be as few as two loads or as many as 13 loads between in-rack sprinklers that are spaced 20 ft (6.1 m) apart vertically.

Figure 25.4.3.1.1(d) In-Rack Sprinkler Arrangements for Exposed Nonencapsulated Class I Commodities Stored Over 25 ft (7.6 m) in Height in Double-Row Racks — Option 1.

Ceiling Design: Exposed Nonencapsulated Class I Commodities**Elevation View****Plan View****Notes:**

- (1) In-rack sprinklers are ordinary-temperature-rated, quick- or standard-response, pendent or upright, minimum K-5.6 (K-80), and designed for a minimum of 10 in-rack sprinklers (five in-rack sprinklers on top two levels) operating at 30 gpm (114 L/min).
- (2) Face sprinklers are to be a minimum of 3 in. (75 mm) from rack uprights and a maximum of 18 in. (450 mm) from the aisle face of storage.
- (3) Sprinkler 1 or Sprinkler 1 and Sprinkler 2 are required where Load A represents the top of storage.
- (4) Sprinkler 1 and Sprinkler 2 or Sprinkler 1 and Sprinkler 3 are required where Load B represents the top of storage.
- (5) Sprinkler 1 and Sprinkler 3 or Sprinkler 1 and Sprinkler 4 are required where Load C represents the top of storage.
- (6) Sprinkler 1 and Sprinkler 4 or Sprinkler 1 and Sprinkler 5 are required where Load D represents the top of storage.
- (7) For storage higher than represented by Load D, the cycle defined by Note 3 through Note 6 above is repeated, with stagger as indicated.
- (8) The storage height above the top level of in-rack sprinklers is limited to a maximum of 10 ft (3.0 m).
- (9) The symbols X and Δ represent in-rack sprinklers that are to be staggered both horizontally and vertically.
- (10) Each square represents a storage cube measuring 4 ft to 5 ft (1.2 m to 1.5 m) on a side. Actual load heights can vary from approximately 18 in. to 10 ft (450 mm to 3.0 m). Therefore, there could be as few as two loads or as many as 13 loads between in-rack sprinklers that are spaced 20 ft (6.1 m) apart vertically.

Figure 25.4.3.1.1(e) In-Rack Sprinkler Arrangements for Exposed Nonencapsulated Class I Commodities Stored Over 25 ft (7.6 m) in Height in Double-Row Racks — Option 2.

Ceiling Design: Exposed Nonencapsulated Class I Commodities**Elevation View****Plan View****Notes:**

- (1) In-rack sprinklers are ordinary-temperature-rated, quick- or standard-response, pendent or upright, minimum K-5.6 (K-80), and designed for a minimum of six in-rack sprinklers operating at 30 gpm (114 L/min) when only one level of in-rack sprinklers is installed or a minimum of 10 in-rack sprinklers (five in-rack sprinklers on top two levels) operating at 30 gpm (114 L/min) when more than one level of in-rack sprinklers is installed.
- (2) Face sprinklers are to be a minimum of 3 in. (75 mm) from rack uprights and a maximum of 18 in. (450 mm) from the aisle face of storage.
- (3) Sprinkler 1 is required where Load A represents the top of storage.
- (4) Sprinkler 1 or Sprinkler 1 and Sprinkler 2 are required where Load B represents the top of storage.
- (5) Sprinkler 1 and Sprinkler 2 or Sprinkler 1 and Sprinkler 3 are required where Load C represents the top of storage.
- (6) Sprinkler 1 and Sprinkler 3 or Sprinkler 1 and Sprinkler 4 are required where Load D represents the top of storage.
- (7) Sprinkler 1 and Sprinkler 4 or Sprinkler 1 and Sprinkler 5 are required where Load E represents the top of storage.
- (8) Sprinkler 1 and Sprinkler 5 or Sprinkler 1 and Sprinkler 6 are required where Load F represents the top of storage.
- (9) For storage higher than represented by Load F, the cycle defined by Note 3 through Note 8 above is repeated.
- (10) The storage height above the top level of in-rack sprinklers is limited to a maximum of 10 ft (3.0 m).
- (11) The symbol X represents in-rack sprinklers.
- (12) Each square represents a storage cube measuring 4 ft to 5 ft (1.2 m to 1.5 m) on a side. Actual load heights can vary from approximately 18 in. to 10 ft (450 mm to 3.0 m). Therefore, there could be as few as two loads or as many as 16 loads between in-rack sprinklers that are spaced 25 ft (7.6 m) apart vertically.

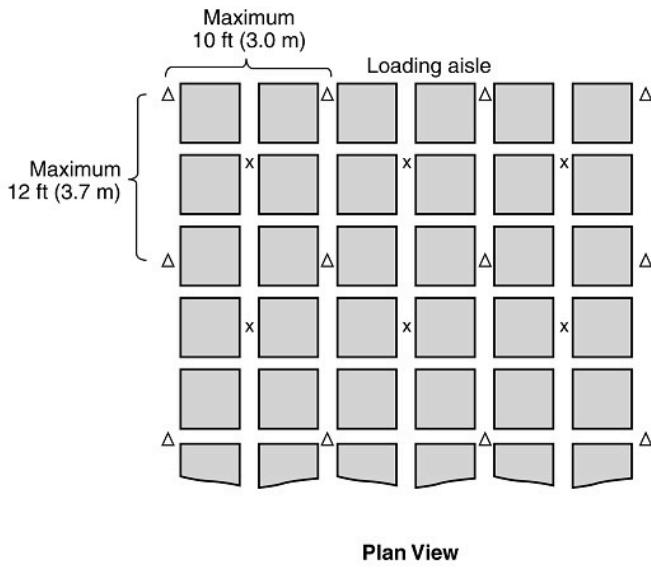
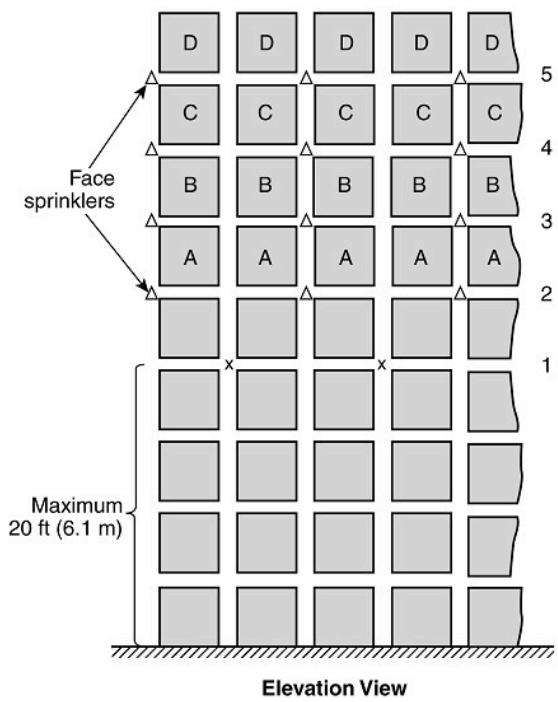
Figure 25.4.3.1.1(f) In-Rack Sprinkler Arrangements for Exposed Nonencapsulated Class I Commodities Stored Over 25 ft (7.6 m) in Height in Multiple-Row Racks.

Ceiling Design: Exposed Nonencapsulated Class I Commodities0.25 gpm/ft² over 2000 ft² (10.2 mm/min over 185 m²)

with ordinary-temperature ceiling sprinklers

0.35 gpm/ft² over 2000 ft² (14.3 mm/min over 185 m²)

with high-temperature ceiling sprinklers

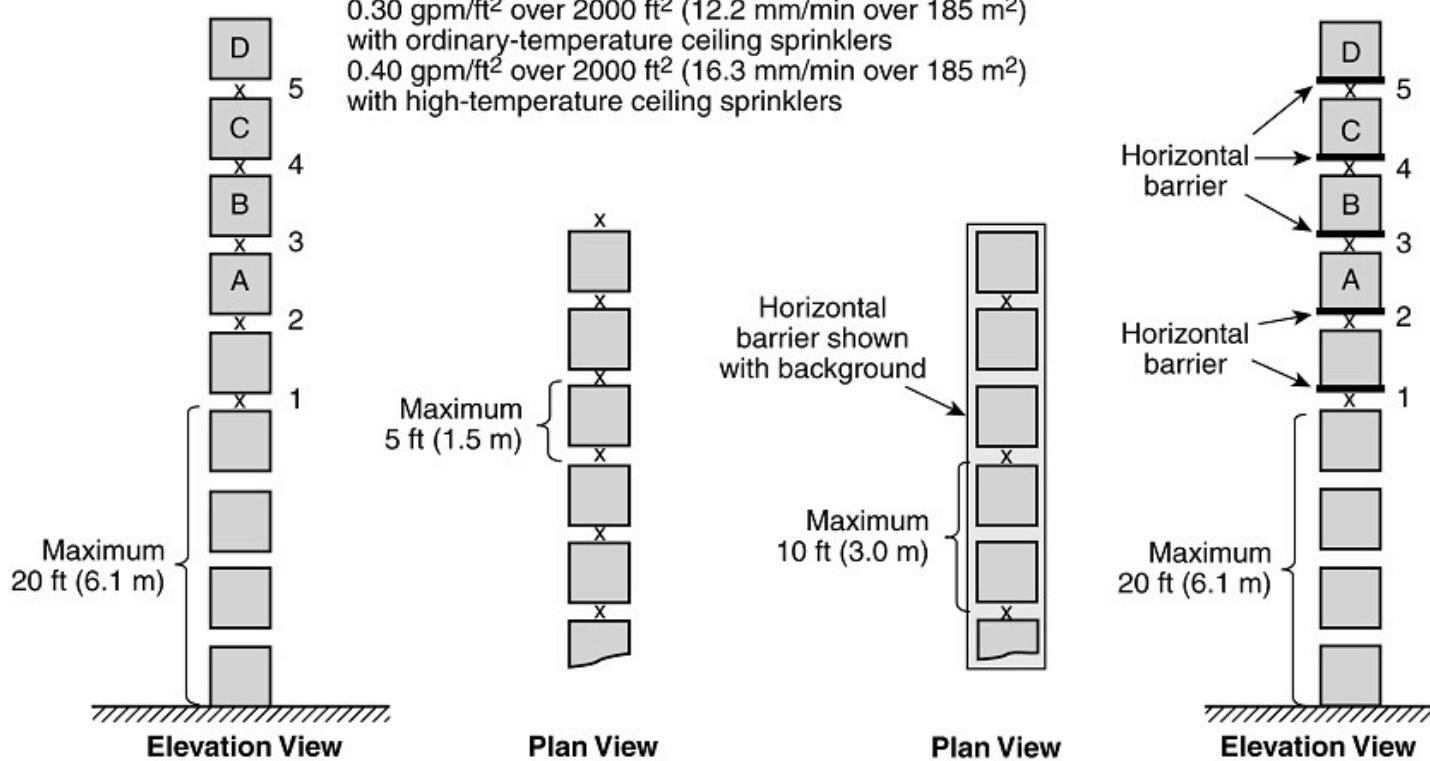
**Notes:**

- (1) In-rack sprinklers are ordinary-temperature-rated, quick- or standard-response, pendent or upright, minimum K-5.6 (K-80), and designed for a minimum of six in-rack sprinklers operating at 30 gpm (114 L/min) when only one level of in-rack sprinklers is installed or a minimum of 10 in-rack sprinklers (five in-rack sprinklers on the top two levels) operating at 30 gpm (114 L/min) when more than one level of in-rack sprinklers are installed.
- (2) Face sprinklers are to be a minimum of 3 in. (75 mm) from rack uprights and a maximum of 18 in. (450 mm) from the aisle face of storage.
- (3) Sprinkler 1 or Sprinkler 1 and Sprinkler 2 are required where Load A represents the top of storage.
- (4) Sprinkler 1 and Sprinkler 2 or Sprinkler 1 and Sprinkler 3 are required where Load B represents the top of storage.
- (5) Sprinkler 1 and Sprinkler 3 or Sprinkler 1 and Sprinkler 4 are required where Load C represents the top of storage.
- (6) Sprinkler 1 and Sprinkler 4 or Sprinkler 1 and Sprinkler 5 are required where Load D represents the top of storage.
- (7) For storage higher than represented by Load D, the cycle defined by Note 3 through Note 6 above is repeated, with stagger as indicated.
- (8) The storage height above the top level of in-rack sprinklers is limited to a maximum of 10 ft (3.0 m).
- (9) The symbols X and Δ represent in-rack sprinklers that are to be staggered both horizontally and vertically.
- (10) Each square represents a storage cube measuring 4 ft to 5 ft (1.2 m to 1.5 m) on a side. Actual load heights can vary from approximately 18 in. to 10 ft (450 mm to 3.0 m). Therefore, there could be as few as two loads or as many as 13 loads between in-rack sprinklers that are spaced 20 ft (6.1 m) apart vertically.

25.4.3.1.1.2

Where rack storage of exposed nonencapsulated Class II or Class III commodities stored over 25 ft (7.6 m) in height will be protected by in-rack sprinklers, in-rack sprinkler arrangements and designs shall be selected from Figure 25.4.3.1.1.2(a) through Figure 25.4.3.1.1.2(g). (See Section 25.3 for racks with solid shelving.)

Figure 25.4.3.1.1.2(a) In-Rack Sprinkler Arrangements for Exposed Nonencapsulated Class I, Class II, or Class III Commodities Stored Over 25 ft (7.6 m) in Height in Single-Row Racks.

Ceiling Design: Exposed Nonencapsulated Class I, Class II, or Class III Commodities**Notes:**

- (1) In-rack sprinklers are ordinary-temperature-rated, quick- or standard-response, pendent or upright, minimum K-5.6 (K-80), and designed for a minimum of six in-rack sprinklers operating at 30 gpm (114 L/min) when only one level of in-rack sprinklers is installed or a minimum of 10 in-rack sprinklers (five in-rack sprinklers on the top two levels) operating at 30 gpm (114 L/min) when more than one level is installed.
- (2) Sprinkler 1 or Sprinkler 1 and Sprinkler 2 are required when Load A represents the top of storage.
- (3) Sprinkler 1 and Sprinkler 2 or Sprinkler 1 and Sprinkler 3 are required when Load B represents the top of storage.
- (4) Sprinkler 1 and Sprinkler 3 or Sprinkler 1 and Sprinkler 4 are required when Load C represents the top of storage.
- (5) Sprinkler 1 and Sprinkler 4 or Sprinkler 1 and Sprinkler 5 are required when Load D represents the top of storage.
- (6) For storage higher than represented by Load D, the cycle defined by Note 2 through Note 5 above is repeated.
- (7) The storage height above the top level of in-rack sprinklers is limited to a maximum of 10 ft (3.0 m).
- (8) In-rack sprinklers in the transverse flue space are permitted to be at any point between load faces.
- (9) The symbol X represents in-rack sprinklers.
- (10) Each square represents a storage cube measuring 4 ft to 5 ft (1.2 m to 1.5 m) on a side. Actual load heights can vary from approximately 18 in. to 10 ft (450 mm to 3.0 m). Therefore, there could be as few as two loads or as many as 13 loads between in-rack sprinklers that are spaced 20 ft (6.1 m) apart vertically.

Figure 25.4.3.1.1.2(b) In-Rack Sprinkler Arrangements for Exposed Nonencapsulated Class I, Class II, or Class III Commodities Stored Over 25 ft (7.6 m) and Up to 30 ft (9.1 m) in Height in Double-Row Racks.

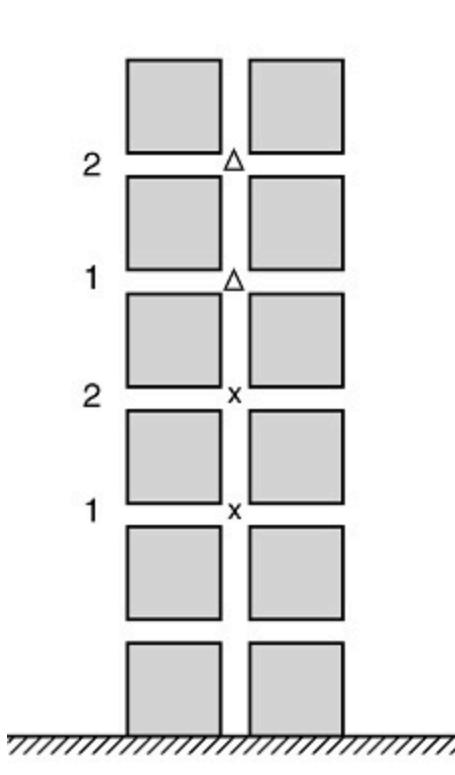
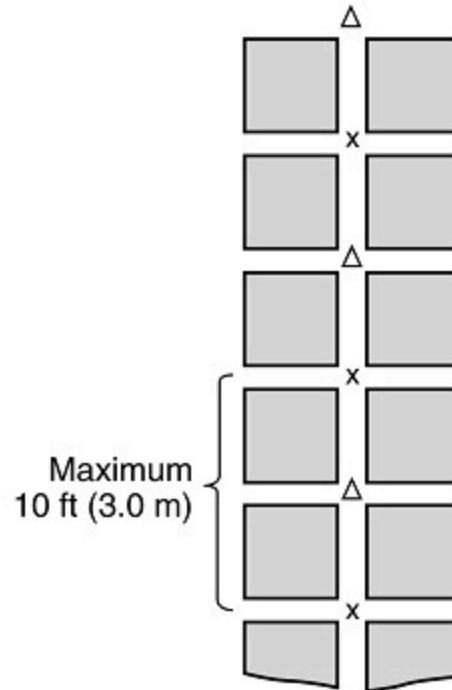
Ceiling Design: Exposed Nonencapsulated Class I, Class II, or Class III Commodities

0.30 gpm/ft² over 2000 ft² (12.2 mm/min over 185 m²)

with ordinary-temperature ceiling sprinklers

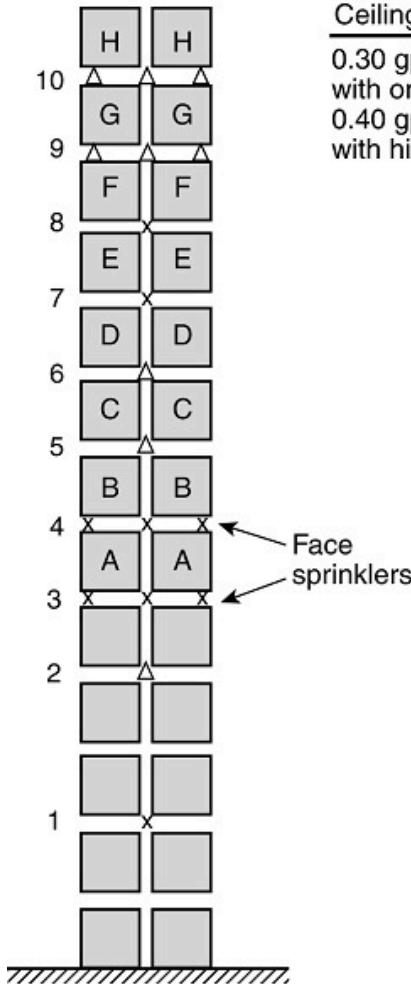
0.40 gpm/ft² over 2000 ft² (16.3 mm/min over 185 m²)

with high-temperature ceiling sprinklers

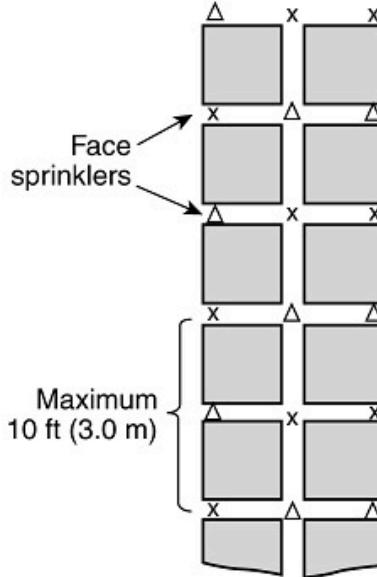
**Elevation View****Plan View****Notes:**

- (1) In-rack sprinklers are ordinary-temperature-rated, quick- or standard-response, pendent or upright, minimum K-5.6 (K-80), and designed for a minimum of 10 in-rack sprinklers (five in-rack sprinklers on two levels) operating at 30 gpm (114 L/min).
- (2) Sprinkler 1 or Sprinkler 2 is required where the maximum storage height is 30 ft (9.1 m).
- (3) The storage height above the top level of in-rack sprinklers is limited to a maximum of 10 ft (3.0 m).
- (4) The symbols X and Δ represent in-rack sprinklers that are to be staggered both horizontally and vertically.
- (5) Each square represents a storage cube measuring 4 ft to 5 ft (1.2 m to 1.5 m) on a side. Actual load heights can vary from approximately 18 in. to 10 ft (450 mm to 3.0 m). Therefore, there could be as few as one load or as many as six loads between in-rack sprinklers that are spaced 10 ft (3.0 m) apart vertically.

Figure 25.4.3.1.1.2(c) In-Rack Sprinkler Arrangements for Exposed Nonencapsulated Class I, Class II, or Class III Commodities Stored Over 25 ft (7.6 m) in Height in Double-Row Racks — Option 1.

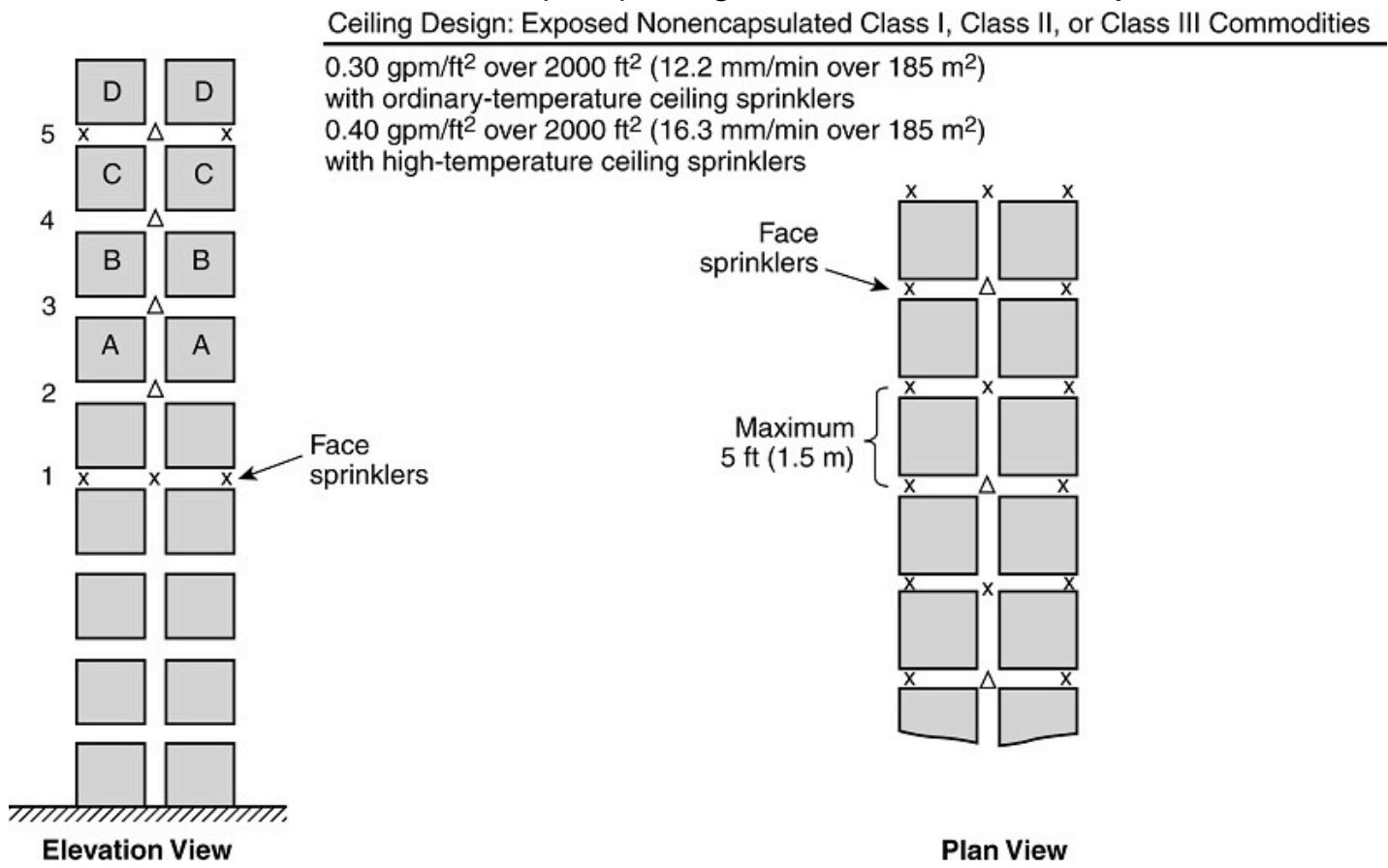
Ceiling Design: Exposed Nonencapsulated Class I, Class II, or Class III Commodities

0.30 gpm/ft² over 2000 ft² (12.2 mm/min over 185 m²)
with ordinary-temperature ceiling sprinklers
0.40 gpm/ft² over 2000 ft² (16.3 mm/min over 185 m²)
with high-temperature ceiling sprinklers

**Notes:**

- (1) In-rack sprinklers are ordinary-temperature-rated, quick- or standard-response, pendent or upright, minimum K-5.6 (K-80), and designed for a minimum of 10 in-rack sprinklers (five in-rack sprinklers on top two levels) operating at 30 gpm (114 L/min).
- (2) Face sprinklers are to be a minimum of 3 in. (75 mm) from rack uprights and a maximum of 18 in. (450 mm) from the aisle face of storage.
- (3) Sprinkler 1 and Sprinkler 2 or Sprinkler 1, Sprinkler 2, and Sprinkler 3 are required where Load A represents the top of storage.
- (4) Sprinkler 1, Sprinkler 2, and Sprinkler 3 or Sprinkler 1, Sprinkler 2, and Sprinkler 4 are required where Load B represents the top of storage.
- (5) Sprinkler 1, Sprinkler 2, and Sprinkler 4 or Sprinkler 1, Sprinkler 2, Sprinkler 4, and Sprinkler 5 are required where Load C represents the top of storage.
- (6) Sprinkler 1 and Sprinkler 4 or Sprinkler 1 and Sprinkler 5 are required where Load D represents the top of storage.
- (7) Sprinkler 1, Sprinkler 2, Sprinkler 4, and Sprinkler 6 or Sprinkler 1, Sprinkler 2, Sprinkler 4, and Sprinkler 7 are required where Load E represents the top of storage.
- (8) Sprinkler 1, Sprinkler 2, Sprinkler 4, Sprinkler 6, and Sprinkler 7 or Sprinkler 1, Sprinkler 2, Sprinkler 4, Sprinkler 6, and Sprinkler 8 are required where Load F represents the top of storage.
- (9) Sprinkler 1, Sprinkler 2, Sprinkler 4, Sprinkler 6, and Sprinkler 8 or Sprinkler 1, Sprinkler 2, Sprinkler 4, Sprinkler 6, Sprinkler 8, and Sprinkler 9 are required where Load G represents the top of storage.
- (10) Sprinkler 1, Sprinkler 2, Sprinkler 4, Sprinkler 6, Sprinkler 8, and Sprinkler 9 or Sprinkler 1, Sprinkler 2, Sprinkler 4, Sprinkler 6, Sprinkler 8, and Sprinkler 10 are required where Load H represents the top of storage.
- (11) For storage higher than represented by Load H, the cycle defined by Note 3 through Note 10 above is repeated, with stagger as indicated.
- (12) The storage height above the top level of in-rack sprinklers is limited to a maximum of 10 ft (3.0 m).
- (13) The symbols X and Δ represent in-rack sprinklers that are to be staggered both horizontally and vertically.
- (14) Each square represents a storage cube measuring 4 ft to 5 ft (1.2 m to 1.5 m) on a side. Actual load heights can vary from approximately 18 in. to 10 ft (450 mm to 3.0 m). Therefore, there could be as few as one load or as many as six loads between in-rack sprinklers that are spaced 10 ft (3.0 m) apart vertically.

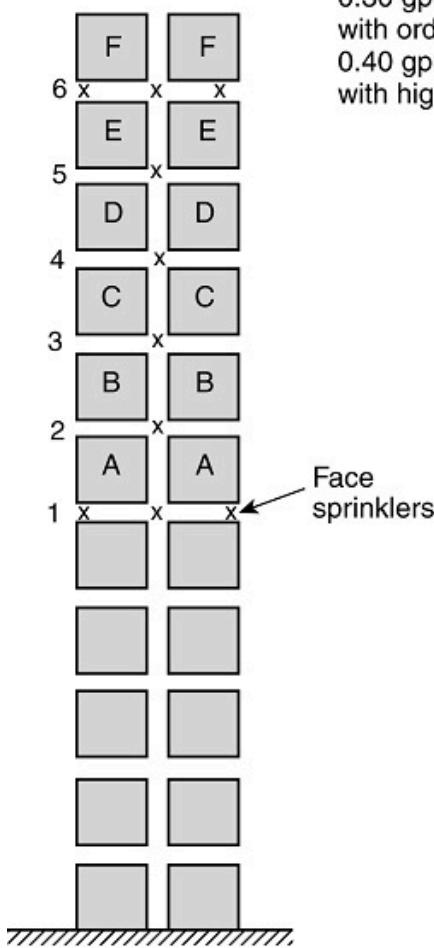
Figure 25.4.3.1.1.2(d) In-Rack Sprinkler Arrangements for Exposed Nonencapsulated Class I, Class II, or Class III Commodities Stored Over 25 ft (7.6 m) in Height in Double-Row Racks — Option 2.



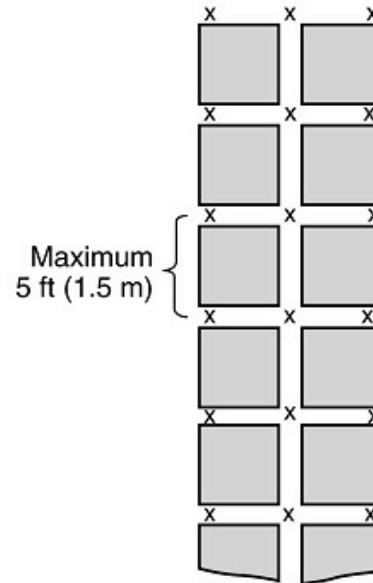
Notes:

- (1) In-rack sprinklers are ordinary-temperature-rated, quick- or standard-response, pendent or upright, minimum K-5.6 (K-80), and designed for a minimum of six in-rack sprinklers operating at 30 gpm (114 L/min) when only one level of in-rack sprinklers is installed or a minimum of 10 in-rack sprinklers (five in-rack sprinklers on top two levels) operating at 30 gpm (114 L/min) when more than one level of in-rack sprinklers are installed.
- (2) Face sprinklers are to be a minimum of 3 in. (75 mm) from rack uprights and a maximum of 18 in. (450 mm) from the aisle face of storage.
- (3) Sprinkler 1 or Sprinkler 1 and Sprinkler 2 are required where Load A represents the top of storage.
- (4) Sprinkler 1 and Sprinkler 2 or Sprinkler 1 and Sprinkler 3 are required where Load B represents the top of storage.
- (5) Sprinkler 1 and Sprinkler 3 or Sprinkler 1 and Sprinkler 4 are required where Load C represents the top of storage.
- (6) Sprinkler 1 and Sprinkler 4 or Sprinkler 1 and Sprinkler 5 are required where Load D represents the top of storage.
- (7) For storage higher than represented by Load D, the cycle defined by Note 3 through Note 6 above is repeated, with stagger as indicated.
- (8) The storage height above the top level of in-rack sprinklers is limited to a maximum of 10 ft (3.0 m).
- (9) The symbols X and Δ represent in-rack sprinklers that are to be staggered both horizontally and vertically.
- (10) Each square represents a storage cube measuring 4 ft to 5 ft (1.2 m to 1.5 m) on a side. Actual load heights can vary from approximately 18 in. to 10 ft (450 mm to 3.0 m). Therefore, there could be as few as two loads or as many as 13 loads between in-rack sprinklers that are spaced 10 ft (3.0 m) apart vertically.

Figure 25.4.3.1.1.2(e) In-Rack Sprinkler Arrangements for Exposed Nonencapsulated Class I, Class II, or Class III Commodities Stored Over 25 ft (7.6 m) in Height in Double-Row Racks — Option 3.

Ceiling Design: Exposed Nonencapsulated Class I, Class II, or Class III Commodities

0.30 gpm/ft² over 2000 ft² (12.2 mm/min over 185 m²)
with ordinary-temperature ceiling sprinklers
0.40 gpm/ft² over 2000 ft² (16.3 mm/min over 185 m²)
with high-temperature ceiling sprinklers

**Notes:**

- (1) In-rack sprinklers are ordinary-temperature-rated, quick- or standard-response, pendent or upright, minimum K-5.6 (K-80), and designed for a minimum of six in-rack sprinklers operating at 30 gpm (114 L/min) when only one level of in-rack sprinklers is installed or a minimum of 10 in-rack sprinklers (five in-rack sprinklers on top two levels) operating at 30 gpm (114 L/min) when more than one level of in-rack sprinklers are installed.
- (2) Face sprinklers are to be a minimum of 3 in. (75 mm) from rack uprights and a maximum of 18 in. (450 mm) from the aisle face of storage.
- (3) Sprinkler 1 is required where Load A represents the top of storage.
- (4) Sprinkler 1 or Sprinkler 1 and Sprinkler 2 are required where Load B represents the top of storage.
- (5) Sprinkler 1 and Sprinkler 2 or Sprinkler 1 and Sprinkler 3 are required where Load C represents the top of storage.
- (6) Sprinkler 1 and Sprinkler 3 or Sprinkler 1 and Sprinkler 4 are required where Load D represents the top of storage.
- (7) Sprinkler 1 and Sprinkler 4 or Sprinkler 1 and Sprinkler 5 are required where Load E represents the top of storage.
- (8) Sprinkler 1 and Sprinkler 5 or Sprinkler 1 and Sprinkler 6 are required where Load F represents the top of storage.
- (9) For storage higher than represented by Load F, the cycle defined by Note 3 through Note 8 above is repeated.
- (10) The storage height above the top level of in-rack sprinklers is limited to a maximum of 10 ft (3.0 m).
- (11) The symbol X represents in-rack sprinklers.
- (12) Each square represents a storage cube measuring 4 ft to 5 ft (1.2 m to 1.5 m) on a side. Actual load heights can vary from approximately 18 in. to 10 ft (450 mm to 3.0 m). Therefore, there could be as few as two loads or as many as 16 loads between in-rack sprinklers that are spaced 25 ft (7.6 m) apart vertically.

Figure 25.4.3.1.1.2(f) In-Rack Sprinkler Arrangements for Exposed Nonencapsulated Class I, Class II, or Class III Commodities Stored Over 25 ft (7.6 m) in Height in Double-Row Racks — Option 4.

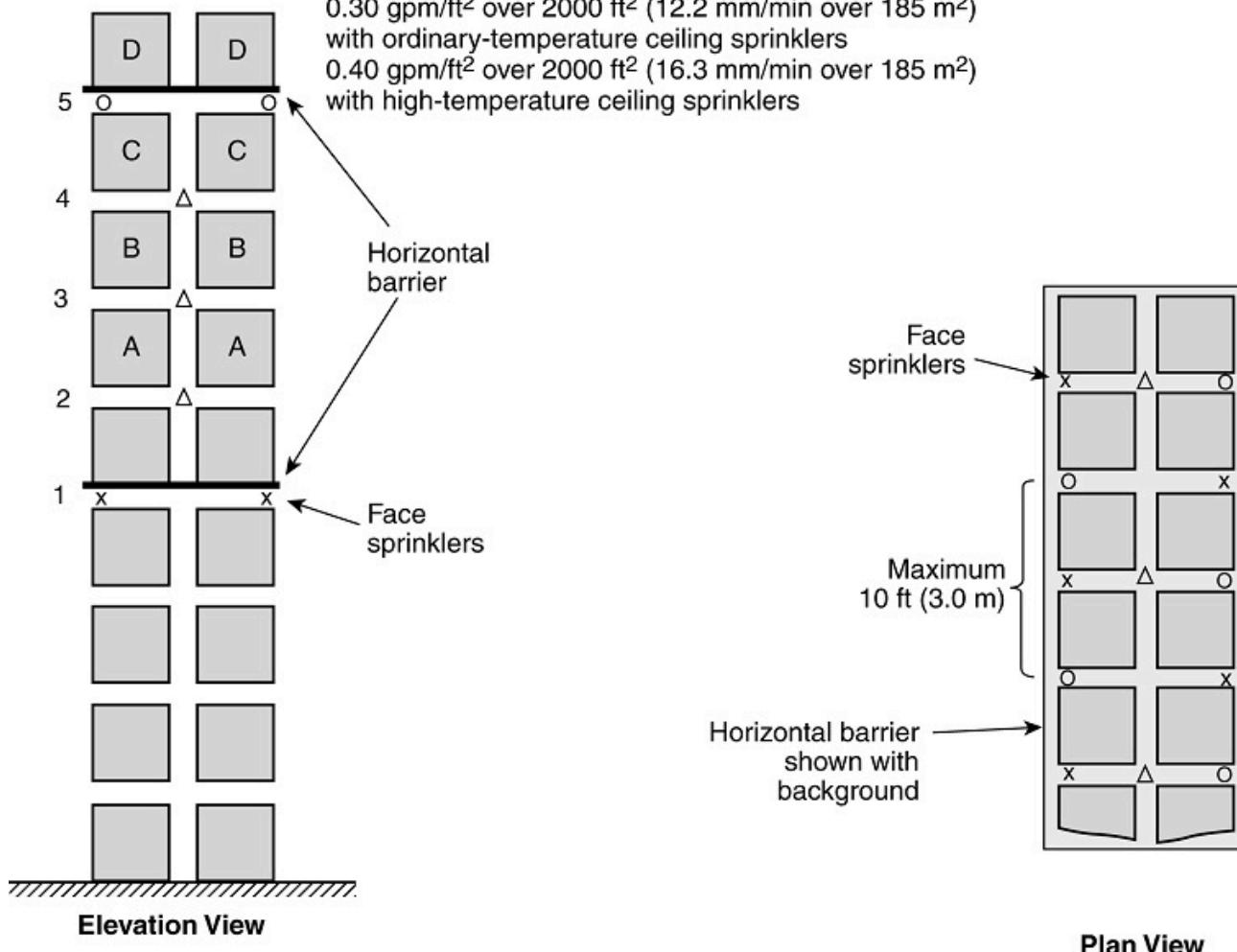
Ceiling Design: Exposed Nonencapsulated Class I, Class II, or Class III Commodities

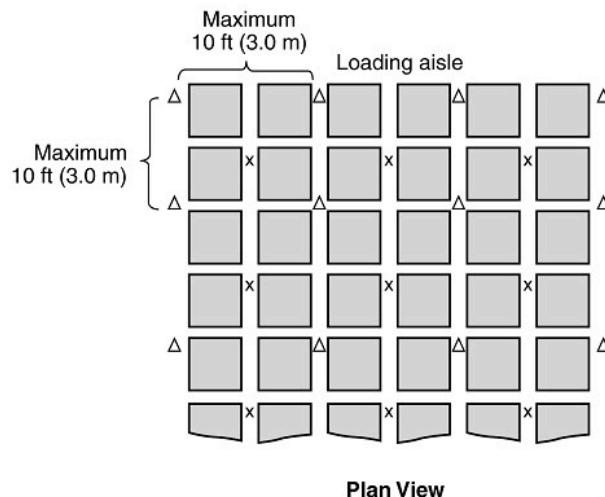
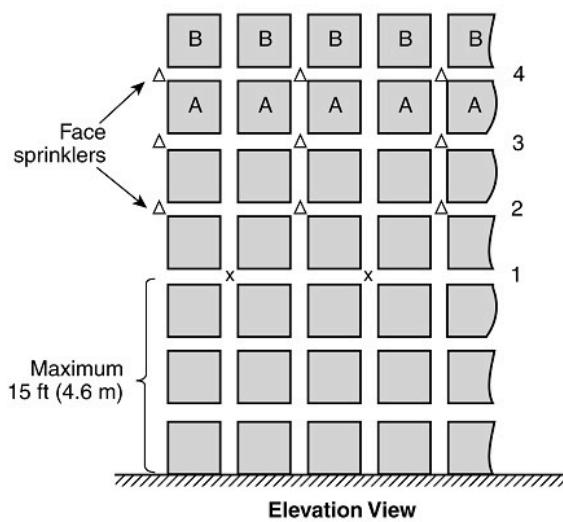
Figure 25.4.3.1.1.2(g) In-Rack Sprinkler Arrangements for Exposed Nonencapsulated Class I, Class II, or Class III Commodities Stored Over 25 ft (7.6 m) in Height in Multiple-Row Racks.

Ceiling Design: Exposed Nonencapsulated Class I, Class II, or Class III Commodities0.30 gpm/ft² over 2000 ft² (12.2 mm/min over 185 m²)

with ordinary-temperature ceiling sprinklers

0.40 gpm/ft² over 2000 ft² (16.3 mm/min over 185 m²)

with high-temperature ceiling sprinklers

**Notes:**

- (1) In-rack sprinklers are ordinary-temperature-rated, quick- or standard-response, pendent or upright, minimum K-5.6 (K-80), and designed for a minimum of 10 in-rack sprinklers (five in-rack sprinklers on the top two levels) operating at 30 gpm (114 L/min).
- (2) Face sprinklers are to be a minimum of 3 in. (75 mm) from rack uprights and a maximum of 18 in. (450 mm) from the aisle face of storage.
- (3) Sprinkler 1 and Sprinkler 2 or Sprinkler 1 and Sprinkler 3 are required where Load A represents the top of storage.
- (4) Sprinkler 1 and Sprinkler 3 or Sprinkler 1 and Sprinkler 4 are required where Load B represents the top of storage.
- (5) For storage higher than represented by Load B, the cycle defined by Note 3 and Note 4 above is repeated, with stagger as indicated.
- (6) The storage height above the top level of in-rack sprinklers is limited to a maximum of 10 ft (3.0 m).
- (7) The symbols X and Δ represent in-rack sprinklers that are to be staggered both horizontally and vertically.
- (8) Each square represents a storage cube measuring 4 ft to 5 ft (1.2 m to 1.5 m) on a side. Actual load heights can vary from approximately 18 in. to 10 ft (450 mm to 3.0 m). Therefore, there could be as few as two loads or as many as 10 loads between in-rack sprinklers that are spaced 15 ft (4.6 m) apart vertically.

25.4.3.1.1.3

Where rack storage of exposed nonencapsulated Class IV commodities stored over 25 ft (7.6 m) in height will be protected by in-rack sprinklers, in-rack sprinkler arrangements and designs shall be selected from Figure 25.4.3.1.1.3(a) through Figure 25.4.3.1.1.3(f). (See Section 25.3 for racks with solid shelving.)

Figure 25.4.3.1.1.3(a) In-Rack Sprinkler Arrangements for Exposed Nonencapsulated Class I, Class II, Class III, or Class IV Commodities Stored Over 25 ft (7.6 m) in Height in Single-Row Racks — Option 1.

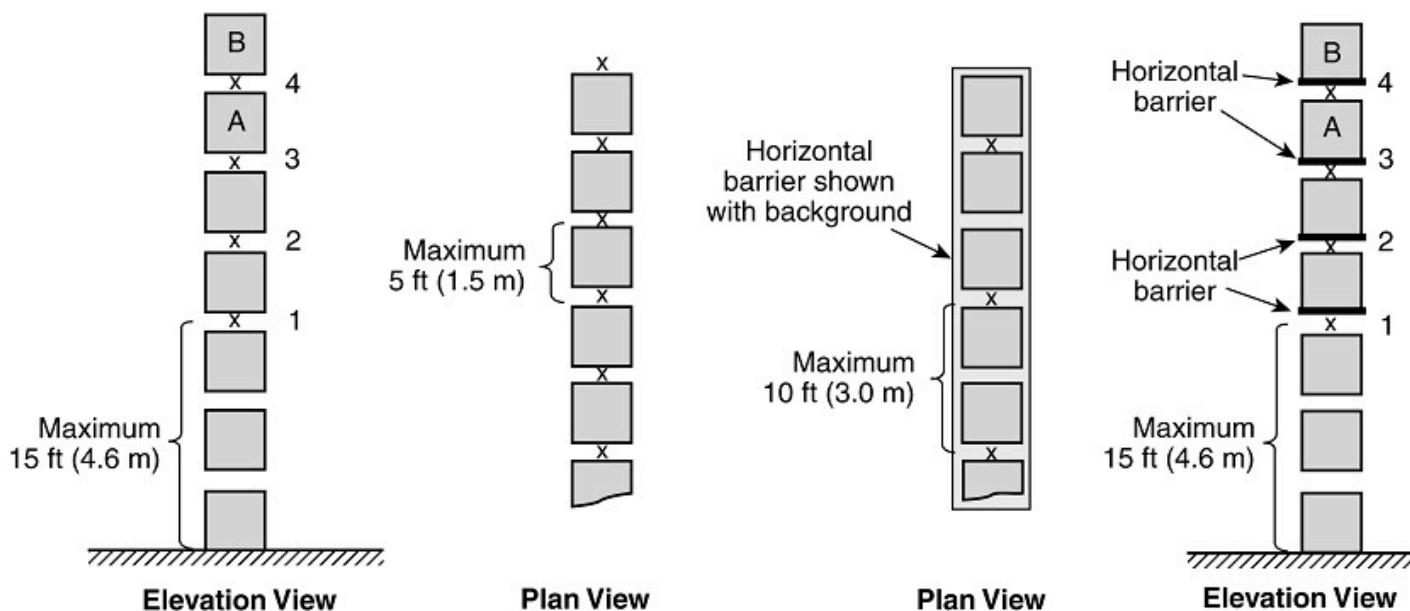
Ceiling Design: Exposed Nonencapsulated Class I, Class II, Class III, or Class IV Commodities

0.35 gpm/ft² over 2000 ft² (14.2 mm/min over 185 m²)

with ordinary-temperature ceiling sprinklers

0.45 gpm/ft² over 2000 ft² (18.3 mm/min over 185 m²)

with high-temperature ceiling sprinklers

**Notes:**

- (1) In-rack sprinklers are ordinary-temperature-rated, quick- or standard-response, pendent or upright, minimum K-5.6 (K-80), and designed for a minimum of 10 in-rack sprinklers (five in-rack sprinklers on the top two levels) operating at 30 gpm (114 L/min).
- (2) Sprinkler 1 and Sprinkler 2 or Sprinkler 1 and Sprinkler 3 are required when Load A represents the top of storage.
- (3) Sprinkler 1 and Sprinkler 3 or Sprinkler 1 and Sprinkler 4 are required when Load B represents the top of storage.
- (4) For storage higher than represented by Load B, the cycle defined by Note 2 and Note 3 above is repeated.
- (5) The storage height above the top level of in-rack sprinklers is limited to a maximum of 10 ft (3.0 m).
- (6) In-rack sprinklers in the transverse flue space are permitted to be at any point between load faces.
- (7) The symbol X represents in-rack sprinklers.
- (8) Each square represents a storage cube measuring 4 ft to 5 ft (1.2 m to 1.5 m) on a side. Actual load heights can vary from approximately 18 in. to 10 ft (450 mm to 3.0 m). Therefore, there could be as few as one load or as many as 10 loads between in-rack sprinklers that are spaced 15 ft (4.6 m) apart vertically.

Figure 25.4.3.1.1.3(b) In-Rack Sprinkler Arrangements for Exposed Nonencapsulated Class I, Class II, Class III, or Class IV Commodities Stored Over 25 ft (7.6 m) in Height in Single-Row Racks — Option 2.

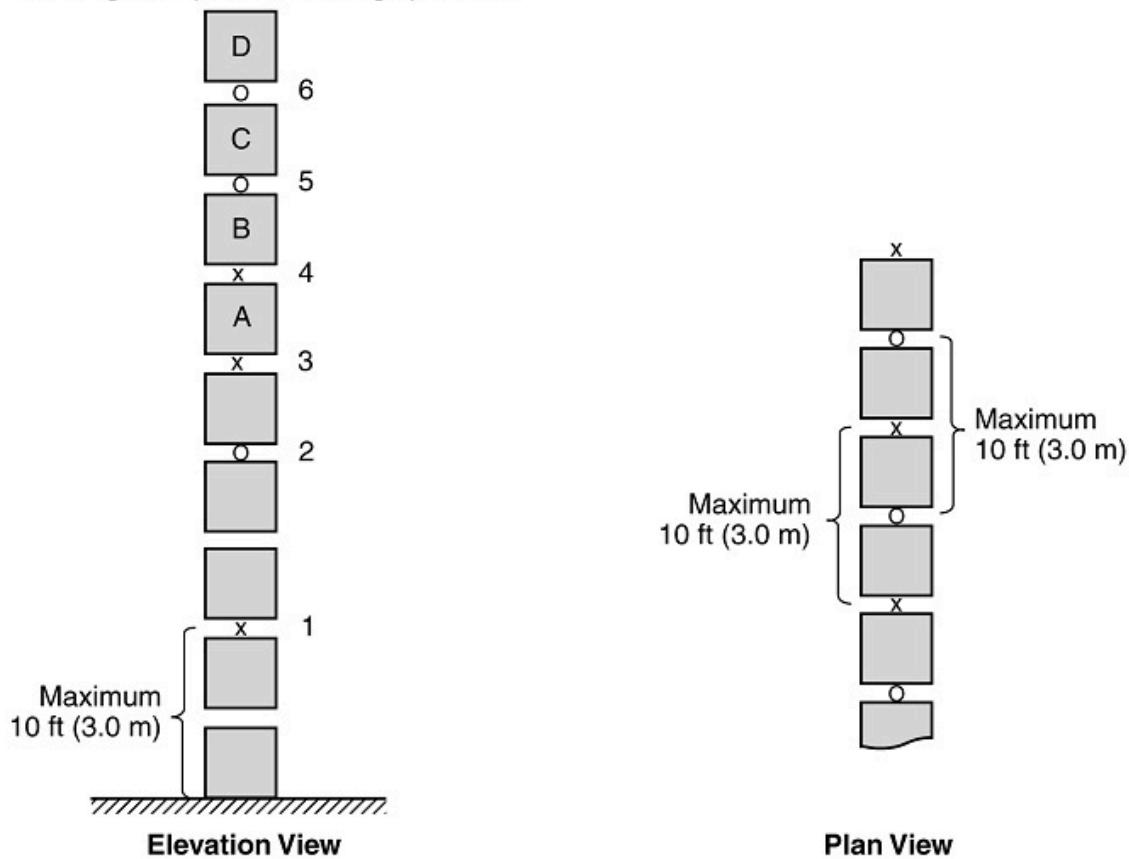
Ceiling Design: Exposed Nonencapsulated Class I, Class II, Class III, or Class IV Commodities

0.35 gpm/ft² over 2000 ft² (14.2 mm/min over 185 m²)

with ordinary-temperature ceiling sprinklers

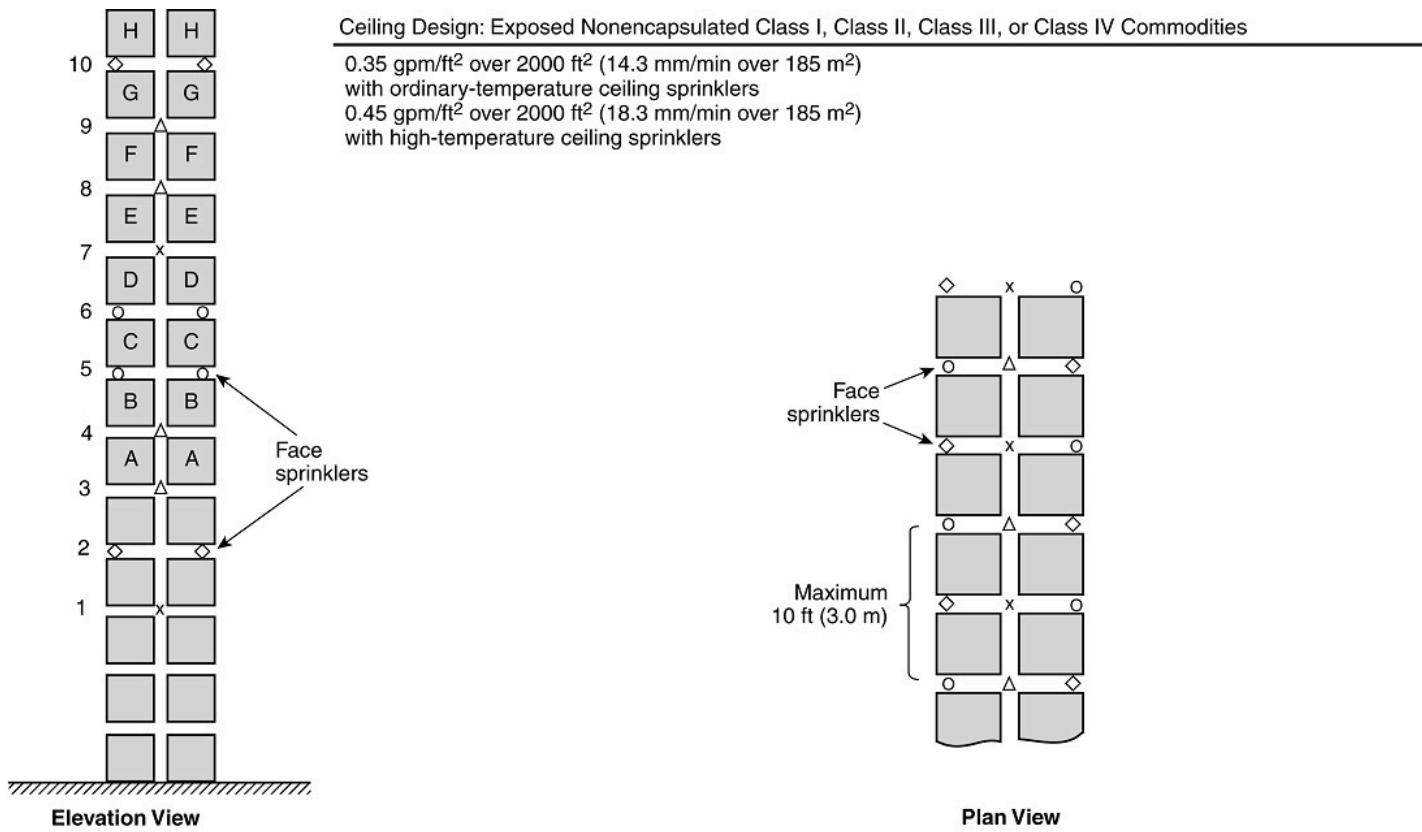
0.45 gpm/ft² over 2000 ft² (18.3 mm/min over 185 m²)

with high-temperature ceiling sprinklers

**Notes:**

- (1) In-rack sprinklers are ordinary-temperature-rated, quick- or standard-response, pendent or upright, minimum K-5.6 (K-80), and designed for a minimum of 10 in-rack sprinklers (five in-rack sprinklers on the top two levels) operating at 30 gpm (114 L/min).
- (2) Sprinkler 1 and Sprinkler 2 or Sprinkler 1, Sprinkler 2, and Sprinkler 3 are required where Load A represents the top of storage.
- (3) Sprinkler 1, Sprinkler 2, and Sprinkler 3 or Sprinkler 1, Sprinkler 2, and Sprinkler 4 are required where Load B represents the top of storage.
- (4) Sprinkler 1, Sprinkler 2, and Sprinkler 4 or Sprinkler 1, Sprinkler 2, Sprinkler 4, and Sprinkler 5 are required where Load C represents the top of storage.
- (5) Sprinkler 1, Sprinkler 2, Sprinkler 4, and Sprinkler 5 or Sprinkler 1, Sprinkler 2, Sprinkler 4, and Sprinkler 6 are required where Load D represents the top of storage.
- (6) For storage higher than represented by Load D, the cycle defined by Note 2 through Note 5 above is repeated.
- (7) The storage height above the top level of in-rack sprinklers is limited to a maximum of 10 ft (3.0 m).
- (8) In-rack sprinklers in the transverse flue space are permitted to be at any point between load faces.
- (9) The symbols X and O represent in-rack sprinklers that are to be staggered vertically.
- (10) Each square represents a storage cube measuring 4 ft to 5 ft (1.2 m to 1.5 m) on a side. Actual load heights can vary from approximately 18 in. to 10 ft (450 mm to 3.0 m). Therefore, there could be as few as one load or as many as six loads between in-rack sprinklers that are spaced 10 ft (3.0 m) apart vertically.

Figure 25.4.3.1.1.3(c) In-Rack Sprinkler Arrangements for Exposed Nonencapsulated Class I, Class II, Class III, or Class IV Commodities Stored Over 25 ft (7.6 m) in Height in Double-Row Racks — Option 1.

**Notes:**

- (1) In-rack sprinklers are ordinary-temperature-rated, quick- or standard-response, pendent or upright, minimum K-5.6 (K-80), and designed for a minimum of 10 in-rack sprinklers (five in-rack sprinklers on the top two levels) operating at 30 gpm (114 L/min).
- (2) Face sprinklers are to be a minimum of 3 in. (75 mm) from rack uprights and a maximum of 18 in. (450 mm) from the aisle face of storage.
- (3) Sprinkler 1 and Sprinkler 2 or Sprinkler 1, Sprinkler 2, and Sprinkler 3 are required where Load A represents the top of storage.
- (4) Sprinkler 1, Sprinkler 2, and Sprinkler 3 or Sprinkler 1, Sprinkler 2, and Sprinkler 4 are required where Load B represents the top of storage.
- (5) Sprinkler 1, Sprinkler 2, and Sprinkler 4 or Sprinkler 1, Sprinkler 2, Sprinkler 4, and Sprinkler 5 are required where Load C represents the top of storage.
- (6) Sprinkler 1, Sprinkler 2, Sprinkler 4, and Sprinkler 5 or Sprinkler 1, Sprinkler 2, Sprinkler 4, and Sprinkler 6 are required where Load D represents the top of storage.
- (7) Sprinkler 1, Sprinkler 2, Sprinkler 4, and Sprinkler 6 or Sprinkler 1, Sprinkler 2, Sprinkler 4, Sprinkler 6, and Sprinkler 7 are required where Load E represents the top of storage.
- (8) Sprinkler 1, Sprinkler 2, Sprinkler 4, Sprinkler 6, and Sprinkler 7 or Sprinkler 1, Sprinkler 2, Sprinkler 4, Sprinkler 6, Sprinkler 7, and Sprinkler 8 are required where Load F represents the top of storage.
- (9) Sprinkler 1, Sprinkler 2, Sprinkler 4, Sprinkler 6, Sprinkler 7, and Sprinkler 8 or Sprinkler 1, Sprinkler 2, Sprinkler 4, Sprinkler 6, Sprinkler 7, and Sprinkler 9 are required where Load G represents the top of storage.
- (10) Sprinkler 1, Sprinkler 2, Sprinkler 4, Sprinkler 6, Sprinkler 7, and Sprinkler 9 or Sprinkler 1, Sprinkler 2, Sprinkler 4, Sprinkler 6, Sprinkler 7, Sprinkler 9, and Sprinkler 10 are required where Load H represents the top of storage.
- (11) For storage higher than represented by Load H, the cycle defined by Note 3 through Note 10 above is repeated, with stagger as indicated.
- (12) The storage height above the top level of in-rack sprinklers is limited to a maximum of 10 ft (3.0 m).
- (13) The symbols X, O, \diamond , and Δ represent in-rack sprinklers that are to be staggered both horizontally and vertically.
- (14) Each square represents a storage cube measuring 4 ft to 5 ft (1.2 m to 1.5 m) on a side. Actual load heights can vary from approximately 18 in. to 10 ft (450 mm to 3.0 m). Therefore, there could be as few as one load or as many as 10 loads between in-rack sprinklers that are spaced 15 ft (4.6 m) apart vertically.

Figure 25.4.3.1.1.3(d) In-Rack Sprinkler Arrangements for Exposed Nonencapsulated Class I, Class II, Class III, or Class IV Commodities Stored Over 25 ft (7.6 m) in Height in Double-Row Racks — Option 2.

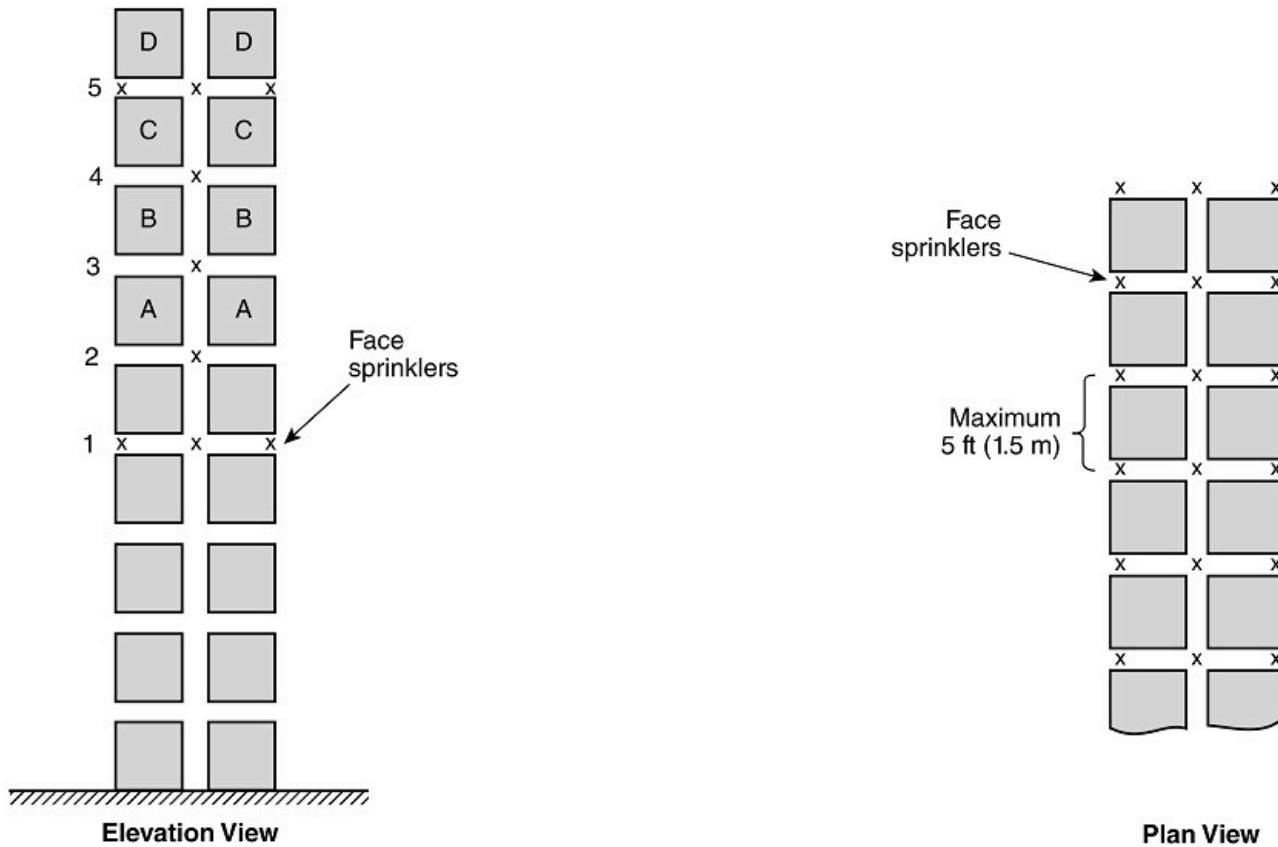
Ceiling Design: Exposed Nonencapsulated Class I through Class IV Commodities

0.35 gpm/ft² over 2000 ft² (15.1 mm/min over 185 m²)

with ordinary-temperature ceiling sprinklers

0.45 gpm/ft² over 2000 ft² (18.3 mm/min over 185 m²)

with high-temperature ceiling sprinklers

**Notes:**

- (1) In-rack sprinklers are ordinary-temperature-rated, quick- or standard-response, pendent or upright, minimum K-5.6 (K-80), and designed for a minimum of six in-rack sprinklers operating at 30 gpm (114 L/min) when only one level of in-rack sprinklers is installed or a minimum of 10 in-rack sprinklers (five in-rack sprinklers on the top two levels) operating at 30 gpm (114 L/min) when more than one level of in-rack sprinklers are installed.
- (2) Face sprinklers are to be a minimum of 3 in. (75 mm) from rack uprights and a maximum of 18 in. (450 mm) from the aisle face of storage.
- (3) Sprinkler 1 or Sprinkler 1 and Sprinkler 2 are required where Load A represents the top of storage.
- (4) Sprinkler 1 and Sprinkler 2 or Sprinkler 1 and Sprinkler 3 are required where Load B represents the top of storage.
- (5) Sprinkler 1 and Sprinkler 3 or Sprinkler 1 and Sprinkler 4 are required where Load C represents the top of storage.
- (6) Sprinkler 1 and Sprinkler 4 or Sprinkler 1 and Sprinkler 5 are required where Load D represents the top of storage.
- (7) For storage higher than represented by Load D, the cycle defined by Note 3 through Note 6 above is repeated.
- (8) The storage height above the top level of in-rack sprinklers is limited to a maximum of 10 ft (3.0 m).
- (9) The symbol X represents in-rack sprinklers.
- (10) Each square represents a storage cube measuring 4 ft to 5 ft (1.2 m to 1.5 m) on a side. Actual load heights can vary from approximately 18 in. to 10 ft (450 mm to 3.0 m). Therefore, there could be as few as two loads or as many as 13 loads between in-rack sprinklers that are spaced 20 ft (6.1 m) apart vertically.

Figure 25.4.3.1.1.3(e) In-Rack Sprinkler Arrangements for Exposed Nonencapsulated Class I, Class II, Class III, or Class IV Commodities Stored Over 25 ft (7.6 m) in Height in Double-Row Racks — Option 3.

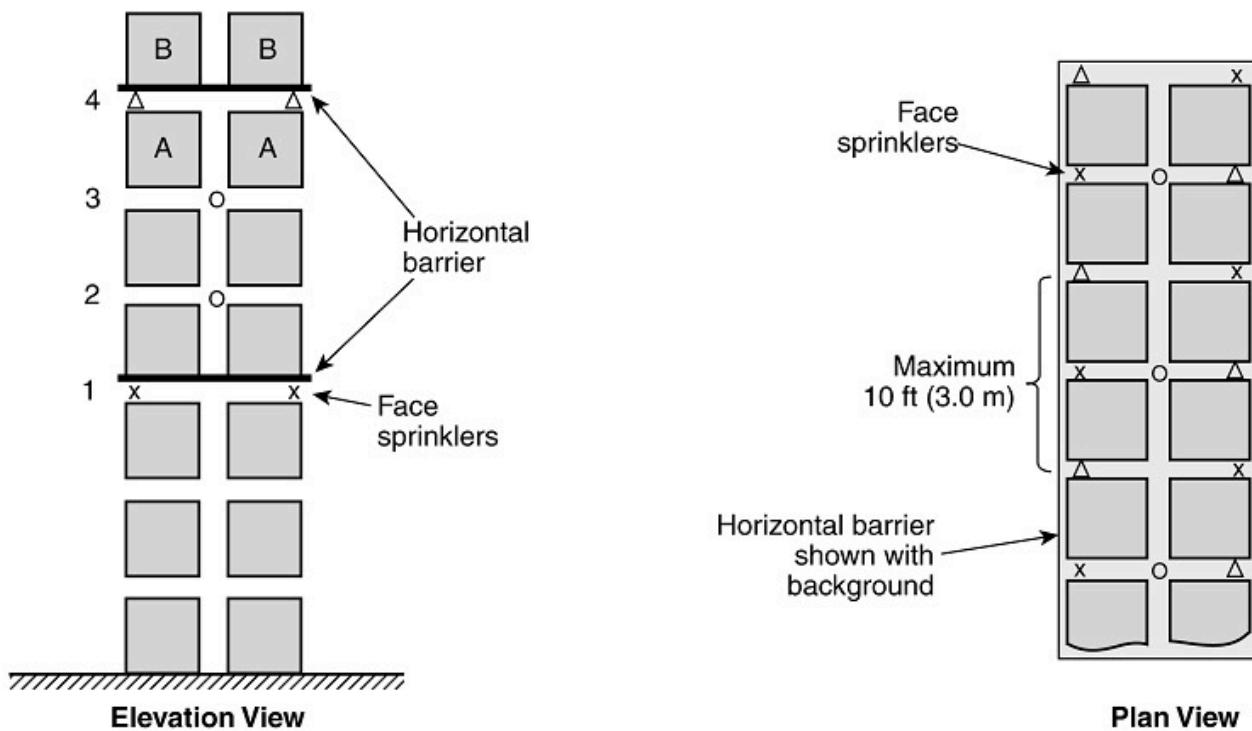
Ceiling Design: Exposed Nonencapsulated Class I, Class II, Class III, or Class IV Commodities

0.35 gpm/ft² over 2000 ft² (14.3 mm/min over 185 m²)

with ordinary-temperature ceiling sprinklers

0.45 gpm/ft² over 2000 ft² (18.3 mm/min over 185 m²)

with high-temperature ceiling sprinklers

**Notes:**

- (1) In-rack sprinklers are ordinary-temperature-rated, quick- or standard-response, pendent or upright, minimum K-5.6 (K-80), and designed for a minimum of 10 in-rack sprinklers (five in-rack sprinklers on the top two levels) operating at 30 gpm (114 L/min).
- (2) Face sprinklers are to be a minimum of 3 in. (75 mm) from rack uprights and a maximum of 18 in. (450 mm) from the aisle face of storage.
- (3) Sprinkler 1 and Sprinkler 2 or Sprinkler 1 and Sprinkler 3 are required where Load A represents the top of storage.
- (4) Sprinkler 1 and Sprinkler 3 or Sprinkler 1 and Sprinkler 4 are required where Load B represents the top of storage.
- (5) For storage higher than represented by Load B, the cycle defined by Note 3 and Note 4 above is repeated, with stagger as indicated.
- (6) The storage height above the top level of in-rack sprinklers is limited to a maximum of 10 ft (3.0 m).
- (7) The symbols X, O, and Δ represent in-rack sprinklers that are to be staggered both horizontally and vertically.
- (8) Each square represents a storage cube measuring 4 ft to 5 ft (1.2 m to 1.5 m) on a side. Actual load heights can vary from approximately 18 in. to 10 ft (450 mm to 3.0 m). Therefore, there could be as few as two loads or as many as 13 loads between in-rack sprinklers that are spaced 20 ft (6.1 m) apart vertically.

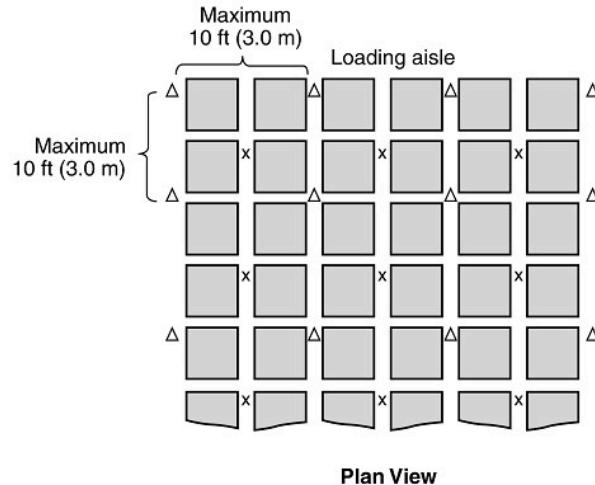
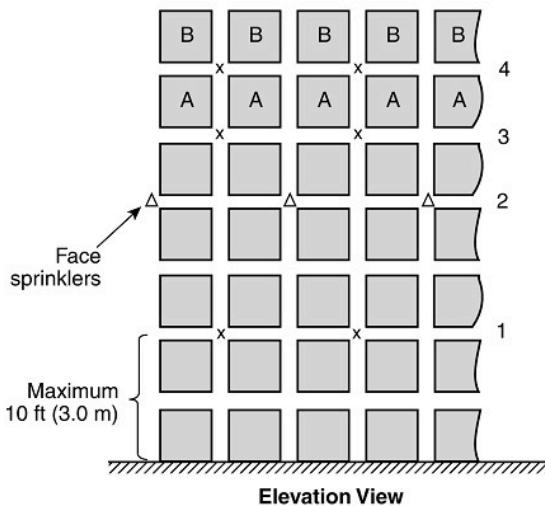
Figure 25.4.3.1.1.3(f) In-Rack Sprinkler Arrangements for Exposed Nonencapsulated Class I, Class II, Class III, or Class IV Commodities Stored Over 25 ft (7.6 m) in Height in Multiple-Row Racks.

Ceiling Design: Exposed Nonencapsulated Class I, Class II, Class III, or Class IV Commodities0.35 gpm/ft² over 2000 ft² (14.3 mm/min over 185 m²)

with ordinary-temperature ceiling sprinklers

0.45 gpm/ft² over 2000 ft² (18.3 mm/min over 185 m²)

with high-temperature ceiling sprinklers

**Notes:**

- (1) In-rack sprinklers are ordinary-temperature-rated, quick- or standard-response, pendent or upright, minimum K-5.6 (K-80), and designed for a minimum of 10 in-rack sprinklers (five in-rack sprinklers on the top two levels) operating at 30 gpm (114 L/min).
- (2) Face sprinklers are to be a minimum of 3 in. (75 mm) from rack uprights and a maximum of 18 in. (450 mm) from the aisle face to storage.
- (3) Sprinkler 1, Sprinkler 2, and Sprinkler 3 are required where Load A represents the top of storage.
- (4) Sprinkler 1, Sprinkler 2, and Sprinkler 4 are required where Load B represents the top of storage.
- (5) For storage higher than represented by Load B, the cycle defined by Note 3 and Note 4 above is repeated, with stagger as indicated.
- (6) The storage height above the top level of in-rack sprinklers is limited to a maximum of 5 ft (1.5 m).
- (7) The symbols X and Δ represent in-rack sprinklers that are to be staggered both horizontally and vertically.
- (8) Each square represents a storage cube measuring 4 ft to 5 ft (1.2 m to 1.5 m) on a side. Actual load heights can vary from approximately 18 in. to 10 ft (450 mm to 3.0 m). Therefore, there could be as few as one load or as many as six loads between in-rack sprinklers that are spaced 10 ft (3.1 m) apart vertically.

25.4.3.1.1.4

The in-rack sprinkler arrangements of 25.4.3.1.1.1 through 25.4.3.1.1.3 for single- and double-row racks shall result in a maximum storage height of 10 ft (3.0 m) above the top level of in-rack sprinklers.

25.4.3.1.1.5

The in-rack sprinkler arrangements of 25.4.3.1.1.1 through 25.4.3.1.1.3 for multiple-row racks shall result in a maximum storage height of 10 ft (3.0 m) above the top level of in-rack sprinklers for Class I, Class II, or Class III commodities, and a maximum storage height of 5 ft (1.5 m) for Class IV commodities.

25.4.3.1.1.6 Excessive Clearance to Ceiling.**(A) ***

Where the clearance to ceiling exceeds 10 ft (3.0 m), the in-rack sprinkler arrangements required for the protection of exposed nonencapsulated Class I, Class II, Class III, or Class IV commodities shall be supplemented with one level of supplemental quick-response in-rack sprinklers installed directly below the top tier of storage and at every flue space intersection.

(B)

Where supplemental in-rack sprinklers have been installed in accordance with 25.4.3.1.1.6(A), the required ceiling-level sprinkler system design shall be based on a ceiling clearance of 10 ft (3.0 m).

25.4.3.1.2 * CMDA Ceiling-Level Sprinkler Designs for Exposed Nonencapsulated Class I, Class II, Class III, or Class IV Commodities Stored Over 25 ft (7.6 m) in Height in Combination with In-Rack Sprinklers.**25.4.3.1.2.1**

Where rack storage of exposed nonencapsulated Class I commodities stored over 25 ft (7.6 m) in height will be protected by in-rack sprinklers, the ceiling-level sprinkler design in terms of density [gpm/ft² (mm/min)] and area of sprinkler operation [ft² (m²) of ceiling or roof sprinklers] shall be in accordance with Figure 25.4.3.1.1.1(a) through Figure 25.4.3.1.1.1(f).

25.4.3.1.2.2

Where rack storage of exposed nonencapsulated Class II or Class III commodities stored over 25 ft (7.6 m) in height will be protected by in-rack sprinklers, the ceiling-level sprinkler design in terms of density [gpm/ft²(mm/min)] and area of sprinkler operation [ft² (m²) of ceiling or roof sprinklers] shall be in accordance with Figure 25.4.3.1.1.2(a) through Figure 25.4.3.1.1.2(g).

25.4.3.1.2.3

Where rack storage of exposed nonencapsulated Class IV commodities stored over 25 ft (7.6 m) in height will be protected by in-rack sprinklers, the ceiling-level sprinkler design in terms of density [gpm/ft² (mm/min)] and area of sprinkler operation [ft² (m²) of ceiling or roof sprinklers] shall be in accordance with Figure 25.4.3.1.1.3(a) through Figure 25.4.3.1.1.3(f).

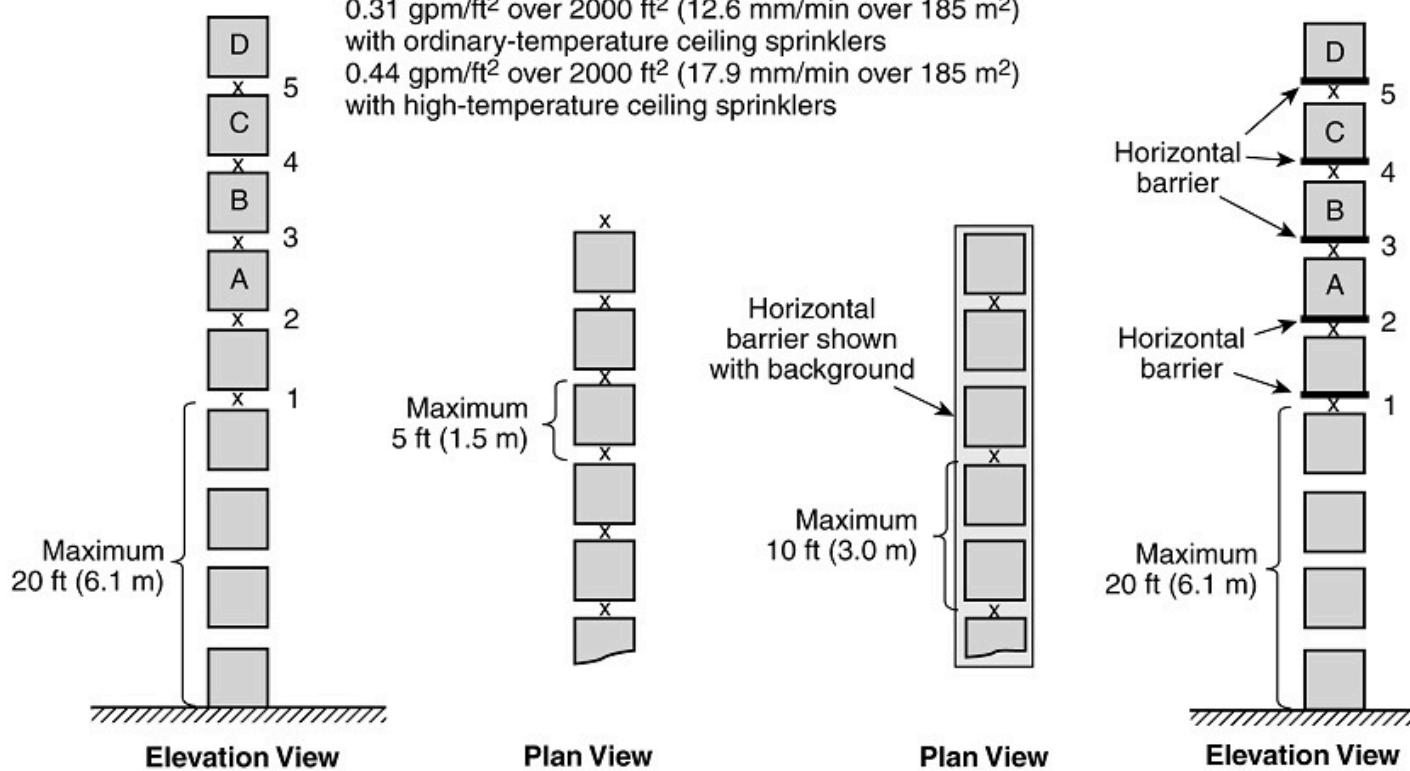
25.4.3.2 Exposed Encapsulated, or Cartoned (Nonencapsulated or Encapsulated) Class I, Class II, Class III, or Class IV Commodities.

25.4.3.2.1 In-Rack Sprinkler Arrangements and Designs for Exposed Encapsulated, or Cartoned (Nonencapsulated or Encapsulated) Class I, Class II, Class III, or Class IV Commodities Stored Over 25 ft (7.6 m) in Height.

25.4.3.2.1.1

Where rack storage of exposed encapsulated, or cartoned (nonencapsulated or encapsulated) Class I commodities stored over 25 ft (7.6 m) in height will be protected by in-rack sprinklers, in-rack sprinkler arrangements and designs shall be selected from Figure 25.4.3.2.1.1(a) through Figure 25.4.3.2.1.1(f). (See Section 25.3 for racks with solid shelving. See also Section C.23.)

Figure 25.4.3.2.1.1(a) In-Rack Sprinkler Arrangements for Exposed Encapsulated, or Cartoned (Nonencapsulated or Encapsulated) Class I Commodities Stored Over 25 ft (7.6 m) in Height in Single-Row Racks.

Ceiling Design: Exposed Encapsulated or Cartoned Class I Commodities**Notes:**

- (1) In-rack sprinklers are ordinary-temperature-rated, quick- or standard-response, pendent or upright, minimum K-5.6 (K-80), and designed for a minimum of six in-rack sprinklers operating at 30 gpm (114 L/min) when only one level of in-rack is installed or a minimum of 10 in-rack sprinklers (five in-rack sprinklers on the top two levels) operating at 30 gpm (114 L/min) when more than one level of in-rack sprinklers are installed.
- (2) Sprinkler 1 or Sprinkler 1 and Sprinkler 2 are required when Load A represents the top of storage.
- (3) Sprinkler 1 and Sprinkler 2 or Sprinkler 1 and Sprinkler 3 are required where Load B represents the top of storage.
- (4) Sprinkler 1 and Sprinkler 3 or Sprinkler 1 and Sprinkler 4 are required where Load C represents the top of storage.
- (5) Sprinkler 1 and Sprinkler 4 or Sprinkler 1 and Sprinkler 5 are required where Load D represents the top of storage.
- (6) For storage higher than represented by Load D, the cycle defined by Note 2 through Note 5 above is repeated.
- (7) The storage height above the top level of in-rack sprinklers is limited to a maximum of 10 ft (3.0 m).
- (8) In-rack sprinklers in the transverse flue space are permitted to be at any point between load faces.
- (9) The symbol X represents in-rack sprinklers.
- (10) Each square represents a storage cube measuring 4 ft to 5 ft (1.2 m to 1.5 m) on a side. Actual load heights can vary from approximately 18 in. to 10 ft (450 mm to 3.0 m). Therefore, there could be as few as two loads or as many as 13 loads between in-rack sprinklers that are spaced 20 ft (6.1 m) apart vertically.

Figure 25.4.3.2.1.1(b) In-Rack Sprinkler Arrangements for Exposed Encapsulated, or Cartoned (Nonencapsulated or Encapsulated) Class I Commodities Stored Over 25 ft (7.6 m) and Up to 30 ft (9.1 m) in Height in Double-Row Racks — Option 1.

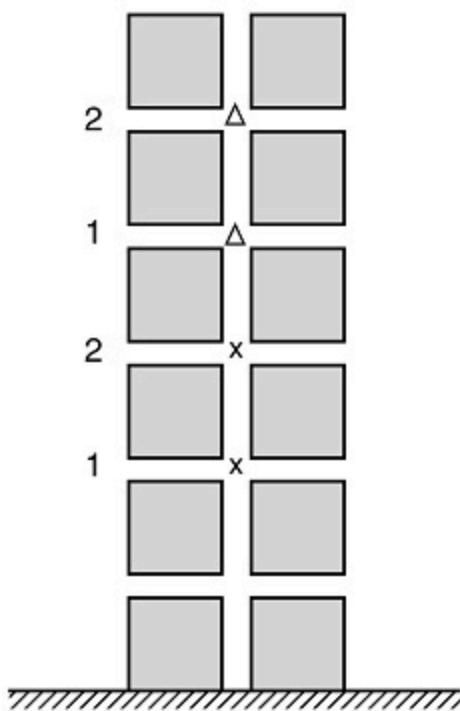
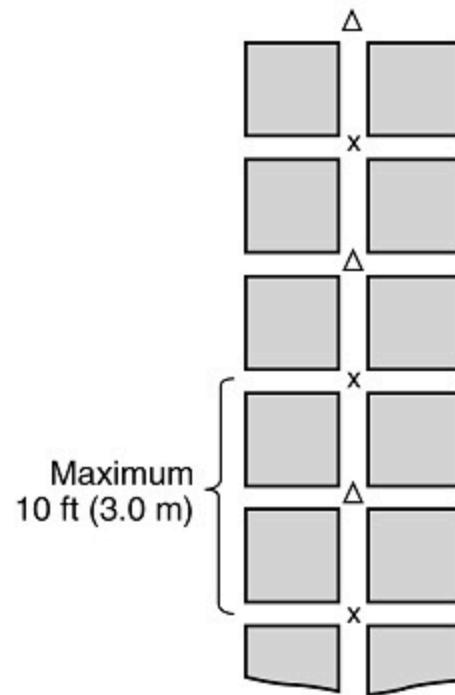
Ceiling Design: Exposed Encapsulated or Cartoned Class I Commodities

0.31 gpm/ft² over 2000 ft² (12.6 mm/min over 185 m²)

with ordinary-temperature ceiling sprinklers

0.44 gpm/ft² over 2000 ft² (17.9 mm/min over 185 m²)

with high-temperature ceiling sprinklers

**Elevation View****Plan View****Notes:**

- (1) In-rack sprinklers are ordinary-temperature-rated, quick- or standard-response, pendent or upright, minimum K-5.6 (K-80), and designed for a minimum of 10 in-rack sprinklers (five in-rack sprinklers on two levels) operating at 30 gpm (114 L/min).
- (2) Sprinkler 1 or Sprinkler 2 is required where the maximum storage height is 30 ft (9.1 m).
- (3) The storage height above the top level of in-rack sprinklers is limited to a maximum of 10 ft (3.0 m).
- (4) The symbols X and Δ represent in-rack sprinklers that are to be staggered both horizontally and vertically.
- (5) Each square represents a storage cube measuring 4 ft to 5 ft (1.2 m to 1.5 m) on a side. Actual load heights can vary from approximately 18 in. to 10 ft (450 mm to 3.0 m). Therefore, there could be as few as one load or as many as six loads between in-rack sprinklers that are spaced 10 ft (3.0 m) apart vertically.

Figure 25.4.3.2.1.1(c) In-Rack Sprinkler Arrangements for Exposed Encapsulated, or Cartoned (Nonencapsulated or Encapsulated) Class I Commodities Stored Over 25 ft (7.6 m) and Up to 30 ft (9.1 m) in Height in Double-Row Racks — Option 2.

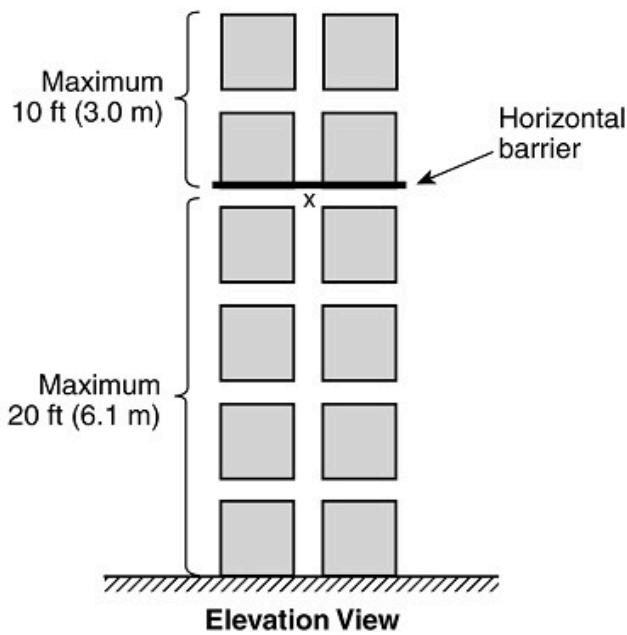
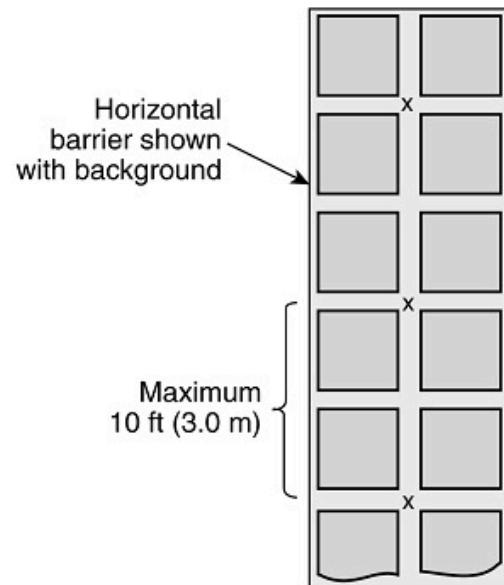
Ceiling Design: Exposed Encapsulated or Cartoned Class I Commodities

0.31 gpm/ft² over 2000 ft² (12.6 mm/min over 185 m²)

with ordinary-temperature ceiling sprinklers

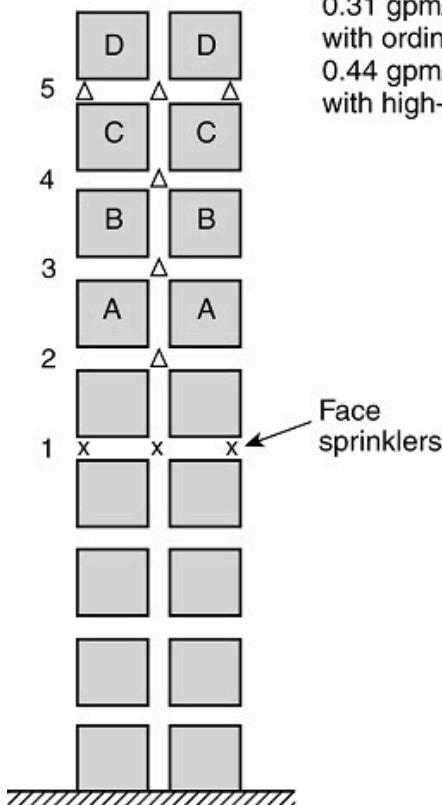
0.44 gpm/ft² over 2000 ft² (17.9 mm/min over 185 m²)

with high-temperature ceiling sprinklers

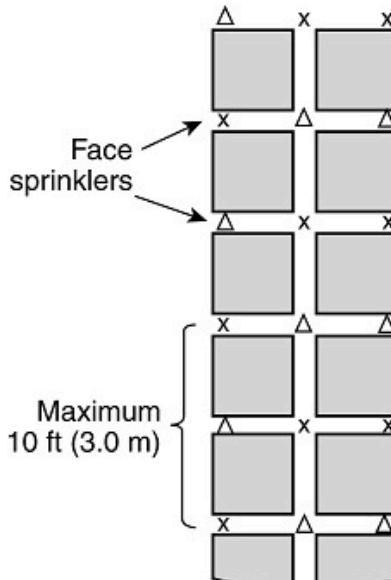
**Elevation View****Plan View****Notes:**

- (1) In-rack sprinklers are ordinary-temperature-rated, quick- or standard-response, pendent or upright, minimum K-5.6 (K-80), and designed for a minimum of six in-rack sprinklers operating at 30 gpm (114 L/min).
- (2) The storage height above the top level of in-rack sprinklers is limited to a maximum of 10 ft (3.0 m).
- (3) The symbol X represents in-rack sprinklers.
- (4) Each square represents a storage cube measuring 4 ft to 5 ft (1.2 m to 1.5 m) on a side. Actual load heights can vary from approximately 18 in. to 10 ft (450 mm to 3.0 m). Therefore, there could be as few as two loads or as many as 13 loads between in-rack sprinklers that are spaced 20 ft (6.1 m) apart vertically.

Figure 25.4.3.2.1.1(d) In-Rack Sprinkler Arrangements for Exposed Encapsulated, or Cartoned (Nonencapsulated or Encapsulated) Class I Commodities Stored Over 25 ft (7.6 m) in Height in Double-Row Racks — Option 1.

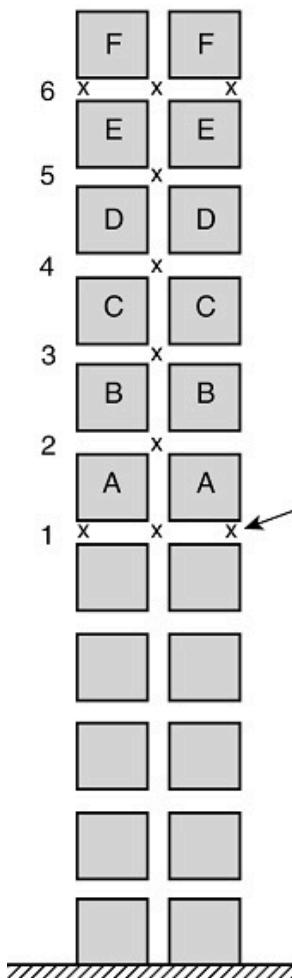
Ceiling Design: Exposed Encapsulated or Cartoned Class I Commodities

0.31 gpm/ft² over 2000 ft² (12.6 mm/min over 185 m²)
with ordinary-temperature ceiling sprinklers
0.44 gpm/ft² over 2000 ft² (17.9 mm/min over 185 m²)
with high-temperature ceiling sprinklers

**Notes:**

- (1) In-rack sprinklers are ordinary-temperature-rated, quick- or standard-response, pendent or upright, minimum K-5.6 (K-80), and designed for a minimum of 10 in-rack sprinklers (five in-rack sprinklers on top two levels) operating at 30 gpm (114 L/min).
- (2) Face sprinklers are to be a minimum of 3 in. (75 mm) from rack uprights and a maximum of 18 in. (450 mm) from the aisle face of storage.
- (3) Sprinkler 1 or Sprinkler 1 and Sprinkler 2 are required where Load A represents the top of storage.
- (4) Sprinkler 1 and Sprinkler 2 or Sprinkler 1 and Sprinkler 3 are required where Load B represents the top of storage.
- (5) Sprinkler 1 and Sprinkler 3 or Sprinkler 1 and Sprinkler 4 are required where Load C represents the top of storage.
- (6) Sprinkler 1 and Sprinkler 4 or Sprinkler 1 and Sprinkler 5 are required where Load D represents the top of storage.
- (7) For storage higher than represented by Load D, the cycle defined by Note 3 through Note 6 above is repeated.
- (8) The storage height above the top level of in-rack sprinklers is limited to a maximum of 10 ft (3.0 m).
- (9) The symbols X and Δ represent in-rack sprinklers that are to be staggered both horizontally and vertically.
- (10) Each square represents a storage cube measuring 4 ft to 5 ft (1.2 m to 1.5 m) on a side. Actual load heights can vary from approximately 18 in. to 10 ft (450 mm to 3.0 m). Therefore, there could be as few as two loads or as many as 13 loads between in-rack sprinklers that are spaced 20 ft (6.1 m) apart vertically.

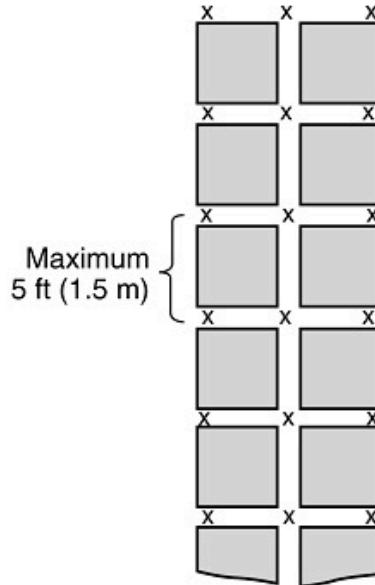
Figure 25.4.3.2.1.1(e) In-Rack Sprinkler Arrangements for Exposed Encapsulated, or Cartoned (Nonencapsulated or Encapsulated) Class I Commodities Stored Over 25 ft (7.6 m) in Height in Double-Row Racks — Option 2.

**Elevation View****Ceiling Design: Exposed Encapsulated or Cartoned Class I Commodities**0.31 gpm/ft² over 2000 ft² (12.6 mm/min over 185 m²)

with ordinary-temperature ceiling sprinklers

0.44 gpm/ft² over 2000 ft² (17.9 mm/min over 185 m²)

with high-temperature ceiling sprinklers

**Plan View****Notes:**

- (1) In-rack sprinklers are ordinary-temperature-rated, quick- or standard-response, pendent or upright, minimum K-5.6 (K-80), and designed for a minimum of six in-rack sprinklers operating at 30 gpm (114 L/min) when only one level of in-rack sprinklers is installed or a minimum of 10 in-rack sprinklers (five in-rack sprinklers on the top two levels) operating at 30 gpm (114 L/min) when more than one level of in-rack sprinklers are installed.
- (2) Face sprinklers are to be a minimum of 3 in. (75 mm) from rack uprights and a maximum of 18 in. (450 mm) from the aisle face to storage.
- (3) Sprinkler 1 is required where Load A represents the top of storage.
- (4) Sprinkler 1 or Sprinkler 1 and Sprinkler 2 are required where Load B represents the top of storage.
- (5) Sprinkler 1 and Sprinkler 2 or Sprinkler 1 and Sprinkler 3 are required where Load C represents the top of storage.
- (6) Sprinkler 1 and Sprinkler 3 or Sprinkler 1 and Sprinkler 4 are required where Load D represents the top of storage.
- (7) Sprinkler 1 and Sprinkler 4 or Sprinkler 1 and Sprinkler 5 are required where Load E represents the top of storage.
- (8) Sprinkler 1 and Sprinkler 5 or Sprinkler 1 and Sprinkler 6 are required where Load F represents the top of storage.
- (9) For storage higher than represented by Load F, the cycle defined by Note 3 through Note 8 above is repeated.
- (10) The storage height above the top level of in-rack sprinklers is limited to a maximum of 10 ft (3.0 m).
- (11) The symbol X represents in-rack sprinklers.
- (12) Each square represents a storage cube measuring 4 ft to 5 ft (1.2 m to 1.5 m) on a side. Actual load heights can vary from approximately 18 in. to 10 ft (450 mm to 3.0 m). Therefore, there could be as few as two loads or as many as 16 loads between in-rack sprinklers that are spaced 25 ft (7.6 m) apart vertically.

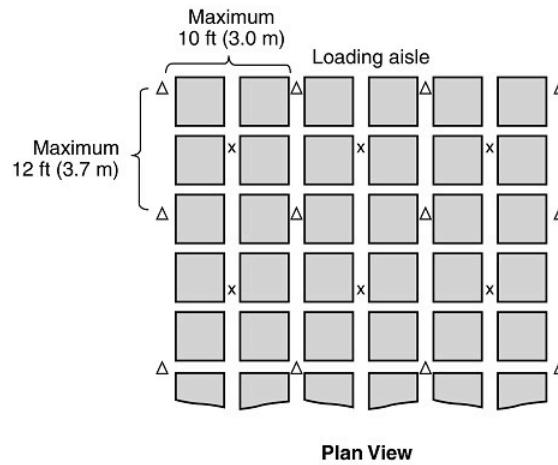
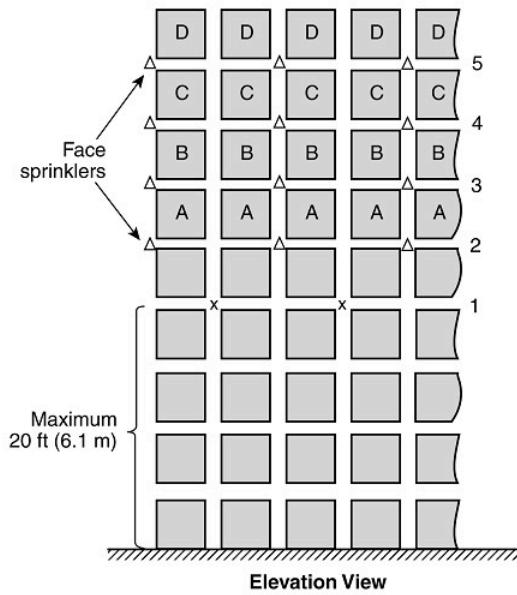
Figure 25.4.3.2.1.1(f) In-Rack Sprinkler Arrangements for Exposed Encapsulated, or Cartoned (Nonencapsulated or Encapsulated) Class I Commodities Stored Over 25 ft (7.6 m) in Height in Multiple-Row Racks.

Ceiling Design: Exposed Encapsulated or Cartoned Class I Commodities0.31 gpm/ft² over 2000 ft² (12.6 mm/min over 185 m²)

with ordinary-temperature ceiling sprinklers

0.44 gpm/ft² over 2000 ft² (17.9 mm/min over 185 m²)

with high-temperature ceiling sprinklers

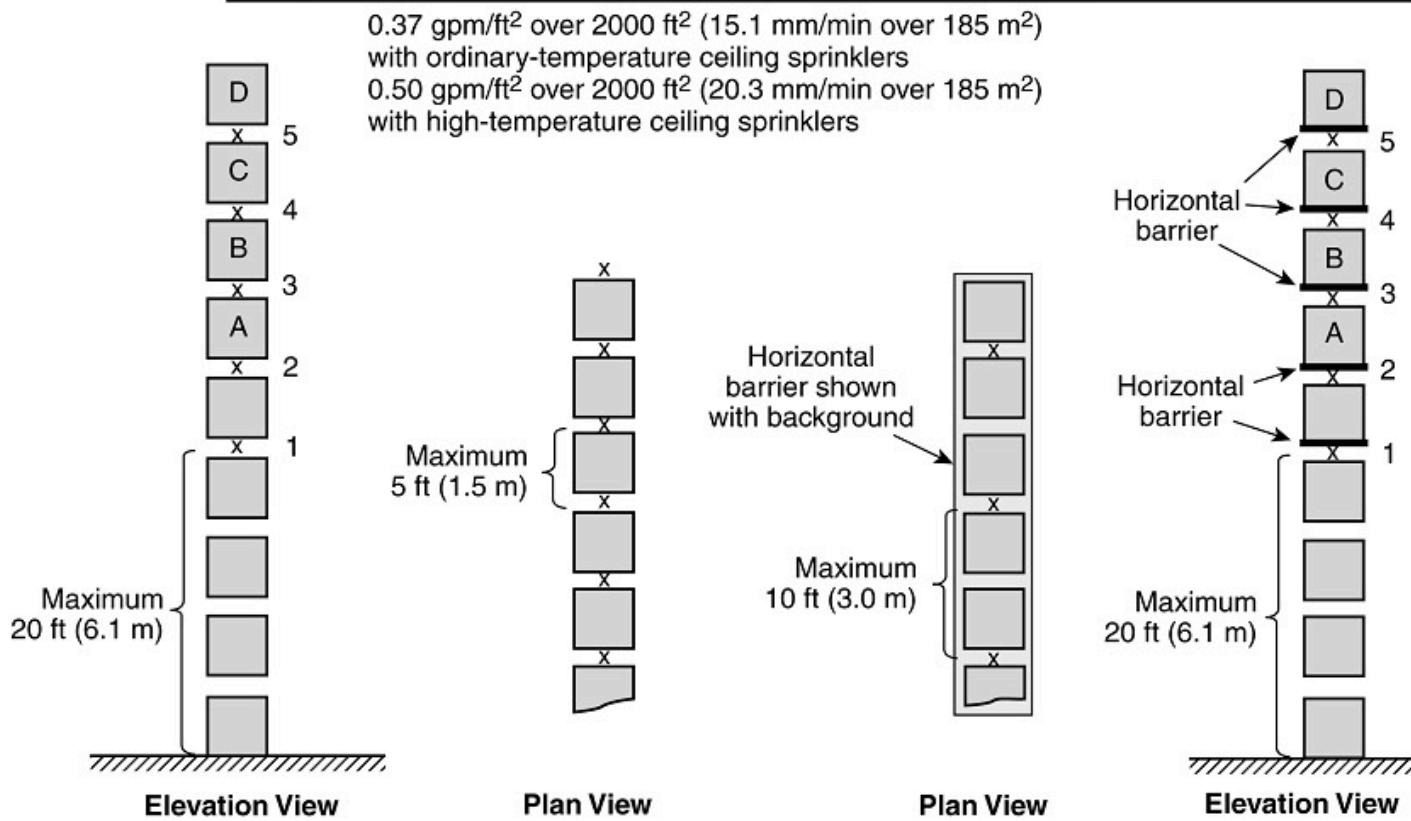
**Notes:**

- (1) In-rack sprinklers are ordinary-temperature-rated, quick- or standard-response, pendent or upright, minimum K-5.6 (K-80), and designed for a minimum of six in-rack sprinklers operating at 30 gpm (114 L/min) when only one level of in-rack sprinklers is installed or a minimum of 10 in-rack sprinklers (five in-rack sprinklers on the top two levels) operating at 30 gpm (114 L/min) when more than one level of in-rack sprinklers are installed.
- (2) Face sprinklers are to be a minimum of 3 in. (75 mm) from rack uprights and a maximum of 18 in. (450 mm) from the aisle face to storage.
- (3) Sprinkler 1 or Sprinkler 1 and Sprinkler 2 are required where Load A represents the top of storage.
- (4) Sprinkler 1 and Sprinkler 2 or Sprinkler 1 and Sprinkler 3 are required where Load B represents the top of storage.
- (5) Sprinkler 1 and Sprinkler 3 or Sprinkler 1 and Sprinkler 4 are required where Load C represents the top of storage.
- (6) Sprinkler 1 and Sprinkler 4 or Sprinkler 1 and Sprinkler 5 are required where Load D represents the top of storage.
- (7) For storage higher than represented by Load D, the cycle defined by Note 3 through Note 6 above is repeated.
- (8) The storage height above the top level of in-rack sprinklers is limited to a maximum of 10 ft (3.0 m).
- (9) The symbols X and Δ represent in-rack sprinklers that are to be staggered both horizontally and vertically.
- (10) Each square represents a storage cube measuring 4 ft to 5 ft (1.2 m to 1.5 m) on a side. Actual load heights can vary from approximately 18 in. to 10 ft (450 mm to 3.0 m). Therefore there could be as few as two loads or as many as 13 loads between in-rack sprinklers that are spaced 20 ft (6.1 m) apart vertically.

25.4.3.2.1.2

Where rack storage of exposed encapsulated, or cartoned (nonencapsulated or encapsulated) Class II or Class III commodities stored over 25 ft (7.6 m) in height will be protected by in-rack sprinklers, in-rack sprinkler arrangements and designs shall be selected from Figure 25.4.3.2.1.2(a) through Figure 25.4.3.2.1.2(g). (See Section 25.3 for racks with solid shelving.)

Figure 25.4.3.2.1.2(a) In-Rack Sprinkler Arrangements for Encapsulated Exposed, or Cartoned (Nonencapsulated or Encapsulated) Class I, Class II, or Class III Commodities Stored Over 25 ft (7.6 m) in Height in Single-Row Racks.

Ceiling Design: Exposed Encapsulated or Cartoned Class I, Class II, or Class III Commodities**Notes:**

- (1) In-rack sprinklers are ordinary-temperature-rated, quick- or standard-response, pendent or upright, minimum K-5.6 (K-80), and designed for a minimum of six in-rack sprinklers operating at 30 gpm (114 L/min) when only one level of in-rack is installed or a minimum of 10 in-rack sprinklers (five in-rack sprinklers on the top two levels) operating at 30 gpm (114 L/min) when more than one level of in-rack sprinklers are installed.
- (2) Sprinkler 1 or Sprinkler 1 and Sprinkler 2 are required when Load A represents the top of storage.
- (3) Sprinkler 1 and Sprinkler 2 or Sprinkler 1 and Sprinkler 3 are required where Load B represents the top of storage.
- (4) Sprinkler 1 and Sprinkler 3 or Sprinkler 1 and Sprinkler 4 are required where Load C represents the top of storage.
- (5) Sprinkler 1 and Sprinkler 4 or Sprinkler 1 and Sprinkler 5 are required where Load D represents the top of storage.
- (6) For storage higher than represented by Load D, the cycle defined by Note 2 through Note 5 above is repeated.
- (7) The storage height above the top level of in-rack sprinklers is limited to a maximum of 10 ft (3.0 m).
- (8) In-rack sprinklers in the transverse flue space are permitted to be at any point between load faces.
- (9) The symbol X represents in-rack sprinklers.
- (10) Each square represents a storage cube measuring 4 ft to 5 ft (1.2 m to 1.5 m) on a side. Actual load heights can vary from approximately 18 in. to 10 ft (450 mm to 3.0 m). Therefore, there could be as few as two loads or as many as 13 loads between in-rack sprinklers that are spaced 20 ft (6.1 m) apart vertically.

Figure 25.4.3.2.1.2(b) In-Rack Sprinkler Arrangements for Encapsulated Exposed, or Cartoned (Nonencapsulated or Encapsulated) Class I, Class II, or Class III Commodities Stored Over 25 ft (7.6 m) and Up to 30 ft (9.1 m) in Height in Double-Row Racks.

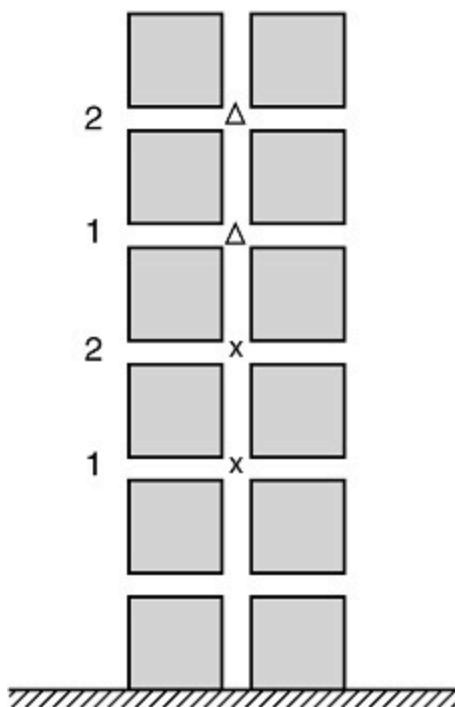
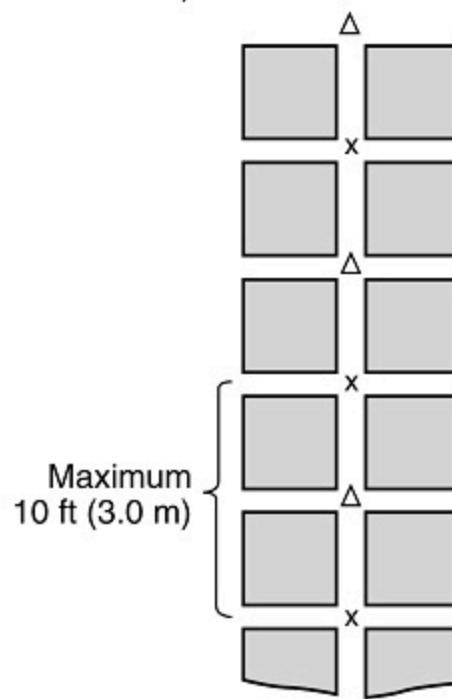
Ceiling Design: Exposed Encapsulated or Cartoned Class I, Class II, or Class III Commodities

0.37 gpm/ft² over 2000 ft² (15.1 mm/min over 185 m²)

with ordinary-temperature ceiling sprinklers

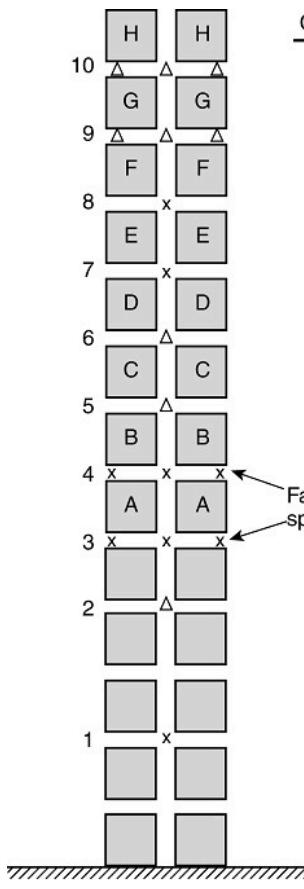
0.50 gpm/ft² over 2000 ft² (20.4 mm/min over 185 m²)

with high-temperature ceiling sprinklers

**Elevation View****Plan View****Notes:**

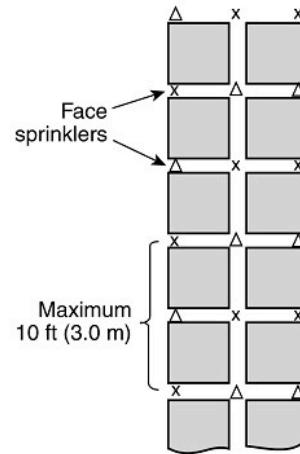
- (1) In-rack sprinklers are ordinary-temperature-rated, quick- or standard-response, pendent or upright, minimum K-5.6 (K-80), and designed for a minimum of 10 in-rack sprinklers (five in-rack sprinklers on two levels) operating at 30 gpm (114 L/min).
- (2) Sprinkler 1 or Sprinkler 2 is required where the maximum storage height is 30 ft (9.1 m).
- (3) The storage height above the top level of in-rack sprinklers is limited to a maximum of 10 ft (3.0 m).
- (4) The symbols X and Δ represent in-rack sprinklers that are to be staggered both horizontally and vertically.
- (5) Each square represents a storage cube measuring 4 ft to 5 ft (1.2 m to 1.5 m) on a side. Actual load heights can vary from approximately 18 in. to 10 ft (450 mm to 3.0 m). Therefore, there could be as few as one load or as many as six loads between in-rack sprinklers that are spaced 10 ft (3.0 m) apart vertically.

Figure 25.4.3.2.1.2(c) In-Rack Sprinkler Arrangements for Encapsulated Exposed, or Cartoned (Nonencapsulated or Encapsulated) Class I, Class II, or Class III Commodities Stored Over 25 ft (7.6 m) in Height in Double-Row Racks — Option 1.



Ceiling Design: Exposed Encapsulated or Cartoned Class I, Class II, or Class III Commodities

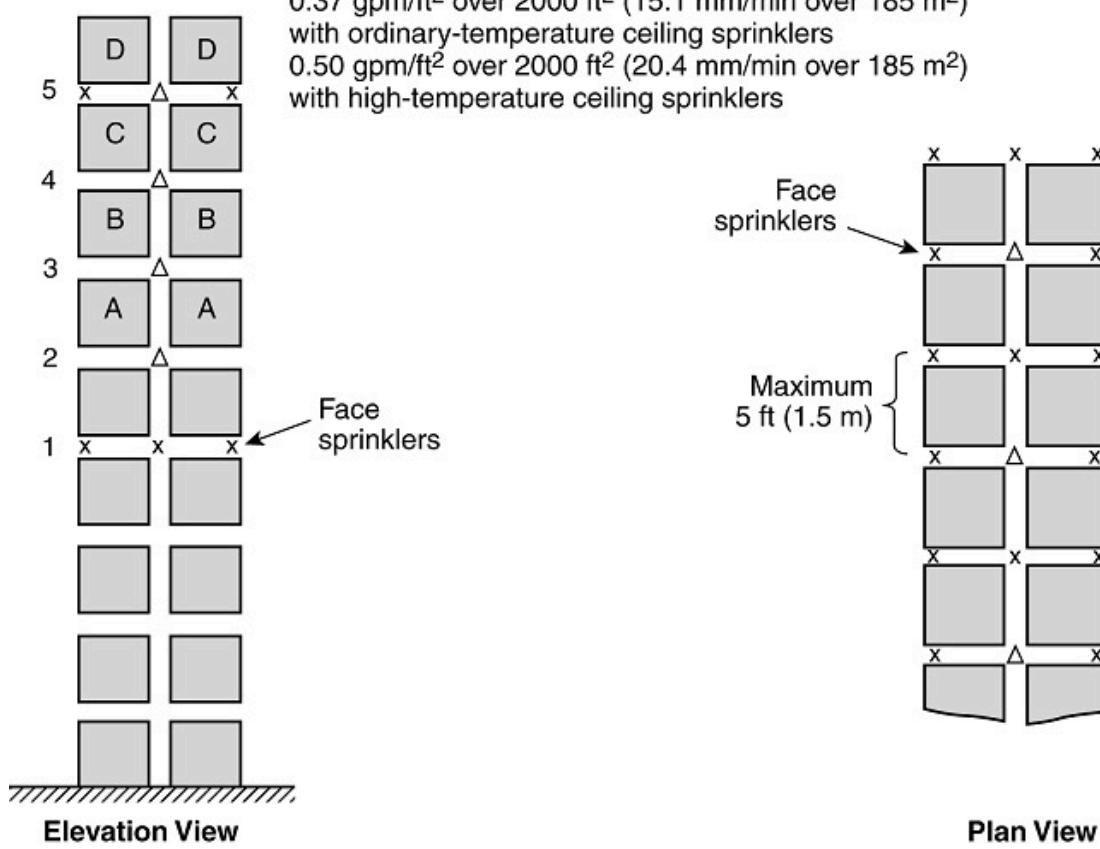
0.37 gpm/ft² over 2000 ft² (15.1 mm/min over 185 m²)
with ordinary-temperature ceiling sprinklers
0.50 gpm/ft² over 2000 ft² (20.4 mm/min over 185 m²)
with high-temperature ceiling sprinklers



Notes:

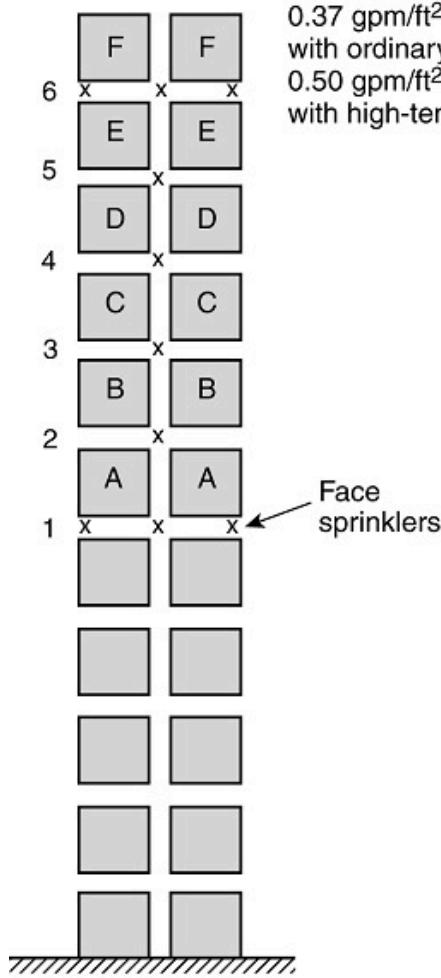
- (1) In-rack sprinklers are ordinary-temperature-rated, quick- or standard-response, pendent or upright, minimum K-5.6 (K-80), and designed for a minimum of 10 in-rack sprinklers (five in-rack sprinklers on the top two levels) operating at 30 gpm (114 L/min).
- (2) Face sprinklers are to be a minimum of 3 in. (75 mm) from rack uprights and a maximum of 18 in. (450 mm) from the aisle face of storage.
- (3) Sprinkler 1 and Sprinkler 2 or Sprinkler 1, Sprinkler 2, and Sprinkler 3 are required where Load A represents the top of storage.
- (4) Sprinkler 1, Sprinkler 2, and Sprinkler 3 or Sprinkler 1, Sprinkler 2, and Sprinkler 4 are required where Load B represents the top of storage.
- (5) Sprinkler 1, Sprinkler 2, and Sprinkler 4 or Sprinkler 1, Sprinkler 2, Sprinkler 4, and Sprinkler 5 are required where Load C represents the top of storage.
- (6) Sprinkler 1, Sprinkler 2, Sprinkler 4, and Sprinkler 5 or Sprinkler 1, Sprinkler 2, Sprinkler 4, and Sprinkler 6 are required where Load D represents the top of storage.
- (7) Sprinkler 1, Sprinkler 2, Sprinkler 4, and Sprinkler 6 or Sprinkler 1, Sprinkler 2, Sprinkler 4, and Sprinkler 7 are required where Load E represents the top of storage.
- (8) Sprinkler 1, Sprinkler 2, Sprinkler 4, Sprinkler 6, and Sprinkler 7 or Sprinkler 1, Sprinkler 2, Sprinkler 4, Sprinkler 6, and Sprinkler 8 are required where Load F represents the top of storage.
- (9) Sprinkler 1, Sprinkler 2, Sprinkler 4, Sprinkler 6, and Sprinkler 8 or Sprinkler 1, Sprinkler 2, Sprinkler 4, Sprinkler 6, Sprinkler 8, and Sprinkler 9 are required where Load G represents the top of storage.
- (10) Sprinkler 1, Sprinkler 2, Sprinkler 4, Sprinkler 6, Sprinkler 8, and Sprinkler 9 or Sprinkler 1, Sprinkler 2, Sprinkler 4, Sprinkler 6, Sprinkler 8, and Sprinkler 10 are required where Load H represents the top of storage.
- (11) For storage higher than represented by Load H, the cycle defined by Note 3 through Note 10 above is repeated, with stagger as indicated.
- (12) The storage height above the top level of in-rack sprinklers is limited to a maximum of 10 ft (3.0 m).
- (13) The symbols X and Δ represent in-rack sprinklers that are to be staggered both horizontally and vertically.
- (14) Each square represents a storage cube measuring 4 ft to 5 ft (1.2 m to 1.5 m) on a side. Actual load heights can vary from approximately 18 in. to 10 ft (450 mm to 3.0 m). Therefore, there could be as few as one load or as many as six loads between in-rack sprinklers that are spaced 10 ft (3.0 m) apart vertically.

Figure 25.4.3.2.1.2(d) In-Rack Sprinkler Arrangements for Encapsulated Exposed, or Cartoned (Nonencapsulated or Encapsulated) Class I, Class II, or Class III Commodities Stored Over 25 ft (7.6 m) in Height in Double-Row Racks — Option 2.

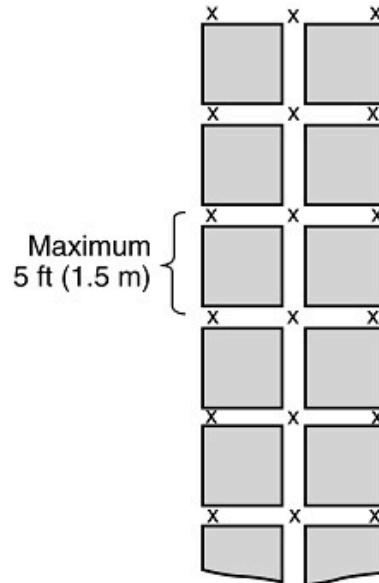
Ceiling Design: Exposed Encapsulated or Cartoned Class I, Class II, or Class III Commodities**Notes:**

- (1) In-rack sprinklers are ordinary-temperature-rated, quick- or standard-response, pendent or upright, minimum K-5.6 (K-80), and designed for a minimum of six in-rack sprinklers operating at 30 gpm (114 L/min) when only one level of in-rack sprinklers is installed or a minimum of 10 in-rack sprinklers (five in-rack sprinklers on top two levels) operating at 30 gpm (114 L/min) when more than one level of in-rack sprinklers are installed.
- (2) Face sprinklers are to be a minimum of 3 in. (75 mm) from rack uprights and a maximum of 18 in. (450 mm) from the aisle face to storage.
- (3) Sprinkler 1 or Sprinkler 1 and Sprinkler 2 are required where Load A represents the top of storage.
- (4) Sprinkler 1 and Sprinkler 2 or Sprinkler 1 and Sprinkler 3 are required where Load B represents the top of storage.
- (5) Sprinkler 1 and Sprinkler 3 or Sprinkler 1 and Sprinkler 4 are required where Load C represents the top of storage.
- (6) Sprinkler 1 and Sprinkler 4 or Sprinkler 1 and Sprinkler 5 are required where Load D represents the top of storage.
- (7) For storage higher than represented by Load D, the cycle defined by Note 3 through Note 6 above is repeated.
- (8) The storage height above the top level of in-rack sprinklers is limited to a maximum of 10 ft (3.0 m).
- (9) The symbols X and Δ represent in-rack sprinklers that are to be staggered both horizontally and vertically.
- (10) Each square represents a storage cube measuring 4 ft to 5 ft (1.2 m to 1.5 m) on a side. Actual load heights can vary from approximately 18 in. to 10 ft (450 mm to 3.0 m). Therefore, there could be as few as two loads or as many as 13 loads between in-rack sprinklers that are spaced 20 ft (6.1 m) apart vertically.

Figure 25.4.3.2.1.2(e) In-Rack Sprinkler Arrangements for Encapsulated Exposed, or Cartoned (Nonencapsulated or Encapsulated) Class I, Class II, or Class III Commodities Stored Over 25 ft (7.6 m) in Height in Double-Row Racks — Option 3.

Ceiling Design: Exposed Encapsulated or Cartoned Class I, Class II, or Class III Commodities

0.37 gpm/ft² over 2000 ft² (15.1 mm/min over 185 m²)
with ordinary-temperature ceiling sprinklers
0.50 gpm/ft² over 2000 ft² (20.4 mm/min over 185 m²)
with high-temperature ceiling sprinklers

**Notes:**

- (1) In-rack sprinklers are ordinary-temperature-rated, quick- or standard-response, pendent or upright, minimum K-5.6 (K-80), and designed for a minimum of six in-rack sprinklers operating at 30 gpm (114 L/min) when only one level of in-rack sprinklers is installed or a minimum of 10 in-rack sprinklers (five in-rack sprinklers on top two levels) operating at 30 gpm (114 L/min) when more than one level of in-rack sprinklers are installed.
- (2) Face sprinklers are to be a minimum of 3 in. (75 mm) from rack uprights and a maximum of 18 in. (450 mm) from the aisle face to storage.
- (3) Sprinkler 1 is required where Load A represents the top of storage.
- (4) Sprinkler 1 or Sprinkler 1 and Sprinkler 2 are required where Load B represents the top of storage.
- (5) Sprinkler 1 and Sprinkler 2 or Sprinkler 1 and Sprinkler 3 are required where Load C represents the top of storage.
- (6) Sprinkler 1 and Sprinkler 3 or Sprinkler 1 and Sprinkler 4 are required where Load D represents the top of storage.
- (7) Sprinkler 1 and Sprinkler 4 or Sprinkler 1 and Sprinkler 5 are required where Load E represents the top of storage.
- (8) Sprinkler 1 and Sprinkler 5 or Sprinkler 1 and Sprinkler 6 are required where Load F represents the top of storage.
- (9) For storage higher than represented by Load F, the cycle defined by Note 3 through Note 8 above is repeated.
- (10) The storage height above the top level of in-rack sprinklers is limited to a maximum of 10 ft (3.0 m).
- (11) The symbol X represents in-rack sprinklers.
- (12) Each square represents a storage cube measuring 4 ft to 5 ft (1.2 m to 1.5 m) on a side. Actual load heights can vary from approximately 18 in. to 10 ft (450 mm to 3.0 m). Therefore, there could be as few as two loads or as many as 16 loads between in-rack sprinklers that are spaced 25 ft (7.6 m) apart vertically.

Figure 25.4.3.2.1.2(f) In-Rack Sprinkler Arrangements for Encapsulated Exposed, or Cartoned (Nonencapsulated or Encapsulated) Class I, Class II, or Class III Commodities Stored Over 25 ft (7.6 m) in Height in Double-Row Racks — Option 4.

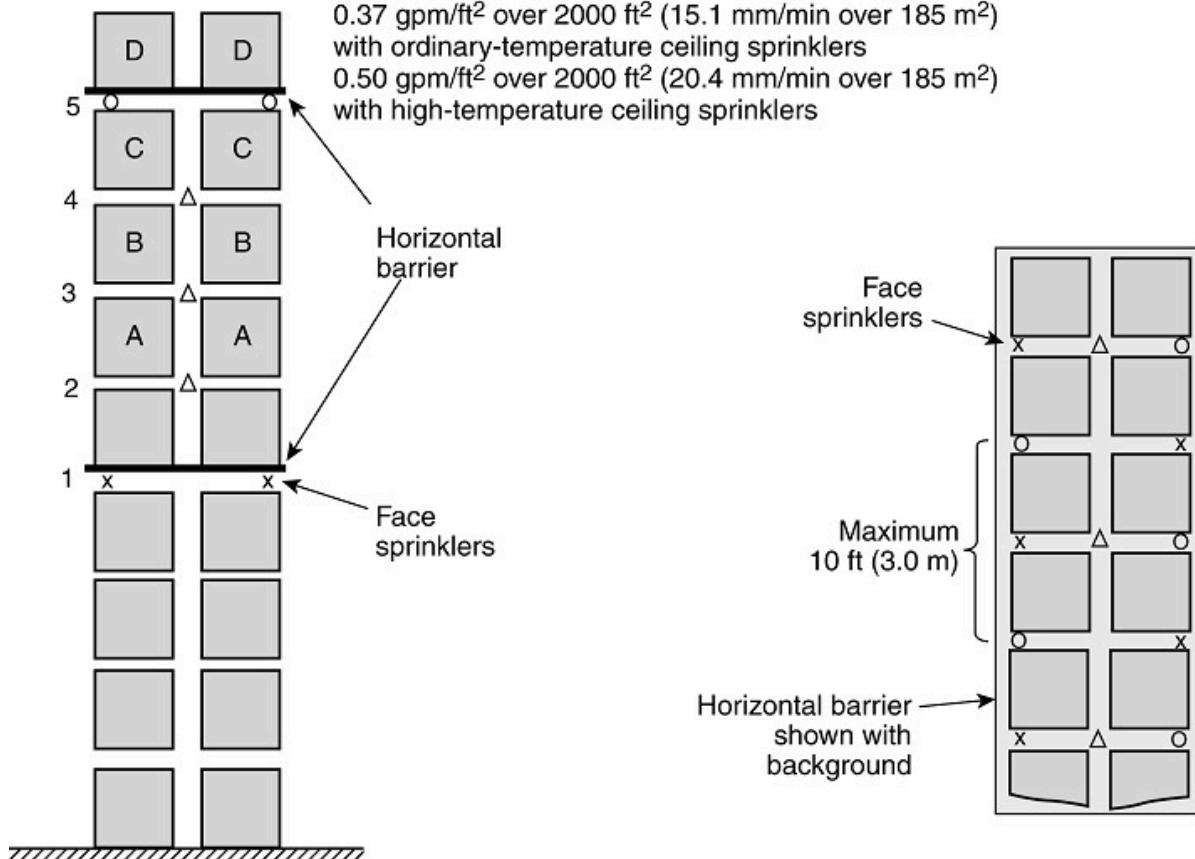
Ceiling Design: Exposed Encapsulated or Cartoned Class I, Class II, or Class III Commodities

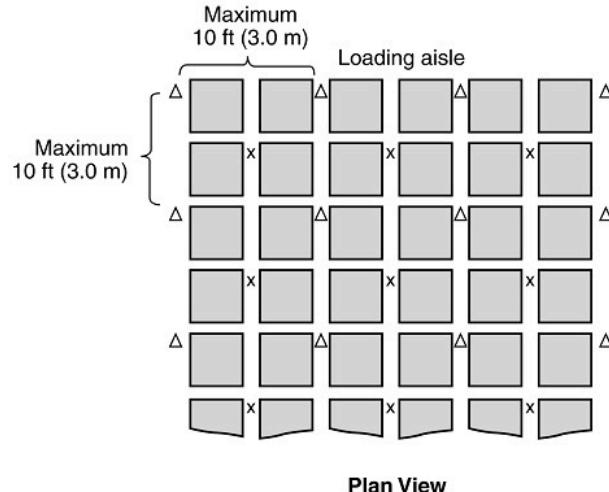
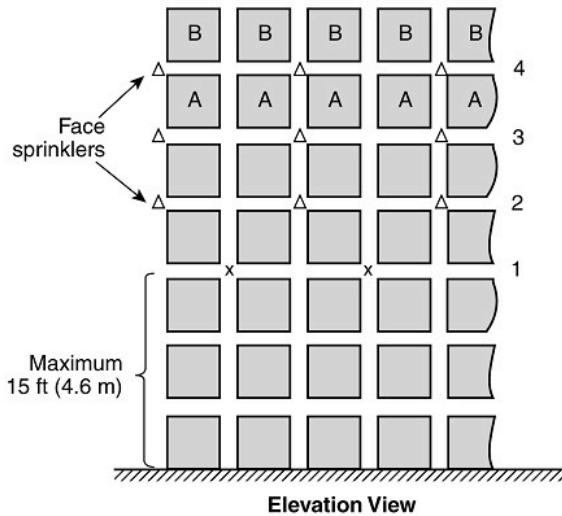
Figure 25.4.3.2.1.2(g) In-Rack Sprinkler Arrangements for Encapsulated Exposed, or Cartoned (Nonencapsulated or Encapsulated) Class I, Class II, or Class III Commodities Stored Over 25 ft (7.6 m) in Height in Multiple-Row Racks.

Ceiling Design: Exposed Encapsulated or Cartoned Class I, Class II, or Class III Commodities0.37 gpm/ft² over 2000 ft² (15.1 mm/min over 185 m²)

with ordinary-temperature ceiling sprinklers

0.50 gpm/ft² over 2000 ft² (20.4 mm/min over 185 m²)

with high-temperature ceiling sprinklers

**Notes:**

- (1) In-rack sprinklers are ordinary-temperature-rated, quick- or standard-response, pendent or upright, minimum K-5.6 (K-80), and designed for a minimum of 10 in-rack sprinklers (five in-rack sprinklers on the top two levels) operating at 30 gpm (114 L/min).
- (2) Face sprinklers are to be a minimum of 3 in. (75 mm) from rack uprights and a maximum of 18 in. (450 mm) from the aisle face of storage.
- (3) Sprinkler 1 and Sprinkler 2 or Sprinkler 1 and Sprinkler 3 are required where Load A represents the top of storage.
- (4) Sprinkler 1 and Sprinkler 3 or Sprinkler 1 and Sprinkler 4 are required where Load B represents the top of storage.
- (5) For storage higher than represented by Load B, the cycle defined by Note 3 and Note 4 above is repeated, with stagger as indicated.
- (6) The storage height above the top level of in-rack sprinklers is limited to a maximum of 10 ft (3.0 m).
- (7) The symbols X and Δ represent in-rack sprinklers that are to be staggered both horizontally and vertically.
- (8) Each square represents a storage cube measuring 4 ft to 5 ft (1.2 m to 1.5 m) on a side. Actual load heights can vary from approximately 18 in. to 10 ft (450 mm to 3.0 m). Therefore, there could be as few as two loads or as many as 10 loads between in-rack sprinklers that are spaced 15 ft (4.6 m) apart vertically.

25.4.3.2.1.3

Where rack storage of exposed encapsulated, or cartoned (nonencapsulated or encapsulated) Class IV commodities stored over 25 ft (7.6 m) in height will be protected by in-rack sprinklers, in-rack sprinkler arrangements and designs shall be selected from Figure 25.4.3.2.1.3(a) through Figure 25.4.3.2.1.3(f). (See Section 25.3 for racks with solid shelving.)

Figure 25.4.3.2.1.3(a) In-Rack Sprinkler Arrangements for Encapsulated Exposed, or Cartoned (Nonencapsulated or Encapsulated) Class I, Class II, Class III, or Class IV Commodities Stored Over 25 ft (7.6 m) in Height in Single-Row Racks — Option 1.

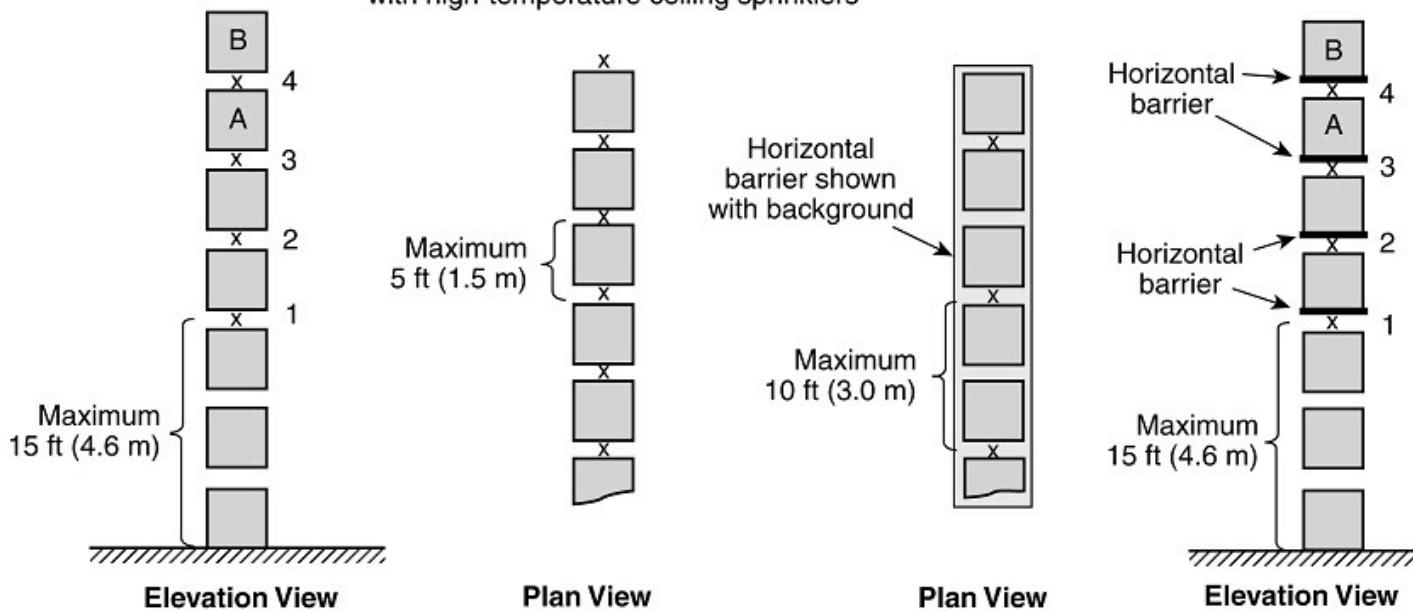
Ceiling Design: Exposed Encapsulated or Cartoned Class I, Class II, Class III, or Class IV Commodities

0.44 gpm/ft² over 2000 ft² (17.9 mm/min over 185 m²)

with ordinary-temperature ceiling sprinklers

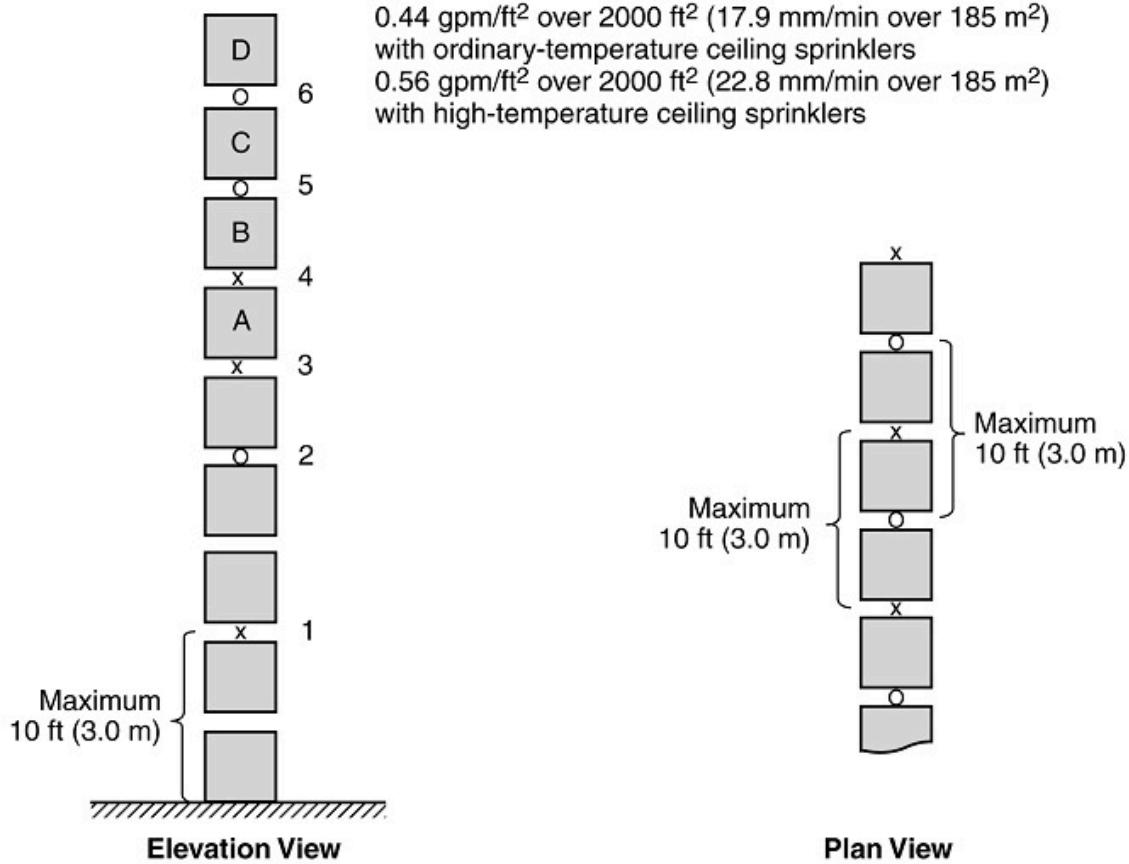
0.56 gpm/ft² over 2000 ft² (22.8 mm/min over 185 m²)

with high-temperature ceiling sprinklers

**Notes:**

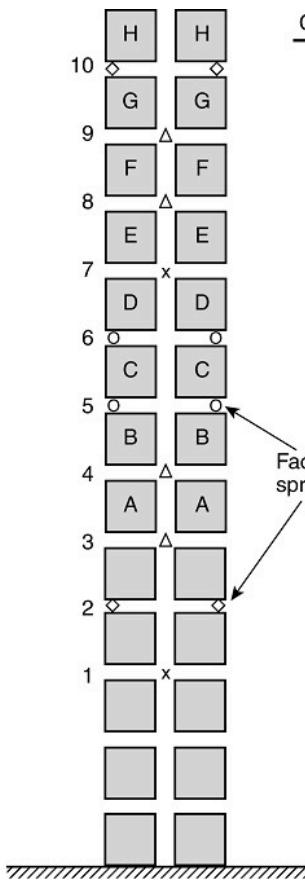
- (1) In-rack sprinklers are ordinary-temperature-rated, quick- or standard-response, pendent or upright, minimum K-5.6 (K-80), and designed for a minimum of 10 in-rack sprinklers (five in-rack sprinklers on the top two levels) operating at 30 gpm (114 L/min).
- (2) Sprinkler 1 and Sprinkler 2 or Sprinkler 1 and Sprinkler 3 are required where Load A represents the top of storage.
- (3) Sprinkler 1 and Sprinkler 3 or Sprinkler 1 and Sprinkler 4 are required where Load B represents the top of storage.
- (4) For storage higher than represented by Load B, the cycle defined by Note 2 and Note 3 above is repeated.
- (5) The storage height above the top level of in-rack sprinklers is limited to a maximum of 10 ft (3.0 m).
- (6) In-rack sprinklers in the transverse flue space are permitted to be at any point between load faces.
- (7) The symbol X represents in-rack sprinklers.
- (8) Each square represents a storage cube measuring 4 ft to 5 ft (1.2 m to 1.5 m) on a side. Actual load heights can vary from approximately 18 in. to 10 ft (450 mm to 3.0 m). Therefore, there could be as few as one load or as many as 10 loads between in-rack sprinklers that are spaced 15 ft (4.6 m) apart vertically.

Figure 25.4.3.2.1.3(b) In-Rack Sprinkler Arrangements for Encapsulated Exposed, or Cartoned (Nonencapsulated or Encapsulated) Class I, Class II, Class III, or Class IV Commodities Stored Over 25 ft (7.6 m) in Height in Single-Row Racks — Option 2.

Ceiling Design: Exposed Encapsulated or Cartoned Class I, Class II, Class III, or Class IV Commodities**Notes:**

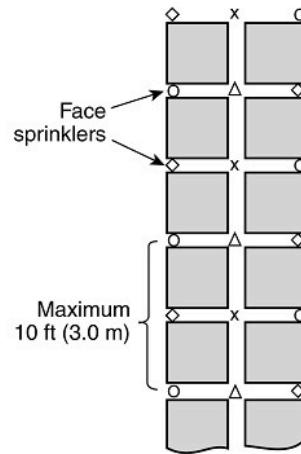
- (1) In-rack sprinklers are ordinary-temperature-rated, quick- or standard-response, pendent or upright, minimum K-5.6 (K-80), and designed for a minimum of 10 in-rack sprinklers (five in-rack sprinklers on the top two levels) operating at 30 gpm (114 L/min).
- (2) Sprinkler 1 and Sprinkler 2 or Sprinkler 1, Sprinkler 2, and Sprinkler 3 are required when Load A represents the top of storage.
- (3) Sprinkler 1, Sprinkler 2, and Sprinkler 3 or Sprinkler 1, Sprinkler 2, and Sprinkler 4 are required when Load B represents the top of storage.
- (4) Sprinkler 1, Sprinkler 2, and Sprinkler 4 or Sprinkler 1, Sprinkler 2, Sprinkler 4, and Sprinkler 5 are required where Load C represents the top of storage.
- (5) Sprinkler 1, Sprinkler 2, Sprinkler 4, and Sprinkler 5 or Sprinkler 1, Sprinkler 2, Sprinkler 4, and Sprinkler 6 are required where Load D represents the top of storage.
- (6) For storage higher than represented by Load D, the cycle defined by Note 2 through Note 5 above is repeated.
- (7) The storage height above the top level of in-rack sprinklers is limited to a maximum of 10 ft (3.0 m).
- (8) In-rack sprinklers in the transverse flue space are permitted to be at any point between load faces.
- (9) The symbols X and O represent in-rack sprinklers that are to be staggered vertically.
- (10) Each square represents a storage cube measuring 4 ft to 5 ft (1.2 m to 1.5 m) on a side. Actual load heights can vary from approximately 18 in. to 10 ft (450 mm to 3.0 m). Therefore, there could be as few as one load or as many as six loads between in-rack sprinklers that are spaced 10 ft (3.0 m) apart vertically.

Figure 25.4.3.2.1.3(c) In-Rack Sprinkler Arrangements for Encapsulated Exposed, or Cartoned (Nonencapsulated or Encapsulated) Class I, Class II, Class III, or Class IV Commodities Stored Over 25 ft (7.6 m) in Height in Double-Row Racks — Option 1.



Ceiling Design: Exposed Encapsulated or Cartoned Class I, Class II, Class III, or Class IV Commodities

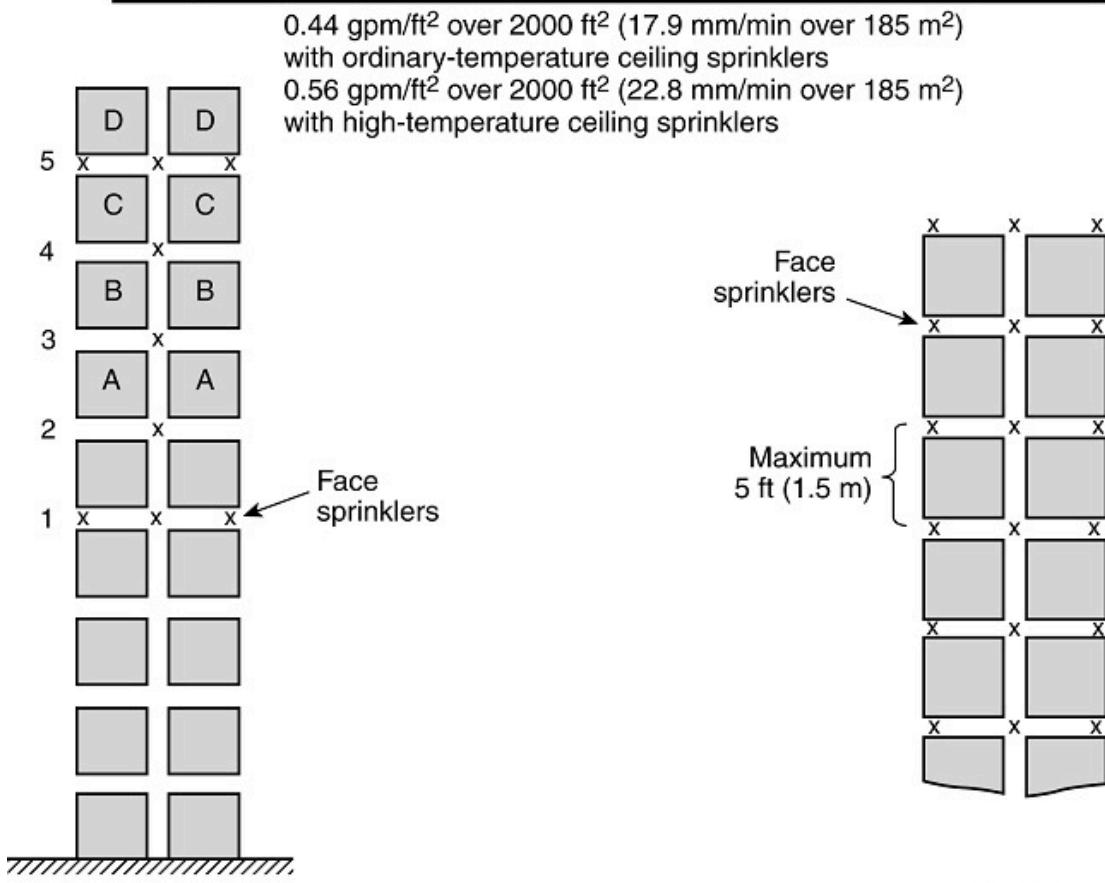
0.44 gpm/ft² over 2000 ft² (17.9 mm/min over 185 m²)
with ordinary-temperature ceiling sprinklers
0.56 gpm/ft² over 2000 ft² (22.8 mm/min over 185 m²)
with high-temperature ceiling sprinklers



Notes:

- (1) In-rack sprinklers are ordinary-temperature-rated, quick- or standard-response, pendent or upright, minimum K-5.6 (K-80), and designed for a minimum of 10 in-rack sprinklers (five in-rack sprinklers on the top two levels) operating at 30 gpm (114 L/min).
- (2) Face sprinklers are to be a minimum of 3 in. (75 mm) from rack uprights and a maximum of 18 in. (450 mm) from the aisle face of storage.
- (3) Sprinkler 1 and Sprinkler 2 or Sprinkler 1, Sprinkler 2, and Sprinkler 3 are required where Load A represents the top of storage.
- (4) Sprinkler 1, Sprinkler 2, and Sprinkler 3 or Sprinkler 1, Sprinkler 2, and Sprinkler 4 are required where Load B represents the top of storage.
- (5) Sprinkler 1, Sprinkler 2, and Sprinkler 4 or Sprinkler 1, Sprinkler 2, Sprinkler 4, and Sprinkler 5 are required where Load C represents the top of storage.
- (6) Sprinkler 1, Sprinkler 2, Sprinkler 4, and Sprinkler 5 or Sprinkler 1, Sprinkler 2, Sprinkler 4, and Sprinkler 6 are required where Load D represents the top of storage.
- (7) Sprinkler 1, Sprinkler 2, Sprinkler 4, and Sprinkler 6 or Sprinkler 1, Sprinkler 2, Sprinkler 4, Sprinkler 6, and Sprinkler 7 are required where Load E represents the top of storage.
- (8) Sprinkler 1, Sprinkler 2, Sprinkler 4, Sprinkler 6, and Sprinkler 7 or Sprinkler 1, Sprinkler 2, Sprinkler 4, Sprinkler 6, Sprinkler 7, and Sprinkler 8 are required where Load F represents the top of storage.
- (9) Sprinkler 1, Sprinkler 2, Sprinkler 4, Sprinkler 6, Sprinkler 7, and Sprinkler 8 or Sprinkler 1, Sprinkler 2, Sprinkler 4, Sprinkler 6, Sprinkler 7, and Sprinkler 9 are required where Load G represents the top of storage.
- (10) Sprinkler 1, Sprinkler 2, Sprinkler 4, Sprinkler 6, Sprinkler 7, and Sprinkler 9 or Sprinkler 1, Sprinkler 2, Sprinkler 4, Sprinkler 6, Sprinkler 7, Sprinkler 9, and Sprinkler 10 are required where Load H represents the top of storage.
- (11) For storage higher than represented by Load H, the cycle defined by Note 3 through Note 10 above is repeated, with stagger as indicated.
- (12) The storage height above the top level of in-rack sprinklers is limited to a maximum of 10 ft (3.0 m).
- (13) The symbols X, O, \diamond , and Δ represent in-rack sprinklers that are to be staggered both horizontally and vertically.
- (14) Each square represents a storage cube measuring 4 ft to 5 ft (1.2 m to 1.5 m) on a side. Actual load heights can vary from approximately 18 in. to 10 ft (450 mm to 3.0 m). Therefore, there could be as few as one load or as many as 10 loads between in-rack sprinklers that are spaced 15 ft (4.6 m) apart vertically.

Figure 25.4.3.2.1.3(d) In-Rack Sprinkler Arrangements for Encapsulated Exposed, or Cartoned (Nonencapsulated or Encapsulated) Class I, Class II, Class III, or Class IV Commodities Stored Over 25 ft (7.6 m) in Height in Double-Row Racks — Option 2.

Ceiling Design: Exposed Encapsulated or Cartoned Class I, Class II, Class III, or Class IV Commodities**Elevation View****Plan View****Notes:**

- (1) In-rack sprinklers are ordinary-temperature-rated, quick- or standard-response, pendent or upright, minimum K-5.6 (K-80), and designed for a minimum of six in-rack sprinklers operating at 30 gpm (114 L/min) when only one level of in-rack sprinklers is installed or a minimum of 10 in-rack sprinklers (five in-rack sprinklers on the top two levels) operating at 30 gpm (114 L/min) when more than one level of in-rack sprinklers are installed.
- (2) Face sprinklers are to be a minimum of 3 in. (75 mm) from rack uprights and a maximum of 18 in. (450 mm) from the aisle face to storage.
- (3) Sprinkler 1 or Sprinkler 1 and Sprinkler 2 are required where Load A represents the top of storage.
- (4) Sprinkler 1 and Sprinkler 2 or Sprinkler 1 and Sprinkler 3 are required where Load B represents the top of storage.
- (5) Sprinkler 1 and Sprinkler 3 or Sprinkler 1 and Sprinkler 4 are required where Load C represents the top of storage.
- (6) Sprinkler 1 and Sprinkler 4 or Sprinkler 1 and Sprinkler 5 are required where Load D represents the top of storage.
- (7) For storage higher than represented by Load D, the cycle defined by Note 3 through Note 6 above is repeated.
- (8) The storage height above the top level of in-rack sprinklers is limited to a maximum of 10 ft (3.0 m).
- (9) The symbol X represents in-rack sprinklers.
- (10) Each square represents a storage cube measuring 4 ft to 5 ft (1.2 m to 1.5 m) on a side. Actual load heights can vary from approximately 18 in. to 10 ft (450 mm to 3.0 m). Therefore, there could be as few as two loads or as many as 13 loads between in-rack sprinklers that are spaced 20 ft (6.1 m) apart vertically.

Figure 25.4.3.2.1.3(e) In-Rack Sprinkler Arrangements for Encapsulated Exposed, or Cartoned (Nonencapsulated or Encapsulated) Class I, Class II, Class III, or Class IV Commodities Stored Over 25 ft (7.6 m) in Height in Double-Row Racks — Option 3.

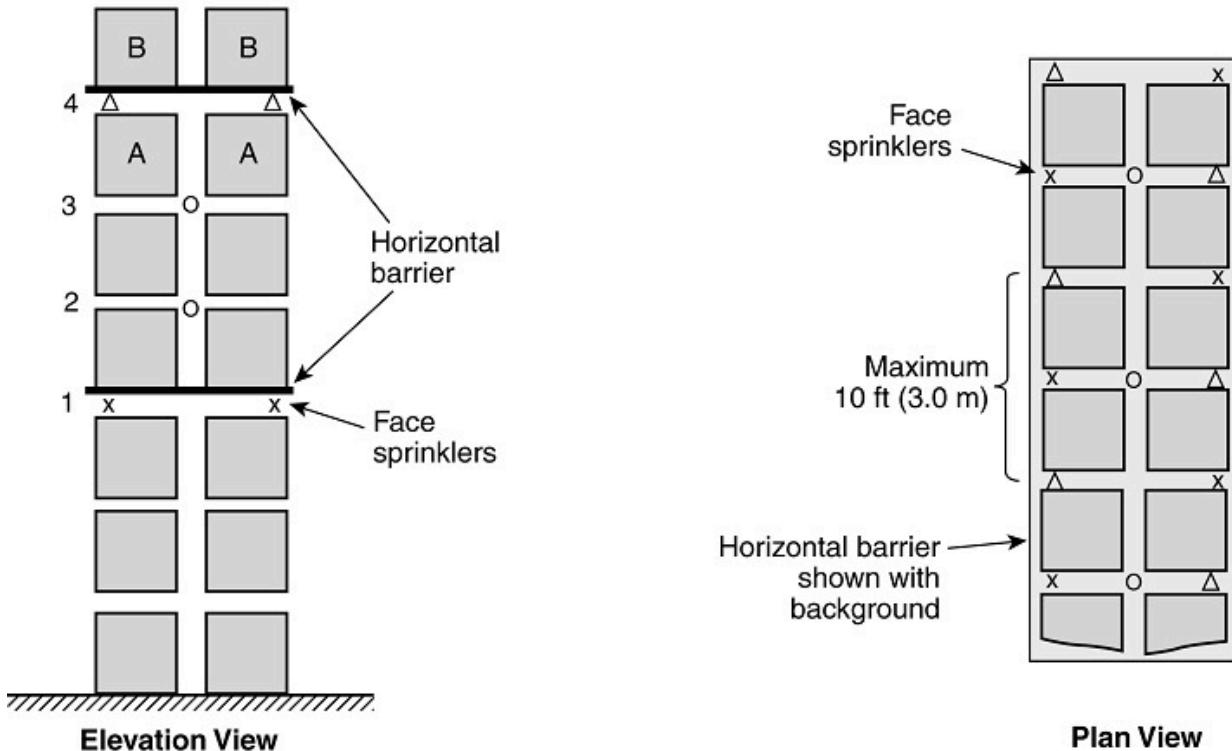
Ceiling Design: Exposed Encapsulated or Cartoned Class I, Class II, Class III, or Class IV Commodities

0.44 gpm/ft² over 2000 ft² (17.9 mm/min over 185 m²)

with ordinary-temperature ceiling sprinklers

0.56 gpm/ft² over 2000 ft² (22.8 mm/min over 185 m²)

with high-temperature ceiling sprinklers

**Notes:**

- (1) In-rack sprinklers are ordinary-temperature-rated, quick- or standard-response, pendent or upright, minimum K-5.6 (K-80), and designed for a minimum of 10 in-rack sprinklers (five in-rack sprinklers on the top two levels) operating at 30 gpm (114 L/min).
- (2) Face sprinklers are to be a minimum of 3 in. (75 mm) from rack uprights and a maximum of 18 in. (450 mm) from the aisle face of storage.
- (3) Sprinkler 1 and Sprinkler 2 or Sprinkler 1 and Sprinkler 3 are required where Load A represents the top of storage.
- (4) Sprinkler 1 and Sprinkler 3 or Sprinkler 1 and Sprinkler 4 are required where Load B represents the top of storage.
- (5) For storage higher than represented by Load B, the cycle defined by Note 3 and Note 4 above is repeated.
- (6) The storage height above the top level of in-rack sprinklers is limited to a maximum of 10 ft (3.0 m).
- (7) The symbols X, O, and Δ represent in-rack sprinklers that are to be staggered both horizontally and vertically.
- (8) Each square represents a storage cube measuring 4 ft to 5 ft (1.2 m to 1.5 m) on a side. Actual load heights can vary from approximately 18 in. to 10 ft (450 mm to 3.0 m). Therefore, there could be as few as two loads or as many as 13 loads between in-rack sprinklers that are spaced 20 ft (6.1 m) apart vertically.

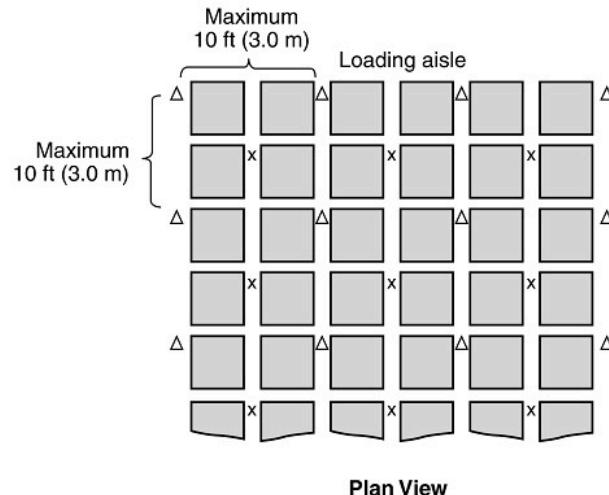
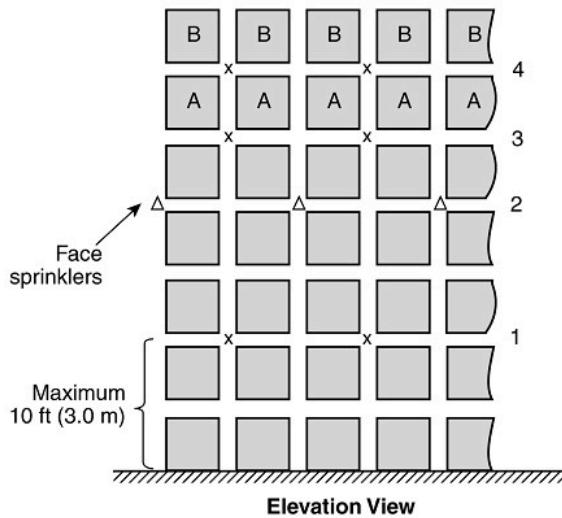
Figure 25.4.3.2.1.3(f) In-Rack Sprinkler Arrangements for Encapsulated Exposed, or Cartoned (Nonencapsulated or Encapsulated) Class I, Class II, Class III, or Class IV Commodities Stored Over 25 ft (7.6 m) in Height in Multiple-Row Racks.

Ceiling Design: Exposed Encapsulated or Cartoned Class I, Class II, Class III, or Class IV Commodities0.44 gpm/ft² over 2000 ft² (117.9 mm/min over 185 m²)

with ordinary-temperature ceiling sprinklers

0.56 gpm/ft² over 2000 ft² (22.8 mm/min over 185 m²)

with high-temperature ceiling sprinklers

**Notes:**

- (1) In-rack sprinklers are ordinary-temperature-rated, quick- or standard-response, pendent or upright, minimum K-5.6 (K-80), and designed for a minimum of 10 in-rack sprinklers (five in-rack sprinklers on the top two levels) operating at 30 gpm (114 L/min).
- (2) Face sprinklers are to be a minimum of 3 in. (75 mm) from rack uprights and a maximum of 18 in. (450 mm) from the aisle face of storage.
- (3) Sprinkler 1, Sprinkler 2, and Sprinkler 3 are required where Load A represents the top of storage.
- (4) Sprinkler 1, Sprinkler 2, and Sprinkler 4 are required where Load B represents the top of storage.
- (5) For storage higher than represented by Load B, the cycle defined by Note 3 and Note 4 above is repeated, with stagger as indicated.
- (6) The storage height above the top level of in-rack sprinklers is limited to a maximum of 5 ft (1.5 m).
- (7) The symbols X and Δ represent in-rack sprinklers that are to be staggered both horizontally and vertically.
- (8) Each square represents a storage cube measuring 4 ft to 5 ft (1.2 m to 1.5 m) on a side. Actual load heights can vary from approximately 18 in. to 10 ft (450 mm to 3.0 m). Therefore, there could be as few as one load or as many as six loads between in-rack sprinklers that are spaced 10 ft (3.1 m) apart vertically.

25.4.3.2.1.4

The in-rack sprinkler arrangements of 25.4.3.2.1.1 through 25.4.3.2.1.3 for single- and double-row racks shall result in a maximum storage height of 10 ft (3.0 m) above the top level of in-rack sprinklers.

25.4.3.2.1.5

The in-rack sprinkler arrangements of 25.4.3.2.1.1 through 25.4.3.2.1.3 for multiple-row racks shall result in a maximum storage height of 10 ft (3.0 m) above the top level of in-rack sprinklers for Class I, Class II, or Class III commodities, and a maximum storage height of 5 ft (1.5 m) for Class IV commodities.

25.4.3.2.1.6 Excessive Clearance to Ceiling.**(A) ***

Where the clearance to ceiling exceeds 10 ft (3.0 m), the in-rack sprinkler arrangements required for the protection of exposed encapsulated, or cartoned (nonencapsulated or encapsulated) Class I, Class II, Class III, or Class IV commodities shall be supplemented with one level of supplemental quick-response in-rack sprinklers installed directly below the top tier of storage and at every flue space intersection.

(B)

Where supplemental in-rack sprinklers have been installed in accordance with 25.4.3.2.1.6(A), the required ceiling-level sprinkler system design shall be based on a ceiling clearance of 10 ft (3.0 m).

25.4.3.2.2 * CMDA Ceiling-Level Sprinkler Designs for Exposed Encapsulated, or Cartoned (Nonencapsulated or Encapsulated) Class I, Class II, Class III, or Class IV Commodities Stored Over 25 ft (7.6 m) in Height in Combination with In-Rack Sprinklers.

25.4.3.2.2.1

Where rack storage of exposed encapsulated, or cartoned (nonencapsulated or encapsulated) Class I commodities stored over 25 ft (7.6 m) in height will be protected by in-rack sprinklers, the ceiling-level sprinkler design in terms of density [gpm/ft² (mm/min)] and area of sprinkler operation [ft² (m²) of ceiling or roof sprinklers] shall be in accordance with Figure 25.4.3.2.1.1(a) through Figure

25.4.3.2.1(f).

25.4.3.2.2

Where rack storage of exposed encapsulated, or cartoned (nonencapsulated or encapsulated) Class II or Class III commodities stored over 25 ft (7.6 m) in height will be protected by in-rack sprinklers, the ceiling-level sprinkler design in terms of density [gpm/ft² (mm/min)] and area of sprinkler operation [ft² (m²) of ceiling or roof sprinklers] shall be in accordance with Figure 25.4.3.2.1.2(a) through Figure 25.4.3.2.1.2(g).

25.4.3.2.2.3

Where rack storage of exposed encapsulated, or cartoned (nonencapsulated or encapsulated) Class IV commodities stored over 25 ft (7.6 m) in height will be protected by in-rack sprinklers, the ceiling-level sprinkler design in terms of density [gpm/ft² (mm/min)] and area of sprinkler operation [ft² (m²) of ceiling or roof sprinklers] shall be in accordance with Figure 25.4.3.2.1.3(a) through Figure 25.4.3.2.1.3(f).

25.4.3.3 Cartoned Group A Plastic Commodities.

25.4.3.3.1 In-Rack Sprinkler Arrangements and Designs for Cartoned Group A Plastic Commodities Stored Over 25 ft (7.6 m) in Height.

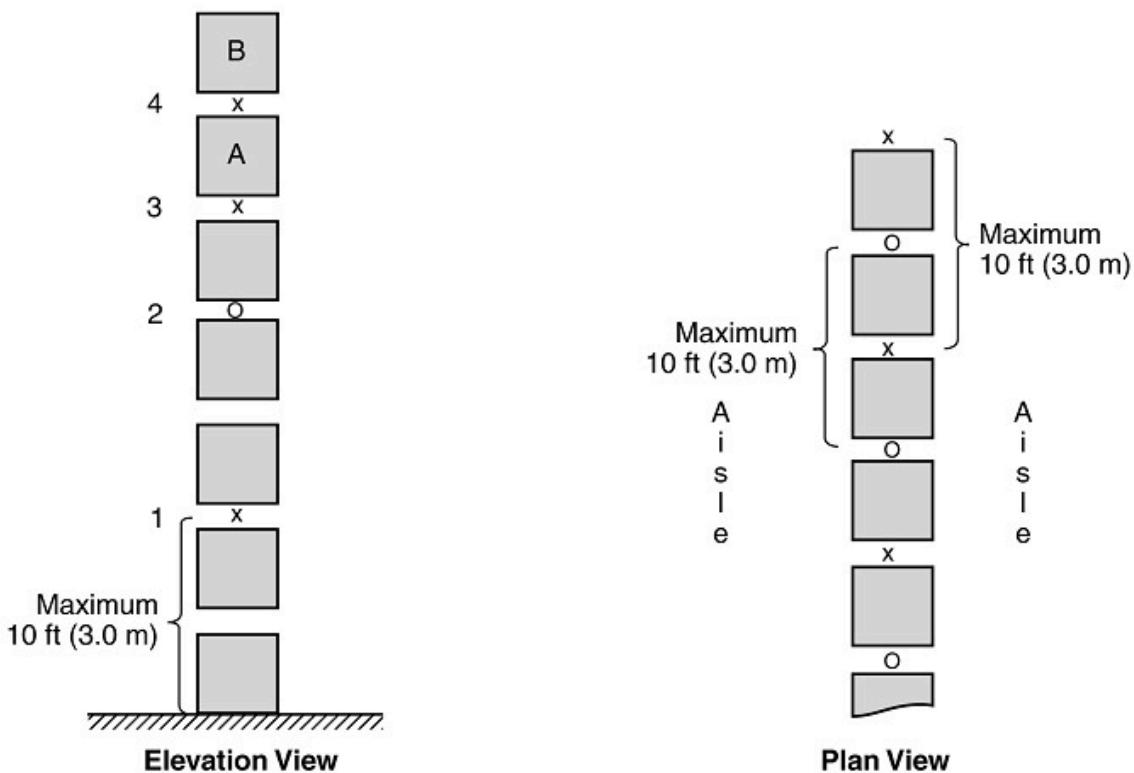
25.4.3.3.1.1

Where rack storage of cartoned Group A plastic commodities stored over 25 ft (7.6 m) in height will be protected by in-rack sprinklers, in-rack sprinkler arrangements and designs shall be selected from Figure 25.4.3.3.1.1(a) through Figure 25.4.3.3.1.1(g). (See Section 25.3 for racks with solid shelving.)

Figure 25.4.3.3.1.1(a) In-Rack Sprinkler Arrangements for Cartoned Group A Plastic Commodities Stored Over 25 ft (7.6 m) in Height — Option 1.

Ceiling Design: Cartoned Group A Plastic Commodities

0.30 gpm/ft² over 2000 ft² (12.2 mm/min over 185 m²)
 where maximum storage height over top of in-rack sprinklers is 5 ft (1.5 m)
 0.45 gpm/ft² over 2000 ft² (18.3 mm/min over 185 m²)
 where maximum storage height over top of in-rack sprinklers is over 5 ft (1.5 m) and up to 10 ft (3.0 m)

**Notes:**

- (1) In-rack sprinklers are ordinary-temperature-rated, quick- or standard-response, pendent or upright, minimum K-5.6 (K-80), and designed for a minimum of 14 in-rack sprinklers (seven in-rack sprinklers on the top two levels) operating at 30 gpm (114 L/min).
- (2) Sprinkler 1 and Sprinkler 2 or Sprinkler 1, Sprinkler 2, and Sprinkler 3 are required when Load A represents the top of storage.
- (3) Sprinkler 1, Sprinkler 2, and Sprinkler 3 or Sprinkler 1, Sprinkler 2, and Sprinkler 4 are required when Load B represents the top of storage.
- (4) For storage higher than represented by Load B, the cycle defined by Note 2 and Note 3 above is repeated.
- (5) The storage height above the top level of in-rack sprinklers is limited to a maximum of 10 ft (3.0 m).
- (6) The symbols X and O represent in-rack sprinklers that are to be staggered vertically.
- (7) Each square represents a storage cube measuring 4 ft to 5 ft (1.2 m to 1.5 m) on a side. Actual load heights can vary from approximately 18 in. to 10 ft (450 mm to 3.0 m). Therefore, there could be as few as one load or as many as six loads between in-rack sprinklers that are spaced 10 ft (3.0 m) apart vertically.

Figure 25.4.3.3.1.1(b) In-Rack Sprinkler Arrangements for Cartoned Group A Plastic Commodities Stored Over 25 ft (7.6 m) in Height — Option 2.

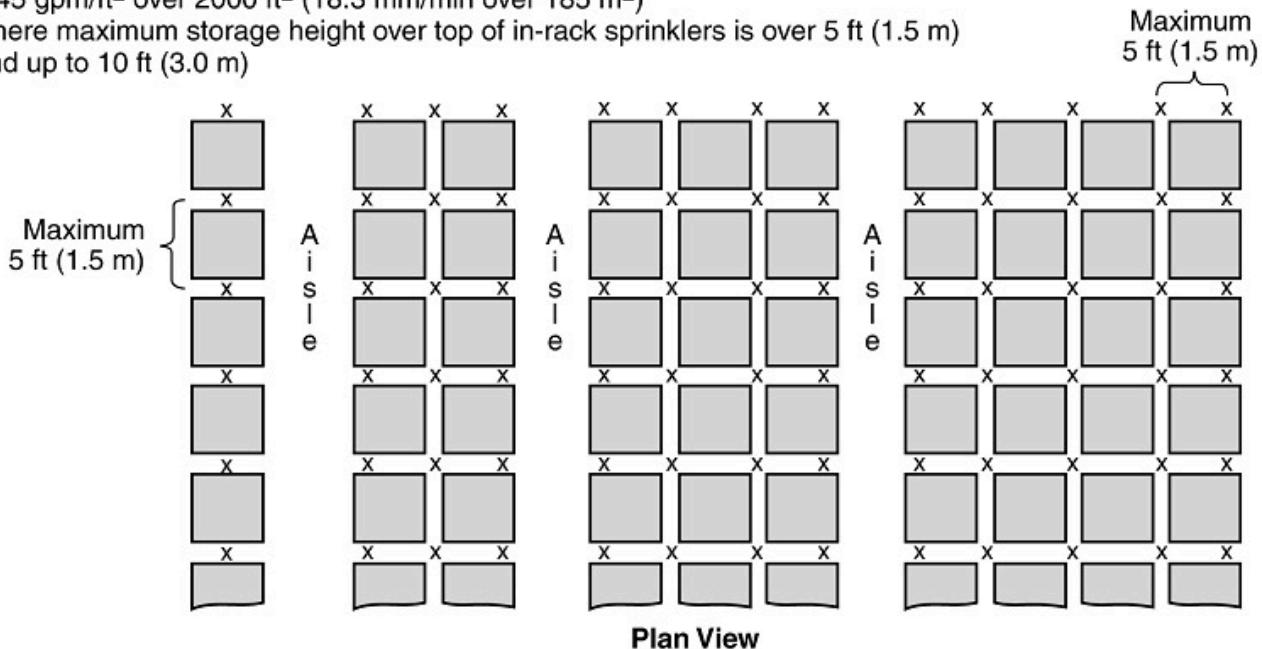
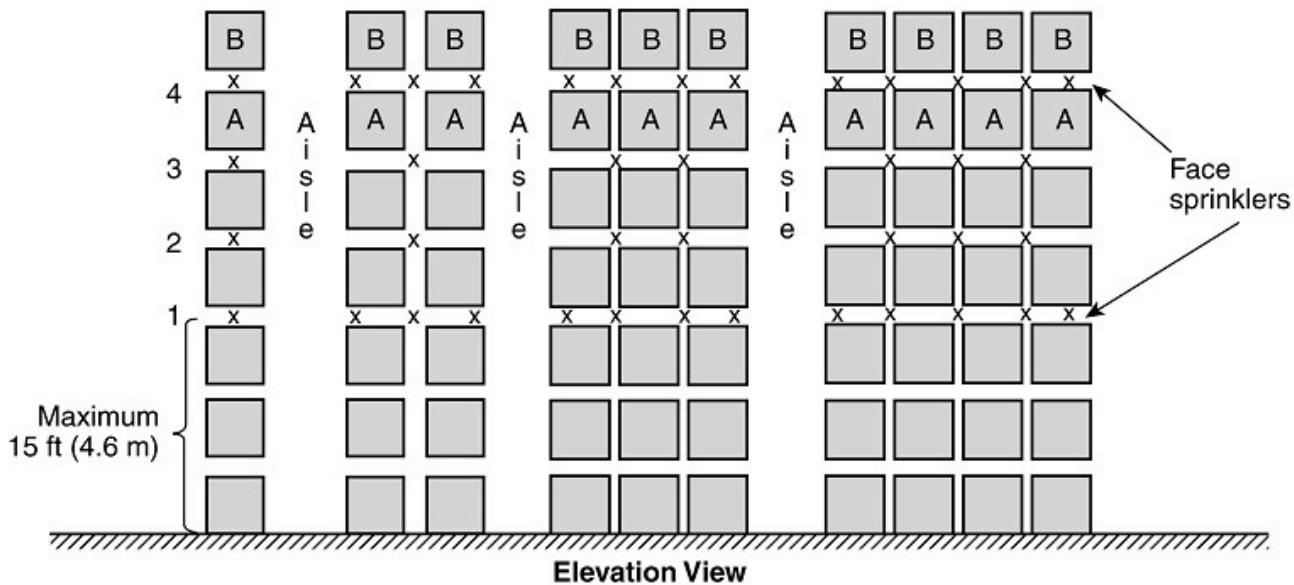
Ceiling Design: Cartoned Group A Plastic Commodities

0.30 gpm/ft² over 2000 ft² (12.2 mm/min over 185 m²)

where maximum storage height over top of in-rack sprinklers is 5 ft (1.5 m)

0.45 gpm/ft² over 2000 ft² (18.3 mm/min over 185 m²)

where maximum storage height over top of in-rack sprinklers is over 5 ft (1.5 m) and up to 10 ft (3.0 m)

**Plan View****Notes:**

- (1) In-rack sprinklers are ordinary-temperature-rated, quick- or standard-response, pendent or upright, minimum K-5.6 (K-80), and designed for a minimum of 14 in-rack sprinklers (seven in-rack sprinklers on the top two levels) operating at 30 gpm (114 L/min).
- (2) Face sprinklers are to be a minimum of 3 in. (75 mm) from rack uprights and a maximum of 18 in. (450 mm) from the aisle face of storage.
- (3) Sprinkler 1 and Sprinkler 2 or Sprinkler 1 and Sprinkler 3 are required where Load A represents the top of storage.
- (4) Sprinkler 1 and Sprinkler 3 or Sprinkler 1 and Sprinkler 4 are required where Load B represents the top of storage.
- (5) For storage higher than represented by Load B, the cycle defined by Note 3 and Note 4 above is repeated.
- (6) The storage height above the top level of in-rack sprinklers is limited to a maximum of 10 ft (3.0 m).
- (7) The symbol X represents in-rack sprinklers.
- (8) Each square represents a storage cube measuring 4 ft to 5 ft (1.2 m to 1.5 m) on a side. Actual load heights can vary from approximately 18 in. to 10 ft (450 mm to 3.0 m). Therefore, there could be as few as one load or as many as 10 loads between in-rack sprinklers that are spaced 15 ft (4.6 m) apart vertically.

Figure 25.4.3.3.1.1(c) In-Rack Sprinkler Arrangements for Cartoned Group A Plastic Commodities Stored Over 25 ft (7.6 m) in Height — Option 3.

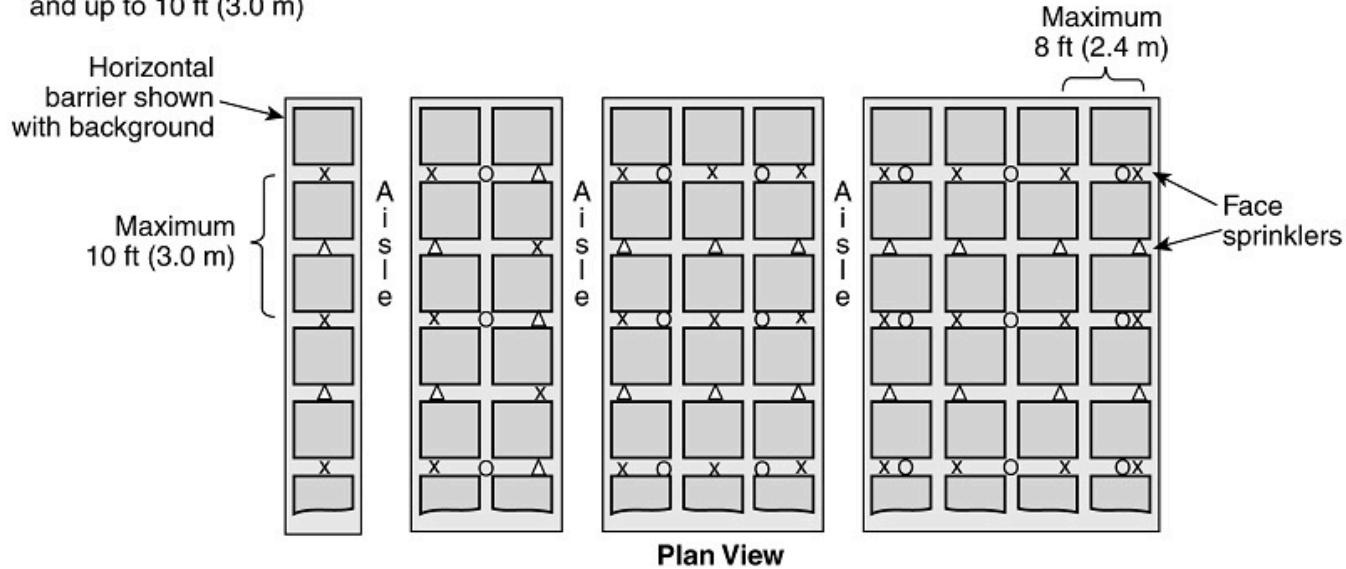
Ceiling Design: Cartoned Group A Plastic Commodities

0.30 gpm/ft² over 2000 ft² (12.2 mm/min over 185 m²)

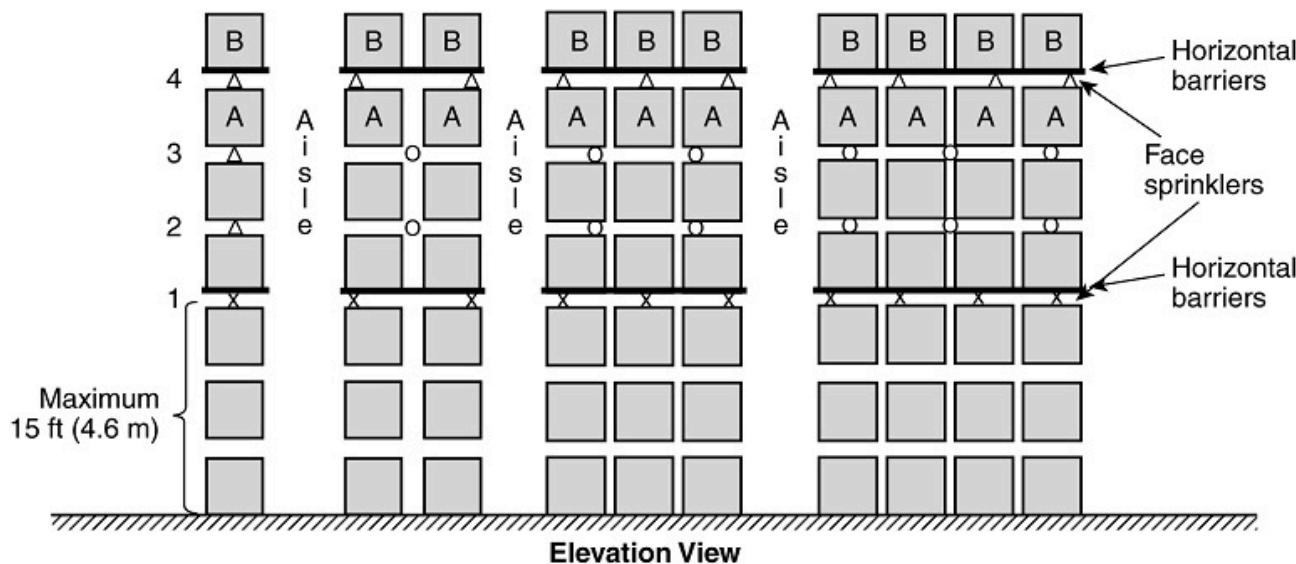
where maximum storage height over top of in-rack sprinklers is 5 ft (1.5 m)

0.45 gpm/ft² over 2000 ft² (18.3 mm/min over 185 m²)

where maximum storage height over top of in-rack sprinklers is over 5 ft (1.5 m)
and up to 10 ft (3.0 m)



Plan View



Notes:

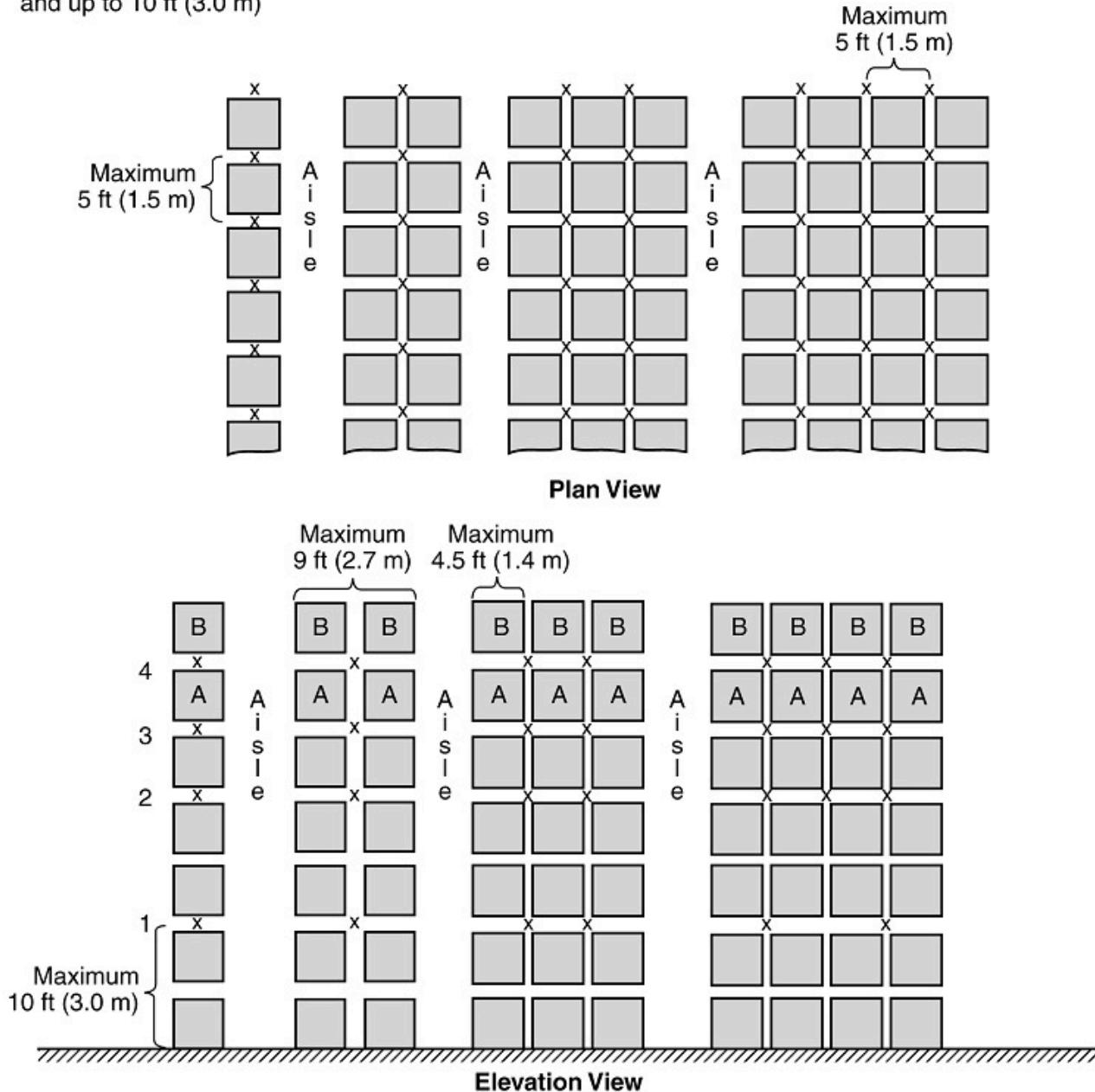
- (1) In-rack sprinklers are ordinary-temperature-rated, quick- or standard-response, pendent or upright, minimum K-5.6 (K-80), and designed for a minimum of 14 in-rack sprinklers (seven in-rack sprinklers on the top two levels) operating at 30 gpm (114 L/min).
- (2) Face sprinklers are to be a minimum of 3 in. (75 mm) from rack uprights and a maximum of 18 in. (450 mm) from the aisle face of storage.
- (3) Sprinkler 1 and Sprinkler 2 or Sprinkler 1 and Sprinkler 3 are required where Load A represents the top of storage.
- (4) Sprinkler 1 and Sprinkler 3 or Sprinkler 1 and Sprinkler 4 are required where Load B represents the top of storage.
- (5) For storage higher than represented by Load B, the cycle defined by Note 3 and Note 4 above is repeated, with stagger as indicated.
- (6) The storage height above the top level of in-rack sprinklers is limited to a maximum of 10 ft (3.0 m).
- (7) The symbols X, O, and Δ represent in-rack sprinklers that are to be staggered both horizontally and vertically.
- (8) Each square represents a storage cube measuring 4 ft to 5 ft (1.2 m to 1.5 m) on a side. Actual load heights can vary from approximately 18 in. to 10 ft (450 mm to 3.0 m). Therefore, there could be as few as two loads or as many as 13 loads between in-rack sprinklers that are spaced 20 ft (6.1 m) apart vertically.

Figure 25.4.3.3.1.1(d) In-Rack Sprinkler Arrangements for Cartoned Group A Plastic Commodities Stored Over 25 ft (7.6 m) in Height — Option 4.

Ceiling Design: Cartoned Group A Plastic Commodities

0.30 gpm/ft² over 2000 ft² (12.2 mm/min over 185 m²)
 where maximum storage height over top of in-rack sprinklers is 5 ft (1.5 m)

0.45 gpm/ft² over 2000 ft² (18.3 mm/min over 185 m²)
 where maximum storage height over top of in-rack sprinklers is over 5 ft (1.5 m)
 and up to 10 ft (3.0 m)

**Notes:**

- (1) In-rack sprinklers are ordinary-temperature-rated, quick- or standard-response, pendent or upright, minimum K-5.6 (K-80), and designed for a minimum of 14 in-rack sprinklers (seven in-rack sprinklers on the top two levels) operating at 30 gpm (114 L/min).
- (2) Sprinkler 1 and Sprinkler 2 or Sprinkler 1, Sprinkler 2, and Sprinkler 3 are required where Load A represents the top of storage.
- (3) Sprinkler 1, Sprinkler 2, and Sprinkler 3 or Sprinkler 1, Sprinkler 2, and Sprinkler 4 are required where Load B represents the top of storage.
- (4) For storage higher than represented by Load B, the cycle defined by Note 2 and Note 3 above is repeated.
- (5) The storage height above the top level of in-rack sprinklers is limited to a maximum of 10 ft (3.0 m).
- (6) In-rack sprinklers in the transverse flue space are permitted to be at any point between load faces.
- (7) The symbol X represents in-rack sprinklers.
- (8) Each square represents a storage cube measuring 4 ft to 5 ft (1.2 m to 1.5 m) on a side. Actual load heights can vary from approximately 18 in. to 10 ft (450 mm to 3.0 m). Therefore, there could be as few as one load or as many as six loads between in-rack sprinklers that are spaced 10 ft (3.0 m) apart vertically.

Figure 25.4.3.3.1.1(e) In-Rack Sprinkler Arrangements for Cartoned Group A Plastic Commodities Stored Over 25 ft (7.6 m) in Height — Option 5.

Ceiling Design: Cartoned Group A Plastic Commodities

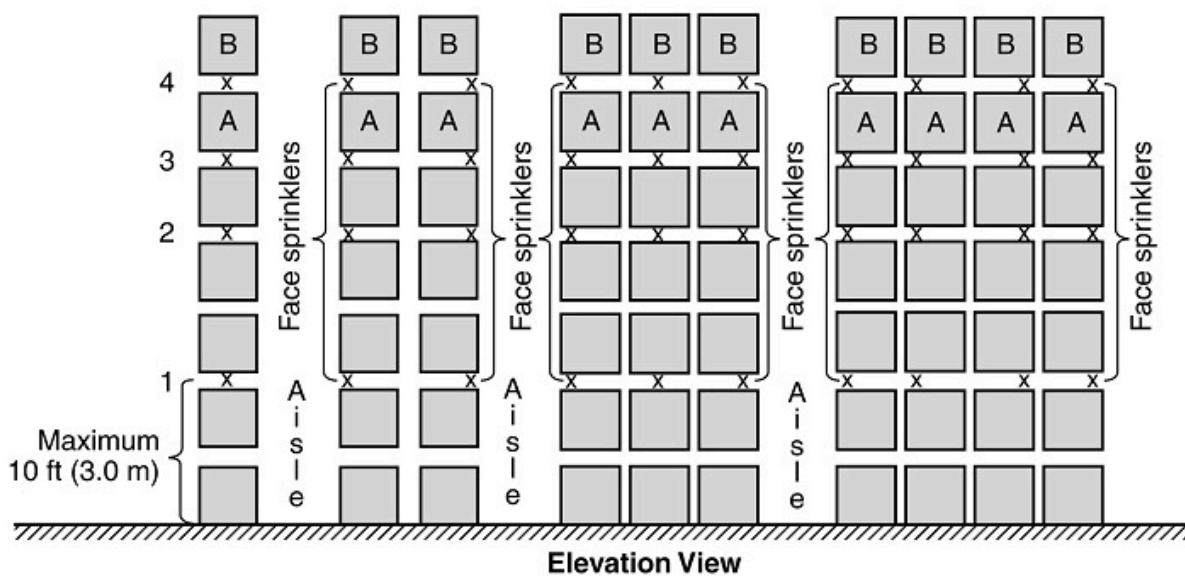
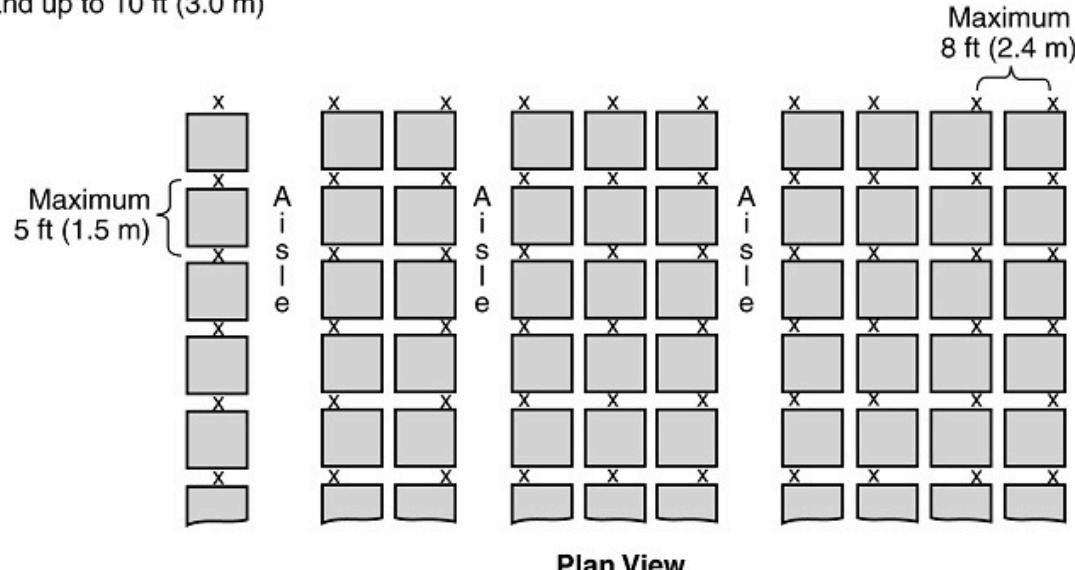
0.30 gpm/ft² over 2000 ft² (12.2 mm/min over 185 m²)

where maximum storage height over top of in-rack sprinklers is 5 ft (1.5 m)

0.45 gpm/ft² over 2000 ft² (18.3 mm/min over 185 m²)

where maximum storage height over top of in-rack sprinklers is over 5 ft (1.5 m)

and up to 10 ft (3.0 m)

**Notes:**

- (1) In-rack sprinklers are ordinary-temperature-rated, quick- or standard-response, pendent or upright, minimum K-5.6 (K-80), and designed for a minimum of 14 in-rack sprinklers (seven in-rack sprinklers on the top two levels) operating at 30 gpm (114 L/min).
- (2) Face sprinklers are to be a minimum of 3 in. (75 mm) from rack uprights and a maximum of 18 in. (450 mm) from the aisle face of storage.
- (3) Sprinkler 1 and Sprinkler 2 or Sprinkler 1, Sprinkler 2, and Sprinkler 3 are required where Load A represents the top of storage.
- (4) Sprinkler 1, Sprinkler 2, and Sprinkler 3 or Sprinkler 1, Sprinkler 2, and Sprinkler 4 are required where Load B represents the top of storage.
- (5) For storage higher than represented by Load B, the cycle defined by Note 3 and Note 4 above is repeated.
- (6) The storage height above the top level of in-rack sprinklers is limited to a maximum of 10 ft (3.0 m).
- (7) The symbol X represents in-rack sprinklers.
- (8) Each square represents a storage cube measuring 4 ft to 5 ft (1.2 m to 1.5 m) on a side. Actual load heights can vary from approximately 18 in. to 10 ft (450 mm to 3.0 m). Therefore, there could be as few as one load or as many as six loads between in-rack sprinklers that are spaced 10 ft (3.0 m) apart vertically.

Figure 25.4.3.3.1.1(f) In-Rack Sprinkler Arrangements for Cartoned Group A Plastic Commodities Stored Over 25 ft (7.6 m) in Height — Option 6.

Ceiling Design: Cartoned Group A Plastic Commodities

0.30 gpm/ft² over 2000 ft² (12.2 mm/min over 185 m²)

where maximum storage height over top of in-rack sprinklers is 5 ft (1.5 m)

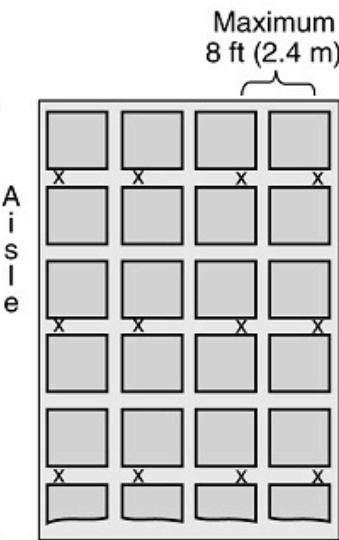
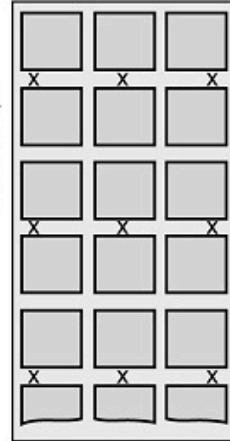
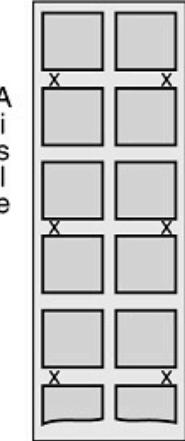
0.45 gpm/ft² over 2000 ft² (18.3 mm/min over 185 m²)

where maximum storage height over top of in-rack sprinklers is over 5 ft (1.5 m)

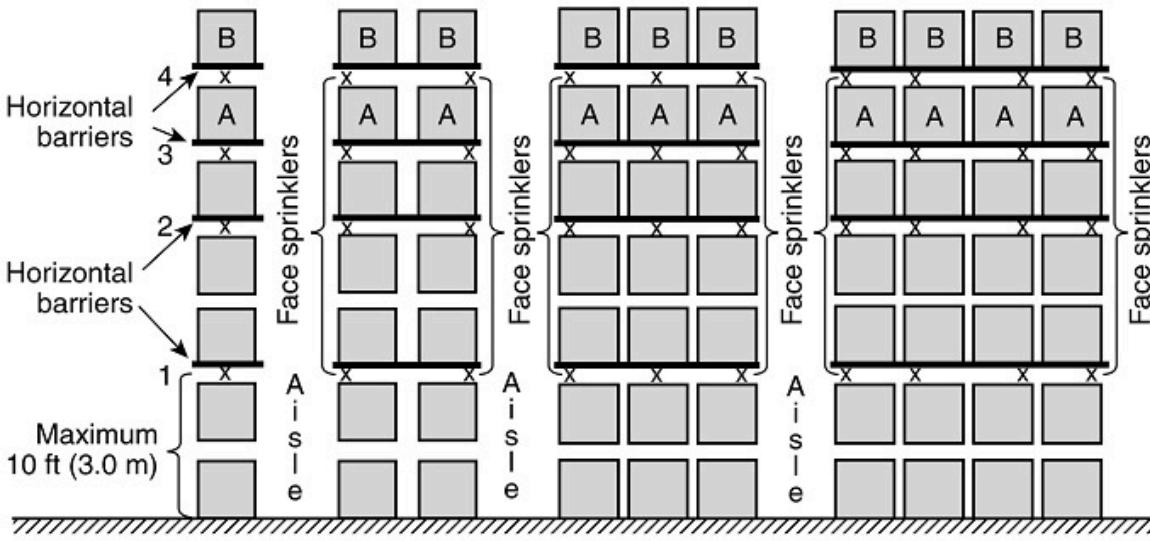
and up to 10 ft (3.0 m)

Horizontal barrier
shown with
background

Maximum
10 ft (3.0 m)



Plan View



Elevation View

Notes:

- (1) In-rack sprinklers are ordinary-temperature-rated, quick- or standard-response, pendent or upright, minimum K-5.6 (K-80), and designed for a minimum of 14 in-rack sprinklers (seven in-rack sprinklers on the top two levels) operating at 30 gpm (114 L/min).
- (2) Face sprinklers are to be a minimum of 3 in. (75 mm) from rack uprights and a maximum of 18 in. (450 mm) from the aisle face of storage.
- (3) Sprinkler 1 and Sprinkler 2 or Sprinkler 1, Sprinkler 2, and Sprinkler 3 are required where Load A represents the top of storage.
- (4) Sprinkler 1, Sprinkler 2, and Sprinkler 3 or Sprinkler 1, Sprinkler 2, and Sprinkler 4 are required where Load B represents the top of storage.
- (5) For storage higher than represented by Load B, the cycle defined by Note 3 and Note 4 above is repeated.
- (6) The storage height above the top level of in-rack sprinklers is limited to a maximum of 10 ft (3.0 m).
- (7) The symbol X represents in-rack sprinklers.
- (8) Each square represents a storage cube measuring 4 ft to 5 ft (1.2 m to 1.5 m) on a side. Actual load heights can vary from approximately 18 in. to 10 ft (450 mm to 3.0 m). Therefore, there could be as few as one load or as many as six loads between in-rack sprinklers that are spaced 10 ft (3.0 m) apart vertically.

Figure 25.4.3.3.1.1(g) In-Rack Sprinkler Arrangements for Cartoned Group A Plastic Commodities Stored Over 25 ft (7.6 m) in Height — Option 7.

Ceiling Design: Cartoned Group A Plastic Commodities

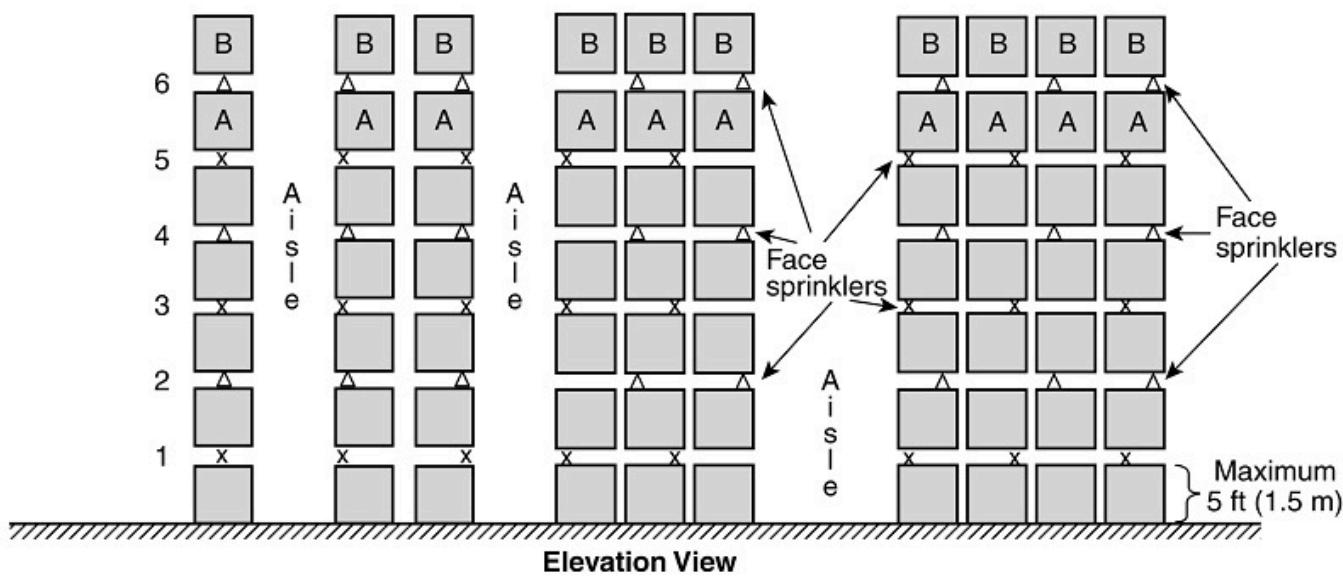
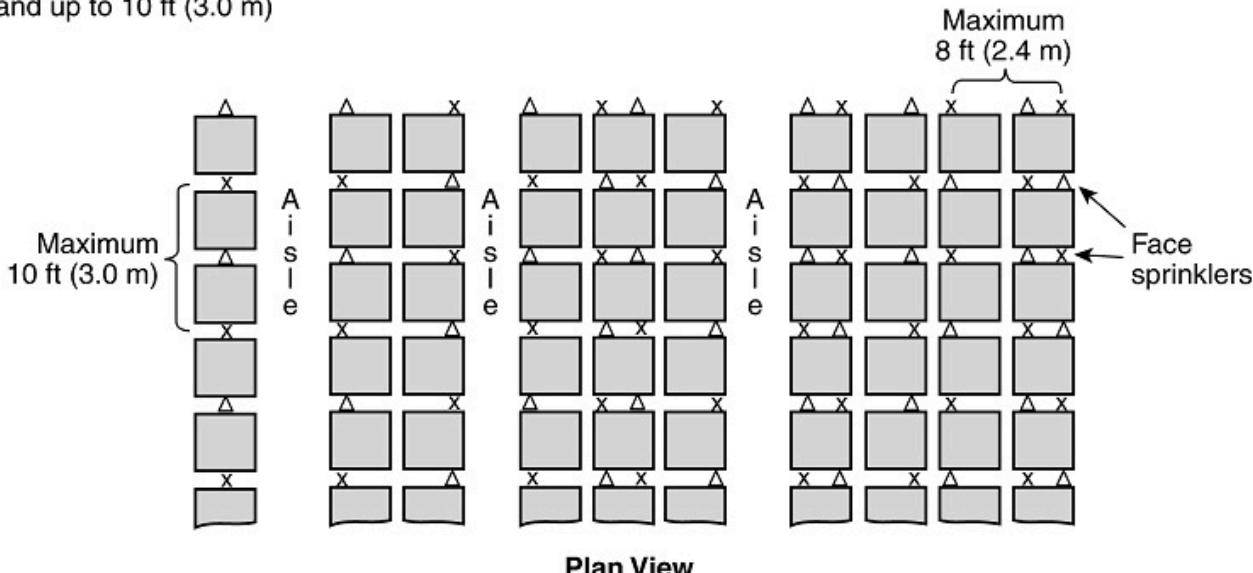
0.30 gpm/ft² over 2000 ft² (12.2 mm/min over 185 m²)

where maximum storage height over top of in-rack sprinklers is 5 ft (1.5 m)

0.45 gpm/ft² over 2000 ft² (18.3 mm/min over 185 m²)

where maximum storage height over top of in-rack sprinklers is over 5 ft (1.5 m)

and up to 10 ft (3.0 m)

**Notes:**

- (1) In-rack sprinklers are ordinary-temperature-rated, quick- or standard-response, pendent or upright, minimum K-5.6 (K-80), and designed for a minimum of 14 in-rack sprinklers (seven in-rack sprinklers on the top two levels) operating at 30 gpm (114 L/min).
- (2) Face sprinklers are to be a minimum of 3 in. (75 mm) from rack uprights and a maximum of 18 in. (450 mm) from the aisle face of storage.
- (3) Sprinkler 1, Sprinkler 2, Sprinkler 3, and Sprinkler 4 or Sprinkler 1, Sprinkler 2, Sprinkler 3, Sprinkler 4, and Sprinkler 5 are required where Load A represents the top of storage.
- (4) Sprinkler 1, Sprinkler 2, Sprinkler 3, Sprinkler 4, and Sprinkler 5 or Sprinkler 1, Sprinkler 2, Sprinkler 3, Sprinkler 4, and Sprinkler 6 are required where Load B represents the top of storage.
- (5) For storage higher than represented by Load B, the cycle defined by Note 3 and Note 4 above is repeated.
- (6) The storage height above the top level of in-rack sprinklers is limited to a maximum of 10 ft (3.0 m).
- (7) The symbols X and Δ represent in-rack sprinklers that are to be staggered both horizontally and vertically.
- (8) Each square represents a storage cube measuring 4 ft to 5 ft (1.2 m to 1.5 m) on a side. Actual load heights can vary from approximately 18 in. to 10 ft (450 mm to 3.0 m). Therefore, there could be as few as one load or as many as six loads between in-rack sprinklers that are spaced 10 ft (3.0 m) apart vertically.

25.4.3.3.1.2

The in-rack sprinkler arrangements of 25.4.3.3.1.1 shall result in a maximum storage height of 10 ft (3.0 m) above the top level of in-rack sprinklers.

25.4.3.3.1.3 Excessive Clearance to Ceiling.

(A)

Where the clearance to ceiling exceeds 10 ft (3.0 m), the existing in-rack sprinkler arrangements indicated in Figure 25.4.3.3.1.1(a) through Figure 25.4.3.3.1.1(g) for cartoned Group A plastic commodities shall be supplemented with one level of supplemental quick-response in-rack sprinklers installed directly below the top tier of storage and at every flue space intersection.

(B)

Where supplemental in-rack sprinklers have been installed in accordance with 25.4.3.3.1.3(A), the required ceiling-level sprinkler system design shall be based on a ceiling clearance of 10 ft (3.0 m).

25.4.3.3.2 * CMDA Ceiling-Level Sprinkler Designs for Cartoned Group A Plastic Commodities Stored Over 25 ft (7.6 m) in Height in Combination with In-Rack Sprinklers.

Where rack storage of cartoned Group A plastic commodities stored over 25 ft (7.6 m) in height will be protected by in-rack sprinklers, the ceiling-level sprinkler design in terms of density [gpm/ft² (mm/min)] and area of sprinkler operation [ft² (m²) of ceiling or roof sprinklers] shall be in accordance with Figure 25.4.3.3.1.1(a) through Figure 25.4.3.3.1.1(g).

25.4.3.4 Exposed Nonexpanded Group A Plastic Commodities.

25.4.3.4.1 In-Rack Sprinkler Arrangements and Designs for Exposed Nonexpanded Group A Plastic Commodities Stored Over 25 ft (7.6 m) in Height.

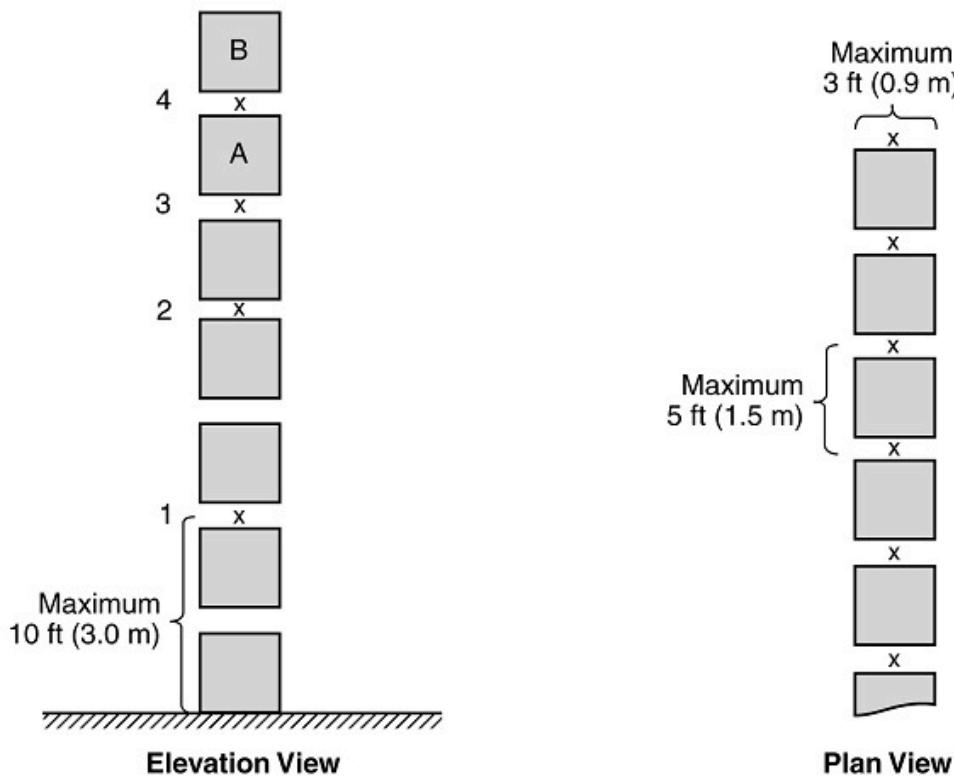
25.4.3.4.1.1

Where rack storage of exposed nonexpanded Group A plastic commodities stored over 25 ft (7.6 m) in height will be protected by in-rack sprinklers, in-rack sprinkler arrangements and designs shall be selected from Figure 25.4.3.4.1.1(a) through Figure 25.4.3.4.1.1(d). (See Section 25.3 for racks with solid shelving.)

Figure 25.4.3.4.1.1(a) In-Rack Sprinkler Arrangements for Exposed Nonexpanded Group A Plastic Commodities Stored Over 25 ft (7.6 m) in Height — Option 1.

Ceiling Design: Exposed, Nonexpanded Group A Plastic Commodities

0.45 gpm/ft² over 2000 ft² (18.3 mm/min over 185 m²)
where maximum storage height over top of in-rack sprinklers is up to 10 ft (3.0 m)

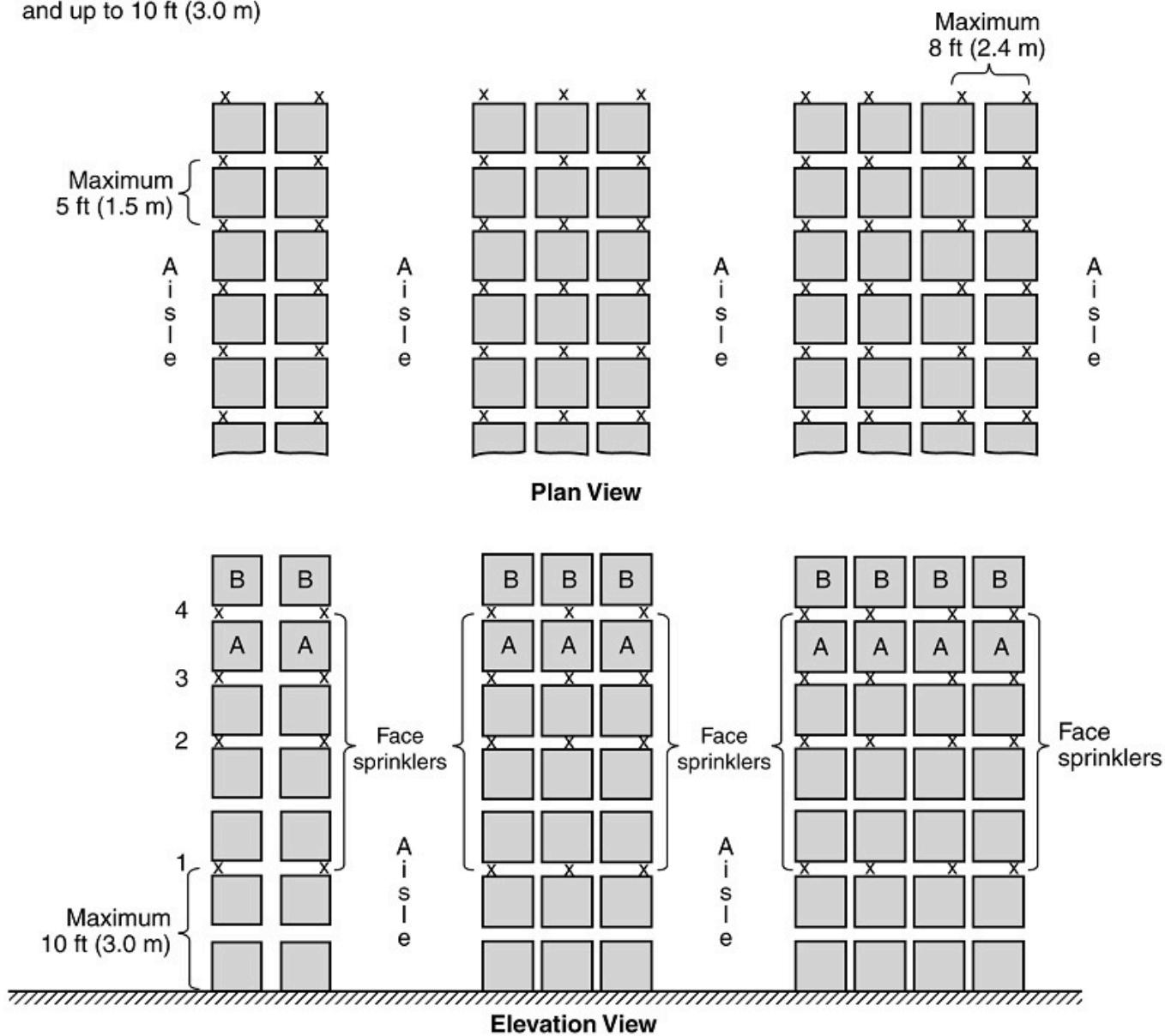
**Notes:**

- (1) In-rack sprinklers are ordinary-temperature-rated, quick- or standard-response, pendent or upright, minimum K-5.6 (K-80), and designed for a minimum of 14 in-rack sprinklers (seven in-rack sprinklers on the top two levels) operating at 30 gpm (114 L/min).
- (2) Sprinkler 1 and Sprinkler 2 or Sprinkler 1, Sprinkler 2, and Sprinkler 3 are required when Load A represents the top of storage.
- (3) Sprinkler 1, Sprinkler 2, and Sprinkler 3 or Sprinkler 1, Sprinkler 2, and Sprinkler 4 are required where Load B represents the top of storage.
- (4) For storage higher than represented by Load B, the cycle defined by Note 2 and Note 3 above is repeated.
- (5) The storage height above the top level of in-rack sprinklers is limited to a maximum of 10 ft (3.0 m).
- (6) The symbol X represents in-rack sprinklers.
- (7) Each square represents a storage cube measuring 4 ft to 5 ft (1.2 m to 1.5 m) on a side. Actual load heights can vary from approximately 18 in. to 10 ft (450 mm to 3.0 m). Therefore, there could be as few as one load or as many as six loads between in-rack sprinklers that are spaced 10 ft (3.0 m) apart vertically.

Figure 25.4.3.4.1.1(b) In-Rack Sprinkler Arrangements for Exposed Nonexpanded Group A Plastic Commodities Stored Over 25 ft (7.6 m) in Height — Option 2.

Ceiling Design: Exposed Nonexpanded Group A Plastic Commodities

0.30 gpm/ft² over 2000 ft² (12.2 mm/min over 185 m²)
 where maximum storage height over top of in-rack sprinklers is 5 ft (1.5 m)
 0.45 gpm/ft² over 2000 ft² (18.3 mm/min over 185 m²)
 where maximum storage height over top of in-rack sprinklers is over 5 ft (1.5 m)
 and up to 10 ft (3.0 m)

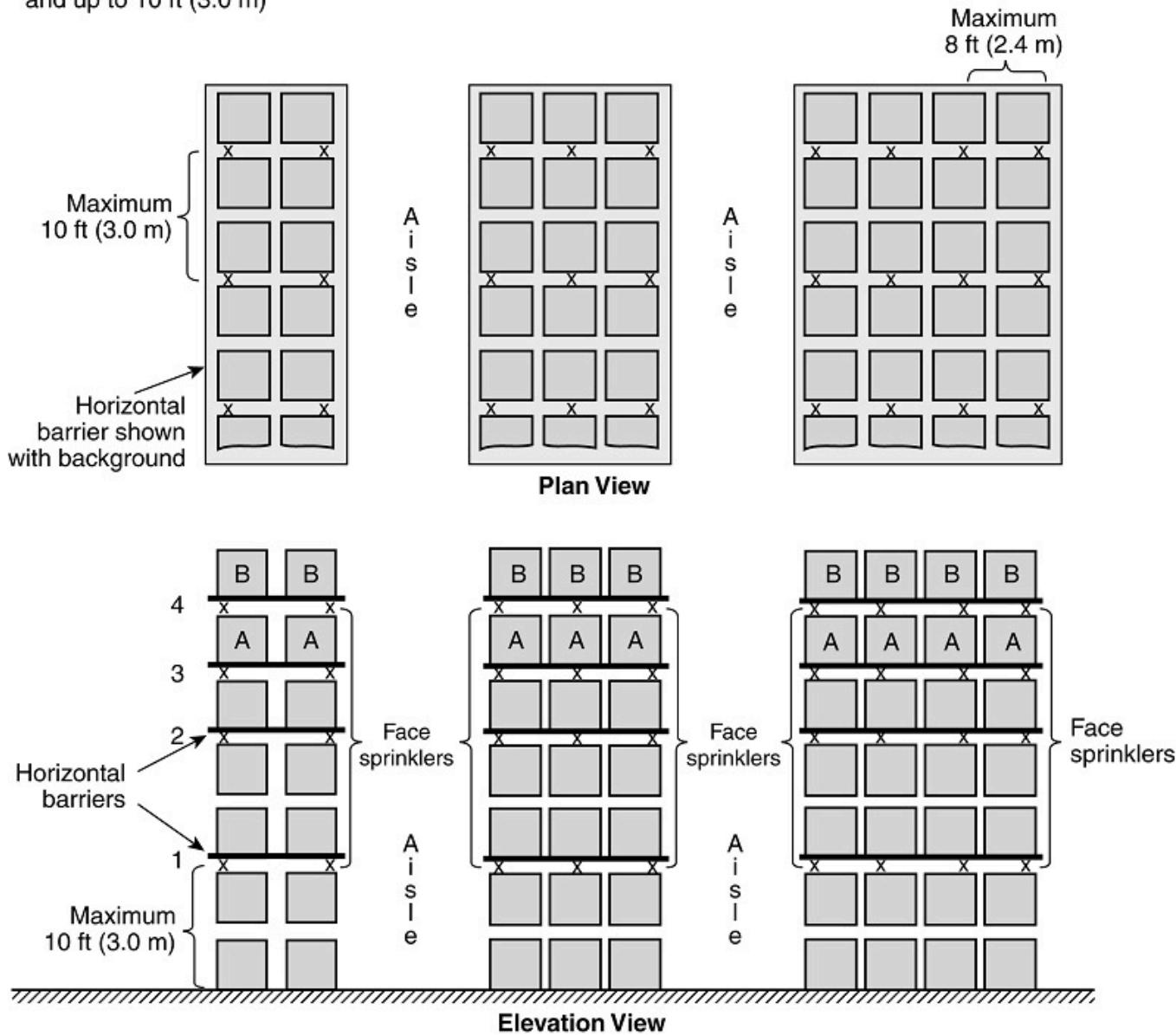
**Notes:**

- (1) In-rack sprinklers are ordinary-temperature-rated, quick- or standard-response, pendent or upright, minimum K-5.6 (K-80), and designed for a minimum of 14 in-rack sprinklers (seven in-rack sprinklers on the top two levels) operating at 30 gpm (114 L/min).
- (2) Face sprinklers are to be a minimum of 3 in. (75 mm) from rack uprights and a maximum of 18 in. (450 mm) from the aisle face of storage.
- (3) Sprinkler 1 and Sprinkler 2 or Sprinkler 1, Sprinkler 2, and Sprinkler 3 are required where Load A represents the top of storage.
- (4) Sprinkler 1, Sprinkler 2, and Sprinkler 3 or Sprinkler 1, Sprinkler 2, and Sprinkler 4 are required where Load B represents the top of storage.
- (5) For storage higher than represented by Load B, the cycle defined by Note 3 and Note 4 above is repeated.
- (6) The storage height above the top level of in-rack sprinklers is limited to a maximum of 10 ft (3.0 m).
- (7) The symbol X represents in-rack sprinklers.
- (8) Each square represents a storage cube measuring 4 ft to 5 ft (1.2 m to 1.5 m) on a side. Actual load heights can vary from approximately 18 in. to 10 ft (450 mm to 3.0 m). Therefore, there could be as few as one load or as many as six loads between in-rack sprinklers that are spaced 10 ft (3.0 m) apart vertically.

Figure 25.4.3.4.1.1(c) In-Rack Sprinkler Arrangements for Exposed Nonexpanded Group A Plastic Commodities Stored Over 25 ft (7.6 m) in Height — Option 3.

Ceiling Design: Exposed Nonexpanded Group A Plastic Commodities

0.30 gpm/ft² over 2000 ft² (12.2 mm/min over 185 m²)
 where maximum storage height over top of in-rack sprinklers is 5 ft (1.5 m)
 0.45 gpm/ft² over 2000 ft² (18.3 mm/min over 185 m²)
 where maximum storage height over top of in-rack sprinklers is over 5 ft (1.5 m)
 and up to 10 ft (3.0 m)

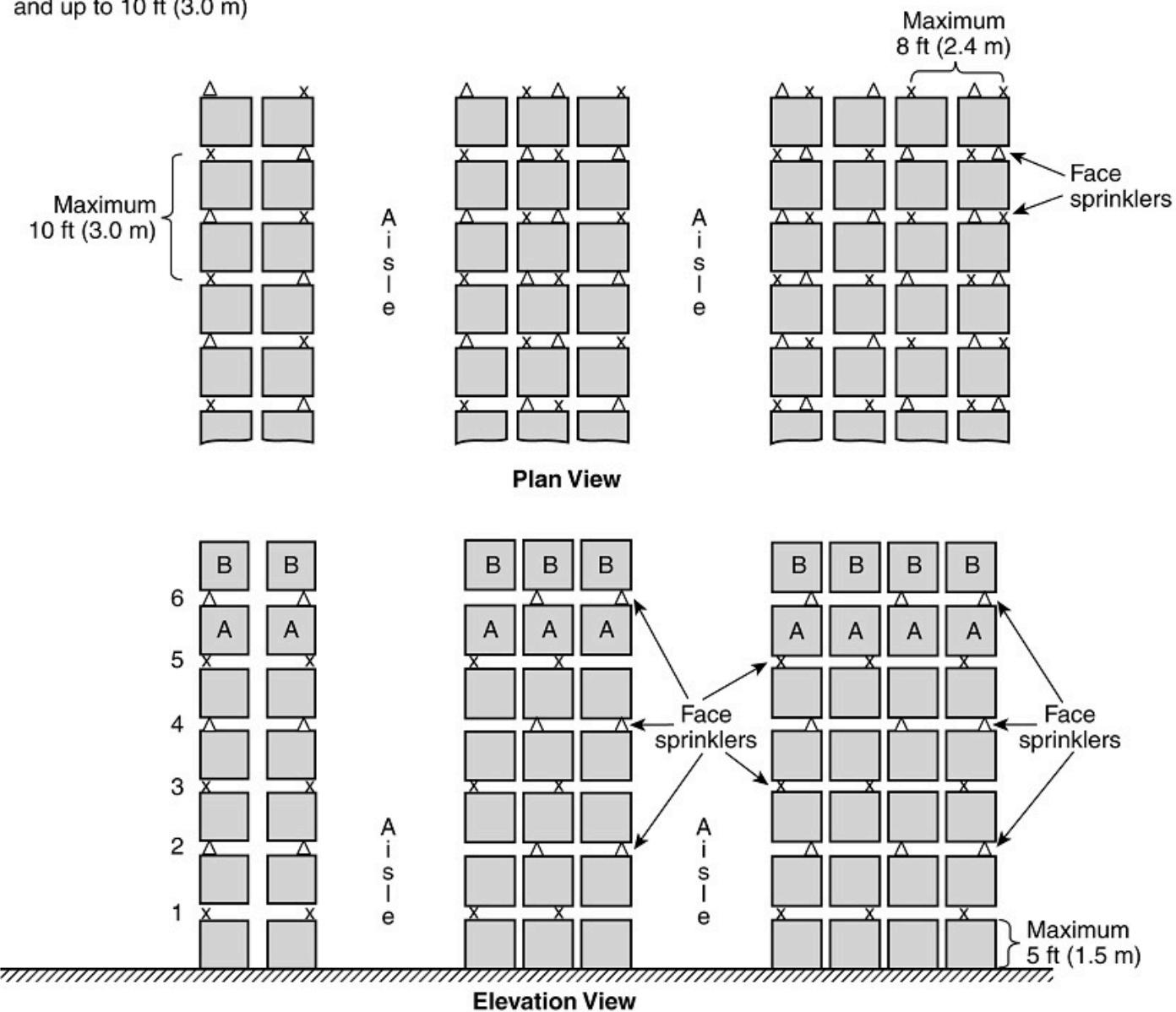
**Notes:**

- (1) In-rack sprinklers are ordinary-temperature-rated, quick- or standard-response, pendent or upright, minimum K-5.6 (K-80), and designed for a minimum of 14 in-rack sprinklers (seven in-rack sprinklers on the top two levels) operating at 30 gpm (114 L/min).
- (2) Face sprinklers are to be a minimum of 3 in. (75 mm) from rack uprights and a maximum of 18 in. (450 mm) from the aisle face of storage.
- (3) Sprinkler 1 and Sprinkler 2 or Sprinkler 1, Sprinkler 2, and Sprinkler 3 are required where Load A represents the top of storage.
- (4) Sprinkler 1, Sprinkler 2, and Sprinkler 3 or Sprinkler 1, Sprinkler 2, and Sprinkler 4 are required where Load B represents the top of storage.
- (5) For storage higher than represented by Load B, the cycle defined by Note 3 and Note 4 above is repeated.
- (6) The storage height above the top level of in-rack sprinklers is limited to a maximum of 10 ft (3.0 m).
- (7) The symbol X represents in-rack sprinklers.
- (8) Each square represents a storage cube measuring 4 ft to 5 ft (1.2 m to 1.5 m) on a side. Actual load heights can vary from approximately 18 in. to 10 ft (450 mm to 3.0 m). Therefore, there could be as few as one load or as many as six loads between in-rack sprinklers that are spaced 10 ft (3.0 m) apart vertically.

Figure 25.4.3.4.1.1(d) In-Rack Sprinkler Arrangements for Exposed Nonexpanded Group A Plastic Commodities Stored Over 25 ft (7.6 m) in Height — Option 4.

Ceiling Design: Exposed Nonexpanded Group A Plastic Commodities

0.30 gpm/ft² over 2000 ft² (12.2 mm/min over 185 m²)
 where maximum storage height over top of in-rack sprinklers is 5 ft (1.5 m)
 0.45 gpm/ft² over 2000 ft² (18.3 mm/min over 185 m²)
 where maximum storage height over top of in-rack sprinklers is over 5 ft (1.5 m)
 and up to 10 ft (3.0 m)

**Notes:**

- (1) In-rack sprinklers are ordinary-temperature-rated, quick- or standard-response, pendent or upright, minimum K-5.6 (K-80), and designed for a minimum of 14 in-rack sprinklers (seven in-rack sprinklers on the top two levels) operating at 30 gpm (114 L/min).
- (2) Face sprinklers are to be a minimum of 3 in. (75 mm) from rack uprights and a maximum of 18 in. (450 mm) from the aisle face of storage.
- (3) Sprinkler 1, Sprinkler 2, Sprinkler 3, and Sprinkler 4 or Sprinkler 1, Sprinkler 2, Sprinkler 3, Sprinkler 4, and Sprinkler 5 are required where Load A represents the top of storage.
- (4) Sprinkler 1, Sprinkler 2, Sprinkler 3, Sprinkler 4, and Sprinkler 5 or Sprinkler 1, Sprinkler 2, Sprinkler 3, Sprinkler 4, and Sprinkler 6 are required where Load B represents the top of storage.
- (5) For storage higher than represented by Load B, the cycle defined by Note 3 and Note 4 above is repeated.
- (6) The storage height above the top level of in-rack sprinklers is limited to a maximum of 10 ft (3.0 m).
- (7) The symbols X and Δ represent in-rack sprinklers that are to be staggered both horizontally and vertically.
- (8) Each square represents a storage cube measuring 4 ft to 5 ft (1.2 m to 1.5 m) on a side. Actual load heights can vary from approximately 18 in. to 10 ft (450 mm to 3.0 m). Therefore, there could be as few as one load or as many as six loads between in-rack sprinklers that are spaced 10 ft (3.0 m) apart vertically.

25.4.3.4.1.2

The in-rack sprinkler arrangements of 25.4.3.4.1.1 shall result in a maximum storage height of 10 ft (3.0 m) above the top level of in-rack sprinklers.

25.4.3.4.1.3 Excessive Clearance to Ceiling.

(A)

Where the clearance to ceiling exceeds 10 ft (3.0 m), the existing in-rack sprinkler arrangements indicated in Figure 25.4.3.4.1.1(a) through Figure 25.4.3.4.1.1(d) for exposed nonexpanded Group A plastic commodities shall be supplemented with one level of supplemental quick-response in-rack sprinklers installed directly below the top tier of storage and at every flue space intersection.

(B)

Where supplemental in-rack sprinklers have been installed in accordance with 25.4.3.4.1.3(A), the required ceiling-level sprinkler system design shall be based on a ceiling clearance of 10 ft (3.0 m).

25.4.3.4.2 * CMDA Ceiling-Level Sprinkler Designs for Exposed Nonexpanded Group A Plastic Commodities Stored Over 25 ft (7.6 m) in Height in Combination with In-Rack Sprinklers.

Where rack storage of exposed nonexpanded Group A plastic commodities stored over 25 ft (7.6 m) in height will be protected by in-rack sprinklers, the ceiling-level sprinkler design in terms of density [gpm/ft² (mm/min)] and area of sprinkler operation [ft² (m²) of ceiling or roof sprinklers] shall be in accordance with Figure 25.4.3.4.1.1(a) through Figure 25.4.3.4.1.1(d).

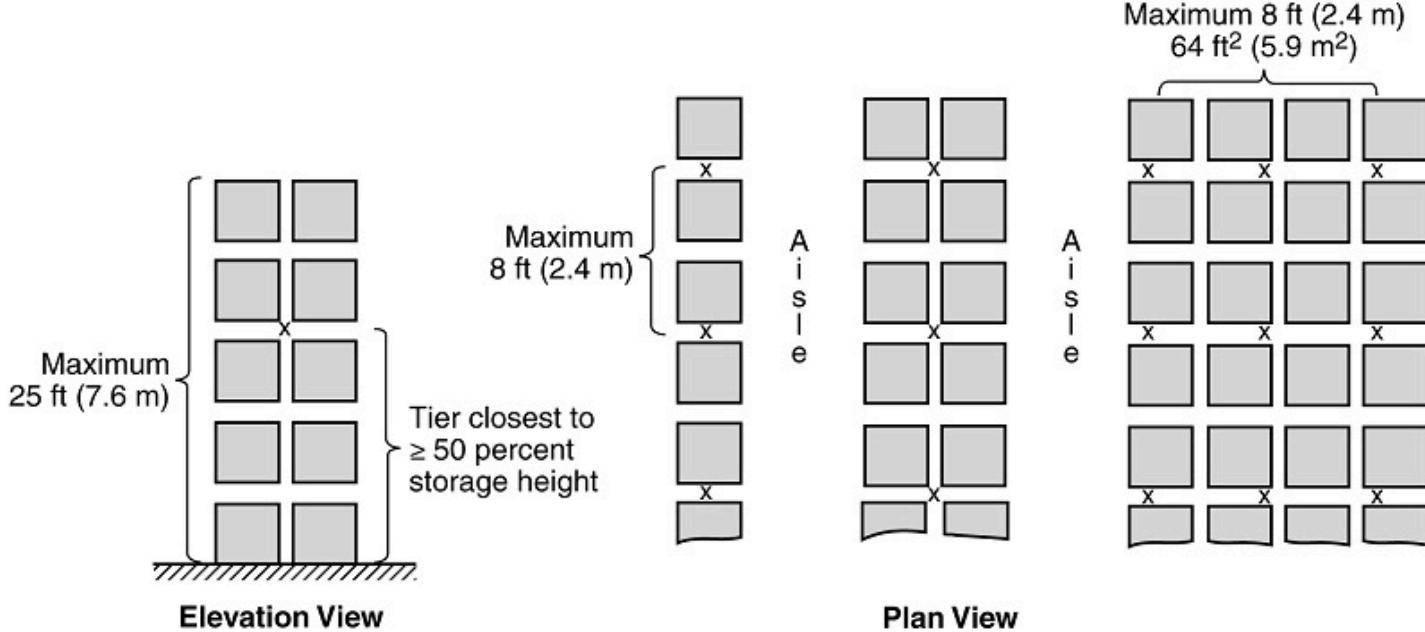
25.5 In-Rack Sprinkler Protection in Combination with CMSA Ceiling-Level Sprinklers.

25.5.1 In-Rack Sprinkler Arrangements and Designs for Class I, Class II, Class III, Class IV, or Group A Plastic Commodities Protected by CMSA Ceiling-Level Sprinklers.

25.5.1.1 In-Rack Sprinkler Arrangements and Designs.

Where rack storage of encapsulated or nonencapsulated Class I, Class II, Class III, Class IV, or Group A plastic commodities will be protected by in-rack sprinklers, the in-rack sprinkler arrangements and designs shall be selected from Figure 25.5.1.1(a) through Figure 25.5.1.1(c). (See 25.5.1 for racks with solid shelving.)

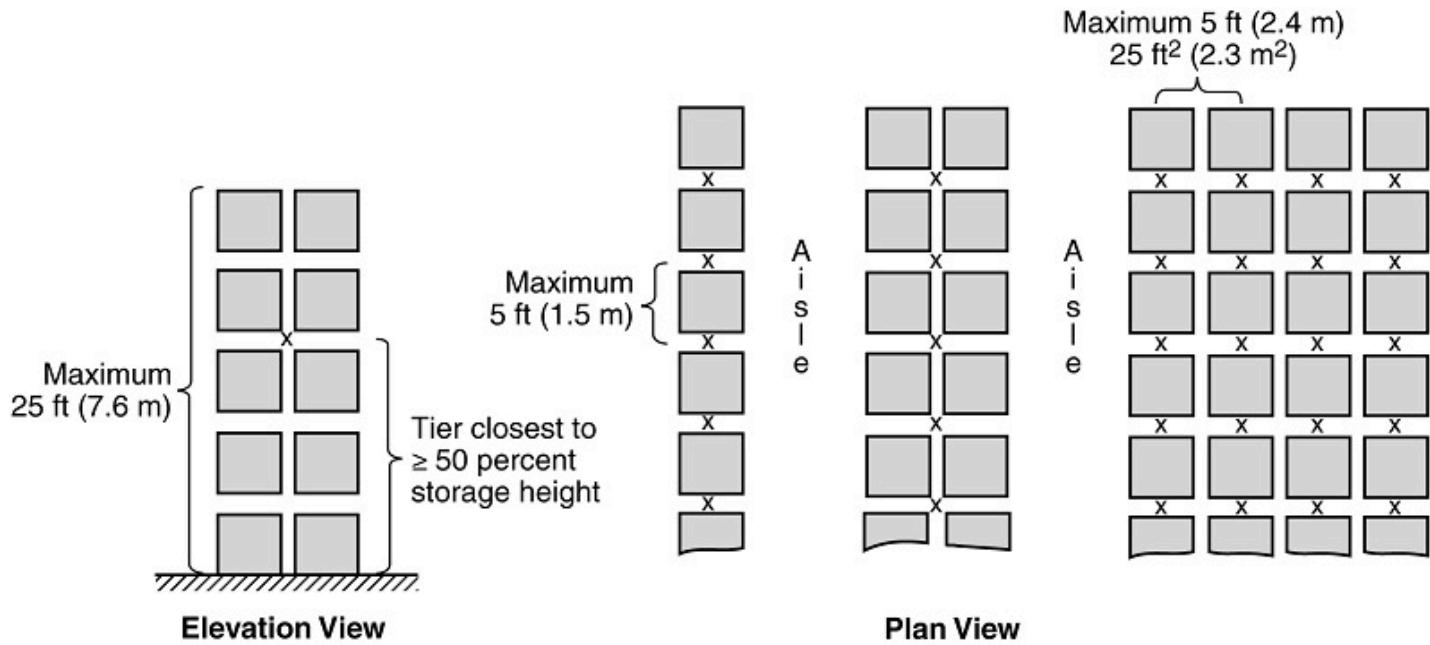
Figure 25.5.1.1(a) In-Rack Sprinkler Arrangements for Encapsulated or Nonencapsulated Class I through Class IV Commodities Stored Up to and Including 25 ft (7.6 m) in Height.



Notes:

- (1) See Table 25.5.1.3 for the CMSA ceiling sprinkler design in combination with one level of in-rack sprinklers.
- (2) In-rack sprinklers are ordinary-temperature-rated, quick- or standard-response, pendant or upright, minimum K-5.6 (K-80), and designed for a minimum of eight (8) in-rack sprinklers operating at 22 gpm (83 L/min).
- (3) The symbol X represents in-rack sprinklers.
- (4) Each square represents a storage cube measuring 4 ft to 5 ft (1.2 m to 1.5 m) on a side.

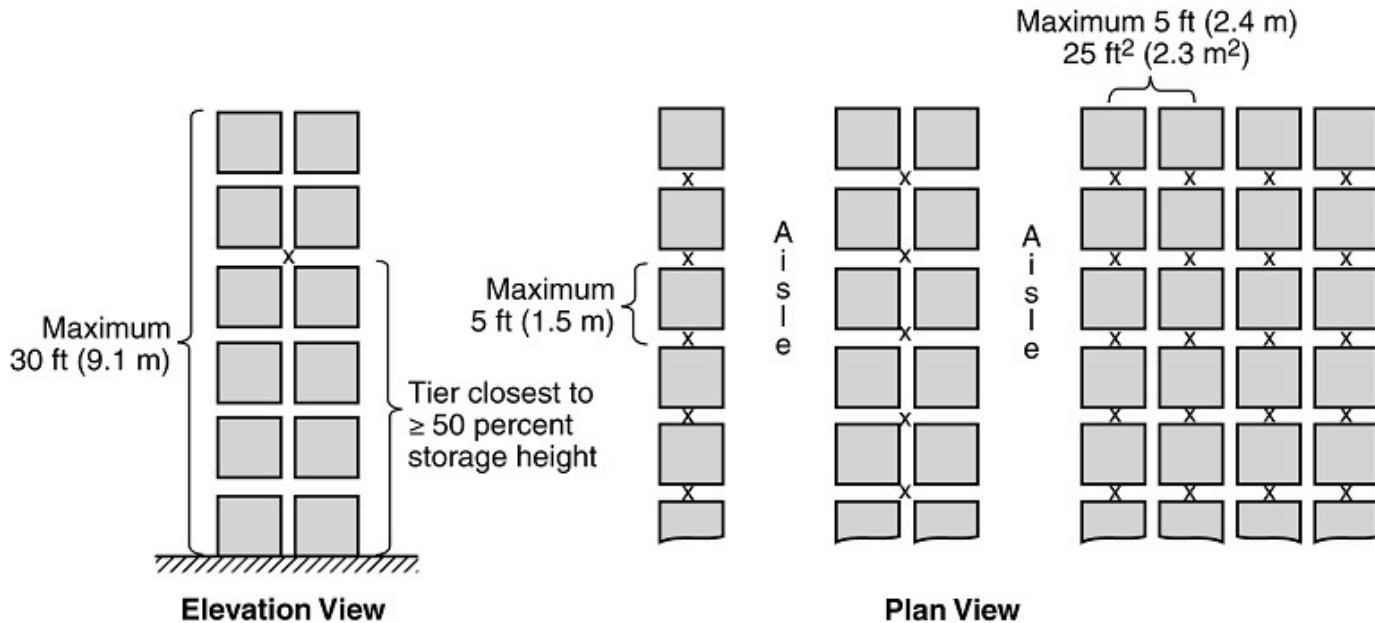
Figure 25.5.1.1(b) In-Rack Sprinkler Arrangements for Nonexpanded, Cartoned or Exposed, Group A Plastic Commodities Stored Up to and Including 25 ft (7.6 m) in Height.



Notes:

- (1) See Table 25.5.1.3 for the CMSA ceiling sprinkler design in combination with one level of in-rack sprinklers.
- (2) In-rack sprinklers are ordinary-temperature-rated, quick- or standard-response, pendent or upright, minimum K-5.6 (K-80), and designed for a minimum of eight (8) in-rack sprinklers operating at 22 gpm (83 L/min).
- (3) The symbol X represents in-rack sprinklers.
- (4) Each square represents a storage cube measuring 4 ft to 5 ft (1.2 m to 1.5 m) on a side.

Figure 25.5.1.1(c) In-Rack Sprinkler Arrangements for Encapsulated or Nonencapsulated Class I or Class II Commodities Stored Over 25 ft (7.6 m) in Height.



Notes:

- (1) See Table 25.5.1.3 for the CMSA ceiling sprinkler design in combination with one level of in-rack sprinklers.
- (2) In-rack sprinklers are ordinary-temperature-rated, quick- or standard-response, pendent or upright, minimum K-5.6 (K-80), and designed for a minimum of eight (8) in-rack sprinklers operating at 22 gpm (83 L/min).
- (3) The symbol X represents in-rack sprinklers.
- (4) Each square represents a storage cube measuring 4 ft to 5 ft (1.2 m to 1.5 m) on a side.

25.5.1.2 Horizontal Spacing of In-Rack Sprinklers in Combination with CMSA Ceiling-Level Sprinklers.

25.5.1.2.1

Where rack storage of encapsulated or nonencapsulated Class I through Class IV commodities is up to and including 25 ft (7.6 m) in height and protected by CMSA ceiling-level sprinklers, the maximum allowable horizontal spacing of in-rack sprinklers shall be 8 ft (2.4 m).

25.5.1.2.2

Where rack storage of Group A plastic commodities is protected by CMSA ceiling-level sprinklers, the maximum allowable horizontal spacing of in-rack sprinklers shall be 5 ft (1.5 m).

25.5.1.2.3

Where rack storage of encapsulated or nonencapsulated Class I through Class IV commodities is over 25 ft (7.6 m) in height and protected by CMSA ceiling-level sprinklers, the maximum allowable horizontal spacing of in-rack sprinklers shall be 5 ft (1.5 m).

25.5.1.3 Design Criteria for In-Rack Sprinklers in Combination with CMSA Ceiling-Level Sprinklers.

The in-rack sprinkler system design, in terms of number of operating sprinklers at a minimum flow from the most remote in-rack sprinkler, in combination with CMSA ceiling-level sprinklers shall be in accordance with Table 25.5.1.3.

Table 25.5.1.3 Design Criteria for In-Rack Sprinklers in Combination with CMSA Ceiling-Level Sprinklers

Commodity Classification	Maximum Storage Height ft (m)	Maximum Ceiling Height ft (m)	Rack Type	No. of IRAS Levels	IRAS Design, No. of IRAS @ gpm (L/min)
Class I and Class II	30 (9.1)	35 (10.7)	Open	1	8 @ 22 (83)
			Solid shelves	1	6 @ 30 (114)
				More than 1	10 (5 on 2 levels) @ 30 (114)
Class III	25 (7.6)	35 (10.7)	Open	1	8 @ 22 (83)
			Solid shelves	1	6 @ 30 (114)
				More than 1	10 (5 on 2 levels) @ 30 (114)
Class IV and Group A plastics	25 (7.6)	35 (10.7)	Open	1	8 @ 22 gpm (83 L/min)
			Solid Shelves	1	8 @ 30 (114)
				More than 1	14 (7 on 2 levels) @ 30 (114)

25.5.2 Ceiling-Level CMSA Sprinkler Designs for Rack Storage of Class I, Class II, Class III, Class IV, and Group A Plastic Commodities in Combinations with In-Rack Sprinklers.**25.5.2.1 * Ceiling-Level CMSA Sprinkler Designs in Combination with In-Rack-Sprinklers.**

Where rack storage of encapsulated or nonencapsulated Class I, Class II, Class III, Class IV, and Group A plastic commodities will be protected by one or more levels of in-rack sprinklers, unless 25.5.2.2 applies, the ceiling-level sprinkler design in terms of minimum operating pressure [psi (bar)] and the number of ceiling-level sprinklers shall be in accordance with Table 25.5.2.1.

Table 25.5.2.1 CMSA Ceiling-Level Sprinkler Design Criteria for Rack Storage of Encapsulated or Nonencapsulated Class I Through Class IV and Nonexpanded, Cartoned or Exposed, Group A Plastic Commodities Supplemented with In-Rack Sprinklers

Commodity Classification	Maximum Storage Height		Maximum Ceiling Height		K-Factor / Orientation	Type of System	No. of Ceiling Sprinklers in the Design	No. of Required IRAS Levels	Minimum Ceiling Sprinkler Operating Pressure	
	ft	m	ft	m					psi	bar

Commodity Classification	Maximum Storage Height		Maximum Ceiling Height		K-Factor / Orientation	Type of System	No. of Ceiling Sprinklers in the Design	No. of Required IRAS Levels	Minimum Ceiling Sprinkler Operating Pressure	
	ft	m	ft	m					psi	bar
Class I or Class II	30	9.1	35	10.7	11.2 (160) Upright	Wet	20	One level	25	1.7
						Dry	30	One level	25	1.7
	25	7.6	30	9.1	16.8 (240) Upright	Wet	20	One level	15	1
						Dry	30	One level	15	1
Class III	25	7.6	30	9.1	11.2 (160) Upright	Wet	15	One level	25	1.7
						Dry	25	One level	25	1.7
			35	10.7	16.8 (240) Upright	Dry	25	One level	15	1
						Wet	15	One level	25	1.7
	25	7.6	30	9.1	11.2 (160) Upright	Dry	25	One level	25	1.7
						Wet	15	One level	15	1
			35	10.7	16.8 (240) Upright	Dry	25	One level	15	1
						Wet	15	One level	15	1
Class IV	25	7.6	30	9.1	11.2 (160) Upright	Wet	15	One level	50	3.4
						Wet	20	One level	50	3.4
			35	10.7	11.2 (160) Upright	Wet	15	One level	75	5.2
						Wet	20	One level	22	1.5
	25	7.6	30	9.1	16.8 (240) Upright	Wet	20	One level	22	1.5
						Wet	15	One level	22	1.5
			35	10.7	11.2 (160) Upright	Wet	15	One level	50	3.4
						Wet	30	One level	50	3.4
Nonexpanded, cartoned and exposed, Group A plastics	25	7.6	30	9.1	11.2 (160) Upright	Wet	20	One level	75	5.2
						Wet	30	One level	22	1.5
			35	10.7	16.8 (240) Upright	Wet	30	One level	22	1.5
						Wet	20	One level	35	2.4

25.5.2.2 Open Wood Joist Construction with CMSA Ceiling-Level Sprinklers.

25.5.2.2.1

Where CMSA ceiling-level sprinklers are installed under open wood joist construction, blocking in accordance with 25.5.2.2 shall be provided or the minimum operating pressure of the sprinklers shall be 50 psi (3.4 bar) for a K-11.2 (K-160) sprinkler or 22 psi (1.5 bar) for a K-16.8 (K240) sprinkler.

25.5.2.2.2

Where each joist channel of open wood joist construction is constructed with blocking at intervals not exceeding 20 ft (6.1 m), the design pressures specified in Table 25.5.2.1 shall be permitted to be used.

25.5.2.3 Preaction Systems for CMSA Sprinklers.

Where CMSA sprinklers will be installed on a preaction sprinkler system, the designs obtained from Table 25.5.2.1 shall be based on those indicated for a dry sprinkler system.

25.6 In-Rack Sprinkler Protection in Combination with ESFR Ceiling-Level Sprinklers.

25.6.1 In-Rack Sprinkler Characteristics.

25.6.1.1

The requirements of 25.1.6 for the installation of in-rack sprinklers shall apply to racks protected by ESFR ceiling-level sprinklers except as modified in this section.

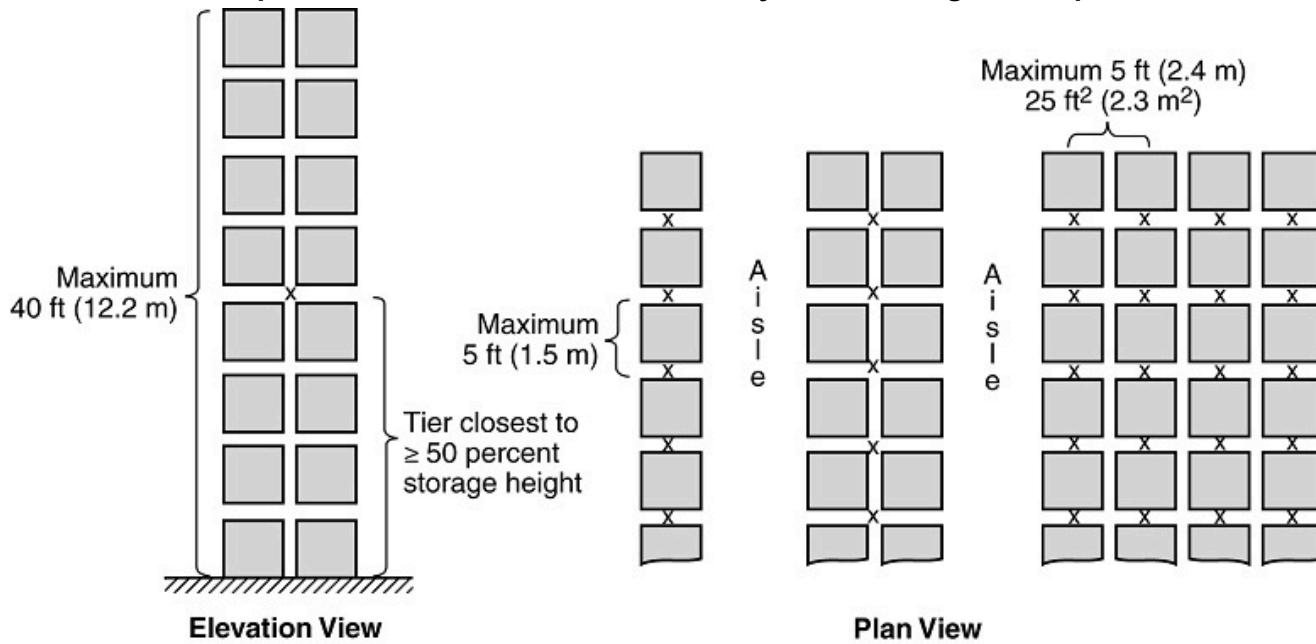
25.6.1.2

In-rack sprinklers protecting open rack storage in combination with ESFR ceiling-level sprinklers shall be quick-response, ordinary-temperature-rated and minimum K-8.0 (K-115).

25.6.2 In-Rack Sprinkler Arrangements and Designs for Class I, Class II, Class III, Class IV, or Group A Plastic Commodities Protected by ESFR Ceiling-Level Sprinklers.**25.6.2.1 General.**

Where rack storage of encapsulated or nonencapsulated Class I through Class IV or Group A plastic commodities is protected by in-rack sprinklers, the in-rack sprinkler arrangement and design shall be selected from Figure 25.6.2.1. (See 25.6.1 for racks with solid shelving.)

Figure 25.6.2.1 In-Rack Sprinkler Arrangements for Encapsulated or Nonencapsulated Class I Through Class IV and Group A Plastic Commodities Protected by ESFR Ceiling-Level Sprinklers.

**Notes:**

- (1) See Table 25.6.3.1 for the ESFR ceiling sprinkler design in combination with one level of in-rack sprinklers.
- (2) In-rack sprinklers are ordinary-temperature-rated, quick-response, pendent or upright, K-8.0 (K-115) or K-11.2 (K-160), and designed for a minimum of eight in-rack sprinklers operating at 60 gpm (227 L/min).
- (3) The symbol X represents in-rack sprinklers.
- (4) Each square represents a storage cube measuring 4 ft to 5 ft (1.2 m to 1.5 m) on a side.

25.6.2.2 Horizontal Spacing of In-Rack Sprinklers in Combination with ESFR Ceiling-Level Sprinklers.

Where rack storage of encapsulated or nonencapsulated Class I through Class IV or Group A plastic commodities is protected by ESFR ceiling-level sprinklers, the maximum allowable horizontal spacing of in-rack sprinklers shall be 5 ft (1.5 m).

25.6.2.3 Design Criteria for In-Rack Sprinklers in Combination with ESFR Ceiling-Level Sprinklers.

The in-rack sprinkler system design, in terms of the number of operating sprinklers at a minimum flow from the most remote in-rack sprinkler, in combination with ESFR ceiling-level sprinklers shall be in accordance with Table 25.6.2.3.

Table 25.6.2.3 Design Criteria for In-Rack Sprinklers in Combination with ESFR Ceiling-Level Sprinklers

Type of Storage	Commodity Classification	Storage Height ft (m)	Ceiling Height ft (m)	Rack Type	No. of IRAS Levels	IRAS Design, No. of IRAS @ gpm (L/min)
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Type of Storage	Commodity Classification	Storage Height ft (m)	Ceiling Height ft (m)	Rack Type	No. of IRAS Levels	IRAS Design, No. of IRAS @ gpm (L/min)
Storage not meeting the definition of miscellaneous	Class I, Class II, Class III	40 (12.2)	45 (13.7)	Open	1	8 @ 60 (230)
				Solid shelves	1	6 @ 30 (115)
					More than 1	10 (5 in-rack sprinklers on top 2 in-rack sprinklers levels) @ 30 (115)
	Class IV and Group A plastics	40 (12.2)	45 (13.7)	Open	1	8 @ 60 (230)
				Solid shelves	1	8 @ 30 (115)
					More than 1	14 (7 in-rack sprinklers on top 2 in-rack sprinklers levels) @ 30 (115)

25.6.3 Ceiling-Level ESFR Sprinkler Designs for Rack Storage of Class I, Class II, Class III, Class IV, and Group A Plastic Commodities in Combination with In-Rack Sprinklers.

25.6.3.1

Where rack storage of encapsulated or nonencapsulated Class I, Class II, Class III, Class IV, or Group A plastic commodities will be protected by one or more levels of in-rack sprinklers, the ceiling-level sprinkler design in terms of minimum operating pressure [psi (bar)] and the number of ceiling-level sprinklers shall be in accordance with Table 25.6.3.1.

Table 25.6.3.1 ESFR Ceiling-Level Sprinkler Design Criteria for Rack Storage of Encapsulated or Nonencapsulated Class I Through Class IV and Nonexpanded, Cartoned or Exposed, Group A Plastic Commodities Supplemented with In-Rack Sprinklers

Storage Arrangement	Commodity Classification	Maximum Storage Height		Maximum Ceiling Height		K-Factor/Orientation	No. of Ceiling Sprinklers in the Design	No. of Required IRAS Levels	Minimum Ceiling Sprinkler Operating Pressure	
		ft	m	ft	m				psi	bar
Single-, double-, and multiple-row racks (no open-top containers)	Class I, Class II, Class III, Class IV, and nonexpanded (cartoned and exposed) Group A plastics	40	12.2	45	13.7	14.0 (200) Pendent	12	One level	90	6.2
						16.8 (240) Pendent	12	One level	63	4.3

25.6.3.2

ESFR sprinkler systems, when supplemented with in-rack sprinklers, shall be designed such that the minimum operating pressure is not less than that indicated in Table 25.6.3.1 for type of storage, commodity, storage height, and building height involved.

25.6.3.3

The design area applicable to the ceiling-level design options listed in Table 25.6.3.1 shall comply with Section 23.2.

25.7 In-Rack Sprinkler Protection Options Independent of Ceiling-Level Sprinklers.

25.7.1 General.

25.7.1.1

Protection of closed-top Class I through Class IV and Group A plastic commodities (i.e., no open-top containers) stored on single-, double-, or multiple-row racks shall be permitted to be protected in accordance with this section.

25.7.1.2

Where the storage rack will not be solely dedicated to storage requiring in-rack sprinkler protection in accordance with this section, either of the following shall apply:

- (1) Extend the in-rack sprinkler protection horizontally one pallet load beyond the commodities requiring protection in accordance with this section.
- (2) Install a vertical barrier to segregate the commodities requiring protection in accordance with this section from any adjacent commodities.

25.7.1.3

Commodities that can be protected by the ceiling-level sprinkler system shall be permitted to be stored vertically above and horizontally adjacent to the portions of the storage rack equipped as prescribed by this section.

25.7.2 Installation Requirements for In-Rack Sprinkler Protection Options.

25.7.2.1 Sprinkler System Type.

In-rack sprinkler systems shall be wet-pipe only.

25.7.2.2 In-Rack Sprinkler Characteristics.

The in-rack sprinkler characteristics shall be in accordance with Table 25.7.2.2.

Table 25.7.2.2 In-Rack Sprinkler Characteristics

Sprinkler Type	K-factor	Coverage Type	Orientation	RTI Rating	Temperature Rating
CMDA (Option 1)	Minimum K-8.0 (K-115)	Standard-coverage	Pendent or upright	Quick-response	Ordinary-temperature
ESFR (Option 2a)	Minimum K-14.0 (K-200)	Standard-coverage	Pendent	Fast-response	Ordinary-temperature
ESFR (Option 2b)	Minimum K-22.4 (K-320)	Standard-coverage	Pendent	Fast-response	Ordinary-temperature
CMDA (Option 3)	K-25.2 (K-360)	Extended-coverage	Pendent	Fast-response	Intermediate-temperature

25.7.2.3 Horizontal Spacing of In-Rack Sprinklers.

25.7.2.3.1

The maximum horizontal distance between in-rack sprinklers shall be in accordance with Table 25.7.2.3.1 in combination with Figure 25.7.2.3.1(a) through Figure 25.7.2.3.1(f).

Table 25.7.2.3.1 Maximum Horizontal Spacing of In-Rack Sprinklers

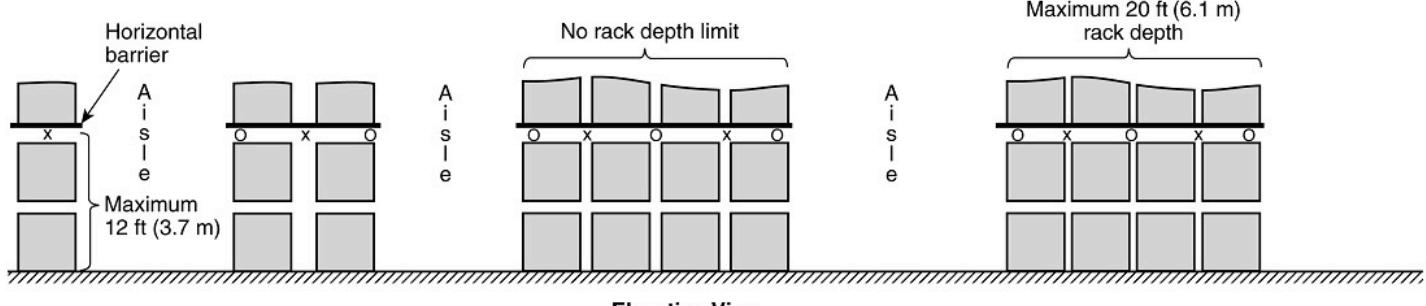
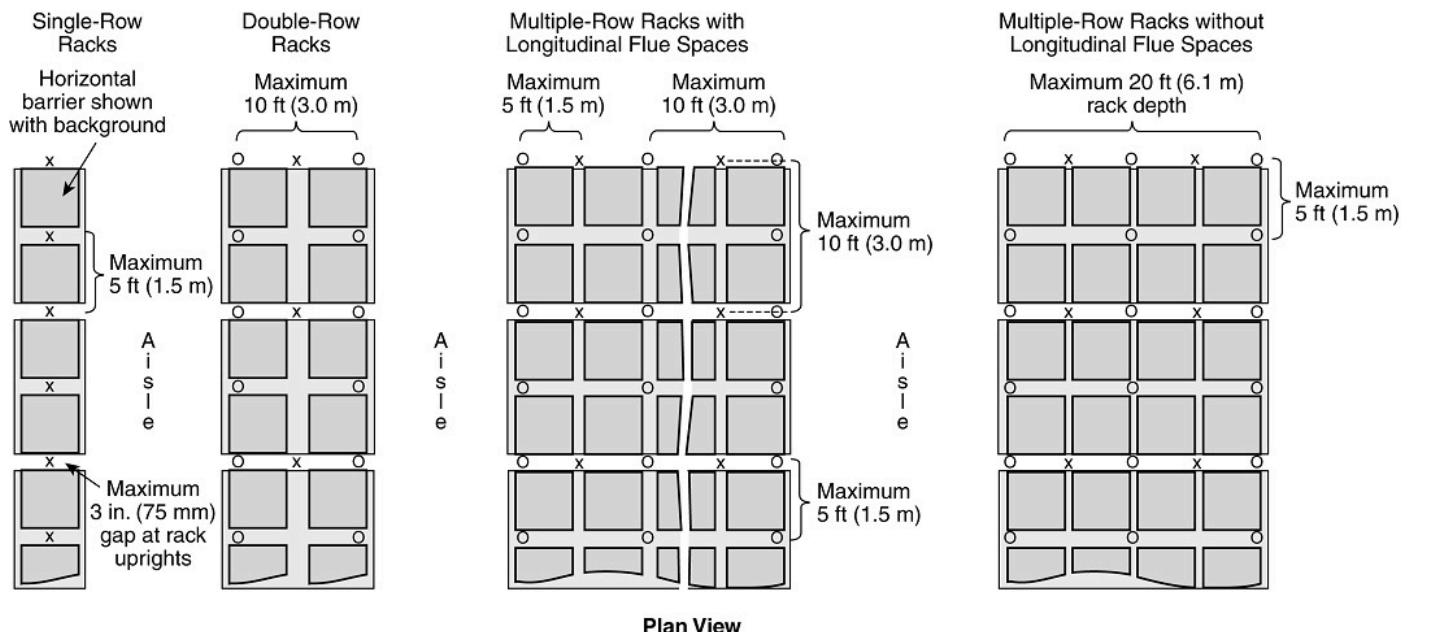
Rack Type	Option 1	Option 2a and Option 2b	Option 3
Single-row racks	5 ft (1.5 m) [See Figure 25.7.2.3.1(a).]	4.5 ft (1.4 m) [See Figure 25.7.2.3.1(b), Figure 25.7.2.3.1(c), and Figure 25.7.2.3.1(d).]	10 ft (3.0 m) [See Figure 25.7.2.3.1(e) and Figure 25.7.2.3.1(f).]
Double-row racks	5 ft (1.5 m) at each rack face 10 ft (3.0 m) within the longitudinal flue space [See Figure 25.7.2.3.1(a).]	4.5 ft (1.4 m) at each rack face* 4.5 ft (1.4 m) within the longitudinal flue space [See Figure 25.7.2.3.1(b), Figure 25.7.2.3.1(c), and Figure 25.7.2.3.1(d).]	Not required at the rack face 10 ft (3.0 m) within the longitudinal flue space [See Figure 25.7.2.3.1(e) and Figure 25.7.2.3.1(f).]

Rack Type	Option 1	Option 2a and Option 2b	Option 3
Multiple-row racks	5 ft (1.5 m) at each rack face and at each alternating rack bay 10 ft (3.0 m) between in-rack sprinkler at every other rack bay [See Figure 25.7.2.3.1(a).]	8 ft 6 in. (2.6 m) at each rack face 4.5 ft (1.4 m) in-between rack faces [See Figure 25.7.2.3.1(b), Figure 25.7.2.3.1(c), and Figure 25.7.2.3.1(d).]	10 ft (3.0 m) at each rack face 10 ft (3.0 m) in-between rack faces [See Figure 25.7.2.3.1(e) and Figure 25.7.2.3.1(f).]

Note: Option 1, Option 2a, Option 2b, and Option 3 are in reference to those listed in Table 25.7.2.2.

*The maximum horizontal distance between in-rack sprinklers is permitted to be increased to 8.5 ft (2.6 m) when the maximum distance between transverse flue spaces does not exceed 4.25 ft (1.3 m).

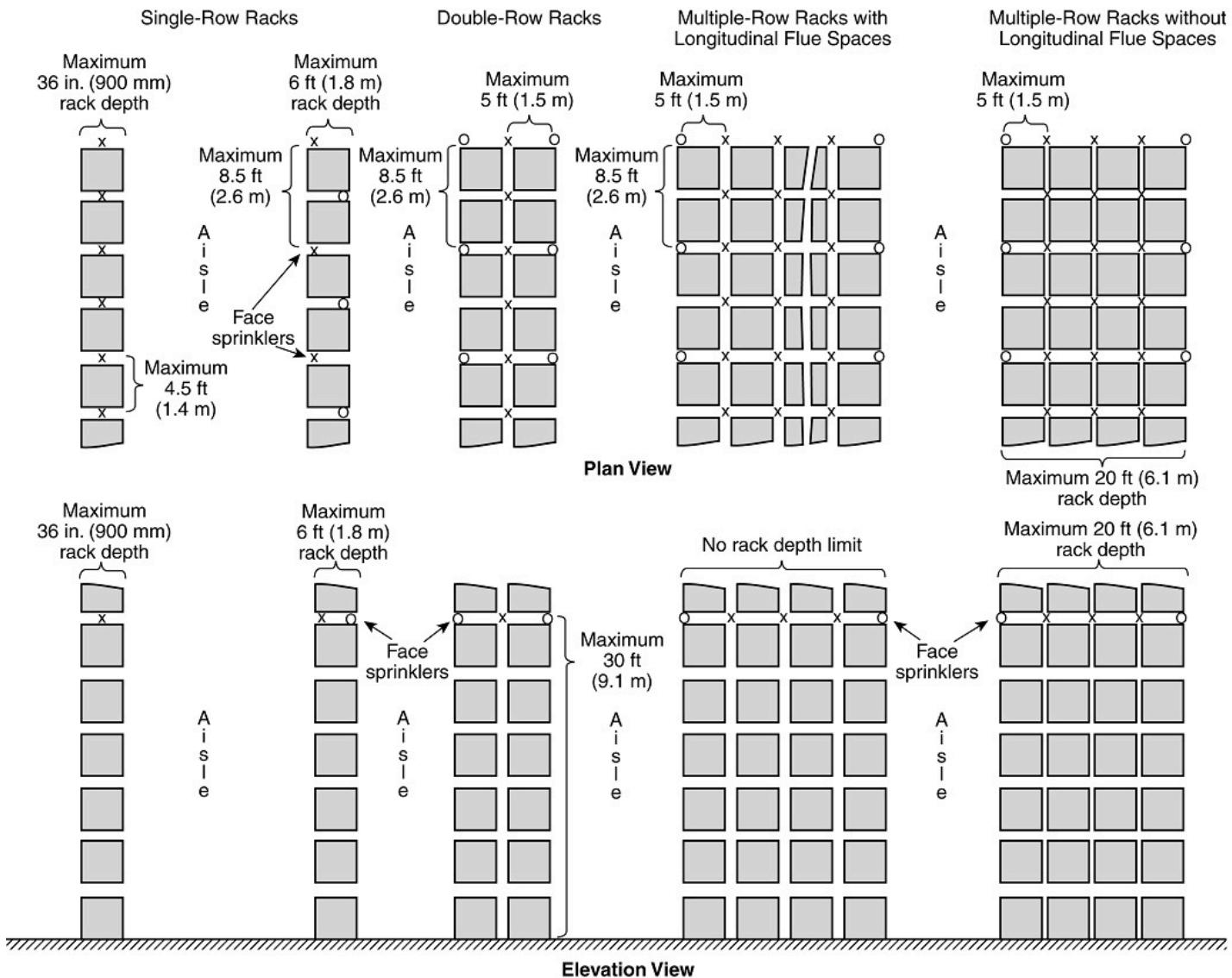
Figure 25.7.2.3.1(a) Option 1 — In-Rack Sprinkler Arrangements for Class I through Class IV and Group A Plastic Commodities.



Notes:

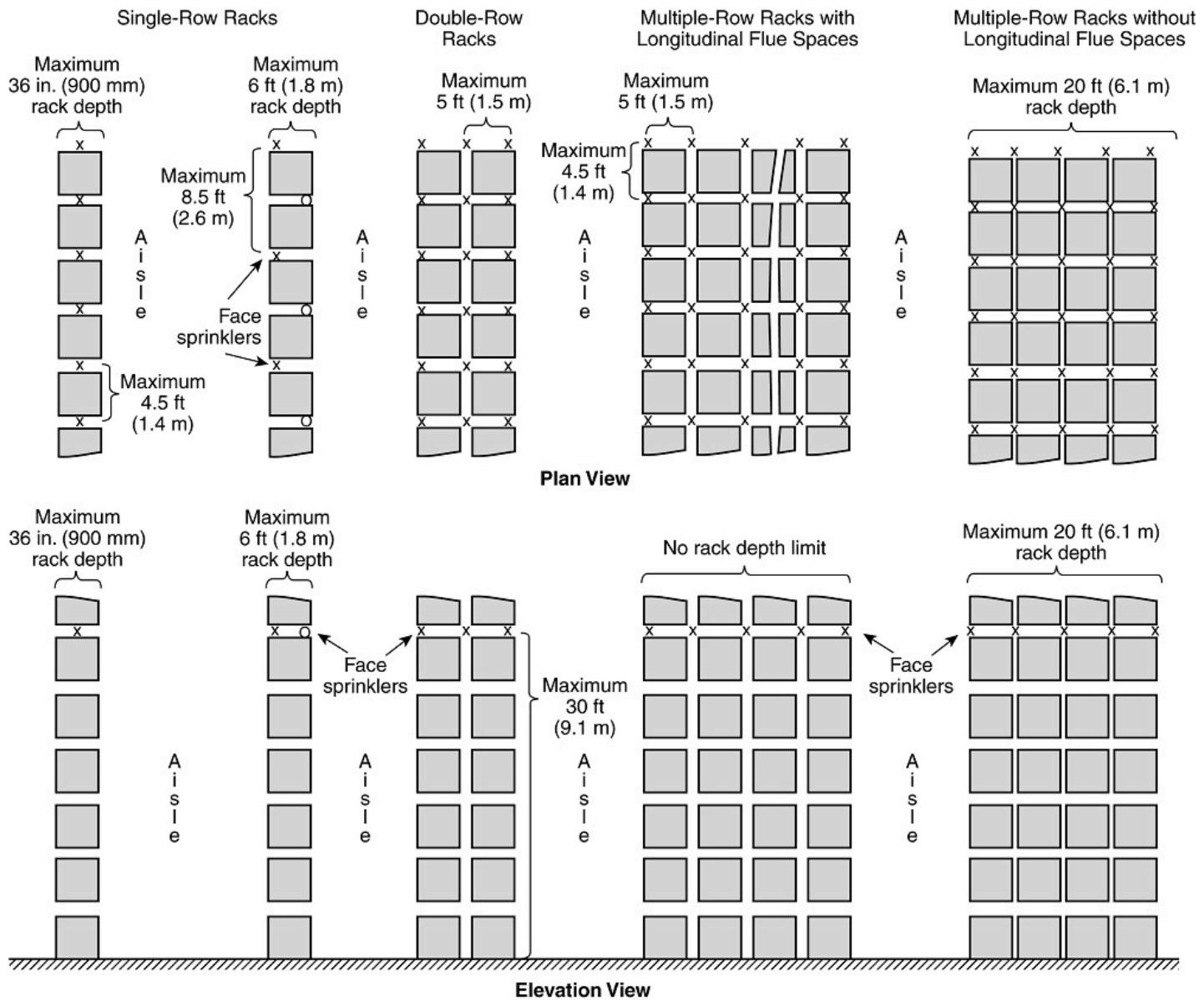
- (1) In-rack sprinklers are ordinary-temperature-rated, quick-response, pendant or upright, and minimum K-8.0 (K-115). The in-rack sprinkler system is to be designed for a minimum of six in-rack sprinklers operating at 60 gpm (230 L/min) for single-row racks or a minimum of eight in-rack sprinklers operating at 60 gpm (230 L/min) for double- or multiple-row racks.
- (2) The symbols X and O represent in-rack sprinklers.
- (3) Each square represents a storage cube measuring 4 ft to 5 ft (1.2 m to 1.5 m) on a side. Actual load heights can vary from approximately 18 in. to 10 ft (450 mm to 3.0 m). Therefore, there could be as few as one load or as many as six loads between in-rack sprinklers that are spaced 10 ft (3.0 m) apart vertically.

Figure 25.7.2.3.1(b) Option 2a — In-Rack Sprinkler Arrangements for Class I through Class IV and Cartoned Group A Plastic Commodities, Maximum 30 ft (9.1 m) Vertical Increments.

**Notes:**

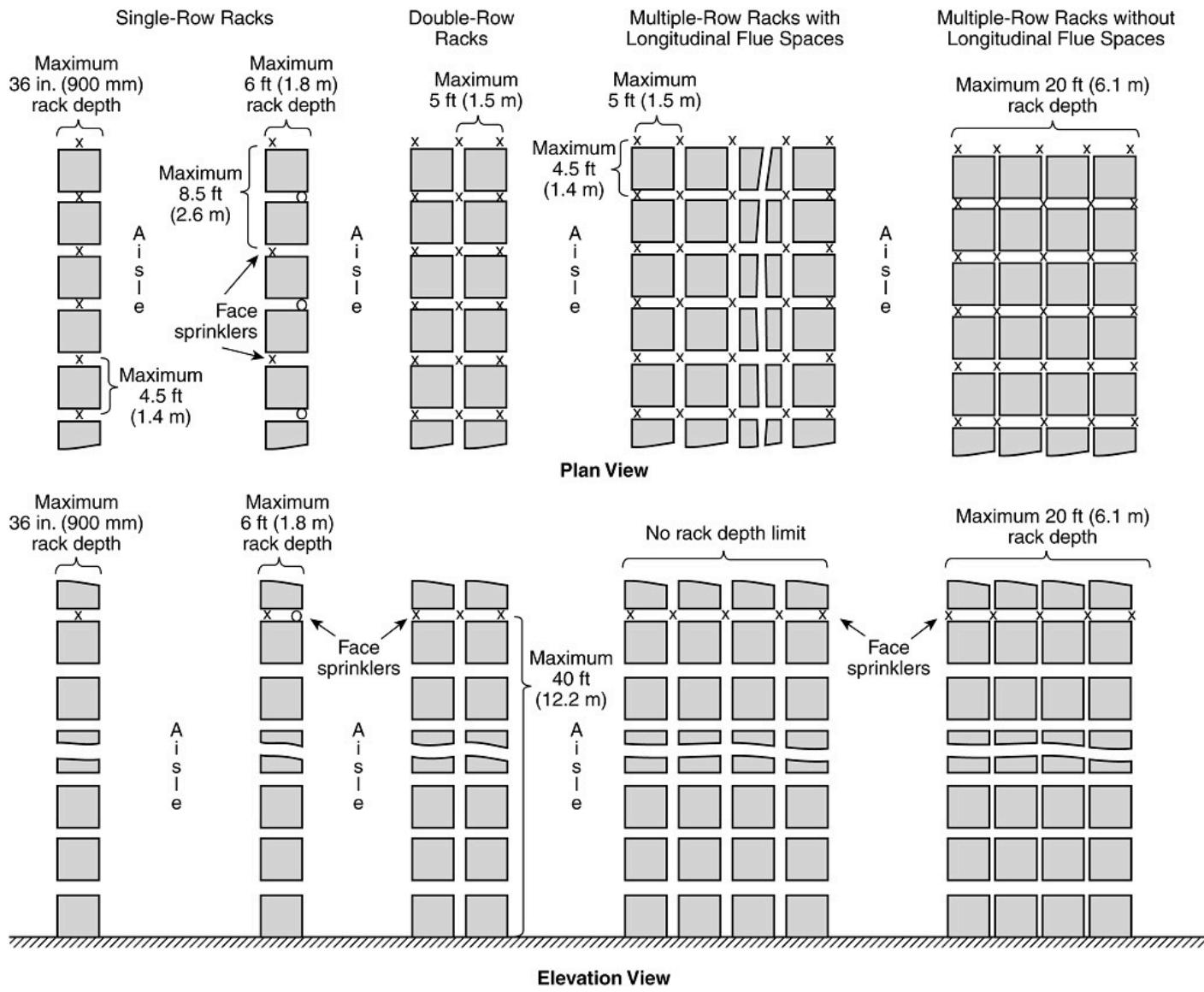
- (1) In-rack sprinklers are ordinary-temperature-rated, fast-response, pendent, and minimum K-14.0 (K-200) ESFR sprinklers.
- (2) Where Class I through Class IV and cartoned nonexpanded Group A plastic commodities are maintained in single-row racks having a maximum rack depth of 36 in. (900 mm), the in-rack sprinkler system is to be designed for a minimum of four in-rack sprinklers operating at 65 gpm (250 L/min).
- (3) Where Class I through Class IV and cartoned (expanded and nonexpanded) Group A plastic commodities are maintained in single-row racks having a maximum rack depth of 36 in. (900 mm), the in-rack sprinkler system is to be designed for a minimum of four in-rack sprinklers operating at 100 gpm (380 L/min).
- (4) Where Class I through Class IV and cartoned nonexpanded Group A plastic commodities are maintained in single-row racks having a maximum rack depth over 36 in. (900 mm) and up to and including 6 ft (1.8 m), the in-rack sprinkler system is to be designed for a minimum of five in-rack sprinklers operating at 65 gpm (250 L/min).
- (5) Where Class I through Class IV and cartoned (expanded and nonexpanded) Group A plastic commodities are maintained in single-row racks having a maximum rack depth over 36 in. (900 mm) and up to and including 6 ft (1.8 m), the in-rack sprinkler system is to be designed for a minimum of five in-rack sprinklers operating at 100 gpm (380 L/min).
- (6) Where Class I through Class IV and cartoned nonexpanded Group A plastic commodities are maintained in double- or multiple-row racks, the in-rack sprinkler system is to be designed for a minimum of six in-rack sprinklers operating at 65 gpm (250 L/min).
- (7) Where Class I through Class IV and cartoned (expanded and nonexpanded) Group A plastic commodities are maintained in double- or multiple-row racks, the in-rack sprinkler system is to be designed for a minimum of six in-rack sprinklers operating at 100 gpm (380 L/min).
- (8) The symbols X and O represent in-rack sprinklers.
- (9) Each square represents a storage cube measuring 4 ft to 5 ft (1.2 m to 1.5 m) on a side. Actual load heights can vary from approximately 18 in. to 10 ft (450 mm to 3.0 m). Therefore, there could be as few as three loads or as many as 20 loads between in-rack sprinklers that are spaced 30 ft (9.1 m) apart vertically.

Figure 25.7.2.3.1(c) Option 2b — In-Rack Sprinkler Arrangements for Class I through Class IV and Group A Plastic Commodities, Maximum 30 ft (9.1 m) Vertical Increments.

**Notes:**

- (1) In-rack sprinklers are ordinary-temperature-rated, fast-response, pendent, and minimum K-22.4 (K-320) ESFR sprinklers.
- (2) Where Class I through Class IV and cartoned and exposed Group A plastic commodities are maintained in single-row racks having a maximum rack depth of 36 in. (900 mm), the in-rack sprinkler system is to be designed for a minimum of four in-rack sprinklers operating at 120 gpm (455 L/min).
- (3) Where Class I through Class IV and cartoned and exposed Group A plastic commodities are maintained in single-row racks having a maximum rack depth over 3 ft (0.9 m) and up to and including 6 ft (1.8 m), the in-rack sprinkler system is to be designed for a minimum of five in-rack sprinklers operating at 120 gpm (455 L/min).
- (4) Where Class I through Class IV and cartoned and exposed Group A plastic commodities are maintained in double- or multiple-row racks, the in-rack sprinkler system is to be designed for a minimum of 10 in-rack sprinklers (five in-rack sprinklers on the top level of the most remote rack as well as five in-rack sprinklers on the top level of the nearest adjacent storage rack) operating at 120 gpm (455 L/min).
- (5) The symbols X and O represent in-rack sprinklers.
- (6) Each square represents a storage cube measuring 4 ft to 5 ft (1.2 m to 1.5 m) on a side. Actual load heights can vary from approximately 18 in. to 10 ft (450 mm to 3.0 m). Therefore, there could be as few as three loads or as many as 20 loads between in-rack sprinklers that are spaced 30 ft (9.1 m) apart vertically.

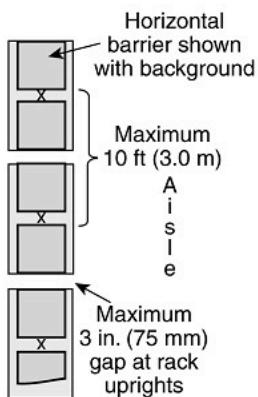
Figure 25.7.2.3.1(d) Option 2b — In-Rack Sprinkler Arrangements for Class I through Class IV and Cartoned Group A Plastic Commodities, Maximum 40 ft (12.2 m) Vertical Increments.

**Notes:**

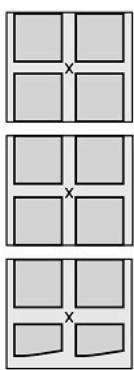
- (1) In-rack sprinklers are ordinary-temperature-rated, fast-response, pendent, and minimum K-22.4 (K-320) ESFR sprinklers.
- (2) Where Class I through Class IV and cartoned expanded Group A plastic commodities are maintained in single-row racks having a maximum rack depth of 36 in. (900 mm), the in-rack sprinkler system is to be designed for a minimum of four in-rack sprinklers operating at 120 gpm (455 L/min).
- (3) Where Class I through Class IV and cartoned nonexpanded Group A plastic commodities are maintained in single-row racks having a maximum rack depth over 36 in. (900 mm) and up to and including 6 ft (1.8 m), the in-rack sprinkler system is to be designed for a minimum of five in-rack sprinklers operating at 120 gpm (455 L/min).
- (4) Where Class I through Class IV and cartoned nonexpanded Group A plastic commodities are maintained in double- or multiple-row racks, the in-rack sprinkler system is to be designed for a minimum of six in-rack sprinklers operating at 120 gpm (455 L/min).
- (5) The symbols X and O represent in-rack sprinklers.
- (6) Each square represents a storage cube measuring 4 ft to 5 ft (1.2 m to 1.5 m) on a side. Actual load heights can vary from approximately 18 in. to 10 ft (450 mm to 3.0 m). Therefore, there could be as few as four loads or as many as 26 loads between in-rack sprinklers that are spaced 40 ft (12.2 m) apart vertically.

Figure 25.7.2.3.1(e) Option 3 — In-Rack Sprinkler Arrangements for Class I through Class IV and Cartoned Group A Plastic Commodities, Maximum 30 ft (9.1 m) Vertical Increments.

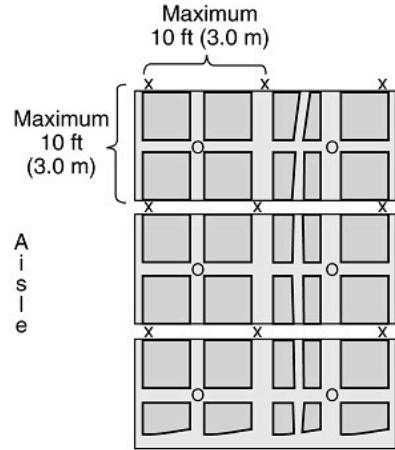
Single-Row Racks



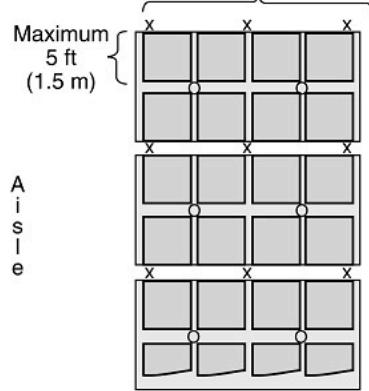
Double-Row Racks



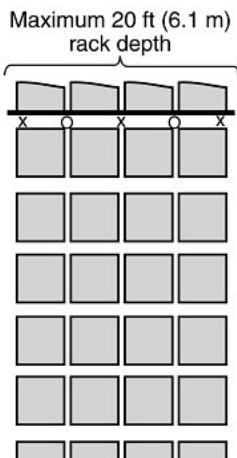
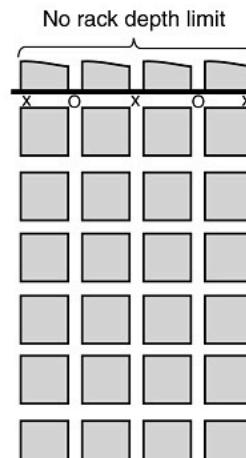
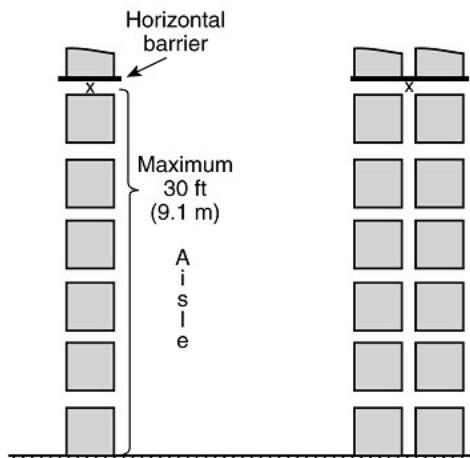
Multiple-Row Racks with Longitudinal Flue Spaces



Multiple-Row Racks without Longitudinal Flue Spaces



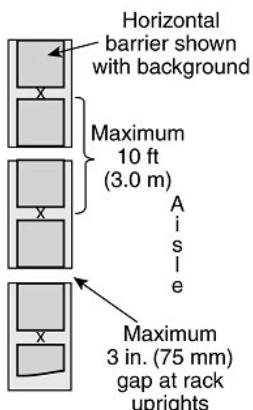
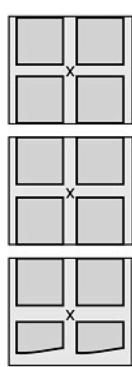
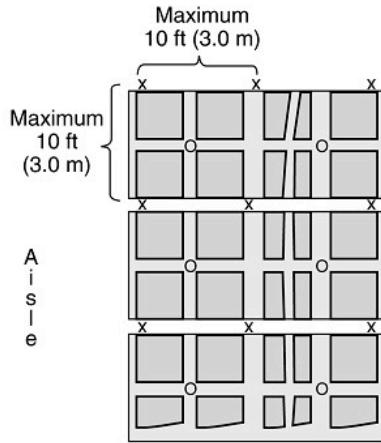
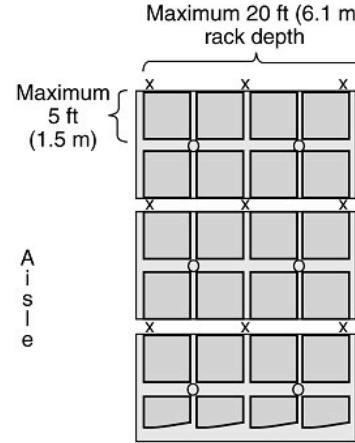
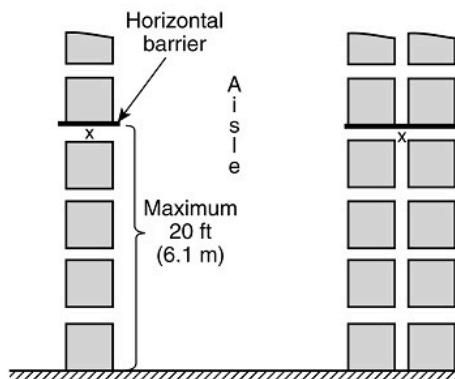
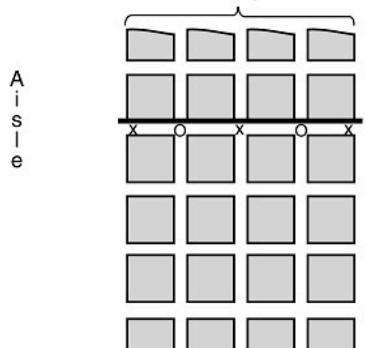
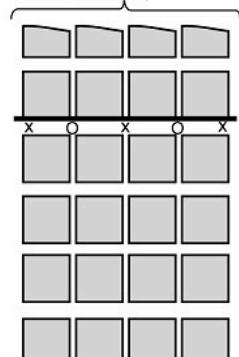
Plan View



Notes:

- (1) In-rack sprinklers are intermediate-temperature-rated, fast-response, pendent, and minimum K-25.2 (K-360) extended-coverage CMDA sprinklers.
- (2) Where Class I through Class IV and cartoned Group A plastic commodities are maintained in single- or double-row racks, the in-rack sprinkler system is to be designed for a minimum of four in-rack sprinklers operating at 138 gpm (520 L/min).
- (3) Where Class I through Class IV and cartoned Group A plastic commodities are maintained in multiple-row racks, the in-rack sprinkler system is to be designed for a minimum of eight in-rack sprinklers (three at each face and two in between) operating at 138 gpm (520 L/min).
- (4) The symbols X and O represent in-rack sprinklers.
- (5) Each square represents a storage cube measuring 4 ft to 5 ft (1.2 m to 1.5 m) on a side. Actual load heights can vary from approximately 18 in. to 10 ft (450 mm to 3.0 m). Therefore, there could be as few as three loads or as many as 20 loads between in-rack sprinklers that are spaced 30 ft (9.1 m) apart vertically.

Figure 25.7.2.3.1(f) Option 3 — In-Rack Sprinkler Arrangements for Class I through Class IV and Group A Plastic Commodities, Maximum 20 ft (6.1 m) Vertical Increments.

Single-Row Racks**Double-Row Racks****Multiple-Row Racks with Longitudinal Flue Spaces****Multiple-Row Racks without Longitudinal Flue Spaces****Plan View****Elevation View****No rack depth limit****Maximum 20 ft (6.1 m) rack depth****Notes:**

- (1) In-rack sprinklers are intermediate-temperature-rated, fast-response, pendent, and minimum K-25.2 (K-360) extended-coverage CMDA sprinklers.
- (2) Where Class I through Class IV and cartoned and exposed Group A plastic commodities are maintained in single- or double-row racks, the in-rack sprinkler system is to be designed for a minimum of four in-rack sprinklers operating at 138 gpm (520 L/min).
- (3) Where Class I through Class IV and cartoned and exposed Group A plastic commodities are maintained in multiple-row racks, the in-rack sprinkler system is to be designed for a minimum of eight in-rack sprinklers (three at each face and two in between) operating at 138 gpm (520 L/min).
- (4) The symbols X and O represent in-rack sprinklers.
- (5) Each square represents a storage cube measuring 4 ft to 5 ft (1.2 m to 1.5 m) on a side. Actual load heights can vary from approximately 18 in. to 10 ft (450 mm to 3.0 m). Therefore, there could be as few as two loads or as many as 13 loads between in-rack sprinklers that are spaced 20 ft (6.1 m) apart vertically.

25.7.2.3.2

The minimum horizontal distance between in-rack sprinklers shall be 27 in (700 mm).

25.7.2.3.3 Locating In-Rack Sprinklers Within Footprint of Rack Structure.**25.7.2.3.3.1**

In-rack sprinklers shall be located within the footprint of the rack structure.

25.7.2.3.3.2

Where the horizontal distance between a single-row rack and an adjacent full-height wall does not exceed 1 ft (0.3 m), in-rack sprinklers in Option 2a and Option 2b of Table 25.7.2.2 shall be permitted to be installed within this space as if it were a longitudinal flue of a double-row rack.

25.7.2.3.4

Where rack storage is protected by face sprinklers, the face sprinklers shall be located within the rack a minimum 3 in. (75 mm) from rack uprights and no more than 18 in. (450 mm) from the aisle face of storage.

25.7.2.4 Vertical Spacing of In-Rack Sprinklers.**25.7.2.4.1**

The maximum vertical spacing of in-rack sprinkler levels shall be in accordance with Table 25.7.2.4.1 in combination with Figure 25.7.2.3.1(a) through Figure 25.7.2.3.1(f).

Table 25.7.2.4.1 Maximum Vertical Spacing of In-Rack Sprinkler Levels

Commodity Classification	Maximum Vertical Spacing of In-rack Sprinkler Levels			
	Option 1	Option 2a	Option 2b	Option 3
Class I through Class IV	12 ft (3.7 m) with horizontal barriers	30 ft (9.1 m)	40 ft (12.2 m)	30 ft (9.1 m) with horizontal barriers
Cartoned nonexpanded Group A plastics	12 ft (3.7 m) with horizontal barriers	30 ft (9.1 m)	40 ft (12.2 m)	30 ft (9.1 m) with horizontal barriers
Cartoned expanded Group A plastics	12 ft (3.7 m) with horizontal barriers	30 ft (9.1 m)	30 ft (9.1 m)	30 ft (9.1 m) with horizontal barriers
Exposed nonexpanded and exposed expanded Group A plastics	12 ft (3.7 m) with horizontal barriers	Not permitted	30 ft (9.1 m)	20 ft (6.1 m) with horizontal barriers

Note: Option 1, Option 2a, Option 2b, and Option 3 are in reference to those listed in Table 25.7.2.2.

25.7.2.4.2

A minimum 6 in. (150 mm) vertical distance between the in-rack sprinkler deflector and the top of storage below shall be maintained.

25.7.2.4.3

A maximum 9 in. (225 mm) vertical distance between the in-rack sprinkler deflector and the underside of the horizontal barrier in Option 1 and Option 3 of Table 25.7.2.2 shall be maintained.

25.7.2.5 Horizontal Barriers.

25.7.2.5.1

Where required by Table 25.7.2.4.1, horizontal barriers shall be provided in accordance with this section.

25.7.2.5.2

Horizontal barriers, in combination with in-rack sprinklers, shall be installed at every tier level of the dedicated storage rack where the rack is equipped with solid shelves.

25.7.2.5.3

Horizontal barriers shall be installed above every level of in-rack sprinklers in open frame racks in accordance with Table 25.7.2.4.1.

25.7.2.5.4

Horizontal barriers shall be constructed of minimum 22 gauge (0.78 mm) sheet metal or $\frac{3}{8}$ in. (10 mm) plywood.

25.7.2.5.5

Horizontal barriers shall span horizontally to both faces of the racks so that all flue spaces of the rack bays are covered.

25.7.2.5.5.1

A maximum 3 in. (75 mm) wide gap in the horizontal barrier shall be permitted at rack uprights continuous from face of rack to face of rack.

25.7.2.5.5.2 *

Horizontal barriers shall be fitted to within 3 in. (75 mm) of any vertical rack member or other equipment that would create an opening.

25.7.3 Hydraulic Design Requirements for In-Rack Sprinkler Protection Options.

25.7.3.1 In-Rack Sprinkler System Requirements.

Regardless of the number of in-rack sprinkler levels installed, the in-rack sprinkler system design, in terms of the number of operating sprinklers at a minimum flow from the most remote in-rack sprinkler, shall be in accordance with Table 25.7.3.1.

Table 25.7.3.1 In-Rack Sprinkler System Design for Options 1, 2a, 2b, and 3

IRAS Option	Commodity Hazard	Maximum In-Rack Sprinkler Vertical Interval ft (m)	In-Rack Sprinkler K-factor	In-Rack Sprinkler System Design, No. of IRAS @ Minimum Flow, gpm (L/min)			
				Single-Row Racks up to 3 ft (0.9 m) Deep	Single-Row Racks over 3 ft (0.9 m) and up to 6 ft (1.8 m) Deep	Double-Row Racks	Multiple-Row Racks
1	Class I–IV and Group A plastic (cartoned and exposed) commodities	12 (3.7)	Minimum K-8.0 (K-115)	6 @ 60 (227)	6 @ 60 (227)	8 @ 60 (227)	8 @ 60 (227)
2a	Class I–IV and cartoned nonexpanded Group A plastics	30 (9.1)	Minimum K-14.0 (K-200) pendent ESFR	4 @ 65 (250)	5 @ 65 (250)	6 @ 65 (250)	6 @ 65 (250)
2a	Class I–IV, cartoned Group A plastics (both nonexpanded and expanded), and exposed nonexpanded Group A plastics	30 (9.1)	Minimum K-14.0 (K-200) pendent ESFR	4 @ 100 (380)	5 @ 100 (380)	6 @ 100 (380)	6 @ 100 (380)
2b	Class I–IV, and Group A plastics (nonexpanded and expanded as well as cartoned and exposed)	30 (9.1)	Minimum K-22.4 (K-320) pendent ESFR	4 @ 120 (455)	5 @ 120 (455)	5 and 5* @ 120 (455)	5 and 5* @ 120 (455)
2b	Class I–IV and cartoned nonexpanded Group A plastics	40 (12.2)	Minimum K-22.4 (K-320) pendent ESFR	4 @ 120 (455)	5 @ 120 (455)	6 @ 120 (455)	6 @ 120 (455)
3	Class I–IV and cartoned (Nonexpanded and expanded) Group A plastic commodities	30 (9.1)	K25.2 (K-360) pendent extended coverage	4 @ 138 (520)	4 @ 138 (520)	4 @ 138 (520)	8† @ 138 (520)
3	Exposed group A plastic commodities (Also, Class I–IV and cartoned Group A plastics)	20 (6.1)	K25.2 (K-360) pendent extended coverage	4 @ 138 (520)	4 @ 138 (520)	4 @ 138 (520)	8† @ 138 (520)

Note: Option 1, Option 2a, Option 2b, and Option 3 are in reference to those listed in Table 25.7.2.2.

*This represents five sprinklers in the most remote rack as well as five sprinklers in the nearest adjacent rack when exposed expanded Group A plastics are being protected.

†This represents three sprinklers at each rack face and the two sprinklers in-between them.

25.7.3.2 Ceiling-Level Sprinkler System Requirements.

25.7.3.2.1 *

Where in-rack sprinklers are in accordance with Section 25.7, the top level of in-rack sprinklers shall be considered a floor for design purposes of the ceiling sprinkler system.

25.7.3.2.2

The ceiling-level sprinkler system shall be in accordance with the guidelines outlined in Chapters 20, 21, 22, or 23, depending on the commodity hazard and the ceiling-level sprinkler, except as modified in Section 25.7.

25.7.3.2.3

Where there is no storage above the highest level of in-rack sprinklers, the ceiling-level sprinkler system shall be in accordance with Chapter 19 and not consider the contents of the racking structure.

25.7.3.3 Water Supply Requirements.

25.7.3.3.1

The minimum water supply requirements for a hydraulically designed in-rack sprinkler system shall be determined by adding the hose stream allowance from Table 20.15.2.6 to the water demand for in-rack sprinklers.

25.7.3.3.2

The water supply requirements of 25.7.3.3.1 shall be available for a minimum duration as required in Table 20.15.2.6.

25.7.3.3.3 *

The water supply for the in-rack sprinkler system shall be capable of providing the required in-rack sprinkler system design obtained from Section 25.7, independent of the design requirements of the ceiling sprinkler system protecting this same area.

25.7.3.3.4

The water supply for the ceiling-level sprinkler system shall be capable of providing the required ceiling-level sprinkler system design obtained from Chapters 21, 22, or 23, independent of the design requirements of the in-rack sprinkler system obtained from Section 25.7.