**Chapter 20 General Requirements for Storage**

20.1 General

This chapter shall provide the necessary steps for identifying commodity, storage arrangements, storage heights, and clearances as well as general protection criteria for storage conditions relative to Chapters 21 through 25.

20.1.1

Miscellaneous and low-piled storage, meeting the criteria of Chapter 4, shall be protected in accordance with the relative occupancy hazard criteria reference in that section.

20.2 Protection of Storage

Protection of storage shall follow the following criteria:

Identify the storage commodity class in accordance with Sections 20.3 and 20.4.

Identify the method of storage in accordance with Section 20.5.

Establish storage height, building height, and associated clearances in accordance with Section 20.6.

Define the general protection criteria that are common to all storage protection options in accordance with Sections 20.7 through 20.15.

Select the appropriate system/sprinkler technology for protection criteria (Chapters 21 through 25).

Design and install system in accordance with the remainder of this document.

20.3\* Classification of Commodities

20.3.1\*

Commodity classification and the corresponding protection requirements shall be determined based on the makeup of individual storage units.

20.3.1.1

The type and amount of materials used as part of the product and its primary packaging as well as the storage pallet shall be considered in the classification of the commodity.

20.3.1.2

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

20.3.2 Pallet Types

20.3.2.1 General

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

20.3.2.2 Plastic Pallet

A pallet having any portion of its construction consisting of a plastic material that has not been listed as equivalent to wood shall increase the class of commodity determined for a storage load in accordance with 20.3.2.2.1 or 20.3.2.2.2.

20.3.2.2.1\* Unreinforced Plastic Pallets

Plastic pallets that have no secondary reinforcing shall be treated as unreinforced plastic pallets.

20.3.2.2.1.1

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

20.3.2.2.1.2

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

20.3.2.2.2 Reinforced Plastic Pallet

A plastic pallet incorporating a secondary reinforcing material (such as steel or fiberglass) within the pallet shall be considered a reinforced plastic pallet.

20.3.2.2.2.1\*

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

20.3.2.2.2.2

Pallets shall be assumed to be reinforced if no permanent marking or manufacturer's certification of nonreinforcement is provided.

20.3.2.2.3

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

20.3.2.2.4

For ceiling-only sprinkler protection, the requirements of 20.3.2.2.1 and 20.3.2.2.2.1 shall not apply where plastic pallets are used and where the sprinkler system uses spray sprinklers with a minimum K-factor of K-16.8 (240).

20.3.2.3

The requirements of 20.3.2.2.1 through 20.3.2.4 shall not apply to nonwood pallets that have demonstrated a fire hazard that is equal to or less than wood pallets and are listed as such.

20.3.2.4

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

20.3.2.5 Slave Pallet

Where solid, flat-bottom, combustible pallets are used for rack storage of Class I through IV commodity up to 25 ft (7.6 m) in height in combination with CMDA sprinklers, 21.4.1.4.2 shall apply. (See Figure A.3.3.147.1.)

20.3.3 Open-Top Container

A container of any shape that is entirely or partially open on the top and arranged so as to allow for the collection of discharging sprinkler water cascading through the storage array shall be considered outside the protection criteria of rack storage protection outlined in Chapters 21 through 25.

20.3.4 Solid Unit Load of Nonexpanded Plastic (Either Cartoned or Exposed)

A load that does not have voids (air) within the load and that burns only on the exterior of the load and that water from sprinklers will reach most surfaces available to burn shall allow a reduction in design density of CMDA sprinklers. [See Table 21.3.3(a).]

20.4\* Commodity Classes

20.4.1\* Class I

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

Placed directly on wood pallets

Placed in single-layer corrugated cartons, with or without single-thickness cardboard dividers, with or without pallets

Shrink-wrapped or paper-wrapped as a unit load with or without pallets

20.4.2\* Class II

A Class II commodity shall be defined as a noncombustible product that is in slatted wooden crates, solid wood boxes, multiple-layered corrugated cartons, or equivalent combustible packaging material, with or without pallets.

20.4.3\* Class III

20.4.3.1

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

20.4.3.2

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

20.4.3.3

Class III commodities containing a mix of both Group A expanded and nonexpanded plastics shall comply with Figure 20.4.3.3(a) where they are within cartons, boxes, or crates or with Figure 20.4.3.3(b) where they are exposed.

III - Class III Commodity. Refer to 20.3.2 if a plastic pallet is used.

IV - Class IV Commodity. Refer to 20.3.2 if a plastic pallet is used.

FIGURE 20.4.3.3(a) Commodities, Cartoned or Within a Wooden Container, Containing a Mixture of Expanded and Nonexpanded Group A Plastics.

III - Class III Commodity. Refer to 20.3.2 if a plastic pallet is used.

IV - Class IV Commodity. Refer to 20.3.2 if a plastic pallet is used.

FIGURE 20.4.3.3(b) Exposed Commodities Containing a Mixture of Expanded and Nonexpanded Group A Plastics.

20.4.4\* Class IV

20.4.4.1

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

Constructed partially or totally of Group B plastics

Consists of free-flowing Group A plastic materials

Cartoned, or within a wooden container, that contains greater than 5 percent and up to 15 percent by weight of Group A nonexpanded plastic

Cartoned, or within a wooden container, that contains greater than 5 percent and up to 25 percent by volume of expanded Group A plastics

Cartoned, or within a wooden container, that contains a mix of Group A expanded and nonexpanded plastics and complies with Figure 20.4.3.3(a)

Exposed, that contains greater than 5 percent and up to 15 percent by weight of Group A nonexpanded plastic

Exposed, that contains a mix of Group A expanded and nonexpanded plastics and complies with Figure 20.4.3.3(b)

20.4.4.2

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

20.4.5\* Classification of Plastics, Elastomers, and Rubber

Plastics, elastomers, and rubber shall be classified as Group A, Group B, or Group C.

20.4.5.1\* Group A

The following materials shall be classified as Group A:

ABS (acrylonitrile-butadiene-styrene copolymer)

Acetal (polyformaldehyde)

Acrylic (polymethyl methacrylate)

Butyl rubber

Cellulosics (cellulose acetate, cellulose acetate butyrate, ethyl cellulose)

EPDM (ethylene-propylene rubber)

FRP (fiberglass-reinforced polyester)

Natural rubber

Nitrile-rubber (acrylonitrile-butadiene-rubber)

Nylon (nylon 6, nylon 6/6)

PET (thermoplastic polyester)

Polybutadiene

Polycarbonate

Polyester elastomer

Polyethylene

Polypropylene

Polystyrene

Polyurethane

PVC (polyvinyl chloride — highly plasticized, with plasticizer content greater than 20 percent) (rarely found)

PVF (polyvinyl fluoride)

SAN (styrene acrylonitrile)

SBR (styrene-butadiene rubber)

20.4.5.2\*

Group A plastics shall be further subdivided as either expanded or nonexpanded.

20.4.5.3

A Group A expanded plastic commodity shall be defined as a product, with or without pallets, that meets one of the following criteria:

Cartoned, or within a wooden container, that contains greater than 40 percent by volume of Group A expanded plastic

Exposed, that contains greater than 25 percent by volume of Group A expanded plastic

20.4.5.4

A Group A nonexpanded plastic commodity shall be defined as a product, with or without pallets, that meets one of the following criteria:

Cartoned, or within a wooden container, that contains greater than 15 percent by weight of Group A nonexpanded plastic

Cartoned, or within a wooden container, that contains greater than 25 percent and up to 40 percent by volume of Group A expanded plastic

Cartoned, or within a wooden container, that contains a mix of Group A nonexpanded and expanded plastics, in compliance with Figure 20.4.3.3(a)

Exposed, that contains greater than 15 percent by weight of Group A nonexpanded plastic

Exposed, that contains greater than 5 percent and up to 25 percent by volume of Group A expanded plastic

Exposed, that contains a mix of Group A nonexpanded and expanded plastics, in compliance with Figure 20.4.3.3(b)

20.4.5.5

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

20.4.6 Group B

The following materials shall be classified as Group B:

Chloroprene rubber

Fluoroplastics (ECTFE — ethylene-chlorotrifluoro-ethylene copolymer; ETFE — ethylene-tetrafluoroethylene-copolymer; FEP — fluorinated ethylene-propylene copolymer)

Silicone rubber

20.4.7 Group C

The following materials shall be classified as Group C:

Fluoroplastics (PCTFE — polychlorotrifluoroethylene; PTFE — polytetrafluoroethylene)

Melamine (melamine formaldehyde)

Phenolic

PVC (polyvinyl chloride — flexible — PVCs with plasticizer content up to 20 percent)

PVDC (polyvinylidene chloride)

PVDF (polyvinylidene fluoride)

Urea (urea formaldehyde)

20.4.8\*

Plastic commodities shall be protected in accordance with Figure 20.4.8. (See Section C.21.)

FIGURE 20.4.8 Decision Tree.

20.4.8.1

Group B plastics and free-flowing Group A plastics shall be protected the same as Class IV commodities.

20.4.8.2

Group C plastics shall be protected the same as Class III commodities.

20.4.9 Rubber Tires

Pneumatic tires for passenger automobiles, aircraft, light and heavy trucks, trailers, farm equipment, construction equipment (off-the-road), and buses shall be protected as rubber tire storage in accordance with Chapters 20 through 25.

20.4.10\* Classification of Rolled Paper Storage

For the purposes of this standard, the classifications of paper described in 20.4.10.1 through 20.4.10.4 shall apply and shall be used to determine the sprinkler system design criteria in accordance with Chapters 20 through 25.

20.4.10.1 Heavyweight Class

Heavyweight class shall be defined so as to include paperboard and paper stock having a basis weight [weight per 1000 ft2 (93 m2)] of 20 lb (9.1 kg).

20.4.10.2 Mediumweight Class

Mediumweight class shall be defined so as to include all the broad range of papers having a basis weight [weight per 1000 ft2 (93 m2)] of 10 lb to 20 lb (4.5 kg to 9.1 kg).

20.4.10.3 Lightweight Class

Lightweight class shall be defined so as to include all papers having a basis weight [weight per 1000 ft2 (93 m2)] of 10 lb (4.5 kg).

20.4.10.4 Tissue

20.4.10.4.1

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

20.4.10.4.2

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

20.4.11\* Plastic Motor Vehicle Components

Group A plastic automotive components and associated packaging material consisting of exposed, expanded Group A plastic dunnage, instrument panels, and plastic bumper fascia shall be permitted to be protected as defined in Chapter 23.

20.4.12 Retail Display/Storage of Up to Cartoned Group A Plastics

Group A plastics combined with Class I through IV in a retail/storage environment (big box retail) that combines customer picking areas with storage above within the retail area shall be permitted to be protected in accordance with retail display/storage of up to cartoned group A plastics in Chapters 20 to 23.

20.4.12.1 Baled Cotton

A natural seed fiber wrapped and secured in industry-accepted materials, usually consisting of burlap, woven polypropylene, or sheet polyethylene, and secured with steel, synthetic or wire bands, or wire; also includes linters (lint removed from the cottonseed) and motes (residual materials from the ginning process) shall be protected as baled cotton in accordance with Chapter 21. (See Table A.3.3.13.)

20.4.13 Carton Records Storage

A Class III commodity consisting predominantly of paper records in cardboard cartons shall be permitted to be protected as cartoned record storage in accordance with Chapter 21 or 23.

20.4.14 Mixed Commodities

20.4.14.1

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

20.4.14.2

Unless the requirements of 20.4.14.3 or 20.4.14.4 are met, mixed commodity storage shall be protected by the requirements for the highest classified commodity and storage arrangement.

20.4.14.3

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

Up to 10 pallet loads of a higher hazard commodity, as described in 20.4.1 through 20.4.7, shall be permitted to be present in an area not exceeding 40,000 ft2 (3720 m2).

The higher hazard commodity shall be randomly dispersed with no adjacent loads in any direction (including diagonally).

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

20.4.14.4 Mixed Commodity Segregation

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

20.5 Storage Arrangement

20.5.1

General storage arrangements defined in this section shall be used to select the appropriate protection criteria in Chapters 21 through 25.

20.5.1.1

Other storage arrangements not covered by this section shall be considered outside the scope of this standard.

20.5.2 Movable Racks

Rack storage in movable racks shall be protected in the same manner as multiple-row racks.

20.5.3\* Rack Storage

20.5.3.1 Shelving

20.5.3.1.1

Shelving material that is less than 50 percent open, or placement of loads that block openings that would otherwise serve as the required flue spaces, greater than 20 ft2 (1.9 m2) in area shall be treated as solid shelf racks.

20.5.3.1.2

Where multiple-row racks of any height have no longitudinal flue or where double-row racks with storage up 25 ft (7.6 m) in height have no longitudinal flue, the situation shall not be considered solid shelves where transverse flues exist at maximum 5 ft (1.5 m) intervals, and additional in-rack sprinklers shall not be required in accordance with 25.6.3.1 and 25.6.3.2.

20.5.3.2 Aisles

20.5.3.2.1

Aisles required by Chapters 21 through 25 shall not be obstructed unless Chapters 21 through 25 include specific guidance allowing obstructions over the aisle.

20.5.3.3 Flues

20.5.3.3.1 Longitudinal Flue Space

20.5.3.3.1.1

For Class I through IV and Group A plastic in double-row and multiple-row open racks, a longitudinal flue space shall not be required for storage up to and including 25 ft (7.6 m). (See Section C.13.)

20.5.3.3.1.2

For Class I through IV and Group A plastic nominal 6 in. (152.4 mm) longitudinal flue spaces shall be provided in double-row racks for storage over 25 ft (7.6 m).

20.5.3.3.2 Transverse Flue Space

20.5.3.3.2.1

Nominal 6 in. (150 mm) transverse flue spaces between loads and at rack uprights shall be maintained in single-row, double-row, and multiple-row racks.

20.5.3.3.2.2

Random variations in the width of flue spaces or in their vertical alignment shall be permitted.

20.5.4 Rubber Tires

20.5.4.1 Water Supplies

Total water supplies shall be capable of providing flow for automatic sprinklers, hose streams, and foam systems (if provided) for the duration required in Table 20.12.2.6.

20.5.5 Roll Paper

20.5.5.1\* Protection Criteria for Roll Paper Storage

20.5.5.2

Wet pipe systems shall be used in tissue storage areas.

20.5.5.2.1

The water supply design shall include the demand of the automatic sprinkler system plus the hose stream allowance plus, where provided, the high-expansion foam system for the duration specified in Table 20.12.2.6.

20.5.5.3

Horizontal storage of heavyweight or mediumweight paper shall be protected as a closed array.

20.5.5.4

Mediumweight paper shall be permitted to be protected as heavyweight paper where wrapped completely on the sides and both ends, or where wrapped on the sides only with steel bands. Wrapping material shall be either a single layer of heavyweight paper with a basis weight of 40 lb (18.1 kg) or two layers of heavyweight paper with a basis weight of less than 40 lb (18.1 kg).

20.5.5.5

Lightweight paper or tissue paper shall be permitted to be protected as mediumweight paper where wrapped completely on the sides and both ends, or where wrapped on the sides only with steel bands. Wrapping material shall be either a single layer of heavyweight paper with a basis weight of 40 lb (18.1 kg) or two layers of heavyweight paper with a basis weight of less than 40 lb (18.1 kg).

20.5.5.6

For purposes of sprinkler system design criteria, lightweight class paper shall be protected as tissue.

20.5.6 Plastic Motor Vehicle Components

Group A plastic automotive components and associated packaging material consisting of exposed, expanded Group A plastic dunnage, instrument panels, and plastic bumper fascia shall be permitted to be protected as defined in Chapter 23.

20.5.6.1

Automotive components covered in this section shall not include the storage of air bags, tires, and seats on portable racks.

20.6 Building Construction and Storage: Heights and Clearance

20.6.1 Ceiling Slope

The sprinkler system criteria specified in Chapters 20 through 25 are intended to apply to buildings with ceiling slopes not exceeding 2 in 12 (16.7 percent) unless modified by a specific section in Chapters 20 through 25.

20.6.2\* Building and Storage Height

20.6.2.1

The maximum building height shall be measured to the underside of the roof deck or ceiling in the storage area or in accordance with 20.6.2.4.1 through 20.6.2.4.2.

20.6.2.2

For corrugated metal deck roofs up to 3 in. (75 mm) in depth, the maximum roof height shall be measured from floor to the bottom of the deck.

20.6.2.3

For decks deeper than 3 in. (75 mm), the maximum roof height shall be measured to the highest point on the deck.

20.6.2.4

For ceilings that have insulation installed directly against underside of the ceiling or roof structure, the maximum roof height shall be measured to the bottom of insulation and shall be in accordance with 20.6.2.4.1 or 20.6.2.4.2.

20.6.2.4.1

For insulation that is installed directly against the ceiling or roof structure and is installed flat and parallel to the ceiling or roof structure, the maximum roof height shall be measured to the underside of the insulation.

20.6.2.4.2

For insulation that is installed in a manner that causes it to deflect or sag down from the ceiling or roof structure, the maximum roof height shall be measured as half of the distance of the deflection from the insulation high point to the insulation low point. If the deflection or sag in the insulation exceeds 6 in. (150 mm), the maximum roof height shall be measured to the high point of the insulation.

20.6.2.5\*

Where the building height changes within a compartment, the sprinklers directly over the storage shall be capable of protecting storage directly beneath.

20.6.2.5.1

Where a barrier to heat and smoke in accordance with 20.10.1 (2) or 20.10.1 (3) is not present, the sprinkler criteria 15 ft (4.6 m) into the perimeter of the lower ceiling area shall be the same as the sprinkler protection for the high ceiling area.

20.6.2.6

ESFR sprinklers shall be used only in buildings equal to, or less than, the height of the building for which they have been listed.

20.6.3 Storage Height

20.6.3.1

The sprinkler system design shall be based on the storage height that routinely or periodically exists in the building and creates the greatest water demand.

20.6.3.2

Where storage is placed above doors, the storage height shall be calculated from the base of storage above the door.

20.6.4 Clearance to Ceiling

20.6.4.1\*

The clearance to ceiling shall be measured in accordance with 20.6.4.1.1 through 20.6.4.1.3.

20.6.4.1.1

For corrugated metal deck roofs up to 3 in. (75 mm) in depth, the clearance to ceiling shall be measured from the top of storage to the bottom of the deck.

20.6.4.1.2

For corrugated metal deck roofs deeper than 3 in. (75 mm), the clearance to ceiling shall be measured to the highest point on the deck.

20.6.4.1.3

For ceilings that have insulation attached directly to underside of the ceiling or roof structure, the clearance to ceiling shall be measured from the top of storage to the bottom of the insulation and shall be in accordance with 20.6.4.1.3(A) or 20.6.4.1.3(B).

(A)

For insulation that is attached directly to the ceiling or roof structure and is installed flat and parallel to the ceiling or roof structure, the clearance to ceiling shall be measured from the top of storage to the underside of the insulation.

(B)

For insulation that is installed in a manner that causes it to deflect or sag down from the ceiling or roof structure, the clearance to ceiling shall be measured from the top of storage to a point half of the distance of the deflection from the insulation high point to the insulation low point. If the deflection or sag in the insulation exceeds 6 in. (150 mm), the clearance to ceiling shall be measured from the top of storage to the high point of the insulation.

20.6.4.2

For CMDA criteria where the clearance to ceiling exceeds those identified in Table 20.6.4.2, the requirements of Table 20.6.4.3 and Table 20.6.4.4 shall apply.

Table 20.6.4.2 Maximum Clearance from Top of Storage to Ceiling for CMDA Protection Criteria

Commodity Class I to IV Group A Plastic

Palletized, solid-piled, bin box, shelf, or back-to-back shelf storage 20 ft (6.1 m) 20 ft (6.1 m)

Rack storage up to 25 ft (7.6 m) 20 ft (6.1 m) 10 ft (3.1 m)

Rack storage >25 ft (7.6 m) 10 ft (3.1 m) 10 ft (3.1 m)

20.6.4.3

Protection of Class I through Class IV commodities using CMDA criteria that exceed the maximum allowable clearance in Table 20.6.4.2 shall be in accordance with Table 20.6.4.3.

Table 20.6.4.3 Class I Through Class IV Commodities

Storage Configuration Where the clearance to ceiling exceeds Protection is based upon the storage height that would result in a clearance to ceiling of... In-rack Sprinklers\*

Palletized, solid-piled, bin box, shelf, or back-to-back shelf storage

20 ft (6.1 m) 20 ft (6.1 m) N/A

Rack storage up to and including 25 ft (7.6 m) in height

20 ft (6.1 m) 20 ft (6.1 m)

Permitted as alternative to presumed clearance of 20 ft (6.1 m)

Rack storage over 25 ft (7.6 m) in height 10 ft (3.1 m) 10 ft (3.1 m) Permitted as alternative to presumed clearance of 10 ft (3.1 m)

\*When applying the supplemental in-rack sprinkler option, the ceiling density is based upon the given storage height with an assumed acceptable clearance to ceiling. Provide one level of supplemental, quick response in-rack sprinklers located directly below the top tier of storage and at every flue space intersection.

20.6.4.4

Protection of plastic and rubber commodities with CMDA criteria having clearance exceeding the allowable limits of Table 20.6.4.3 shall be in accordance with Table 20.6.4.4.

Table 20.6.4.4 Plastics and Rubber Commodities

Storage Configuration Where the clearance to ceiling exceeds Protection is based upon the storage height that would result in a clearance to ceiling of... In-rack Sprinklers\*

Palletized, solid-piled, bin box, shelf, or back-to-back shelf storage

20 ft (6.1 m) 20 ft (6.1 m) N/A

Rack storage up to and including 25 ft (7.6 m) in height

10 ft (3.1 m) 10 ft (3.1 m)

Permitted as alternative to presumed clearance of 10 ft (3.1 m)

Rack storage over 25 ft (7.6 m) in height 10 ft (3.1 m) N/A Required

\*If in-rack sprinklers are required for the actual storage height with an acceptable clearance to ceiling, in-rack sprinklers are installed as indicated by that criteria. Provide one level of supplemental, quick response in-rack sprinklers located directly below the top tier of storage and at every flue space intersection.

20.6.4.5

If in-rack sprinklers are required for the actual storage height with an acceptable clearance to ceiling, in-rack sprinklers shall be installed as indicated by that criteria.

20.6.5 Roof Vents and Draft Curtains

See Section C.6.

20.6.5.1\*

Manually operated roof vents or automatic roof vents with operating elements that have a higher temperature classification than the automatic sprinklers shall be permitted.

20.6.5.2

Early suppression fast-response (ESFR) sprinklers shall not be used in buildings with automatic heat or smoke vents unless the vents use a high-temperature rated, standard-response operating mechanism.

20.6.5.3\*

Draft curtains shall not be used within ESFR sprinkler systems.

20.6.5.3.1

Draft curtains separating ESFR sprinklers at system breaks or from control mode sprinklers or between hazards shall be permitted. (See 14.2.5.)

20.6.5.3.2

Where ESFR sprinkler systems are installed adjacent to sprinkler systems with standard-response sprinklers, a draft curtain of noncombustible construction and at least 2 ft (600 mm) in depth shall be required to separate the two areas.

20.6.5.3.3

A clear aisle of at least 4 ft (1.2 m) centered below the draft curtain shall be maintained for separation.

20.6.6 Clearance From Deflector to Storage

20.6.6.1

Unless the requirements of 20.6.6.2 through 20.6.6.5 are met, the clearance between the deflector and the top of storage or contents of the room shall be 18 in. (450 mm) or greater.

20.6.6.2

Where other standards specify greater clearance to storage minimums, they shall be followed.

20.6.6.3

A minimum clearance to storage of 36 in. (900 mm) shall be permitted for special sprinklers.

20.6.6.4

A minimum clearance to storage of less than 18 in. (450 mm) between the top of storage and ceiling sprinkler deflectors shall be permitted where proven by successful large-scale fire tests for the particular hazard.

20.6.6.5

The clearance from the top of storage to sprinkler deflectors shall be not less than 36 in. (900 mm) where rubber tires are stored.

20.6.7\* High Volume Low Speed (HVLS) Fans

20.6.7.1

The installation of HVLS fans in buildings equipped with sprinklers, including ESFR sprinklers, shall comply with the following:

The maximum fan diameter shall be 24 ft (7.3 m).

The HVLS fan shall be centered approximately between four adjacent sprinklers.

The vertical clearance from the HVLS fan to sprinkler deflector shall be a minimum of 36 in. (900 mm).

All HVLS fans shall be interlocked to shut down immediately upon a waterflow alarm.

Where the building is protected with a fire alarm system, this interlock shall be in accordance with the requirements of NFPA 72.

20.7 Unsprinklered Combustible Concealed Spaces

20.7.1\*

When using the density/area method or room design method, unless the requirements of 20.7.2 are met for buildings having unsprinklered combustible concealed spaces as described in 9.2.1 and 9.3.18, the minimum area of sprinkler operation for that portion of the building shall be 3000 ft2 (280 m2).

20.7.1.1

The design area of 3000 ft2 (280 m2) shall be applied only to the sprinkler system or portions of the sprinkler system that are adjacent to the qualifying combustible concealed space.

20.7.1.2

The term adjacent shall apply to any sprinkler system protecting a space above, below, or next to the qualifying concealed space except where a barrier with a fire resistance rating at least equivalent to the water supply duration completely separates the concealed space from the sprinklered area.

20.7.2

The following unsprinklered combustible concealed spaces shall not require a minimum design area of sprinkler operation of 3000 ft2 (280 m2):

Noncombustible and limited-combustible concealed spaces with minimal combustible loading having no access. The space shall be considered a concealed space even with small openings such as those used as return air for a plenum.

Noncombustible and limited-combustible concealed spaces with limited access and not permitting occupancy or storage of combustibles. The space shall be considered a concealed space even with small openings such as those used as return air for a plenum.

Combustible concealed spaces filled entirely with noncombustible insulation.

Concealed spaces where rigid materials are used and the exposed surfaces have a flame spread index of 25 or less and the materials have been demonstrated to not propagate fire more than 10.5 ft (3.2 m) when tested in accordance with ASTM E84, Standard Test Method for Surface Burning Characteristics of Building Materials, or UL 723, Standard for Test for Surface Burning Characteristics of Building Materials, extended for an additional 20 minutes in the form in which they are installed in the space.

Concealed spaces in which the exposed materials are constructed entirely of fire retardant-treated wood as defined by NFPA 703.

Concealed spaces over isolated small compartments not exceeding 55 ft2 (5.1 m2) in area.

Vertical pipe chases under 10 ft2 (0.9 m2), provided that in multifloor buildings the chases are firestopped at each floor using materials equivalent to the floor construction. Such pipe chases shall contain no sources of ignition, piping shall be noncombustible, and pipe penetrations at each floor shall be properly sealed.

Exterior columns under 10 ft2 (0.9 m2) in area formed by studs or wood joists, supporting exterior canopies that are fully protected with a sprinkler system.

Cavities within unsprinklered wall spaces.

20.8 Room Design Method

20.8.1\*

The water supply requirements for sprinklers only shall be based upon the room that creates the greatest demand.

20.8.2

To utilize the room design method, all rooms shall be enclosed with walls having a fire resistance rating equal to the required water supply duration.

20.8.2.1

Minimum protection of openings shall include automatic- or self-closing doors with the appropriate fire protection rating for the enclosure.

20.8.3

Where the room design method is used, the density shall correspond to that required for the smallest area acceptable under the density/area method.

20.9\* High-Expansion Foam Systems

20.9.1 General: High Expansion Foam Systems

20.9.1.1

High-expansion foam systems that are installed in addition to automatic sprinklers shall be installed in accordance with NFPA 11.

20.9.1.2

High-expansion foam systems shall be automatic in operation.

20.9.1.3

High-expansion foam used to protect the idle pallet shall have a maximum fill time of 4 minutes.

20.9.1.4

Detectors for high-expansion foam systems shall be listed and shall be installed at no more than one-half the listed spacing.

20.9.1.5

The release system for the high expansion foam deluge system shall be designed to operate prior to the sprinklers installed in the area.

20.9.1.5.1

The maximum submergence time for the high-expansion foam shall be 5 minutes for Class I, Class II, or Class III commodities and 4 minutes for Class IV commodities.

20.9.2 High-Expansion Foam: Reduction in Ceiling Density

20.9.2.1

Using CMDA sprinkler protection criteria for palletized, solid-piled, bin box, shelf, or back-to-back shelf storage of Class I through Class IV commodities, idle pallets, or plastics, where high-expansion foam systems are used in combination with ceiling sprinklers, a reduction in ceiling density to one-half that required for Class I through Class IV commodities, idle pallets, or plastics shall be permitted without revising the design area, but the density shall be no less than 0.15 gpm/ft2 (6.1 mm/min).

20.9.2.2

Using CMDA sprinkler protection criteria for rack storage, where high-expansion foam systems are used in combination with ceiling sprinklers, the minimum ceiling sprinkler design density shall be 0.2 gpm/ft2 (8.2 mm/min) for Class I, Class II, or Class III commodities or 0.25 gpm/ft2 (10.2 mm/min) for Class IV commodities for the most hydraulically remote 2000 ft2 (185 m2) operating area.

20.9.2.3

Where high-expansion foam systems are used in combination with ceiling sprinklers, the maximum submergence time shall be 7 minutes for Class I, Class II, or Class III commodities and 5 minutes for Class IV commodities.

20.9.2.4

Where high-expansion foam systems are used for rack storage of Class I through IV commodities over 25 ft (7.6 m) high up to and including 35 ft (11 m) high, they shall be used in combination with ceiling sprinklers.

20.9.2.5 Reduced-Discharge Density

Where high-expansion foam systems for rubber tire protection are installed in accordance with NFPA 11, a reduction in sprinkler discharge density to one-half the density specified in Table 21.6.1(a) or 0.24 gpm/ft2 (9.8 mm/min), whichever is higher, shall be permitted.

20.9.2.6

In-rack sprinklers for the protection of Class I through IV commodities shall not be required where high-expansion foam systems are used in combination with ceiling sprinklers.

20.9.2.7 Detectors for High-Expansion Foam Systems

20.9.2.7.1

Detectors shall be listed and shall be installed in one of the following configurations:

At the ceiling only where installed at one-half the listed linear spacing [e.g., 15 ft × 15 ft (4.6 m × 4.6 m) rather than at 30 ft × 30 ft (9.1 m × 9.1 m)]; at the ceiling at the listed spacing and in racks at alternate levels

Where listed for rack storage installation and installed in accordance with the listing to provide response within 1 minute after ignition using an ignition source that is equivalent to that used in a rack storage testing program

20.9.2.7.2

Ceiling detectors alone shall not be used where the clearance to ceiling exceeds 10 ft (3.0 m) or the height of the storage exceeds 25 ft (7.6 m).

20.9.2.7.3

Detectors for preaction systems shall be installed in accordance with 20.9.2.7.

20.10\* Adjacent Hazards or Design Methods

20.10.1

For buildings with two or more adjacent hazards or design methods, the following shall apply:

Where areas are not physically separated by a barrier or partition capable of delaying heat from a fire in one area from fusing sprinklers in the adjacent area, the required sprinkler protection for the more demanding design basis shall extend 15 ft (4.6 m) beyond its perimeter.

The requirements of 20.10.1 (1) shall not apply where the areas are separated by a draft curtain or barrier located above an aisle, horizontally a minimum of 24 in. (600 mm) from the adjacent hazard on each side, or a partition that is capable of delaying heat from a fire in one area from fusing sprinklers in the adjacent area.

The requirements of 20.10.1(1) shall not apply to the extension of more demanding criteria from an upper ceiling level to beneath a lower ceiling level where the difference in height between the ceiling levels is at least 24 in. (600 mm), located above an aisle, horizontally a minimum 24 in. (600 mm) from the adjacent hazard on each side.

20.10.2\*

Protection criteria for Group A plastics shall be permitted for the protection of the same storage height and configuration of Class I, II, III, and IV commodities.

20.10.3

CMSA and ESFR sprinklers shall be permitted to protect storage of Class I through Class IV commodities, Group A plastic commodities, miscellaneous storage, and other storage as specified in Chapters 20 through 25 or by other NFPA standards.

20.10.4 Systems With Multiple Hazard Classifications

For systems with multiple hazard classifications, the hose stream allowance and water supply duration shall be in accordance with 20.12.2 as well as one of the following:

The water supply requirements for the highest hazard classification within the system shall be used.

The water supply requirements for each individual hazard classification shall be used in the calculations for the design area for that hazard.

\* For systems with multiple hazard classifications where the higher classification only lies within single rooms less than or equal to 400 ft2 (37 m2) in area with no such rooms adjacent, the water supply requirements for the principal occupancy shall be used for the remainder of the system.

20.11\* Hose Connections

20.11.1 Small [11/2 in. (40 mm)] Hose Connections

See Section C.5.

20.11.1.1 Hose Connection

Small hose connections [11/2 in. (40 mm)] shall be provided where required by the authority having jurisdiction in accordance with Section 16.15 for first-aid, fire-fighting, and overhaul operations.

20.11.1.2

Small hose connections shall not be required for the protection of Class I, II, III, and IV commodities stored 12 ft (3.7 m) or less in height.

20.12 Hose Stream Allowance and Water Supply Duration

20.12.1

Hose stream allowance and water supply duration for Chapters 20 through 25 shall be in accordance with Section 20.12.

20.12.2 Hose Stream Allowance and Water Supply Duration

20.12.2.1\*

Tanks shall be sized to supply the equipment that they serve.

20.12.2.2\*

Pumps shall be sized to supply the equipment that they serve.

20.12.2.3

Water allowance for outside hose shall be added to the sprinkler requirement at the connection to the city main or a yard hydrant, whichever is closer to the system riser.

20.12.2.4

Where inside hose connections are planned or are required, the following shall apply:

A total water allowance of 50 gpm (190 L/min) for a single hose connection installation shall be added to the sprinkler requirements.

A total water allowance of 100 gpm (380 L/min) for a multiple hose connection installation shall be added to the sprinkler requirements.

The water allowance shall be added in 50 gpm (190 L/min) increments beginning at the most remote hose connection, with each increment added at the pressure required by the sprinkler system design at that point.

20.12.2.5

When hose valves for fire department use are attached to wet pipe sprinkler system risers in accordance with 16.15.2, the following shall apply:

The water supply shall not be required to be added to standpipe demand as determined from NFPA 14.

Where the combined sprinkler system demand and hose stream allowance of Chapters 20 through 25 exceeds the requirements of NFPA 14, this higher demand shall be used.

For partially sprinklered buildings, the sprinkler demand, not including hose stream allowance, as indicated in Chapters 20 through 25 shall be added to the requirements given in NFPA 14.

20.12.2.6

Unless indicated otherwise, the minimum water supply requirements for a hydraulically designed sprinkler system shall be determined by adding the hose stream allowance from Table 20.12.2.6 to the water demand for sprinklers.

Table 20.12.2.6 Hose Stream Allowance and Water Supply Duration

Commodity Sprinkler Type Sprinkler Spacing Type Number of Ceiling Sprinklers in Design Areaa Size of Design Area at Ceiling Hose Stream Allowance Water Supply Duration (minutes)

gpm L/min

Class I-IV Commodities, Group A plastics, idle wood pallets, idle plastic pallets and miscellaneous storage Control mode density/area (CMDA) Standard and extended-coverage NA Up to 1200 ft2 (112 m2) 250 950 60

Over 1200 ft2 (112 m2) up to 1500 ft2 (140 m2) 500 1900 90

Over 1500 ft2 (140 m2) up to 2600 ft2 (240 m2) 500 1900 120

Over 2600 ft2 (240 m2) 500 1900 150

Control mode specific application (CMSA) Standard Up to 12 NA 250 950 60

Over 12 to 15 NA 500 1900 90

Over 15 to 25 NA 500 1900 120

Over 25 NA 500 1900 150

Extended-coverage Up to 6 NA 250 950 60

Up to 8b NA 250 950 60

Over 6 to 8 NA 500 1900 90

Over 8 to 12 NA 500 1900 120

Over 12 NA 500 1900 150

Early suppression fast response (ESFR) Standard Up to 12 NA 250 950 60

Over 12 to 15 NA 500 1900 90

Over 15 to 25 NA 500 1900 120

Over 25 NA 500 1900 150

On-floor rubber tire storage up to 5 ft (1.5 m) in height CMDA & CMSA Standard and extended-coverage Any Any 250 950 120

Rubber tire storage CMDA Standard and extended-coverage NA Up to 5000 ft2 (465 m2) 750 2850 180

CMSA Standard Up to 15 NA 500 1900 180

ESFR Standard Up to 12 NA 250 950 60

Over 12 to 20 NA 500 1900 120c

Roll paper CMDA Standard NA Up to 4000 ft2 (370 m2) 500 1900 120

CMSA Standard Up to 25 NA 500 1900 120

ESFR Standard Up to 12 NA 250 950 120

Alternative protection per 25.8.3.3 NA NA NA NA 500 1900 120

NA: Not applicable.

aFor CSMA and ESFR sprinklers, the additional sprinklers included in the design area for obstructions do not need to be considered in determining the total number of sprinklers in this column.

bLimited to a maximum of 144 ft2 (13 m2) per sprinkler.

cFor storage on-tread, on-side, and laced tires in open portable steel racks or palletized portable racks, with pile height up to 25 ft (7.6 m) and building height up to 30 ft (9.1 m) with K-14.0 (K-200) or K16.8 (K-240) ESFR sprinklers, the water supply duration is 180 minutes.

20.12.2.7

For the protection of baled cotton, the total water supply available shall be sufficient to provide the recommended sprinkler discharge density over the area to be protected, plus a minimum of 500 gpm (1900 L/min) for hose streams.

20.12.2.7.1

Water supplies shall be capable of supplying the total demand for sprinklers and hose streams for not less than 2 hours.

20.12.3

The minimum water supply requirements shall be determined by adding the hose stream allowance from 20.12.2 to the water supply for sprinklers as determined by Chapters 20 through 25.

20.12.4

The minimum water supply requirements determined from 20.12.3 shall be available for the minimum duration specified in 20.12.2.

20.12.5

Total system water supply requirements shall be determined in accordance with the hydraulic calculation procedures of Chapter 27.

20.13 Discharge Considerations: General

20.13.1 Multiple Adjustments

20.13.1.1

Where multiple adjustments to the area of operation are required to be made, these adjustments shall be compounded based on the area of operation originally selected.

20.13.1.2

If the building has unsprinklered combustible concealed spaces, the rules of Section 20.7 shall be applied after all other modifications have been made.

20.13.2\* Wet Pipe Systems

20.13.2.1

Sprinkler systems shall be wet pipe systems.

20.13.2.2\*

In areas that are subject to freezing or where special conditions exist, dry pipe systems and preaction systems shall be permitted to protect storage occupancies.

20.13.3 Dry Pipe and Preaction Systems

For dry pipe systems and preaction systems using control mode density/area (CMDA) criteria, the area of sprinkler operation shall be increased by 30 percent without revising the density.

20.14\* Protection of Idle Pallets

20.14.1 Wood Pallets

20.14.1.1\*

Wood pallets shall be permitted to be stored in the following arrangements:

Stored outside

Stored in a detached structure

Stored indoors where arranged and protected in accordance with 20.14.1.2

20.14.1.2

Wood pallets, where stored indoors, shall be protected in accordance with one of the following:

Control mode density/area sprinkler protection as specified in Table 20.14.1.2(a).

CMSA sprinkler protection in accordance with Table 20.14.1.2(b).

ESFR sprinkler protection in accordance with Table 20.14.1.2(c).

Control mode density/area sprinkler protection in accordance with the Ordinary Hazard Group 2 curve and Figure 19.3.3.1.1 with a hose stream demand of at least 250 gpm (950 L/min) for a duration of at least 60 minutes when pallets are stored no higher than 6 ft (1.8 m) and each pile of no more than four stacks is separated from other pallet piles by at least 8 ft (2.4 m) of clear space or 25 ft (7.6 m) of commodity. The maximum clearance to ceiling of 20 ft (6.1 m) specified in 20.6.4 shall not apply to arrangement 20.14.1.2(4).

Table 20.14.1.2(a) Control Mode Density/Area Sprinkler Protection for Indoor Storage of Idle Wood Pallets

Type of Sprinkler Location of Storage Nominal K-Factor Maximum Storage Height Maximum Ceiling/Roof Height Sprinkler Density Areas of Operation

ft m ft m gpm/ft2 mm/min ft2 m2

Control mode density/area On floor 8 (115) or larger Up to 6 Up to 1.8 20 6.1 0.20 8.2 3000\* 280\*

On floor 11.2 (160) or larger Up to 8 Up to 2.4 30 9.1 0.45 18.3 2500 230

On floor or rack without solid shelves 11.2 (160) or larger 8 to 12 2.4 to 3.7 30 9.1 0.6 24.5 3500 325

12 to 20 3.7 to 6.1 30 9.1 0.6 24.5 4500 420

On floor 16.8 (240) or larger Up to 20 Up to 6.1 30 9.1 0.6 24.5 2000 185

\*The area of sprinkler operation should be permitted to be reduced to 2000 ft2 (186 m2) when sprinklers having a nominal K-factor of 11.2 or larger are used or if high-temperature-rated sprinklers with a nominal K-factor of 8.0 are used.

Table 20.14.1.2(b) CMSA Sprinkler Protection for Indoor Storage of Idle Wood Pallets

Storage Arrangement Commodity Class Maximum Storage Height Maximum Ceiling/Roof Height K-Factor/Orientation Type of System Number of Design Sprinklers Minimum Operating Pressure

ft m ft m psi bar

On floor Idle wood pallets 20 6.1 30 9.1 11.2 (160) Upright Wet 15 25 1.7

Dry 25 25 1.7

16.8 (240) Upright Wet 15 15 1.0

Dry 25 15 1.0

19.6 (280) Pendent Wet 15 16 1.1

35 11 19.6 (280) Pendent Wet 15 25 1.7

40 12 19.6 (280) Pendent Wet 15 30 2.1

Table 20.14.1.2(c) ESFR Sprinkler Protection for Indoor Storage of Idle Wood Pallets

Type of Sprinkler (Orientation) Location of Storage Nominal K-Factor Maximum Storage Height Maximum Ceiling/Roof Height Minimum Operating Pressure

ft m ft m psi bar

ESFR (pendent) On floor or rack without solid shelves 14.0 (200) 25 7.6 30 9.1 50 3.4

25 7.6 32 10 60 4.1

16.8 (240) 25 7.6 30 9.1 35 2.4

25 7.6 32 10 42 2.9

35 11 40 12 52 3.6

22.4 (320) 25 7.6 30 9.1 25 1.7

30 9.1 35 11 35 2.4

35 11 40 12 40 2.7

25.2 (360) 25 7.6 30 9.1 15 1.0

30 9.1 35 11 20 1.4

35 11 40 12 25 1.7

ESFR (upright) On floor 14.0 (200) 20 6.1 30 9.1 50 3.4

20 6.1 35 11 75 5.2

16.8 (240) 20 6.1 30 9.1 35 2.4

20 6.1 35 11 52 3.6

20.14.1.2.1

The maximum clearance to ceiling of 20 ft (6.1 m) specified in 20.6.4 shall not apply to arrangement 20.14.1.2(4).

20.14.1.3

Idle wood pallets shall not be stored in racks unless they are protected in accordance with the appropriate requirements of Table 20.14.1.2(a) or Table 20.14.1.2(c). (See Section C.7.)

20.14.2 Plastic Pallets

20.14.2.1

Plastic pallets shall be permitted to be stored in the following manner:

Plastic pallets shall be permitted to be stored outside.

Plastic pallets shall be permitted to be stored in a detached structure.

Plastic pallets shall be permitted to be stored indoors where arranged and protected in accordance with the requirements of 20.14.2.2.

20.14.2.2 Protection Criteria for Plastic Pallets Stored Indoors

20.14.2.2.1

Plastic pallets having a demonstrated fire hazard that is equal to or less than idle wood pallets and is listed for such equivalency shall be permitted to be protected in accordance with 20.14.1.

20.14.2.2.2

When specific test data are available, the data shall take precedence in determining the required protection of idle plastic pallets.

20.14.2.2.3

Protection with ESFR sprinklers shall be in accordance with the requirements of Table 20.14.2.2.3.

Table 20.14.2.2.3 ESFR Sprinkler Protection for Indoor Storage of Idle Plastic Pallets

Type of Sprinkler (Orientation) Location of Storage Nominal K-Factor Maximum Storage Height Maximum Ceiling/Roof Height Minimum Operating Pressure

ft m ft m psi bar

ESFR (pendent) On floor or rack without solid shelves 14.0 (200) 25 7.6 30 9.1 50 3.4

25 7.6 32 10 60 4.1

16.8 (240) 25 7.6 30 9.1 35 2.4

25 7.6 32 10 42 2.9

35 11 40 12 52 3.6

20.14.2.2.4

Protection with spray sprinklers shall be in accordance with one of the scenarios in 20.14.2.2.4.1 through 20.14.2.2.4.3.

20.14.2.2.4.1

Where plastic pallets are stored in cutoff rooms, the following shall apply:

The cutoff rooms shall have at least one exterior wall.

The plastic pallet storage shall be separated from the remainder of the building by 3-hour-rated fire walls.

The storage shall be protected by sprinklers designed to deliver 0.6 gpm/ft2 (24.5 mm/min) for the entire room or by high-expansion foam and sprinklers designed to deliver 0.3 gpm/ft2 (12.2 mm/min) for the entire room.

The storage shall be piled no higher than 12 ft (3.7 m).

Any steel columns shall be protected by 1-hour fireproofing or a sidewall sprinkler directed to one side of the column at the top or at the 15 ft (4.6 m) level, whichever is lower. Flow from these sprinklers shall be permitted to be omitted from the sprinkler system demand for hydraulic calculations.

20.14.2.2.4.2

Where plastic pallets are stored without cutoffs from other storage, the following shall apply:

Maximum storage height of 10 ft (3.0 m)

Maximum ceiling height of 30 ft (9.1 m)

Sprinkler density 0.6 gpm/ft2 over 2000 ft2 (24.5 mm/min over 185 m2)

Minimum sprinkler K-factor of 16.8 (240)

20.14.2.2.4.3

Plastic pallets shall have no impact on the required sprinkler protection when stored as follows:

Storage shall be piled no higher than 4 ft (1.2 m).

Sprinkler protection shall employ high temperature-rated sprinklers.

Each pallet pile of no more than two stacks shall be separated from other pallet piles by at least 8 ft (2.4 m) of clear space or 25 ft (7.6 m) of stored commodity.

Minimum ceiling design of OH2 shall be used.

20.14.2.3

Idle plastic pallets shall be stored only in racks where protected in accordance with the requirements of Table 20.14.2.2.3.

20.14.2.3.1

When specific test data and a product listing are available, the data shall take precedence in determining the required protection of idle plastic pallets stored in racks.

20.14.3 Idle Pallets Stored on Racks, on Shelves, and Above Doors

20.14.3.1

Idle pallets shall not be stored on racks or shelves, except where permitted in 20.14.1.3, 20.14.2.3, and 20.14.3.2.

20.14.3.2

Idle pallets shall be permitted to be stored on the lowest level of storage only where no storage or shelves are located above the stored pallets and the applicable protection criteria referenced for on-floor storage in Section 20.14 are applied.

20.14.3.3

Where idle pallet storage is above a door, the idle pallet storage height and ceiling height shall be calculated from the base of storage above the door using the applicable protection criteria referenced in Section 20.14.

20.15 Column Protection: Rack Storage and Rubber Tire Storage

20.15.1\*

Where fireproofing of building columns is not provided and storage heights are in excess of 15 ft (4.6 m), protection of building columns located wholly or partially within the rack footprint inclusive of flue spaces or within 12 in. (300 mm) of the footprint shall be protected in accordance with one of the following:

In-rack sprinklers

Sidewall sprinklers at the 15 ft (4.6 m) elevation, pointed toward one side of the steel column

Provision of ceiling sprinkler density for a minimum of 2000 ft2 (186 m2) with ordinary 165°F (74°C) or high-temperature 286°F (140°C) rated sprinklers as shown in Table 20.15.1 for storage heights above 15 ft (4.6 m), up to and including 20 ft (6.1 m)

Provision of CMSA or ESFR ceiling sprinkler protection

Table 20.15.1 Ceiling Sprinkler Densities for Protection of Steel Building Columns

Commodity Classification Aisle Width

4 ft (1.2 m) 8 ft (2.4 m)

gpm/ft2 mm/min gpm/ft2 mm/min

Class I 0.37 15.1 0.33 13.4

Class II 0.44 17.9 0.37 15.1

Class III 0.49 20.0 0.42 17.1

Class IV and Group A plastics 0.68 27.7 0.57 23.2

20.15.1.1

Where storage heights are in excess of 15 ft (4.6 m) and vertical rack members support the building structure, the vertical rack members shall be protected in accordance with one of the options in 20.15.1.

20.15.1.2

The flow from a column sprinkler(s) shall be permitted to be omitted from the sprinkler system hydraulic calculations.

20.15.2 Columns Within Rubber Tire Storage

20.15.2.1

Where fireproofing is not provided, steel columns shall be protected as follows:

Storage exceeding 15 ft through 20 ft (4.6 m through 6.1 m) in height — one sidewall sprinkler directed to one side of the column at a 15 ft (4.6 m) level

Storage exceeding 20 ft (6.1 m) in height — two sidewall sprinklers, one at the top of the column and the other at a 15 ft (4.6 m) level, both directed to the side of the

20.15.2.2

The flow from a column sprinkler(s) shall be permitted to be omitted from the sprinkler system hydraulic calculations.

20.15.2.3

The protection specified in 20.15.2.1(1) and 20.15.2.1(2) shall not be required where storage in fixed racks is protected by in-rack sprinklers.

20.15.2.4

The protection specified in 20.15.2.1 shall not be required where ESFR or CMSA sprinkler systems that are approved for rubber tire storage are installed.

20.15.2.5

The rate of water supply shall be sufficient to provide the required sprinkler discharge density over the required area of application plus provision for generation of high-expansion foam and in-rack sprinklers where used.