Central Engineering and Consultant Co.,Ltd.

Part 1

- Commodity Classification

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Sprinkler Storage

Classification of Commodities.

Commodity classification and the corresponding protection requirements shall be determined based **on the make-up of individual storage units (i.e., unit load, pallet load).** The type and number 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. 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.

Commodity Classes.

Class I.

A Class I (figure 1) commodity shall be defined as a noncombustible product that meets one of the following criteria:

(1) Placed directly on wood pallets

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

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

Single-layer corrugated car

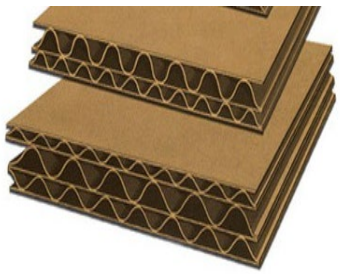
Shrink-wrapped on wooded pallet.

Figure 1 : Class I commodity

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.


Slatted wooden crates Multiple-layered corrugated cartons.

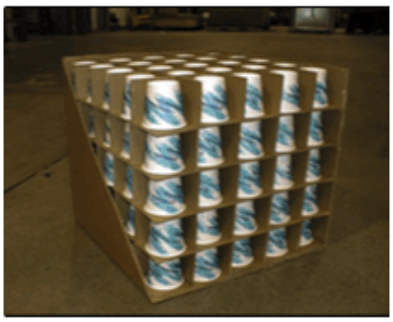
Figure 2 : Class II commodity

Class III.

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.

- Class III commodity shall be permitted to contain a limited amount (5 percent or less by weight of unexpanded plastic or 5 percent or less by volume of expanded plastic) of Group A or Group B plastics.
- Class III commodities containing a mix of both Group A expanded and unexpanded plastics shall comply with where they are within cartons, boxes, or crates where they are exposed.





Cartooned Unexpended Group A Plastic

Cartooned Expended Group A Plastic

Class III

Figure 3 : Class III commodit

Class IV.

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

(1) Constructed partially or totally of Group B plastics

(2) Consists of free-flowing Group A plastic materials

(3) Cartooned, or within a wooden container, that contains greater than 5 percent and up to 15 percent by weight of Group A unexpanded plastic

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

(5) Cartoned, or within a wooden container, that contains a mix of Group A expanded and unexpanded plastics and Complies with Figure

(6) Exposed, that contains greater than 5 percent and up to15 percent by weight of Group A unexpanded plastic

(7) Exposed, which contains a mix of Group A expanded and unexpanded plastics and complies with Figure

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

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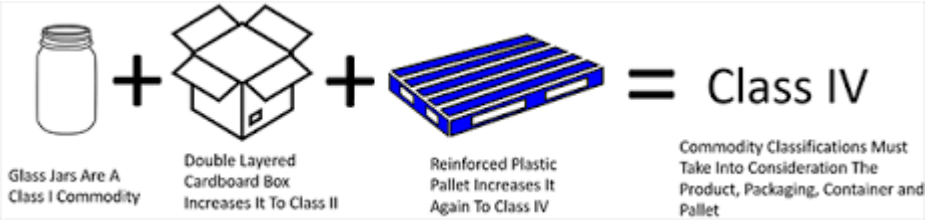
Class IV

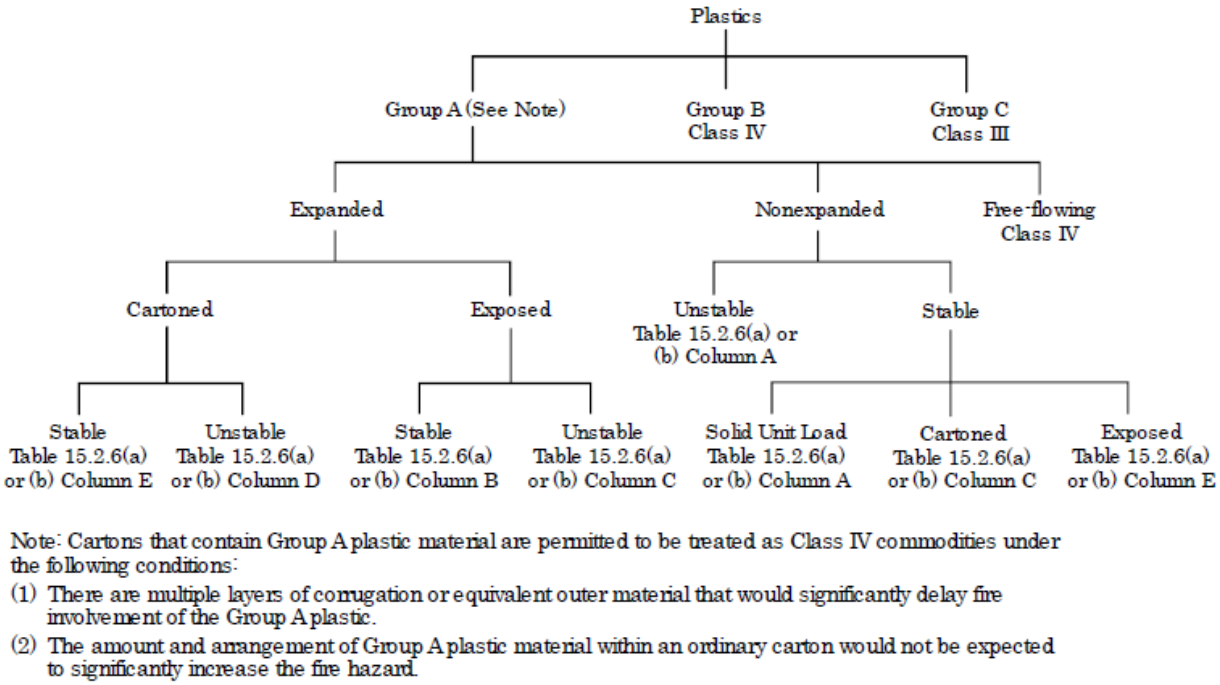
Exposed Expended Group A Plastic

Figure 3 : Class IV commodity



Classification of Plastics, Elastomers, and Rubber.

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



Note: Cartons that contain Group A plastic material are permitted to be treated as Class IV commodities under the following conditions:

(1) There are multiple layers of corrugation or equivalent outer material that would significantly delay fire involvement of the Group A plastic.

(2) The amount and arrangement of Group A plastic material within an ordinary carton would not be expected to significantly increase the fire hazard.

Figure 4: Plastic Group A,B,C Classification Chart

<u>Group A.</u> The following can be classified as Group A:

(1) ABS (acrylonitrile-butadiene-styrene copolymer)

(2) Acetal (poly formaldehyde)

(3) Acrylic (polymethyl methacrylate)

(4) Butyl rubber 5) Cellulosic (cellulose acetate, cellulose acetate butyrate, ethyl cellulose)

(6) EPDM (ethylene-propylene rubber)

(7) FRP (fiberglass-reinforced polyester)

(8) Natural rubber

(9) Nitrile-rubber (acrylonitrile-butadiene-rubber)

(10) Nylon (nylon 6, nylon 6/ 6)

(11) PET (thermoplastic polyester)

(12) Polybutadiene

(13) Polycarbonate

(14) Polyester elastomer

(15) Polyethylene

(16) Polypropylene

(17) Polystyrene

(18) Polyurethane

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

(20) PVF(polyvinyl fluoride)

(21) SAN(styrene acrylonitrile)

(22) SBR(styrene-butadiene rubber)

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

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

(1) Cartooned, or within a wooden container, that contains greater than 40 percent by volume of Group A expanded Plastic

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

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

(1) Cartooned, or within a wooden container, that contains greater than 15 percent by weight of Group A unexpanded plastic

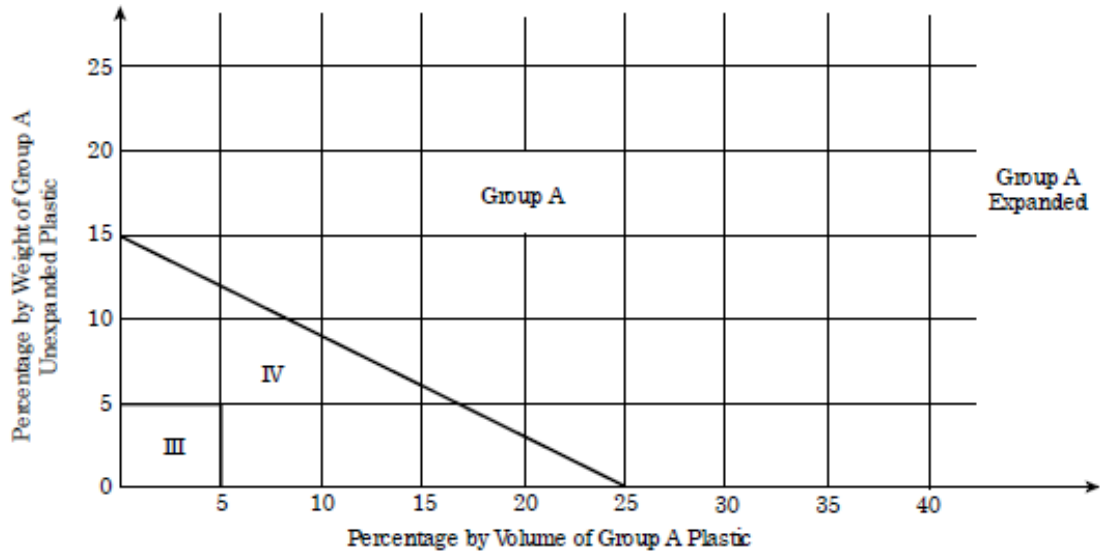
(2) Cartooned, or within a wooden container, that contains greater than 25 percent and up to 40 percent by volume of Group A expanded plastic

(3) Cartooned, or within a wooden container, that contains a mix of Group A unexpanded and expanded plastics, in compliance with Figure

(4) Exposed, that contains greater than 15 percent by weight of Group A unexpanded plastic

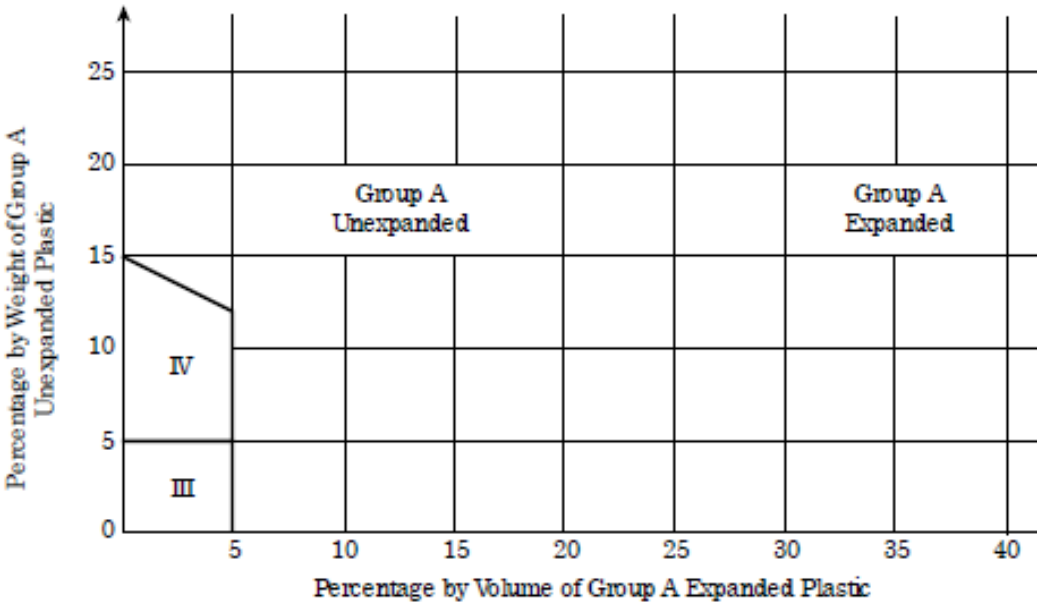
(5) Exposed, that contains greater than 5 percent and up to 25 percent by volume of Group A expanded plastic

(6) Exposed, which contains mix of Group A unexpanded and expanded plastics, in compliance with Figure The remaining materials shall be permitted to be noncombustible, wood, paper, natural or synthetic fibers, or Group A, Group B, or Group C plastics



III - Class III Commodity. Refer to 5.6.2 if a plastic pallet is used.

IV - Class IV Commodity. Refer to 5.6.2 if a plastic pallet is used.



III - Class III Commodity. Refer to 5.6.2 if a plastic pallet is used.

IV - Class IV Commodity. Refer to 5.6.2 if a plastic pallet is used.

Figure 5: Percentage of volume of Group A Plastic for classification

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

(1) Chloroprene rubber

(2) Fluoro plastics (ECTFE ethylene-chlorotic fluoroethylene copolymer; ETFE ethylene-tetrafluoroethylene-copolymer; FEP fluorinated ethylene-propylene copolymer)

(3) Silicone rubber

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

(1) Fluoroplastics (PCTFE polychlorotrifluoroethylene; PTFE polytetrafluoroethylene)

(2) Melamine (melamine formaldehyde)

(3) Phenolic

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

(5) PVDC (polyvinylidene chloride)

(6) PVDF (polyvinylidene fluoride)

(7) Urea (urea formaldehyde)

Classification of Rolled Paper Storage.

For the purposes of NFPA standard, the classifications of paper described to apply and shall be used to determine the sprinkler system design criteria.

- **Heavyweight Class**. Heavyweight class shall be defined so as to include paperboard and paper stock having a basis weight [weight per 1000 ft2 (92.9m2)] of 20 lb (9.1 kg).
- **Mediumweight Class**. Medium weight class be defined so as to include all the broad range of papers having a basis weight [weight per 1000 ft2 (92.9 m2)] of 10 lb to 20 lb (4.5 kg to 9.1 kg).
- **Lightweight Class**. Lightweight class shall be defined to include all papers having a basis weight [weight per 1000 ft2 (92.9m2)] of 10 lb (4.5 kg).

Figure 6: Rolled Paper Storage.

Rubber Tire Storage

Figure 7: Tire Storage.

Sprinkler Store Design

General Data Requirements for Storage

1. Roof Vents and Draft Curtains - Manually operated roof vents or automatic roof vents with operating elements that have a higher temperature classification than the automatic sprinklers shall be permitted

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

3. **Draft curtains** shall not be used within ESFR sprinkler systems. Draft curtains separating ESFR sprinklers at system breaks from control mode sprinklers or between hazards shall be permitted.

4. Ceiling Slope. The sprinkler system criteria specified in Chapter 12 and Chapters 14 through 20 are intended to apply to buildings with ceiling slopes not exceeding 2 in 12 (16.7 percent) unless modified by a specific section in Chapter 12 and Chapters14 through 20.

Building and Storage Height.

- The maximum building height shall be measured to the underside of the roof deck or ceiling.
- 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.
- ESFR sprinklers shall be used only in buildings equal to, or less than, the height of the building for which they have been listed.
- The sprinkler system design shall be based on the storage height and clearance to ceiling that routinely or periodically exist in the building and create the greatest water demand. Where storage is placed above doors, the storage height shall be calculated from the base of storage above the door.

Clearance to Ceiling

- For corrugated metal deck roofs up to 3 in.(75mm) in depth, the clearance to ceiling shall be measured from the top of storage to the bottom of the deck.
- Where the clearance to ceiling exceeds 20 ft (6.1 m) for Chapters 14 and 15, protection shall be based upon the storage height that would result in a clearance to ceiling of 20 ft (6.1m).
- Where the clearance to ceiling exceeds 20 ft (6.1 m) for Section 16.2, protection shall be based upon the storage height that would result in a clearance to the ceiling of 20 ft (6.1 m) or providing one level of supplemental, quicker response in-rack sprinklers located directly below the top tier of storage and at every flue space intersection.
- Where the clearance to ceiling exceeds 10 ft (3.0 m) for Section 16.3 or Section 17.2, protection shall be based upon the storage height that would result in a clearance to ceiling of 10 ft(3.0m) or providing one level of supplemental, quick-response in-rack sprinklers located directly below the top tier of storage and at every flue space intersection.

Inrack Sprinkler

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

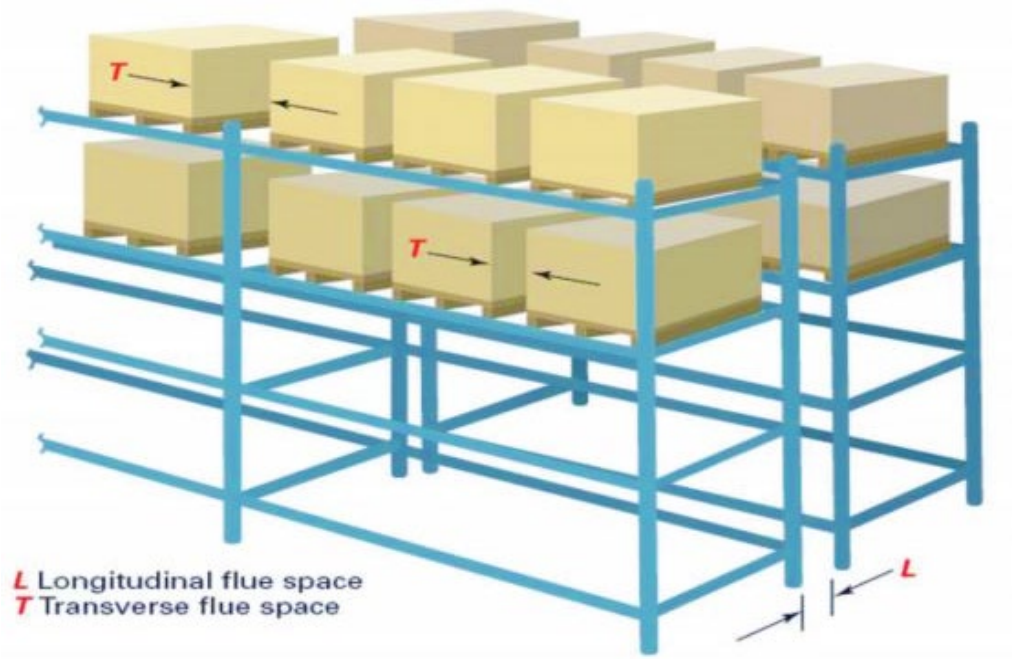


Figure 8: Inrack Storage definition

HVLS Fan

Figure 10: High Volume Low Speed (HVLS) Fans.

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

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

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

(3) The vertical clearance from the HVLS fan to the sprinkler deflector shall be a minimum of 3 ft (900mm).

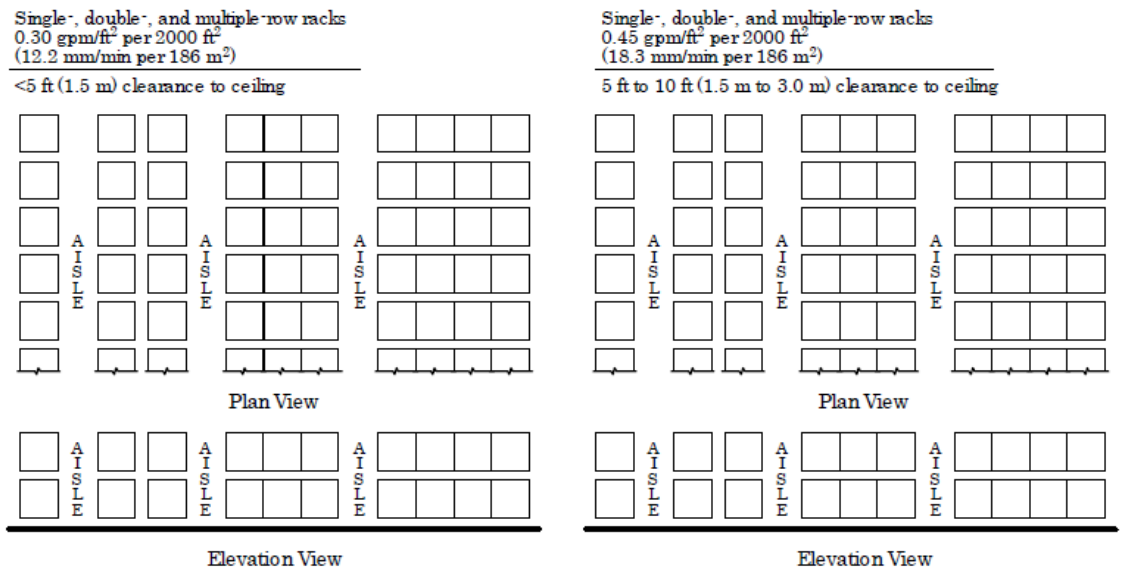
(4) All HVLS fans shall be interlocked to shut down immediately upon receiving a water flow signal from the alarm system in accordance with the requirements of NFPA72

Wet Pipe Systems.

- Sprinkler systems shall be wet pipe systems in areas that are subject to freezing or where special conditions exist, dry pipe systems and pre-action systems shall be permitted to protect storage occupancies.
- Dry Pipe and Pre-action Systems. For dry pipe systems and pre-action systems, the area of sprinkler operation shall be Increased by a 30 percent without revising the density

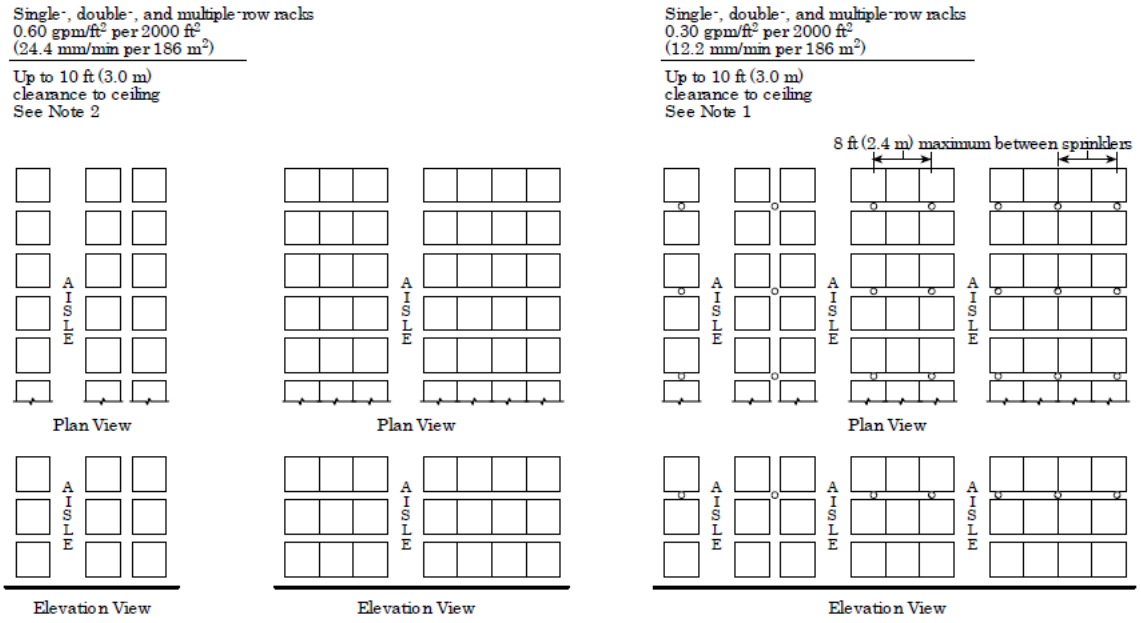
Storage Applications.

- For storage applications with densities of 0.2 gpm/ ft2 (8.1 mm/ min) or less, standard-response sprinklers with a K-factor of K-5.6 (80) or larger shall be permitted.
- For general storage applications, rack storage, rubber tire storage, roll paper storage, and baled cotton storage beingprotected with upright and pendent spray sprinklers with required densities of greater than 0.2 gpm/ ft2 to 0.34 gpm/ ft2 (8.1mm/ min to 13.9mm/ min), standard-response sprinklers with a nominal K-factor of K-8.0 (115) or larger shall be used.
- For general storage applications, rack storage, rubber tire storage, roll paper storage, and baled cotton storage beingprotected with upright and pendent spray sprinklers with required densities greater than 0.34 gpm/ ft2 (13.9 mm/ min),standard-response spraysprinklerswithaK-factorofK-11.2(161)or larger that are listed for storage applications shall be used.
- Where applying the requirements of Figure17.2.1.2.1(b) and Figure 17.2.1.2.1(c) utilizing the designcriteria of 0.6 gpm/ ft2 per 2000 ft2 (24.4 mm/ min per186 m2) to existing storage applications, the requirements of 12.6.3 shall apply.



Note: 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) up to 10 ft (3.0 m). Therefore, there could be as few as one load or as many as six or seven loads between in-rack sprinklers that are spaced 10 ft (3.0 m) apart vertically.

FIGURE 17.2.1.2.1(a) Storage 5 ft to 10 ft (1.5 m to 3.0 m) in Height with Up to 10 ft (3.0 m) Clearance to Ceiling.



Notes:

1. Single level of in-rack sprinklers [K-5.6 (80) or K-8.0 (115) operating at 15 psi (1.0 bar) minimum] installed as indicated in the transverse flue spaces.
2. Where sprinklers listed for storage use are installed at the ceiling only and the ceiling height in the protected area does not exceed 22 ft (6.7 m) and a minimum clearance of 5 ft (1.5 m) and the storage height does not exceed 15 ft (4.6 m), the ceiling sprinkler discharge criteria shall be permitted to be reduced to 0.45 gpm/ft² per 2000 ft² (18.3 mm/min per 186 m²).
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. (450 mm) up to 10 ft (3.0 m). Therefore, there could be as few as one load or as many as six or seven loads between in-rack sprinklers that are spaced 10 ft (3.0 m) apart vertically.

FIGURE 17.2.1.2.1(b) Storage 15 ft (4.6 m) in Height with Up to 10 ft (3.0 m) Clearance to Ceiling.

CMSA and ESFR sprinklers shall be permitted to protect the storage of Class I through Class IV commodities, Group A plastic commodities, miscellaneous storage, and other storage as specified in Chapter 12 through Chapter 20 or by other NFPA standards.

ESFR sprinklers designed to meet any criteria in Chapter 12 or Chapter 14 through Chapter 20 shall be permitted to protect any of the following:

(1) Light hazard occupancies

(2) Ordinary hazard occupancies

(3) Any storage arrangement in Chapter 13 referencing OH1, OH2, EH1, and EH2 design criteria

Quick-response CMSA sprinklers designed to meet any criteria in Chapter 12 or Chapter 14 through Chapter 20 shall be permitted to protect any of the following:

(1) Light hazard occupancies

(2) Ordinary hazard occupancies

(3) Any storage arrangement in Chapter 13 referencing OH1, OH2, EH1, and EH2 design criteria

Standard-response CMSA sprinklers designed to meet any criteria in Chapter 12 or Chapter 14 through Chapter 20 shall be permitted to protect any of the following:

(1) Ordinary hazard occupancies

(2) Any storage arrangement in Chapter 13 referencing OH1, OH2, EH1, and EH2 design criteria

- The design figures indicate water demands for ordinary temperature-rated and nominal high-temperature-rated sprinklers at the ceiling.
- The ordinary-temperature design densities correspond to ordinary-temperature-rated sprinklers and shall be used for sprinklers with ordinary- and intermediate temperature classification.
- The high-temperature design densities correspond to high-temperature-rated sprinklers and shall be used for Sprinklers have a high-temperature rating.

- Ordinary- and intermediate-temperature sprinklers with K-factors of K-11.2 (161) or larger, were listed for storage shall be permitted to use the densities for high temperature sprinklers.

Discharge Considerations

- The minimum design density for any sprinkler system installed in a storage occupancy shall be not less than 0.15 gpm/ ft2 (6.1mm/ min) after all adjustments are made.

Unsprinklered Combustible Concealed Spaces

- When using the density/ area method or room design, unless the requirements of 12.9.2 are met for buildings having unsprinklered combustible concealed spaces as described in 8.15.1.2 and 8.15.6, the minimum area of sprinkler operation for that portion of the building shall be 3000 ft2(280m2).
- The design area of 3000 ft2 (280m2) shall be applied only to the sprinkler system or portions of the sprinkler system that are adjacent to the qualifying combustible concealed.

Table 12.8.6 Hose Stream Allowance and Water Supply Duration

Commodity	Sprinkler Type	Sprinkler Spacing Type	Number of Ceiling Sprinklers in Design Area*	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 ft^2 (110 m^2)	250	950	60
				Over 1200 ft^2 (111 m^2) up to 1500 ft^2 (140 m^2)	500	1900	90
				Over 1500 ft^2 (139 m^2) up to 2600 ft^2 (240 m^2)	500	1900	120
				Over 2600 ft^2 (240 m^2)	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 8†	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

Table 12.8.6 Continued

Commodity	Sprinkler Type	Sprinkler Spacing Type	Number of Ceiling Sprinklers in Design Area*	Size of Design Area at Ceiling	Hose Stream Allowance		Water Supply Duration (minutes)
					gpm	L/ min	
Rubber tire storage	CMDA	Standard and extended coverage	NA	Up to 5000 ft^2 (372 m^2)	750	2850	180
	CMSA	Standard	Up to 15	NA	500	1900	180
	ESFR	Standard	Up to 12	NA	250	950	180
			Over 12 to20	NA	500	1900	180
Roll paper	CMDA	Standard	NA	Up to 4000 ft^2 (372 m^2)	500	1900	120
	CMSA	Standard	Up to 25	NA	500	1900	120
	ESFR	Standard	Up to 12	NA	250	950	60
Alternative Protection per 16.1.2.4 or 17.1.2.9	NA	NA	NA	NA	500	1900	120

NA: Not applicable.
*For 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.
†Limited to a maximum of 144 ft^2 (13.4 m^2) per sprinkler.

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

(1) 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.

(2) Noncombustible and limited-combustible concealed spaces have limited access and do not permit 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.

(3) Combustible concealed spaces filled entirely with noncombustible insulation.

(4) 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 (3.2m) when tested in accordance with ASTM E 84, Standard Test Method for Surface Burning Characteristics of Building Materials, or ANSI/UL723, Standard for Test for Surface Burning Characteristics of Building Materials, extended for an additional 20 minutes in the forming in which they are installed in the space.

(5) Concealed spaces in which the exposed materials are constructed entirely of fire retardant-treated wood as defined by NFPA703.

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

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

(8) 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.

Protection of Idle Pallets.

- Wood Pallets.

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

  (1) Stored outside

  (2) Stored in a detached structure

  (3) Stored indoors where arranged and protected in accordance with 12.12.1.2

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

  (1) Control mode density/ area sprinkler protection as specified in Table 12.12.1.2(a).

  (2) CMSA sprinkler protection in accordance with Table 12.12.1.2(b).

  (3) ESFR sprinkler protection in accordance with Table 12.12.1.2 (c).

  (4) Control mode density/ area sprinkler protection in accordance with the OH2 curve of Figure 13.2.1 existing with a hose stream demand of at least 250 gpm(950 L/ min) for a duration of at least 60minuteswhen pallets are stored no higher than 6 ft(for 1.8m) 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 (7.6m) of commodity. The maximum clearance to ceiling of 20 ft (6.1m) specified in 12.1.3.4 shall not apply to arrangement 12.12.1.2(4). The maximum clearance to ceiling of 20 ft (6.1 m) specified in 12.1.3.4 shall not apply to arrangement 12.12.1.2(4). Idle wood pallets shall not be stored in racks unless they are protected in accordance with the appropriate requirements of Table 12.12.1.2(a) or Table 12.12.1.2(c). (See Section C.7.)

Table 12.12.1.2(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/ ft^2	mm/ min	ft^2	m^2
Control mode density/ area	On floor	8 (115) or larger	Up to 6	Up to 1.8	20	6.1	0.20	8.1	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	24.4	3500	325
			12 to 20	3.7 to 6.1	30	9.1	0.6	24.4	4500	420
	On floor	16.8 (240) or larger	Up to 20	Up to 6.1	30	9.1	0.6	24.4	2000	185

*The area of sprinkler operation should be permitted to be reduced to 2000 ft^2 (186 m^2) 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 12.12.1.2(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

Plastic Pallets.

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

(1) Plastic pallets shall be permitted to be stored outside.

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

(3) Plastic pallets shall be permitted to be stored indoors where arranged and protected in accordance with the requirement of 12.12.2.2.

- Protection Criteria for Plastic Pallets Stored Indoors.
- Plastic pallet shaving 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 12.12.1.
- When specific test data are available, the data shall take precedence in determining the required protection of idle plastic pallets.

Protection with ESFR sprinklers shall be in accordance with Table 12.12.2.2.3.

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

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

(1) The cutoff rooms shall have at least one exterior wall.

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

(3) The storage shall be protected by sprinklers designed to deliver 0.6 gpm/ ft2 (24.4 mm/ min) for the entire room or by high-expansion foam and sprinklers designed to deliver 0.3 gpm/ ft2 (12.2mm/ min) for the entire room.

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

(5) Any steel columns shall be protected by1-hour fireproofing, or a sidewall sprinkler directed to one side of the column at the top or at the 15 ft (4.6m) level, whichever is lower. Flow from these sprinklers shall be permitted to be omitted from the sprinkler system demand for hydraulic calculations.

Table 12.12.2.2.3 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

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

  (1) Maximum storage height of 10 ft (3.0m)

  (2) Maximum ceiling height of 30 ft (9.1m)

  (3) Sprinkler density 0.6 gpm/ ft2 over 2000 ft2 (24.4 mm/min over 186m2)

  (4) Minimum sprinkler K-factor of 16.8 (240)12.12.2.2.4.3 Plastic pallets shall have no impact on the required sprinkler protection when stored as follows:

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

  (4.2) Sprinkler protection shall employ high-temperature-rated sprinklers.

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

  (4.4) Minimum ceiling design of OH2 shall be used.

Protection of Rack Storage of Class I through Class IV Commodities

In-Rack Sprinklers. MinimumK-8.0 (K-115) quick response sprinklers (ceiling-level or in-rack) shall be installed beneath each horizontal barrier. The deflector of the sprinkler shall be located as close to the underside of the horizontal barrier as possible.

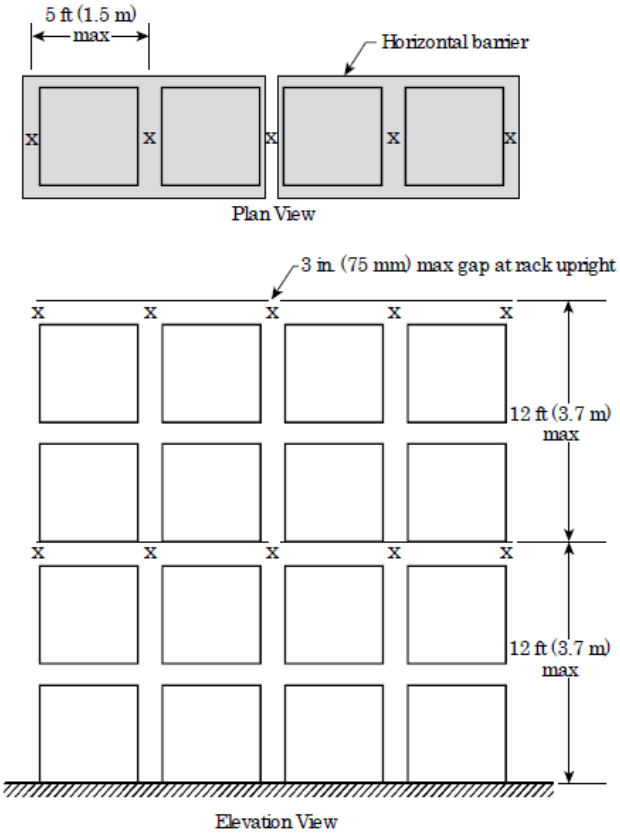


FIGURE 16.1.2.4.4.1(A) Alternative Protection for Single-Row Racks.

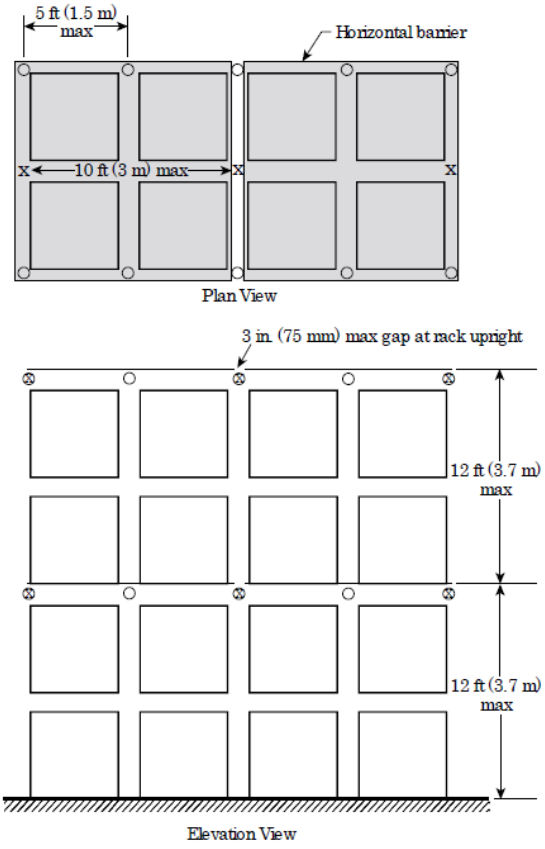


FIGURE 16.1.2.4.4.2(A) Alternative Protection for Double-Row Racks.

Table 16.1.4.1 Ceiling Sprinkler Densities for Protection of Steel Building Columns

Commodity Classification	Aisle Width			
	4 ft (1.2 m)		8 ft (2.4 m)	
	gpm/ ft^2	(L/ min)/ m^2	gpm/ ft^2	(L/ min)/ m^2
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	0.68	27.7	0.57	23.2

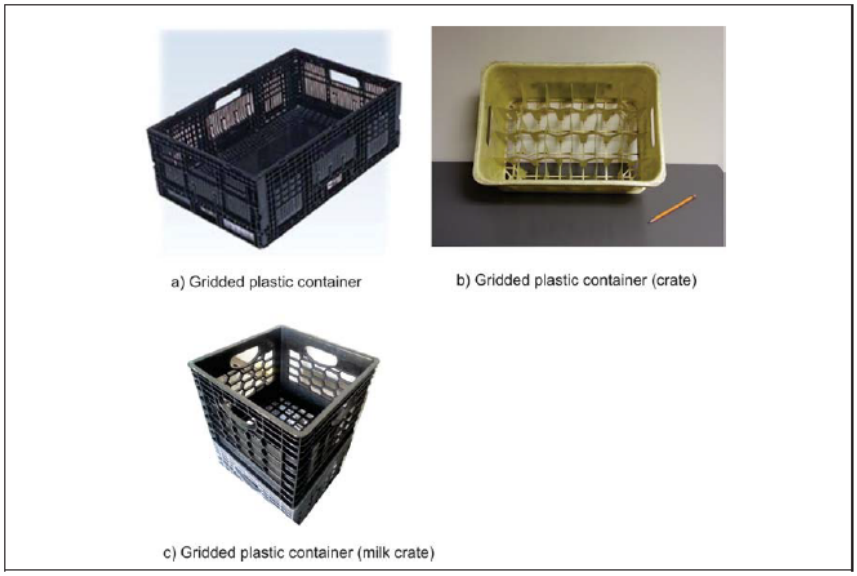


Fig. 4. Examples of gridded plastic containers (i.e., plastic containers that are significantly open on the sides and/or bottoms)

Fig. 5. Examples of solid plastic containers (i.e., plastic containers that do not have openings on the sides and/or bottoms)

Table 1. Products Stored in Plastic Containers

General Contents	*Container Sides and/or Bottoms*	*Wall Thickness in. (mm)*	*Volume gal (L)*	*Description of Contents*	*Commodity Classification*
Solid	Solids or gridded	Any	> 1 (4)	Noncombustible	UUP
			≤ 1 (4)	Noncombustible	CUP
			Any	Combustible UUP or a lesser hazard	UUP
			Any	UEP commodities	UEP
Liquid or Semi-Liquids	Gridded	Any	Any	Bottles or jars containing nonignitable liquids/semi-liquids	Class 1
	Solid	Any	Any	Bottles or jars containing nonignitable liquids/semi-liquids	UUP
			≤ 5 (19)	Nonignitable liquids/semi-liquids	Class 1
		≥ 1/4 (6)	> 5 (19)	Nonignitable liquids/semi-liquids	UUP
		< 1/4 (6)	> 5 (19)	Nonignitable liquids/semi-liquids	Class 2

Ref. FMDS0801 Community classification