RUBBER TIRE STORAGE

Table of Contents

List of Figures

List of Tables

1.0 SCOPE

This data sheet provides fire protection guidelines for the storage of rubber tires. This includes car, truck and tractor, motorcycle, and bicycle tires. Protection of rubber tires mounted on metal wheels also is covered in this data sheet. This data sheet provides guidelines for warehouse storage and for indoor locations other than warehouses. Outdoor storage of rubber tires is not included in this data sheet.

1.1 Changes

January 2009. Corrections were made to Tables 2 and 4.

2.0 LOSS PREVENTION RECOMMENDATIONS

2.1 Introduction

The required protection for storage of rubber tires falls into several categories: construction and location, occupancy, and automatic sprinkler protection. Most rubber products have a smooth surface which does not absorb water. Pre-wetting with water, which is possible with products like paper or wood, is not possible with rubber tires. Also, rubber tires lose their stability in case of fire, collapse, and produce pool fires. In addition, rubber tires fire generate a great deal of smoke, and toxic products of combustion which hinders manual fire fighting and causes extensive damage. Finally, storage and stacking arrangements of rubber tires create difficult challenges with regards to fire fighting since the tire's hollow, doughnut shaped form allows flames to grow on its inner surface while at the same time shielding flames from sprinkler spray.

2.2 Construction and Location

2.2.1 Steel Protection

2.2.1.1 Steel deck roofs do not require additional protection when sprinkler protection is installed in accordance with this data sheet.

2.2.1.2 Provide column steel protection for all tire storage when storage heights are greater than 15 ft (4.6 m). However, column steel protection can be omitted provided ceiling sprinkler systems can provide a 0.90 gpm/ft^2 (37 mm/min) minimum density over the most remote 3000 ft^2 (279 m^2) demand area, using 160° F (70° C) rated sprinklers, or the recommended combination of ceiling and in-rack protection is provided.

2.2.1.3 When column protection is used, provide a coating of at least one-hour fire resistance along the entire length of the column, or one of the following:

- For solid ''H'' columns, provide a sidewall sprinkler directed toward the column at the 15 ft (4.6 m) level.
- For hollow ''tube'' and ''box'' columns, provide two sidewall sprinklers, one on each side of the column, directed at the column at the 15 ft (4.6 m) level.

2.2.2 Smoke and Heat Venting

2.2.2.1 FM recommendations for heat and smoke venting are provided in Data Sheet 1-10, *Smoke and Heat Venting in Sprinklered Buildings*. Protection options in this data sheet are based on the heat generated by a fire being trapped and maintained at ceiling level.

2.2.2.2 Fire tests have shown that automatic heat and smoke vents are not cost-effective and can increase sprinkler water demand. Therefore, if heat or smoke vents are used, arrange them for manual operation.

2.2.2.3 If local codes require heat or smoke vents be arranged for automatic operation, ensure the types and operating temperatures are in accordance with Table 1.

Table 1. Acceptable Types of Heat and Smoke Vents

Sprinkler Type	*Acceptable Type of Vent*	*Vent Operating Temperature*
Suppression mode	Fusible link operated	Minimum 360°F (180°C) using standard-response links
	Drop-out	As FM Approved specifically for suppression mode sprinklers
CMSA	Fusible link operated	Minimum 360°F (180°C) using standard-response links
	Drop-out	As FM Approved
CMDA	Fusible link operated	Minimum one rating higher than ceiling sprinklers using standard-response links
	Drop-out	As FM Approved

2.3 Occupancy

2.3.1 When tires are stored on-tread, limit the dimension of the pile in the direction of the wheel hole to 25 ft (7.6 m) with aisles or vertical barriers.

2.3.2 Dimensions in the direction of wheel holes need not be considered when in-rack sprinklers are used.

2.3.3 Maintain at least 8 ft (2.5 m) wide aisles between racks, floor piles of tire storage, or any other combustible storage.

2.3.4 Provide a minimum of 3 ft (0.91 m) clearance from the top of storage to ceiling sprinkler deflectors.

2.4 Protection

2.4.1 General Protection

2.4.1.1 Follow the sprinkler installation guidelines indicated for storage sprinklers in Data Sheet 2-0, *Installation Guidelines for Automatic Sprinklers.*

2.4.1.2 Protect single-row racks in the same manner as double-row racks and multi-row racks.

2.4.1.3 Provide ceiling sprinkler protection for portable racks in the same manner as permanent racks.

2.4.1.4 Protection options for rack storage arrangements are based on ceiling-only sprinkler systems, or a combination of ceiling-level and in-rack sprinkler systems. For excessive building heights and high storage in permanent racks, reference Fire Protection Scheme 8-9A in Data Sheet 8-9, *Storage of Class 1, 2, 3, 4 and Plastic Commodities*, as an option.

2.4.2 Ceiling Sprinkler Protection

2.4.2.1 For on-floor, or on-side and on-tread tire storage in open-frame permanent or portable racks, provide control mode density area (CMDA) sprinklers in nominal temperature ratings of 160°F (70°C), 212°F (100°C), and 280°F (140°C), and with K-factor values of 11.2 (160), 14.0 (200), 16.8 (240), and 25.2 EC (360 EC) as recommended in the protection tables.

2.4.2.2 For on-side and on-tread tire storage in permanent racks with solid shelves greater in area than 20 ft^2 (2.0 m^2), provide CMDA sprinklers as recommended in the protection tables, and install one level of in-rack sprinklers at every tier level spaced horizontally at every other transverse flue space.

2.4.2.3 Use 160°F (70°C) nominal temperature-rated sprinklers for wet-pipe systems, and 280°F (140°C) sprinklers for dry-pipe systems.

2.4.2.4 Use 212°F (100°C) nominal temperature-rated sprinklers when the ambient temperature does not allow the use of 160°F (70°C) sprinklers. Treat the 212°F (100°C) sprinklers as 160°F (70°C) sprinklers for design purposes.

2.4.2.5 Use CMDA sprinklers as per requirements within Table 2 for permanent or portable on-side open frame tire rack storage up to 25 ft (7.5 m) high. Table 2 also applies for on-side tire storage up to 30 ft (9.0 m) <u>in permanent racks only</u>.

2.4.2.6 Use CMDA sprinklers as per requirements within Table 3 for permanent on-side tire rack storage over 30 ft (9.0 m) high.

2.4.2.7 Use CMDA sprinklers as per requirements within Table 4 for permanent or portable on-tread open frame tire rack storage up to 25 ft (7.5 m) high. Table 4 also applies for on-tread tire storage up to 30 ft (9.0 m) in permanent racks only.

2.4.2.8 Use CMDA sprinklers as per requirements within Table 5 for permanent on-tread tire rack storage over 30 ft (9.0 m) high.

2.4.2.9 Use Table 6 for tire storage on-floor up to 20 ft (6.0 m) high.

2.4.2.10 Use Control Mode Specific Application (CMSA) sprinklers as per requirements within Table 7 for protection of all tire storage in permanent and portable racks with open shelves up to 25 ft (7.6 m) in a 30 ft (9.0 m) building.

2.4.2.11 Use suppression mode sprinklers in wet-pipe systems only. Apply design criteria in accordance with Table 8 for on-side, on-tread and laced storage of tire in permanent and portable racks with open shelves up to 30 ft (9.0 m) in a 40 ft (12 m) building.

2.4.2.12 Space ceiling sprinklers in accordance with Table 9.

2.4.2.13 Treat green tires and tires mounted on metal wheels as uncartoned unexpanded plastic and protect per guidelines in Data Sheet 8-9, *Storage of Class 1, 2, 3, 4 and Plastic Commodities.*

Table 2. CMDA Sprinklers for On-Side Tire Storage up to 30 ft (9.1 m) High, Open Frame, Permanent or Portable Racks

K-Factors 25.2 (360) EC, 16.8 (240), 14.0 (200) & 11.2 (160)				
Storage Height, ft (m)	Building Height, ft (m)	Density, gpm/ft^2 (mm/min)	Wet System, 160°F (70°C), Demand Area ft^2 (m^2)	Dry System, 280°F (140°C), Demand Area ft^2 (m^2)
5 (1.5)	10 (3.0)	0.30 (12)	2300 (210)	2900 (270)
	15 (4.5)	0.30 (12)	3000 (280)	3900 (360)
	20 (6.0)	0.45 (18)	3000 (280)	3900 (360)
	25 (7.5)	0.60 (24)	3000 (280)	3900 (360)
	35 (10.5)	0.90 (36)	3000 (280)	3900 (360)
10 (3.0)	15 (4.5)	0.45 (18)	2300 (210)	2900 (270)
		0.30 (12) & IRAS (EO)	2300 (210)	2900 (270)
	20 (6.0)	0.45 (18)	3000 (280)	3900 (360)
		0.30 (12) & IRAS (EO)	3000 (280)	3900 (360)
	25 (7.5)	0.60 (24)	3000 (280)	3900 (360)
		0.45 (18) & IRAS (EO)	3000 (280)	3900 (360)
	30 (9.0)	0.90 (36)	3000 (280)	3900 (360)
		0.60 (24) & IRAS (EO)	3000 (280)	3900 (360)
	35 (10.5)	0.90 (36)	3000 (280)	3900 (360)
		0.60 (24) & IRAS (EO)	3000 (280)	3900 (360)
	40 (12.2)	0.90 (36) & IRAS (EO)	3000 (280)	3900 (360)
15 (4.5)	20 (6.0)	0.60 (24)	2300 (210)	2900 (270)
		0.30 (12) & IRAS (EO)	2300 (210)	2900 (270)
	25 (7.5)	0.60 (24)	3000 (280)	3900 (360)
		0.30 (12) & IRAS (EO)	3000 (280)	3900 (360)
	30 (9.0)	0.90 (36)	3000 (280)	3900 (360)
		0.45 (18) & IRAS (EO)	3000 (280)	3900 (360)
	35 (10.5)	0.90 (36)	3000 (280)	3900 (360)
		0.60 (24) & IRAS (EO)	3000 (280)	3900 (360)
	40 (12.2)	0.90 (36) & IRAS (EO)	3000 (280)	3900 (360)
20 (6.0)	25 (7.5)	0.90 (36)	3000 (280)	3900 (360)
		0.30 (12) & IRAS (EO)	2300 (210)	2900 (270)
	30 (9.0)	0.90 (36)	3000 (280)	3900 (360)
		0.30 (12) & IRAS (EO)	3000 (280)	3900 (360)
	35 (10.5)	0.90 (36)	3000 (280)	3900 (360)
		0.45 (18) & IRAS (EO)	3000 (280)	3900 (360)
	40 (12.2)	0.60 (24) & IRAS (EO)	3000 (280)	3900 (360)
25 (7.5)	30 (9.0)	0.90 (36)	3000 (280)	3900 (360)
		0.45 (18) & IRAS (EO)	2300 (210)	2900 (270)
		0.30 (12) & IRAS (E)	2300 (210)	2900 (270)
	35 (10.5)	0.90 (36)	3000 (280)	3900 (360)
		0.45 (18) & IRAS (EO)	3000 (280)	3900 (360)
		0.30 (12) & IRAS (E)	3000 (280)	3900 (360)
	40 (12.2)	0.60 (24) & IRAS (EO)	3000 (280)	3900 (360)
		0.45 (18) & IRAS (E)	3000 (280)	3900 (360)
30 (9.0)	35 (10.5)	0.60 (24) & IRAS (EO)	2300 (210)	2900 (270)
		0.30 (12) & IRAS (E)	2300 (210)	2900 (270)
	40 (12.2)	0.60 (24) & IRAS (EO)	3000 (280)	3900 (360)
		0.30 (12) & IRAS (E)	3000 (280)	3900 (360)

Table 3. CMDA Sprinklers for Permanent On-Side Tire Rack Storage over 30 ft High.

K-Factors 25.2 (360) EC, 16.8 (240), 14.0 (200) & 11.2 (160)				
Storage Height above top level of IRAS, ft (m)	Clearance between top of storage and ceiling, ft (m)	Density, gpm/ft^2 (mm/min)	Wet System, 160°F (70°C), Demand Area ft^2 (m^2)	Dry System, 280°F (140°C), Demand Area ft^2 (m^2)
5 (1.5)	5 (1.5)	0.30 (12)	2300 (210)	2900 (270)
	10 (3.0)	0.30 (12)	3000 (280)	3900 (360)
	15 (4.6)	0.45 (18)	3000 (280)	3900 (360)
	20 (6.1)	0.60 (24)	3000 (280)	3900 (360)
	25 (7.6)	0.90 (24)	3000 (280)	3900 (360)
	30 (9.1)	0.90 (36)	3000 (280)	3900 (360)
10 (3.0)	5 (1.5)	0.45 (18)	2300 (210)	2900 (270)
	10 (3.0)	0.45 (18)	3000 (280)	3900 (360)
	15 (4.6)	0.60 (24)	3000 (280)	3900 (360)
	20 (6.1)	0.90 (36)	3000 (280)	3900 (360)
	25 (7.6)	0.90 (36)	3000 (280)	3900 (360)
15 (4.6)	5 (1.5)	0.60 (24)	2300 (210)	2900 (270)
	10 (3.0)	0.60 (24)	3000 (280)	3900 (360)
	15 (4.6)	0.90 (36)	3000 (280)	3900 (360)
	20 (6.1)	0.90 (36)	3000 (280)	3900 (360)

Table 4. CMDA Sprinklers for On-Tread Tire Storage up to 30 ft High, Open Frame, Portable or Permanent Racks.

K-Factors 25.2 (360) EC, 16.8 (240), 14.0 (200) & 11.2 (160)				
Storage Height, ft (m)	Building Height, ft (m)	Density, gpm/ft² (mm/min)	Wet System, 160°F (70°C), Demand Area ft² (m²)	Dry System, 280°F (140°C), Demand Area ft² (m²)
5 (1.5)	10 (3.0)	0.30 (12)	2300 (210)	2900 (270)
	15 (4.5)	0.30 (12)	3000 (280)	3900 (360)
	20(6.0)	0.50(20)	3000 (280)	3900 (360)
	25 (7.5)	0.60 (24)	3000 (280)	3900 (360)
	30 (9.0)	0.90 (36)	3000 (280)	3900 (360)
10 (3.0)	15(4.5)	0.40 (16)	2300 (210)	2900 (270)
		0.30 (12) & IRAS (EO)	2300 (210)	2900 (270)
	20 (6.0)	0.50 (20)	3000 (280)	3900 (360)
		0.30 (12) & IRAS (EO)	3000 (280)	3900 (360)
	25 (7.5)	0.60 (24)	3000 (280)	3900 (360)
		0.40 (16) & IRAS (EO)	3000 (280)	3900 (360)
	30 (9.0)	0.90 (36)	3000 (280)	3900 (360)
		0.60 (24) & IRAS (EO)	3000 (280)	3900 (360)
	35 (10.5)	0.90 (36) & IRAS (EO)	3000 (280)	3900 (360)
15(4.5)	20(6.0)	0.90 (36)	3000 (280)	3900 (369)
		0.30 (12) & IRAS (EO)	3000 (280)	3900 (369)
	25 (7.5)	0.90 (36)	3000 (280)	3900 (360)
		0.40 (16) & IRAS (EO)	3000 (280)	3900 (360)
	30 (9.0)	0.90 (36)	3000 (280)	3900 (360)
		0.60 (24) & IRAS (EO)	3000 (280)	3900 (360)
	35 (10.5)	0.90 (36) & IRAS (EO)	3000 (280)	3900 (360)
20 (6.0)	25 (7.5)	0.90 (36)	3000 (280)	3900 (360)
		0.30 (12) & IRAS (EO)	2300 (210)	2900 (270)
	30 (9.0)	0.90 (36)	3000 (280)	3900 (360)
		0.30 (12) & IRAS (EO)	3000 (280)	3900 (360)
	35 (10.5)	0.60 (24) & IRAS (EO)	3000 (280)	3900 (360)
	40 (12.2)	0.90 (36) & IRAS (EO)	3000 (280)	3900 (360)
25 (7.5)	30 (9.0)	0.60 (24) & IRAS (EO)	2300 (210)	2900 (270)
		0.30 (12) & IRAS (E)	2300 (210)	2900 (270)
	35 (10.5)	0.60 (24) & IRAS (EO)	3000 (280)	3900 (360)
		0.30 (12) & IRAS (E)	3000 (280)	3900 (360)
	40 (12.2)	0.90 (36) & IRAS (EO)	3000 (280)	3900 (360)
		0.40 (16) & IRAS (E)	3000 (280)	3900 (360)
30 (9.1)	35 (10.5)	0.90 (36) & IRAS (EO)	2300 (210)	2900 (270)
		0.30 (12) & IRAS (E)	2300 (210)	2900 (270)
	40 (12.2)	0.90 (36) & IRAS (EO)	3000 (280)	3900 (360)
		0.30 (12) & IRAS (E)	3000 (280)	3900 (360)

Table 5. CMDA Sprinklers for Permanent On-Tread Tire Rack Storage over 30 ft (9.1 m) High

K-Factors 25.2 (360) EC, 16.8 (240), 14.0 (200) & 11.2 (160))				
Storage Height above top level of IRAS, ft (m)	Clearance between top of storage and ceiling, ft (m)	Density, gpm/ft^2 (mm/min)	Wet System, 160°F (70°C), Demand Area ft^2 (m^2)	Dry System, 280°F (140°C), Demand Area ft^2 (m^2)
5 (1.5)	5 (1.5)	0.30 (12)	2300 (210)	2900 (270)
	10 (3.0)	0.30 (12)	3000 (280)	3900 (360)
	15 (4.5)	0.50 (20)	3000 (280)	3900 (360)
	20 (6.0)	0.60 (24)	3000 (280)	3900 (360)
	25 (7.5)	0.90 (36)	3000 (280)	3900 (360)
10(3.0)	5 (2.4)	0.40 (18)	2300 (210)	2900 (270)
	10(3.0)	0.50 (20)	3000 (280)	3900 (360)
	15 (4.5)	0.60 (24)	3000 (280)	3900 (360)
	20 (6.0)	0.90 (36)	3000 (280)	3900 (360)
15 (4.5)	5 (2.4)	0.90 (36)	3000 (280)	3900 (360)
	10(3.9)	0.90 (36)	3000 (280)	3900 (360)
	15 (4.5)	0.90 (36)	3000 (280)	3900 (360)

Table 6. CMDA Sprinklers for On-Floor Rubber Tire Storage up to 20 ft (6.0 m) High

K-Factors 25.2 (360) EC, 16.8 (240), 14.0 (200) & 11.2 (160)				
Storage Height, ft (m)	Building Height, ft (m)	Density, gpm/ft^2 (mm/min)	Wet System, 160°F (70°C), Demand Area ft^2 (m^2)	Dry System, 280°F (140°C), Demand Area ft^2 (m^2)
5 (1.5)	10 (3.0)	0.25 (10)	2000 (185)	2600 (240)
	15 (4.5)	0.25 (10)	2000 (185)	2600 (240)
	20 (6.0)	0.35 (14)	2000 (185)	2600 (240)
	25 (7.5)	0.45 (20)	2000 (185)	2600 (240)
	30 (9.0)	0.60 (24)	3000 (280)	3900 (360)
10 (3.0)	15 (4.5)	0.35 (14)	2000 (185)	2600 (240)
	20 (6.0)	0.35 (14)	2000 (185)	2600 (240)
	25 (7.5)	0.45 (20)	2000 (185)	2600 (240)
	30 (9.0)	0.60 (24)	3000 (280)	3900 (360)
15 (4.5)	20 (6.0)	0.45 (20)	2000 (185)	2600 (240)
	25 (7.5)	0.45 (20)	2000 (185)	2600 (240)
	30 (9.0)	0.60 (24)	3000 (280)	3900 (360)
20 (6.0)	25 (7.5)	0.60 (24)	2300 (210)	2900 (270)
	30 (9.0)	0.60 (24)	3000 (280)	3900 (360)

Table 7. Control Mode Specific Application Protection for Rubber Tires stored in Permanent and Portable Racks with Open Shelves

Tire Arrangement	*Maximum Storage Height ft (m)*	*Maximum Building Height ft (m)*	*Wet-Pipe systems only Number of sprinklers @ Pressure, psi (bar)*		
			K-Factor 11.2 (160), 160°F (70°C)	K-Factor 14.0 (200), 160°F (70°C) pendent	K-Factor 16.8 (240), 160°F (70°C)
On-side or on-tread	25 (7.6)	30 (9.1)	20@75 (5.1)	20@75 (5.1)	20 @ 35 (2.4)
laced	25 (7.6)	30 (9.1)	Not an option	20@75 (5.1) (Note 1)	20 @ 35 (2.4) (Note 1)

Note 1. Use FM Approved suppression mode sprinkler only for this control mode specific application. Design and install sprinkler system using the recommendations in Data Sheet 2-0.

Table 8. Suppression Mode Sprinkler Protection for Rubber Tires Stored in Permanent and Portable Racks with Open Shelves

Tire Arrangement	*Maximum Storage Height ft (m)*	*Maximum Building Height ft (m)*	*Wet-Pipe systems only Number of sprinklers @ Pressure, psi (bar)*				
			K-Factor 25.2 (360), 160°F (70°C) Pendent	K-Factor 22.4 (320), 160°F (70°C) Pendent	K-Factor 16.8 (235), 160°F (70°C) Pendent	K-Factor 16.8 (235), 160°F (70°C) Upright	K-Factor 14.0 (200), 160°F (70°C) Pendent
On-side or on-tread	25 (7.6)	30 (9.1)	12 @ 20 (1.4)	12 @ 25 (1.7)	12 @ 35 (2.4)	12 @ 35 (2.4)	12 @ 50 (3.5)
On-side, on-tread or laced	30 (9.1)	40 (12.0)	12 @ 75 (5.2)	Not an option	Not an option	Not an option	Not an option

Table 9. Ceiling Sprinkler Spacing

Sprinkler Type	*K-Factor*	*Building Height ft (m)*	*Minimum Linear Spacing, ft (m)*	*Maximum Linear Spacing, ft (m)*	*Minimum Area, ft^2 (m^2)*	*Maximum Area, ft^2 (m^2)*
Suppression Mode	14.0 (200)	≤ 30 (9.0)	8 (2.4)	12 (3.6)	64 (6.0)	100 (9.0)
	16.8 (240)					
	22.4 (320)					
	25.2 (360)					
CMSA	11.2 (160)	≤ 40 (12)	8 (2.4)	12 (3.6)	80 (7.5)	100 (9.0)
	16.8 (240)					
CMDA	11.2 (160)	≥ 10 (3.0)	7 (2.1)	12 (3.6)	70 (6.5)	100 (9.0)
	14.0 (200)					
	16.8 (240)					
CMDA (EC)	25.2 (360)	≥ 10 (3.0)	10 (3.0)	14 (4.2)	100 (9.0)	196 (18.0)

2.4.3 In-Rack Sprinkler Protection

2.4.3.1 For rack storage arrangements protected by ceiling-level CMDA sprinklers in which the protection tables call for in-rack sprinklers, the following terms apply:

- IRAS (EO), which indicates one level of in-rack sprinklers spaced horizontally at every other transverse flue space.
- IRAS (E), which indicates one level of in-rack sprinklers spaced horizontally at every transverse flue space.

When arranging protection in accordance with the above terms, ensure the maximum horizontal distance between transverse flue spaces is 8 ft (2.4 m), and the maximum horizontal distance between every other transverse flue space is 12 ft (3.6 m). Also ensure the minimum distance between transverse flue spaces is greater than 2 ft (0.6 m).

2.4.3.2 Locate all in-rack sprinklers within the rack storage array. Position the in-rack sprinklers so they are not directly behind rack uprights, and are no more than 3 in. (75 mm) horizontally away from the transverse flue space intersection they are intended to protect.

2.4.3.3 Position the in-rack sprinkler's deflector so it is at or just below the bottom of the rack's horizontal support member at each tier level under full load condition where in-rack sprinklers are recommended. Ensure a minimum 6 in. (150 mm) clearance is provided between the deflector of the in-rack sprinkler and the top of storage. The minimum 6 in. (150 mm) clearance between the deflector of the in-rack sprinkler and the top of storage is only required when in-rack sprinklers are not being provided at every transverse flue space intersection.

2.4.3.4 Arrange sprinkler piping and the in-rack sprinklers to avoid mechanical damage, but ensure proper distribution from the in-rack sprinkler can be achieved. Prior to installing the in-rack sprinklers, check the proposed in-rack sprinkler locations to ensure both adequate protection against mechanical damage and proper sprinkler discharge.

2.4.3.5 In-rack sprinkler systems can be wet-pipe, dry-pipe, or preaction. Note, however, that grid-type piping configurations are only recommended for wet-pipe sprinkler systems. For in-rack sprinkler protection, use nominally rated 160°F (70°C) FM Approved, quick-response, in-rack sprinklers having a minimum K-factor of 5.6 (80). Use an in-rack sprinkler having a minimum K-factor of 8.0 (120) if the required flow per in-rack sprinkler is 30 gpm (115 L/min) or greater. In all cases, follow in-rack sprinkler hydraulic design in DS 8-9.

2.4.3.6 Do not use on-off sprinklers as in-rack sprinklers.

2.4.4 Water Supplies

2.4.4.1 Ensure water supplies include provision for hose streams in addition to that required for sprinklers at ceiling and in racks. Ensure hose stream allowance and the duration of supply are in accordance with Table 10.

Table 10. Hose Demand and Duration of Water Supplies

Sprinkler Type	*Hose Demand, gpm (l/min)*	*Duration, hr*
Suppression Mode	500 (1900)	1
Control Mode Specific Application (CMSA) and Control Mode Area Density (CMAD) with a K-Factor of 11.2 (160) and greater	500 (1900)	2

2.4.5 Recommended Safe Practices

2.4.5.1 Provide a well-trained Emergency Response Team (ERT) at rubber tire storage locations. Early detection and effective action by personnel during the early stages of a rubber tire fire can greatly help reduce ensuing damage. Controlling possible ignition sources, maintaining proper aisle spaces, and practicing good housekeeping are other recommended safe practices.

2.4.5.2 When fighting a rubber tire fire, caution must exercised because of the intense heat and large volume of smoke generated in this type of fire. It is not intended that fires beyond the incipient stage (see Appendix C) be fought by anyone other than trained firefighters.

2.4.5.3 More specific details regarding manual firefighting and fire behavior of a rubber tire fire can be found in the Appendix C, Firefighting.

3.0 SUPPORT FOR RECOMMENDATIONS

3.1 General

Tire storage presents a severe fire hazard. Tires burn rapidly, emitting intense heat and large quantities of dense smoke that hamper firefighting. Tires are generally manufactured from synthetic compounds, carbon, oil, various additives and steel, fiberglass, polyester, cotton, etc. The principal materials used in tires are synthetic rubbers. Heat of combustion can vary from 14,000 to 20,000 Btu/lb (33 to 34 MJ/kg). Ignition temperature can vary from 700°F to 800°F (371°C to 425°C).

The hollow, toroidal shape of the tire provides a large shielded surface area and flue spaces which, combined with the material, result in a severe fire hazard. Automatic sprinklers can control fires in most tire storages, but water demands are high. Manual firefighting is valuable, but difficult because of the intense heat and smoke produced.

The recommendations in this data sheet are specific to storage arrangements that are less than or equal to the storage heights and building heights described in protection tables. Without additional testing, protection recommendations for higher buildings or storage heights cannot be provided.

3.2 Loss History

Loss data regarding fire in sprinklered buildings with rubber tires is very limited. Fire tests and loss experience, however, have demonstrated that increased storage heights raise the level of the fire hazard. In a recent survey of FM loss data, the largest fire loss that involved rubber tire storage happened at a tire-tread manufacturing and distribution facility, was of unknown cause, and burned out of control due to a frozen sprinkler system. Another loss was a fire of suspected incendiary origin that severely damaged an unsprinklered rubber tire manufacturing facility. The facility was on a summer shutdown with few employees present; a smoke detector sounded an alarm at a guard shack, but the severe fire and extensive smoke made firefighting difficult. All other recorded rubber tire fire losses involved storage without sprinklers or where sprinkler protection was out of service.

4.0 REFERENCES

4.1 FM

Data Sheet 1-10, *Smoke and Heat Venting in Sprinklered Buildings*
Data Sheet 2-0, *Installation Guidelines for Automatic Sprinklers*
Data Sheet 8-9, *Storage of Class 1, 2, 3, 4 and Plastic Commodities*

APPENDIX A GLOSSARY OF TERMS

FM Approved: References to ‘‘FM Approved’’ in this data sheet mean the product or service has satisfied the criteria for FM Approval. Refer to the *Approval Guide*, a publication of FM Approvals, for a complete listing of products and services that are FM Approved.

Green tires: A green tire consists of a tire ‘‘carcass,’’ cylindrical in shape, approximately 17 in. (0.43 m) in diameter by 2 ft (0.61 m) long. The tire at this point in the manufacturing process is ready for molding and curing into a finished tire. The preparatory process results in an advanced supply of green tires in storage in the manufacturing area awaiting molding and curing. (See Fig. 1.)

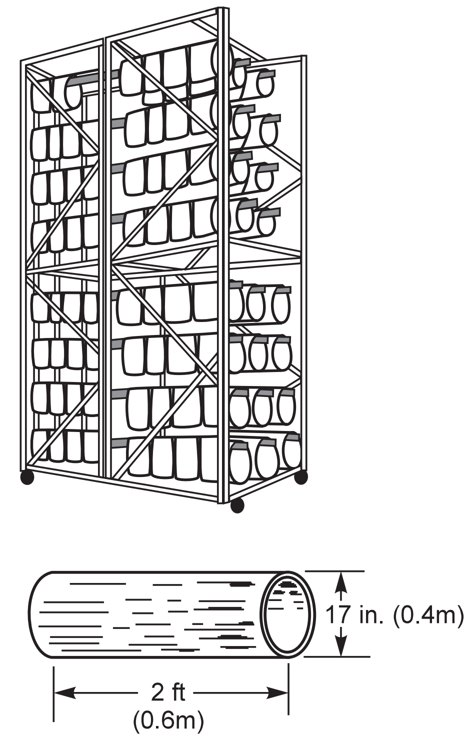

Fig. 1. Typical green tire storage. Storage is two carts high or 16 ft (4.9 m)

Horizontal barriers: Solid barriers on a horizontal plane within a rack, beneath which in-rack sprinklers are installed. They extend to both ends and both aisle faces of the racks, and are fitted to within 2 in. (50 mm) of any vertical rack member or other equipment that would create an opening, such as vertical in-rack sprinkler pipe drops. Their purpose is to impede vertical fire spread by blocking off normally open flue spaces, while also helping to achieve prompt in-rack sprinkler operation by banking heat down to the in-rack sprinklers that must be installed under each barrier.

Horizontal channel: An uninterrupted space in excess of 5 ft (1.5 m) in length between horizontal layers of storage. Such channels may be formed by pallets, shelving, racks, or other storage aids.

In-rack sprinklers: (also called intermediate level sprinklers or rack storage sprinklers): These sprinklers are typically CMDA sprinklers equipped with an attached water shield over the top of the operating element. The water shield prevents wetting of the operating element by water from sprinklers at a higher elevation in the rack or at ceiling level. Note that the water shield is not a heat collector and has virtually no effect on how fast the in-rack sprinkler will operate.

Laced tire storage: Tires stored where the sides of the tires overlap, creating a woven or laced appearance. (See Figs. 2 and 3)

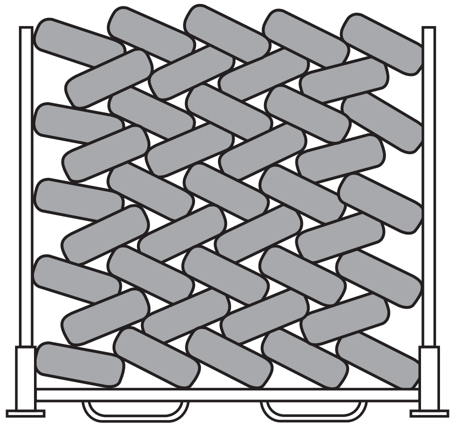

Fig. 2. Typical lace tire storage

Fig. 3. Laced tire storage in portable racks

On-floor storages: Tires stored directly on the floor, on side or on tread; may be pyramided to provide pile stability. (See Figs. 4 and 5)

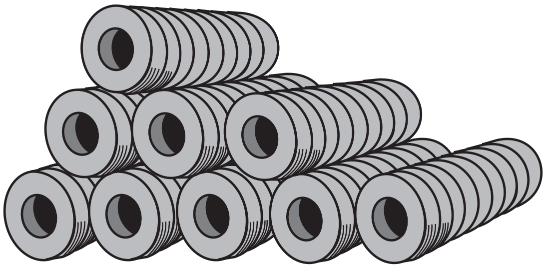

Fig. 4. On-tread on-floor tire storage. Distance along tire hole less than 25 ft (7.6 m)

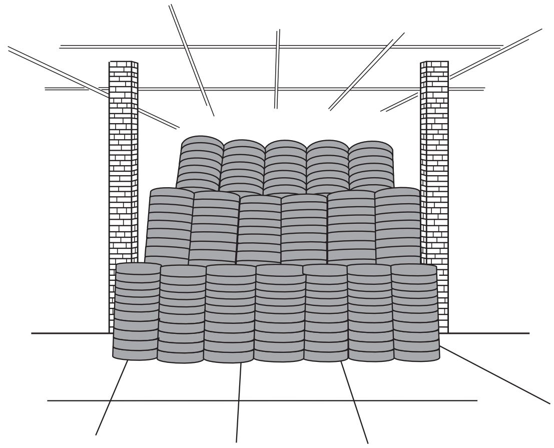

Fig. 5. Pyramid tire storage, on-side, on-floor

On-side storage: Tires stored horizontally or flat. (See Figs.6 and 7)

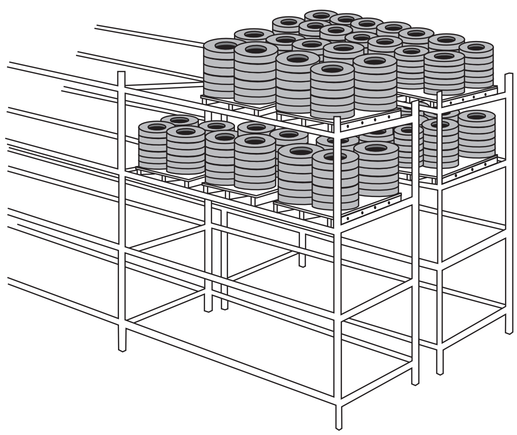

Fig. 6. Double-row rack storage with on-side palletizes storage

Fig. 7. Typical on-side storage arrangement using pallet based portable rack

On-tread storage: Tires stored vertically or on their treads. (See Figs. 8 and 9)

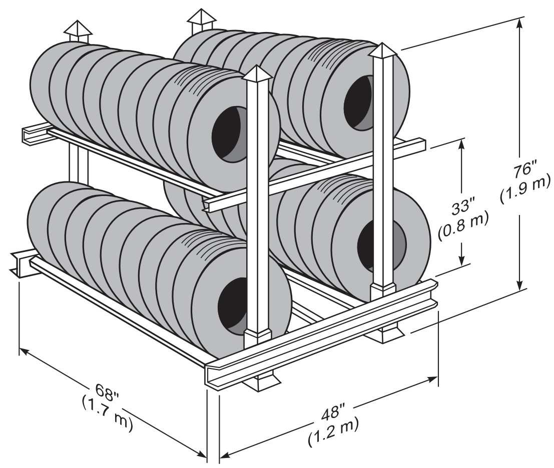

Fig. 8. On-tread storage in portable rack

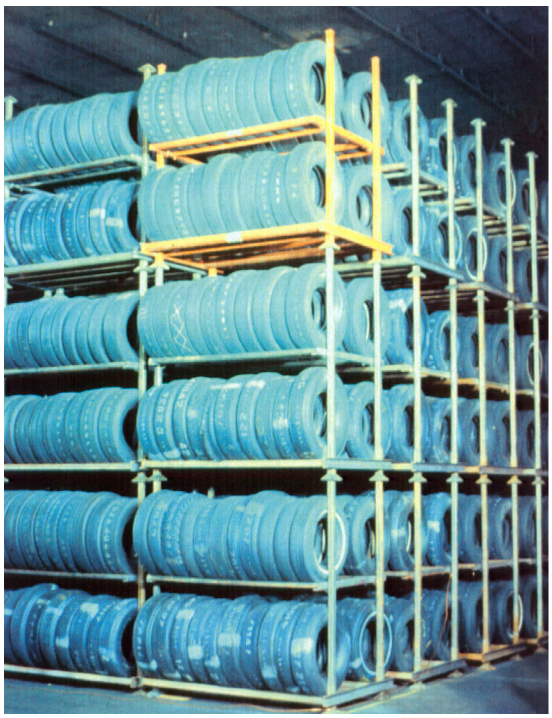

Fig. 9. On-tread tire storage in racks

Open-frame rack storage: This storage arrangement is void of any solid shelves within the storage array and has adequate flue spaces to allow sprinkler water penetration throughout the height of the rack. Open-frame rack storage allows water discharge to reach all vertical surfaces of a commodity that can burn. For rack storage to qualify as open-framed it must have adequate transverse flue spaces throughout the height of the rack at least every 8 ft (2.4 m) horizontally and be void of blocked transverse flue spaces.

Palletized storage: A term used by the tire industry to designate tire storage on portable racks as shown in Figures 8 and 10. The conventional piling method is to store tires on-side when using portable pipe racks.

However, using an alternative piling method, tires are piled both on-tread and on-side, enabling more tires to be stored per pallet. Racks are fully loaded and packed tight, such that there are no horizontal channels. Figure 11 shows a closer view of a single pallet load. Figure 13 shows fully loaded portable racks using wooden pallets.

Partial loads: a portable rack is considered to be partially loaded when the open space between the top tire in one rack and the bottom of the next rack above is 12 in. (25 mm) or more. When the space is less than 12 in. (25 mm), the loads should be considered fully loaded. The requirements within this data sheet are the same for partially loaded portable racks as for fully loaded portable racks.

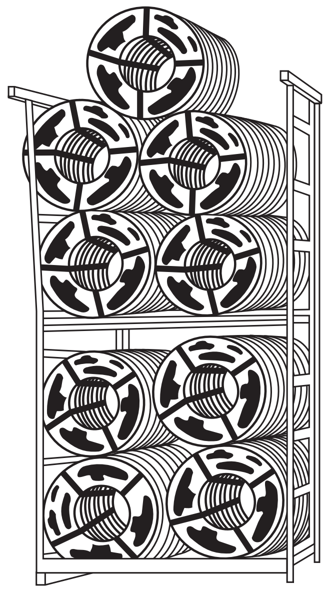

Fig. 10. Palletized storage

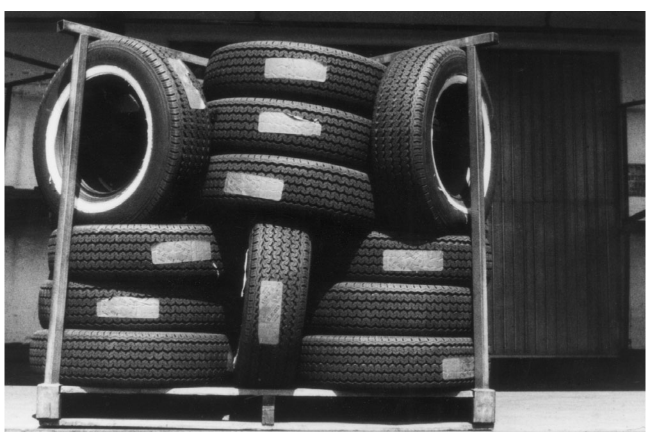

Fig. 11. On-side and on-tread palletized storage

Rack Storage: Storage in racks that use combinations of vertical, horizontal, and diagonal members, with or without solid shelves, to support tires. Racks may be fixed in place or portable. Loading may be conducted manually by using lift trucks, stacker cranes, or hand placement, or automatically by using machine-controlled storage and retrieval systems. The racks can be equipped with solid shelves provided they are fixed-in-place, are no larger than 20 ft^2 (2.0 m^2) in area, and do not block transverse flue spaces. The racks can also be provided with grated shelves as long as the grating is at least 70% uniformly open, or they can be provided with fixed-in-place solid slats as long as adequate transverse flue spaces are provided between all pallet loads.

Portable racks are not fixed in place. They can be arranged in any number of configurations. Some portable racks use a wood pallet as the base. Portable racks, as arranged in Figure 12, are called palletized storage in the tire industry.

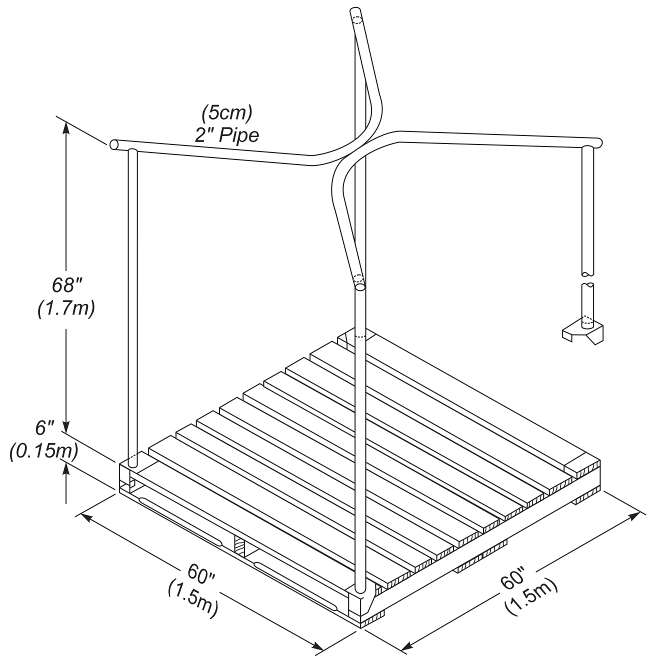

Fig. 12. Portable rack using wood pallet base and steel frame

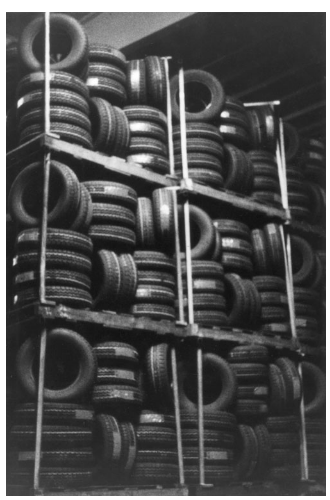

Fig. 13. Portable racks using wood pallets

Vertical barriers: Solid material such as sheet metal, plywood, gypsum board, etc., arranged to limit horizontal fire spread through the wheel holes.

APPENDIX B DOCUMENT REVISION HISTORY

January 2009. Corrections were made to Tables 2 and 4.

July 2008. Completely revised. The following outlines the major changes:

1. Recommended nominal temperature rating of 160°F (70°C) for all ceiling-level sprinklers in wet-pipe sprinkler systems, and a nominal temperature rating of 280°F (140°C) for all ceiling-level sprinklers in dry-pipe sprinkler systems.

2. Combined fully and partially loaded protection requirements for permanent and portable rack storage.

3. Recommended K11.2 (K160) or greater for ceiling-level CMDA sprinklers. As a result, the minimum ceiling level density in all protection tables is 0.30 gpm/ft^2 (12 mm/min), based on a minimum sprinkler pressure of 7 psi (0.5 bar) and a maximum sprinkler area spacing of 100 ft^2 (9.0 m^2).

4. Removed high expansion foam as a protection option.

5. Recommended green tires and tires mounted on metal wheels be treated as uncartoned unexpanded plastic and protected per guidelines in Data Sheet 8-9, *Storage of Class 1, 2, 3, 4 and Plastic Commodities*.

6. Added new recommendations for on-side, on-tread, and laced tire arrangements in portable racks up to 30 ft in a 40 ft building.

7. Added option to use Scheme 8-9A per DS 8-9, where applicable.

8. K16.8 (K240) CMSA sprinkler can now be used as a protection option wherever the K11.2 (K160) CMSA sprinkler is used.

September 2004. Recommendations were added to include protection criteria for upright K16.8 (235) suppression mode sprinklers.

Editorial changes were included to reflect current automatic sprinkler terminology.

May 2001. Added recommendations for the protection of specific storage arrangements of rubber tires using suppression mode and control mode specific application sprinklers.

January 2000. This revision of the document has been reorganized to provide a consistent format.

September 1998. The following changes were made during this revision:

1. Demand areas for 212°F (100°C) sprinklers has been included.

2. A ‘‘Recommended Safe Practice’’ section has been added recommending a well trained Emergency Organization.

3. Protection of mounted tires has been included.

4. In-rack design for locations other than warehouses has been revised. Previously extra-hazard pipe schedule system and a rack water demand of 150 gpm (568 dm^3 / min) was recommended.

A hydraulic design is now recommended, mainly for ease of use because almost all systems are now being hydraulically designed. Also, it represents a reduction in cost of providing the protection without reducing the protection. Using the pipe schedule approach to size the in-rack piping can still be considered an acceptable design method, although the cost of installation may be higher.

APPENDIX C FIREFIGHTING

FM Research fire tests have indicated that while properly designed sprinkler systems can control a fire in tire storage, manual fire fighting may be necessary for complete extinguishment. An understanding of the behavior of tire storage fires is therefore essential if a fire under control is to be completely extinguished by the overhaul crew.

Due to the hazardous conditions present in developed fires involving rubber tires, it is not intended that fires beyond the incipient stage be fought by anyone other than trained firefighters.

C.1 Incipient Stage

If discovered in the early stages, the fire can be effectively extinguished with manual protection. Dry-chemical extinguishers are effective because the powder can pass into the mass of tires and control the fire temporarily. However, it is necessary to back up extinguishers with small hose, and to remove burning tires from the pile. Removed tires should be taken outdoors away from other combustibles and thoroughly wetted down. The area in which the fire occurred should be constantly attended for several hours to watch for rekindling.

Automatic sprinklers usually operate within two to five minutes of ignition. At this point, extinguishers are not generally effective. Because of smoke, the area becomes increasingly obscured and untenable.

C.2 Active Stage

At this point, because of poor visibility in the building, the ability to use hose streams effectively is questionable.

Sprinklers should be allowed to operate until control of the fire is obtained. During this period, the building is best left unventilated. As control of the fire is gained, smoke will tend to change from black to gray and will diminish in intensity. Charged 1-½ in. (38 mm) hose lines should be laid out prior to entering the building for overhaul. Portable flood lights, self-contained breathing apparatus, personal protective gear, etc., should be assembled for the crew.

C.3 Critical Stage

After 60 to 90 minutes, when smoke intensity should have diminished, the building should be ventilated around the periphery of the suspected fire location. Close observation should be made of smoke conditions. If smoke generation increases, cease ventilating and close up the building if possible. Sprinklers should remain in operation during the critical stage.

C.4 Overhaul

As soon as smoke clears enough to permit entry, the building should be entered, with small hose streams directed into burning tires. Sprinklers should remain in operation until the fire chief is certain that the fire is small enough to be extinguished by hose streams. Any sprinkler control valve that is shut off should be manned during the entire period of closure, to enable prompt reopening of the valve, if needed.

Fork trucks and other means should be employed to remove tires from the fire area. It will be necessary to keep sprinklers or hose streams in operation during this procedure at least until evidence of flame is gone. The fire area should be patrolled for 24 hours following the fire.

APPENDIX D NFPA STANDARDS

NFPA standards for the protection of rubber tire storage are covered in NFPA 13. There are some differences in protection guidelines between this data sheet and NFPA 13.