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We combine technology with insights to build purposeful solutions that help the world progress, meeting today’s needs and shaping better tomorrows.
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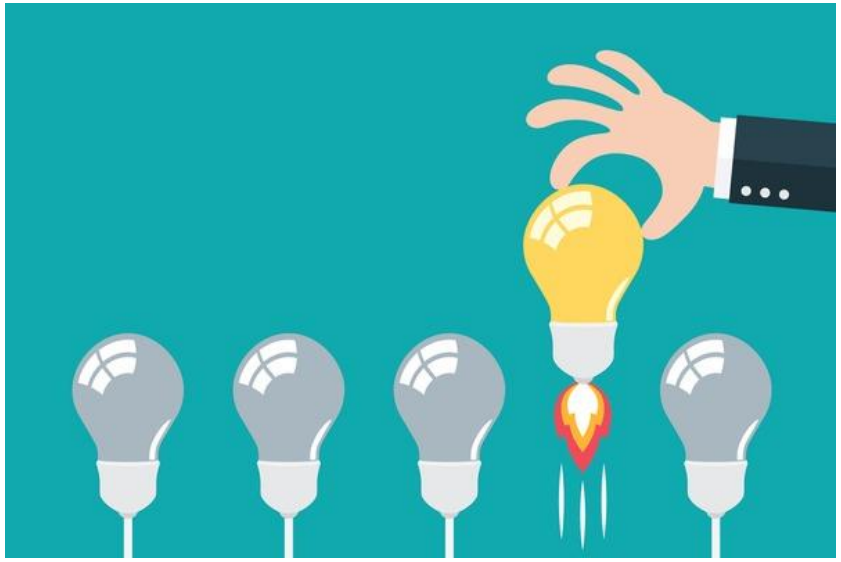

EN, NFPA and FM. Selecting the best fit for purpose.

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Agenda

- Sprinkler Standards
- Selecting the best fit for purpose
  - High-rise building
  - Ceiling-only Storage Protection
  - Automatic Storage and Retrieval Systems

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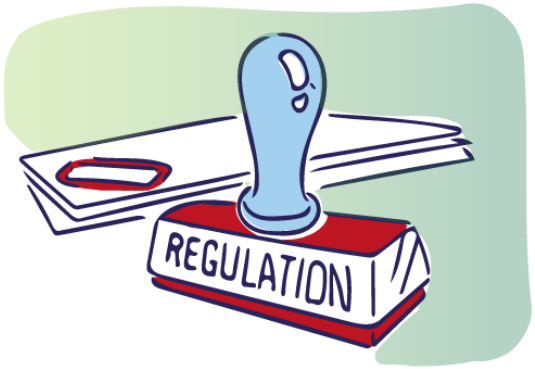
Sprinkler Standards

EN, NFPA and FM



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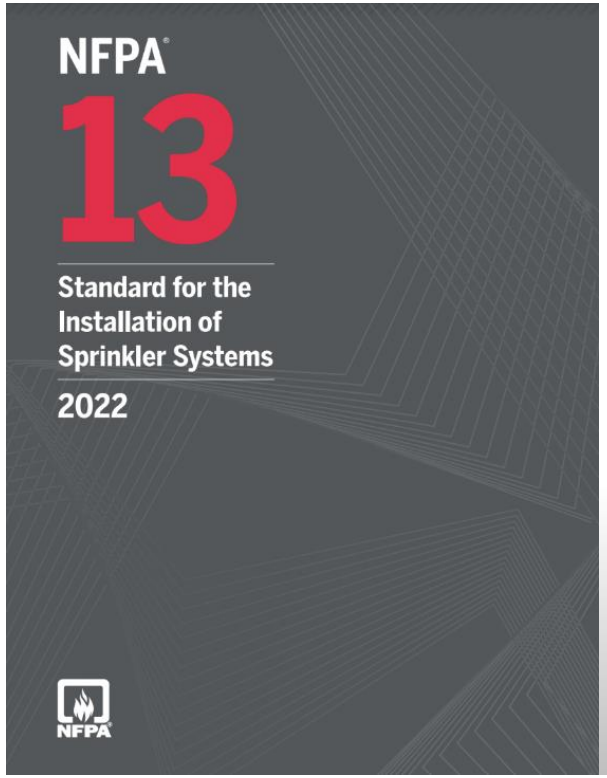
Sprinkler Standards and Approvals

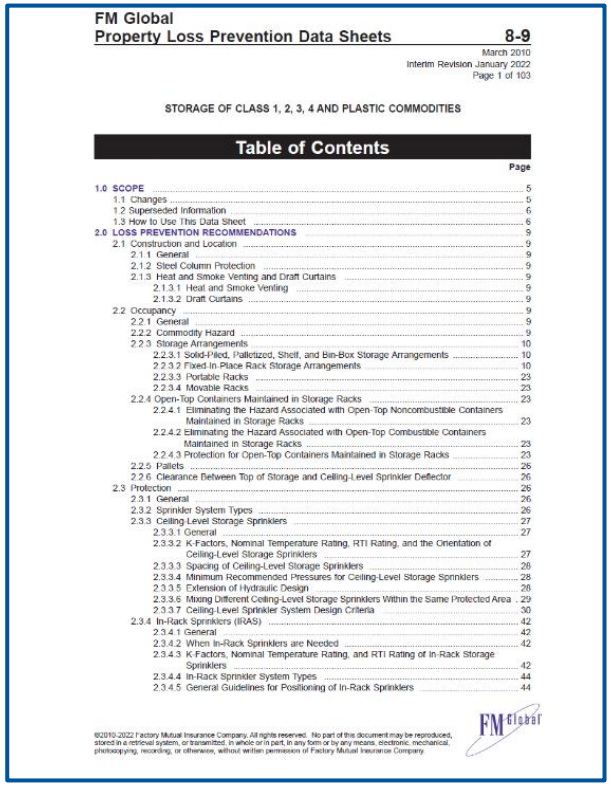
- EN – European Norm (EN 12845 – July 2015)
- NFPA – National Fire Protection Association (NFPA13 2022 edition – October 2021)
- FM – Factory Mutual (FM DS8-9 – January 2022)
- FM – Factory Mutual
- UL – Underwriters Laboratories Inc.
- LPCB – Loss Prevention Certification Board
- VdS – Approval body and insurance company
- AHJ – Authority Having Jurisdiction

NFPA 13 Revision Process



- Next edition will be published late fall 2024 (2025 edition)

FM DS Revision Process



FM Global
Property Loss Prevention Data Sheets 8-9

March 2010
Interim Revision January 2022
Page 1 of 103

STORAGE OF CLASS 1, 2, 3, 4 AND PLASTIC COMMODITIES

Table of Contents

Revising Data Sheets

Draft Versions of Data Sheets:

- 1st Draft
- 2nd Draft
- Final Draft for Sr. Management review

Data Sheets Update Release Dates:

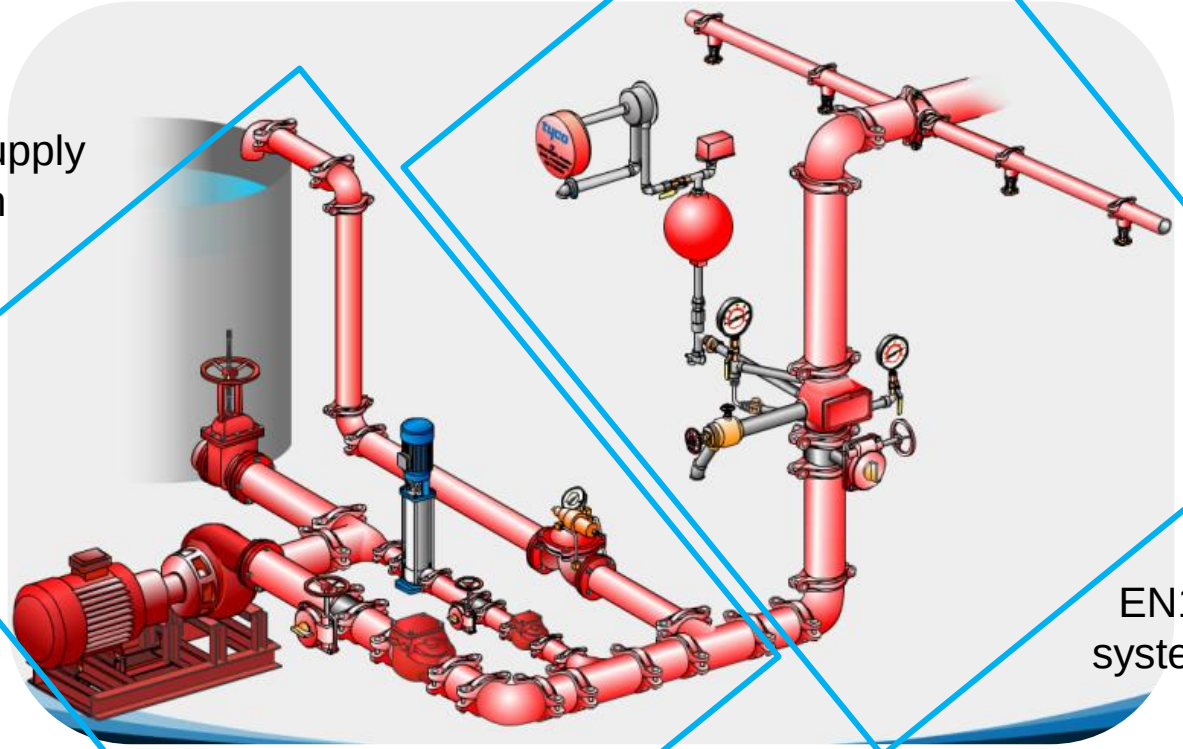
- January
- April
- July
- October

- Next edition will be published when FM deems it necessary

Combining Sprinkler Standards

NFPA13 or FM DS8-9:
Sprinkler installation

EN12845: Water supply
and Pumproom

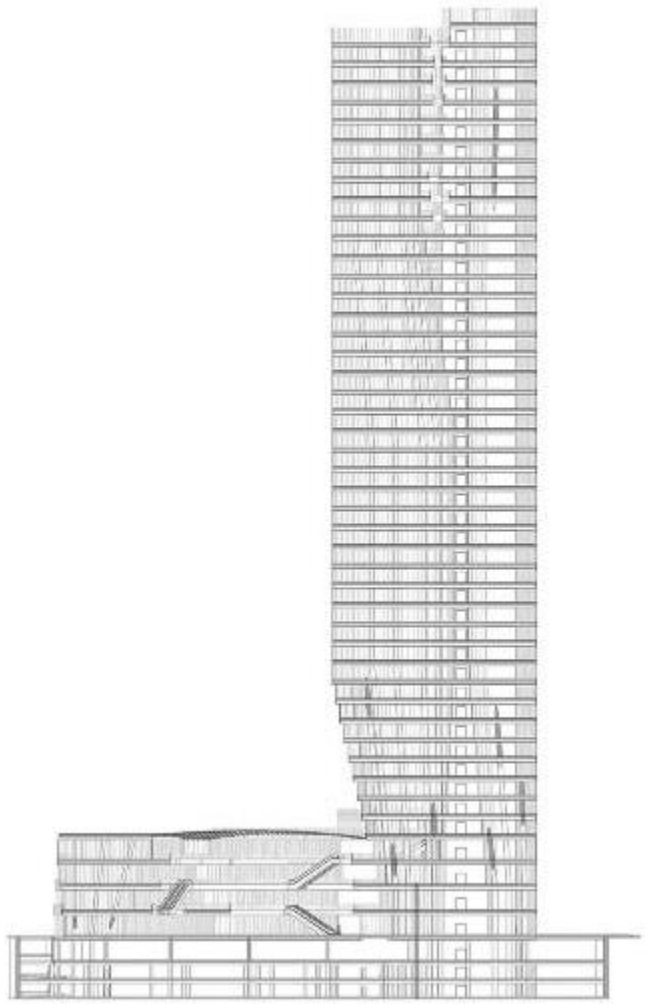


EN12845: Piping
system and support

Best fit for purpose

High-rise building

High-rise Building



EN12845 versus NFPA13

	Residential		Retail		Parking Garage	
	EN12845	NFPA13	EN12845	NFPA13	EN12845	NFPA13
Hazard Class	OH3	LH	OH3	OH2	OH2	OH2
Density (mm/min)	5	4,1	5	8,1	5	8,1
Design Area (m^2)	216	139*	216	139	144	139
Duration (minutes)	60	30	60	60	60	60
Theoretic Flow (lpm)	1080	570	1080	1126	720	1126
Water Amount (m^3)	65	18	65	68	44	68
Sprinkler Type	CMDA (SC)	CMDA (SC/EC) or Residential	CMDA (SC)	CMDA (SC/EC)	CMDA (SC)	CMDA (SC/EC)
Max. Coverage Area (m^2)	12	21/37	12	12/37	12	12/37

* 4 sprinklers when using residential sprinklers

Reduction remote area QR sprinklers NFPA13 2022

(1) Wet pipe system

(2) Light hazard or ordinary hazard occupancy

(3) 20 ft (6.1 m) maximum ceiling height

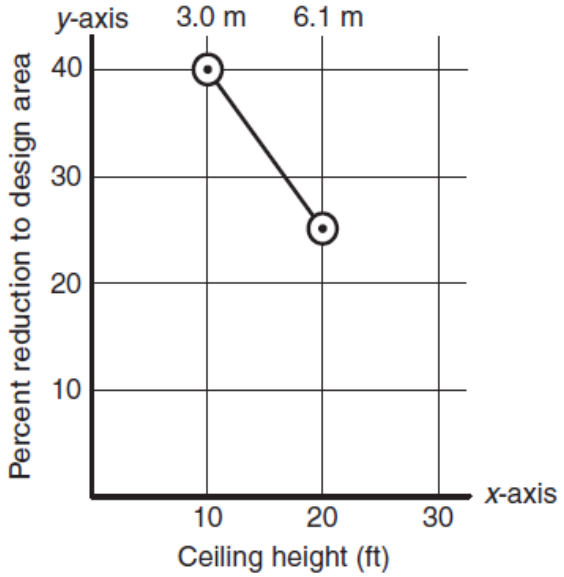
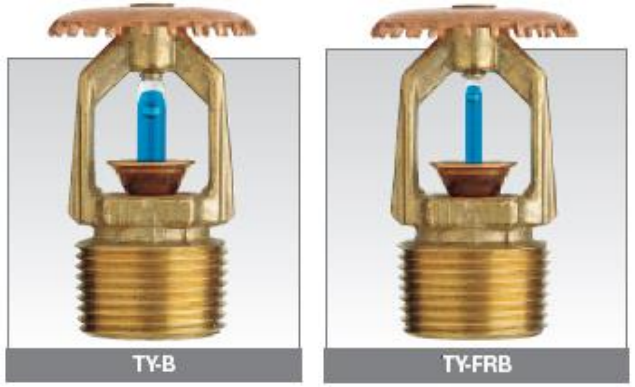
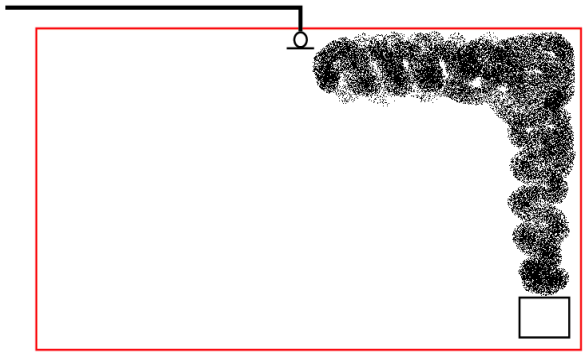


FIGURE 19.3.3.2.3.1 Design Area Reduction for Quick-Response Sprinklers.

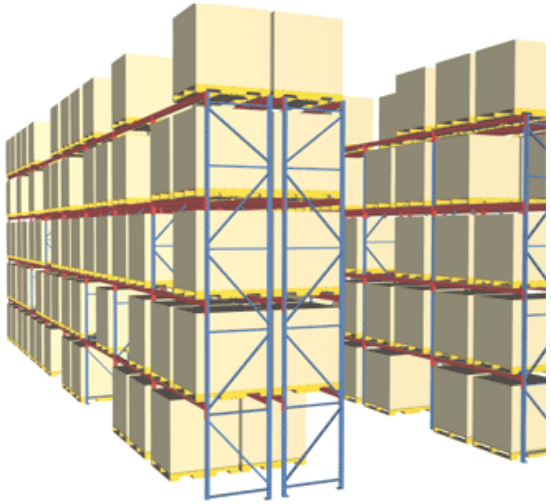




- 19.2.3.2.3.2 The number of sprinklers in the design area shall never be less than five.
- Light Hazard >> Ceiling height: 3 meters >> 139 * 0,6 = 84 m^2
- Ordinary Hazard >> Ceiling height: 3 meters >> 139 * 0,6 = 84 m^2

Best fit for purpose

Ceiling-only Storage Protection



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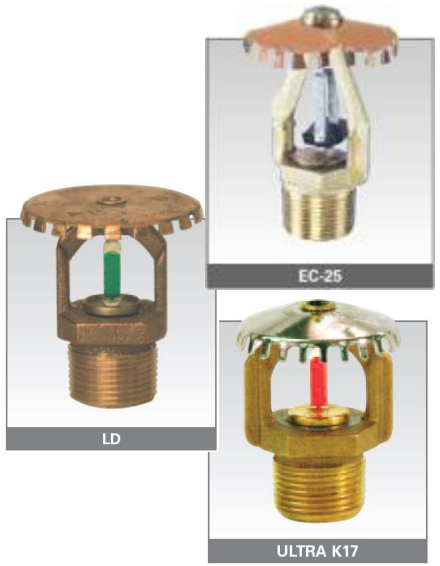
Storage Sprinklers



CMDA	CMSA	ESFR

Storage Sprinklers

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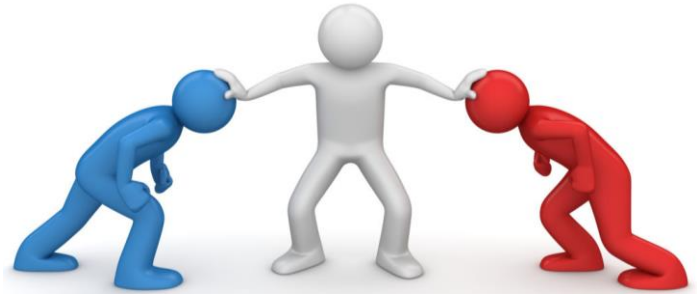
NFPA13 – Ceiling-only ESFR

- 23.2.2 All design areas shall consist of the most hydraulically demanding 12 sprinklers, with four sprinklers on each of three branch lines, unless otherwise specified.

Commodity[a]	Maximum Ceiling/Roof Height		ESFR Sprinklers — Pendent Orientation Minimum Operating Pressure psi (bar) Nominal K-Factors			
	ft	m	14 (200)	16.8 (240)	22.4 (320)	25.2 (360)
Class I through Class IV and cartoned nonexpanded Group A plastics	25	7.6	50 (3.4)	35 (2.4)	25 (1.7)	15 (1.0)
	30	9.1	50 (3.4)	35 (2.4)	25 (1.7)	15 (1.0)
	35	10.7	75 (5.2)	52 (3.6)	35 (2.4)	20 (1.4)
	40	12.2	–	52 (3.6)	–	25 (1.7)
	45	13.7	–	–	40 (2.8)	40 (2.8)
Cartoned expanded Group A plastics	25	7.6	50 (3.4)	35 (2.4)	–	–
	30	9.1	50 (3.4)	35 (2.4)	–	–
	35	10.7	–	–	–	–
	40	12.2	–	–	–	–
	45	13.7	–	–	–	–
Exposed nonexpanded, Group A plastics	25	7.6	50 (3.4)	35 (2.4)	–	–
	30	9.1	50 (3.4)	35 (2.4)	–	–
	35	10.7	–	–	–	–
	40	12.2	–	–	75 (5.2)	60 (4.1)

NFPA13 – Ceiling-only ESFR

- Minimum of 12 ESFR sprinklers in the hydraulic calculations
- Maximum ceiling height is 13,7 meters for cartoned nonexpanded plastics
- Limited options for commodity classes higher then cartoned nonexpanded plastics
- Exposed expanded plastics require vertical barriers within the racks
- Bigger k-factors (K400 and K480) are not included



FM DS8-9 – Ceiling-only ESFR CUP

Table 8. Ceiling-Level Protection Guidelines for Class 4 and Cartoned Unexpanded Plastic Commodities in Open-Frame Rack Storage Arrangements

Protection of Class 4 and Cartoned Unexpanded Plastic Commodities in Open-Frame Storage Racks; No. of AS @ psi (bar)																				
Max. Ceiling Height, ft (m)	Wet System, 160ºF (70ºC) Nominally Rated, Pendent Sprinklers										Wet System, 160ºF (70ºC) Nominally Rated, Upright Sprinklers							Dry System, 280ºF (140ºC) Nominally Rated, Upright Sprinklers		
	Quick Response						Standard Response				Quick Response				Standard Response			Standard Response		
	K11.2 (K160)	K14.0 (K200)	K16.8 (K240)	K22.4 (K320)	K25.2 (K360)	K25.2EC (K360EC)	K11.2 (K160)	K14.0 (K200)	K19.6 (K280)	K25.2 (K360)	K11.2 (K160)	K14.0 (K200)	K16.8 (K240)	K25.2EC (K360EC)	K11.2 (K160)	K16.8 (K240)	K25.2 (K360)	K11.2 (K160)	K16.8 (K240)	K25.2 (K360)
10 (3.0)	12 @ 7 (0.5)	9 @ 7 (0.5)	9 @ 7 (0.5)	9 @ 20 (1.4)	9 @ 20 (1.4)	6 @ 20 (1.4)	12 @ 7 (0.5)	9 @ 7 (0.5)	9 @ 16 (1.1)	9 @ 7 (0.5)	12 @ 7 (0.5)	9 @ 7 (0.5)	9 @ 7 (0.5)	6 @ 20 (1.4)	12 @ 7 (0.5)	9 @ 7 (0.5)	9 @ 7 (0.5)	16 @ 7 (0.5)	16 @ 7 (0.5)	16 @ 7 (0.5)
15 (4.5)	15 @ 16 (1.1)	12 @ 16 (1.1)	12 @ 11 (0.8)	9 @ 20 (1.4)	9 @ 20 (1.4)	6 @ 20 (1.4)	15 @ 16 (1.1)	12 @ 16 (1.1)	9 @ 16 (1.1)	10 @ 7 (0.5)	15 @ 16 (1.1)	12 @ 16 (1.1)	12 @ 11 (0.8)	6 @ 20 (1.4)	15 @ 16 (1.1)	12 @ 11 (0.8)	10 @ 7 (0.5)	20 @ 16 (1.1)	20 @ 7 (0.5)	20 @ 7 (0.5)
20 (6.0)	12 @ 30 (2.1)	12 @ 18 (1.2)	12 @ 13 (0.9)	9 @ 20 (1.4)	9 @ 20 (1.4)	6 @ 22 (1.5)	12 @ 30 (2.1)	12 @ 18 (1.2)	9 @ 16 (1.1)	12 @ 7 (0.5)	12 @ 30 (2.1)	12 @ 18 (1.2)	12 @ 13 (0.9)	6 @ 22 (1.5)	12 @ 30 (2.1)	12 @ 13 (0.9)	12 @ 7 (0.5)	20 @ 30 (2.1)	20 @ 13 (0.9)	20 @ 7 (0.5)
25 (7.5)	15 @ 65 (4.5)	9 @ 35 (2.4)	9 @ 24 (1.7)	9 @ 20 (1.4)	9 @ 20 (1.4)	6 @ 22 (1.5)	15 @ 65 (4.5)	15 @ 42 (2.9)	9 @ 16 (1.1)	12 @ 10 (0.7)	15 @ 65 (4.5)	12 @ 50 (3.5)	12 @ 35 (2.4)	6 @ 22 (1.5)	15 @ 65 (4.5)	15 @ 29 (2.0)	12 @ 20 (1.4)	20 @ 65 (4.5)	20 @ 29 (2.0)	20 @ 13 (0.9)
30 (9.0)		12 @ 50 (3.5)	12 @ 35 (2.4)	9 @ 20 (1.4)	9 @ 20 (1.4)	6 @ 30 (2.1)			9 @ 16 (1.1)	12 @ 15 (1.0)				6 @ 30 (2.1)			12 @ 20 (1.4)			30 @ 20 (1.4)
35 (10.5)		12 @ 75 (5.2)	12 @ 52 (3.6)	12 @ 29 (2.0)	12 @ 23 (1.6)	6 @ 60 (4.1)[a]			15 @ 25 (1.7)	9 @ 30 (2.1)				8 @ 40 (2.8)						
40 (12.0)		12 @ 75 (5.2)	12 @ 52 (3.6)	9 @ 50 (3.5)	9 @ 40 (2.8)					9 @ 30 (2.1)										

[a] An acceptable alternative design is 8 @ 40 (2.8) when a 12 ft (3.6 m) maximum linear spacing is used

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FM DS8-9 – Ceiling-only ESFR CUP

Table 8. Ceiling-Level Protection Gui

	Protection of Class 4 an				
Max. Ceiling Height, ft (m)	Wet System, 160°F (70°C) Nomi				
	Quick Response				
	K11.2 (K160)	K14.0 (K200)	K16.8 (K240)	K22.4 (K320)	K25.2 (K360)
10 (3.0)	12 @ 7 (0.5)	9 @ 7 (0.5)	9 @ 7 (0.5)	9 @ 20 (1.4)	9 @ 20 (1.4)
15 (4.5)	15 @ 16 (1.1)	12 @ 16 (1.1)	12 @ 11 (0.8)	9 @ 20 (1.4)	9 @ 20 (1.4)
20 (6.0)	12 @ 30 (2.1)	12 @ 18 (1.2)	12 @ 13 (0.9)	9 @ 20 (1.4)	9 @ 20 (1.4)
25 (7.5)	15 @ 65 (4.5)	9 @ 35 (2.4)	9 @ 24 (1.7)	9 @ 20 (1.4)	9 @ 20 (1.4)
30 (9.0)		12 @ 50 (3.5)	12 @ 35 (2.4)	9 @ 20 (1.4)	9 @ 20 (1.4)
35 (10.5)		12 @ 75 (5.2)	12 @ 52 (3.6)	12 @ 29 (2.0)	12 @ 23 (1.6)
40 (12.0)		12 @ 75 (5.2)	12 @ 52 (3.6)	9 @ 50 (3.5)	9 @ 40 (2.8)

[a] An acceptable alternative design is 8 @ 40 (2.8) when a 1

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FM DS8-9 – Ceiling-only ESFR UEP

Table 11. Ceiling-Level Protection Guidelines for Uncartoned Expanded P

Protection of Uncartoned Expanded Plastic Commodities in

Max. Ceiling Height, ft (m)	Wet System, 160ºF (70ºC) Nominally Rated, Pendent Sprinklers									
	Quick Response						Standard Response			
	K11.2 (K160)	K14.0 (K200)	K16.8 (K240)	K22.4 (K320)	K25.2 (K360)	K25.2EC (K360EC)	K11.2 (K160)	K14.0 (K200)	K19.6 (K280)	K25.2 (K360)
10 (3.0)	15 @ 10 (0.7)	15 @ 7 (0.5)	15 @ 7 (0.5)	9 @ 20 (1.4)	9 @ 20 (1.4)	6 @ 20 (1.4)	15 @ 10 (0.7)	15 @ 7 (0.5)	12 @ 16 (1.1)	15 @ 7 (0.5)
15 (4.5)	15 @ 50 (3.5)	12 @ 32 (2.2)	12 @ 22 (1.5)	9 @ 25 (1.7)	9 @ 20 (1.4)	8 @ 35 (2.4)	15 @ 50 (3.5)	15 @ 32 (2.2)	15 @ 16 (1.1)	15 @ 10 (0.7)
25 (7.5)		12 @ 75 (5.2)	12 @ 52 (3.6)	9 @ 32 (2.2)	9 @ 25 (1.7)					
30 (9.0)		12 @ 100 (6.9)	12 @ 70 (4.8)	12 @ 50 (3.5)	12 @ 40 (2.8)					
40 (12.0)					20 @ 75 (5.2)					

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FM DS8-9 - Ceiling-only ESFR CUP

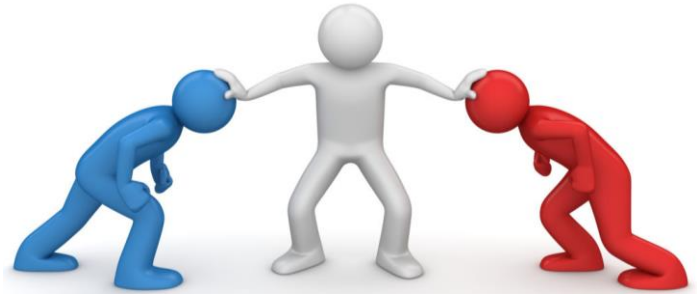
Table 17b. Quick-Response, 160°F (70°C) Nominally Rated, Standard-Coverage Pendent Storage Sprinkler Ceiling-Only Designs for Ceiling Heights Over 40 ft (12.0 m)

Storage Arrangement	*Commodity*	*Max. Storage Height, ft (m)*	*Max. Ceiling Height, ft (m)*	*Ceiling Sprinkler K-Factor*	*Max. Vertical Distance from Ceiling to Sprinkler's Thermal Element, in. (mm)*	*Min. Aisle Width, ft (m)*	*Sprinkler System Design*		
							Ceiling Sprinkler System, No. of AS @ psi (bar)	Hose Demand, gpm (L/min)	System Duration, min
Solid-Piled, Palletized, Bin-Box, Shelf, and Open-Frame Racks*	Class 1, 2, 3, 4 and Cartoned Unexpanded Plastics	45 (13.7)	50 (15.2)	22.4 (320)	13 (325)	6 (1.8)	10 @ 63 (4.3)	250 (950)	60
				25.2 (360)	13 (325)	6 (1.8)	10 @ 50 (3.5)		
					17 (425)	6 (1.8)	10 @ 75 (5.2)		
				28.0** (400**)	13 (325)	6 (1.8)	10 @ 40 (2.8)		
				33.6 (480)	17 (425)	6 (1.8)	9 @ 55 (3.8)		
		50 (15.2)	55 (16.8)	28.0 (400)	13 (325)	8 (2.4)	9 @ 80 (5.5)		
				33.6 (480)	17 (425)	6 (1.8)	9 @ 55 (3.8)		

FM DS8-9 paragraph 2.3.6.9

FM DS8-9 – Ceiling-only ESFR

- Minimum of 9 ESFR sprinklers in the hydraulic calculations
- Maximum ceiling height is 12 meters in general tables (table 2 – 11)
- Protection options for all commodity classes up to a height of 12 meters
- No requirements for vertical barriers for exposed expanded plastics
- Protection option for cartoned unexpanded plastics up to and including 16,8 meters (table 17b)
- Bigger k-factors (K400 and K480) are included



Best fit for purpose

Automatic Storage and Retrieval Systems

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FM DS8-34

- Latest revision July 2023
- Includes the following ASRS:
  - Mini-Load Automatic Storage and Retrieval Systems (ASRS)
  - Top-Loading Automatic Storage and Retrieval Systems (TL-ASRS)
  - Vertically Enclosed Automatic Storage and Retrieval System Storage Arrangements

ASRS

TL-ASRS

Vertically Enclosed

Questions??

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Thank You
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