

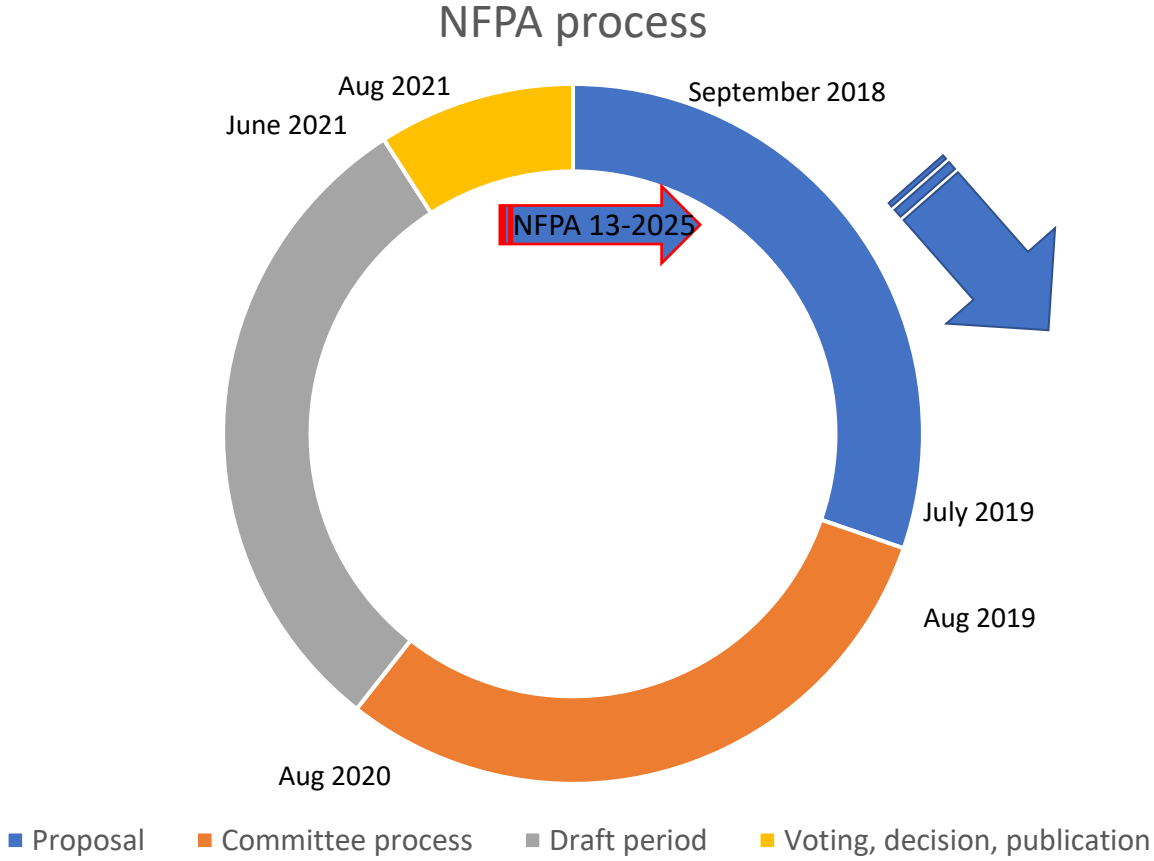


NFPA 13-2022

Changes to the standard

Bo Hjorth

NFPA 13-2022





NFPA replaces 2021 Conference & Expo with new virtual conference series to run throughout 2021



VOTING AT ANNUAL CONFERENCE



NFPA 13 Committees



- TCC
- Hanging and bracing
- Water supply
- Residential
- System Discharge Criteria
- System Installation Criteria

NFPA 13 - COMMITTEES



A balance of special interest groups. E.g. Sprinkler Discharge Criteria

• M	Manufacturer	6	(5)	[4]
• U	User	1	(1)	[3]
• IM	Installer/Maintainer	6	(5)	[4]
• L	Labor	1	(1)	[-]
• RT	Applied Research/Testing Laboratory	1	(1)	[3]
• E	Enforcing Authority	5	(4)	[3]
• I	Insurance	5	(5)	[5]
• C	Consumer	-	(-)	[-]
• SE	Special Expert	9	(8)	[4]

OVERVIEW

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- 4 General requirements
- 5 Water supplies
- 6 Installation Underground piping
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- 8 System types and requirements
- 9 Sprinkler location requirements
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- 11 Installation req. EC (SSU, SSP and SW) sprinklers
- 12 Installation req. Residential sprinklers
- 13 Installation req. CMSA sprinklers
- 14 Installation req. ESFR sprinklers
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- Annex C Explanation of tests
- Annex D Info from Life Safety Code
- Annex E [Background Seismic design]
- Annex F Informational references



Chad Duffy

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Metric conversions

General principles:

- Use mm up to 900 mm, then m (1,0 m)
- Use one decimal from 1,0 m to 9,9m, then no decimal (and same applies for bar and other units)
- Exception: tables for ESFR and CMSA – keep well established values (e.g. 10,7 m, not 11m)
- Nominal values used for pipe dimensions etc
- Soft, but not super-soft, rounding off (e.g. 40 ft (12.16m) = 12,2 m, not 12m)

1.6.3

Some dimensions used in this standard are exact and some are not. The metric equivalent shown in this standard might not be an exact conversion to the SI unit, but the nominal metric equivalent is typically used or a reasonably equivalent value or approximate conversion is used. **It shall be acceptable to use the exact conversion or the conversions stated in the standard, even though they might not be exact.**

Metric conversions – example of change

NFPA 13-2019

Table 23.9 ESFR Sprinkler

ESFR K-Factor	Orientation
14.0 (201)	Upright/ pendent
16.8 (242)	Upright/ pendent
22.4 (322)	Pendent
25.2 (363)	Pendent
14.0 (201)	Upright/ pendent
16.8 (242)	Upright/ pendent
16.8 (242)	Pendent
22.4 (322)	Pendent
25.2 (363)	Pendent
22.4 (322)	Pendent
25.2 (363)	Pendent

Table 23.6 ESFR Sprinkler

ESFR K- Factor	Orientation
14.0 (200)	Upright/pendent
16.8 (240)	Upright/pendent
22.4 (320)	Pendent
25.2 (360)	Pendent
14.0 (200)	Upright/pendent
16.8 (240)	Upright/pendent
16.8 (240)	Pendent
22.4 (320)	Pendent
25.2 (360)	Pendent
22.4 (320)	Pendent
25.2 (360)	Pendent

NFPA 13-2022

Metric conversions – almost perfect

Table 22.5 CMSA Sprinkler Design Criteria for Rack Storage of Group A Plastic Commodities Stored Up to and Including 35 ft (10.7 m) in Height

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				
--- --- --- --- --- --- --- --- --- ---	Cartoned nonexpanded plastics	25	7.6	35	10.7	25.2 (360) Pendent	Wet	15	10	0.7				
						11.2 (160) Upright	Wet	In-rack sprinklers required. See Chapter 25.	NA	NA				
							Wet	In-rack sprinklers required. See Chapter 25.	NA	NA				
						16.8 (240) Upright	Wet	In-rack sprinklers required. See Chapter 25.	NA	NA				
							Wet	In-rack sprinklers required. See Chapter 25.	NA	NA				
						19.6 (280) Pendent	Wet	15	25	1.7				
							30	9.1	35	10.7	19.6 (280) Pendent	Wet	15	25
						35	10.6	40	12.2	19.6 (280) Pendent	Wet	15	30	2.1
										25.2 (360) Pendent	Wet	15	23	1.6

Pkt 4.3.3 Ordinary Hazard Occupancies

Car parking garages
Up-graded hazard classification

NFPA 13-2019

Automobile parking garage and showrooms OH1

NFPA 13-2022

Automobile showrooms OH1

Automobile parking garages OH2





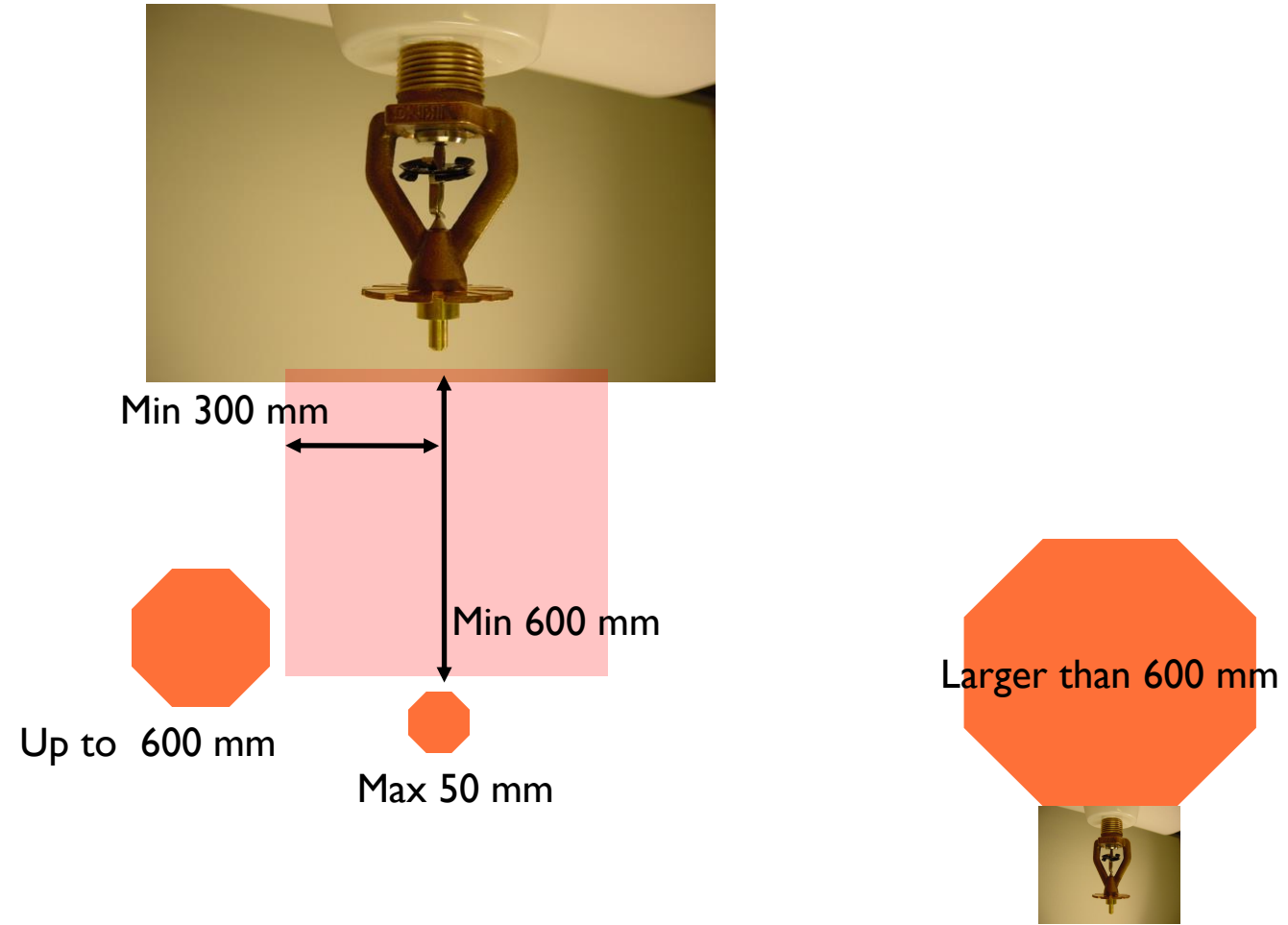
Obstruction criteria

- When introducing ESFR K25.2 (in NFPA 13-1999) it was also added new, much more restrictive obstruction criteria

- Isolated obstructions
- Continuous obstructions



NFPA 13-2019: 14.2.11.2 ISOLATED OBSTRUCTIONS



Obstructions and ESFR Sprinklers – Phase 1

Final Report

Prepared by:

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RESEARCH FOUNDATION
RESEARCH FOR THE NFPA MISSION

Obstructions and Early Suppression Fast Response Sprinklers

Final Report by:

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August 2020



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Obstructions and ESFR Sprinklers – Phase 3

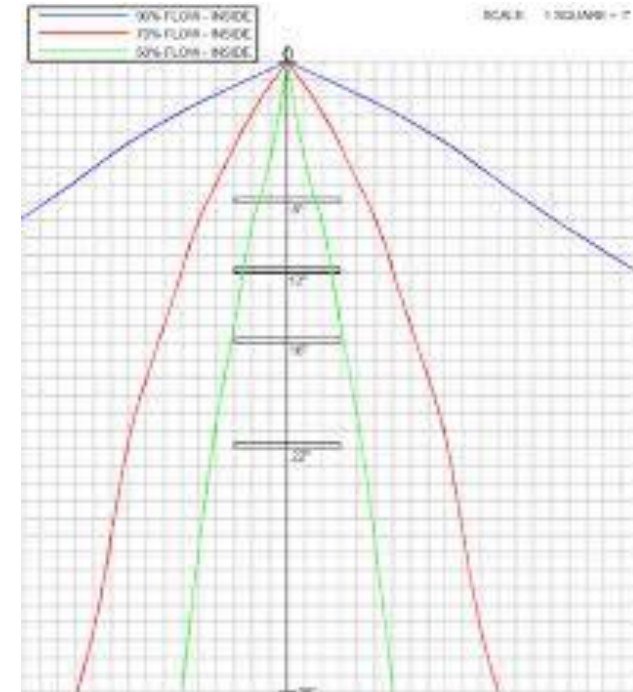
FINAL REPORT BY:

Garner A. Palenski, P.E., and William N. Fletcher, P.E.

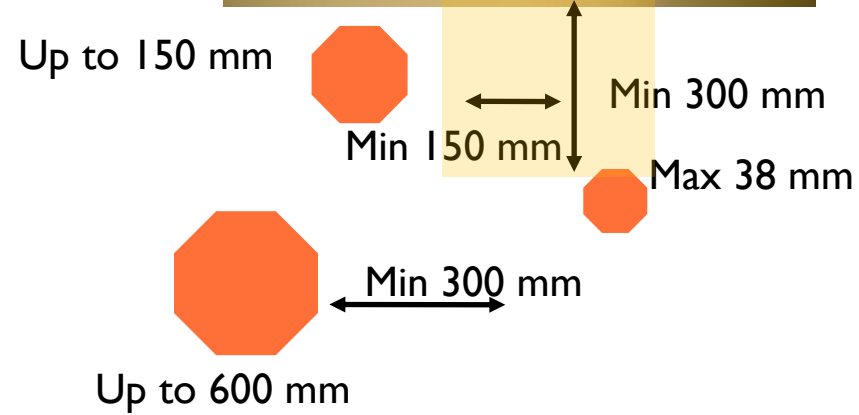
Jensen Hughes
San Diego, CA, USA

December 2016

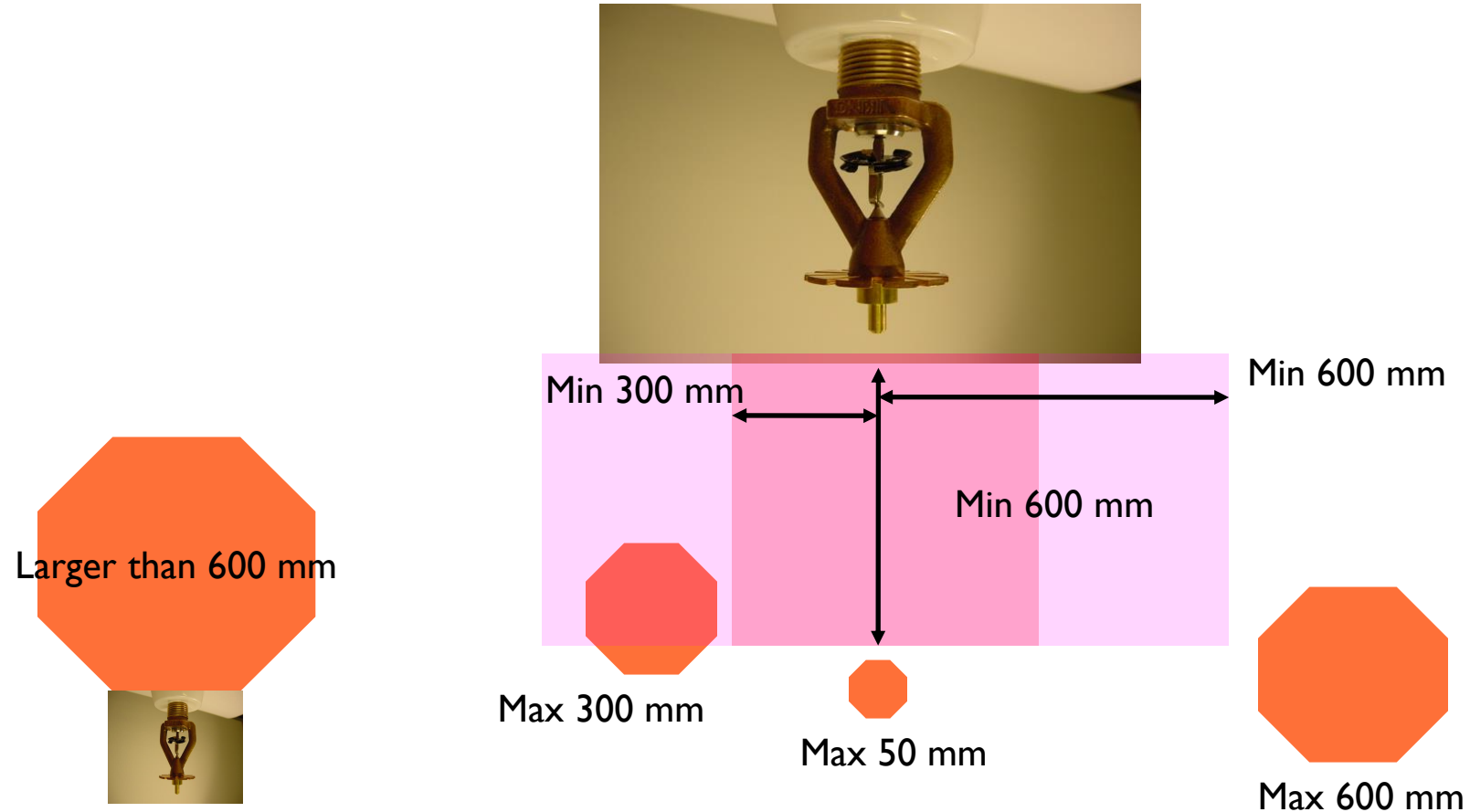
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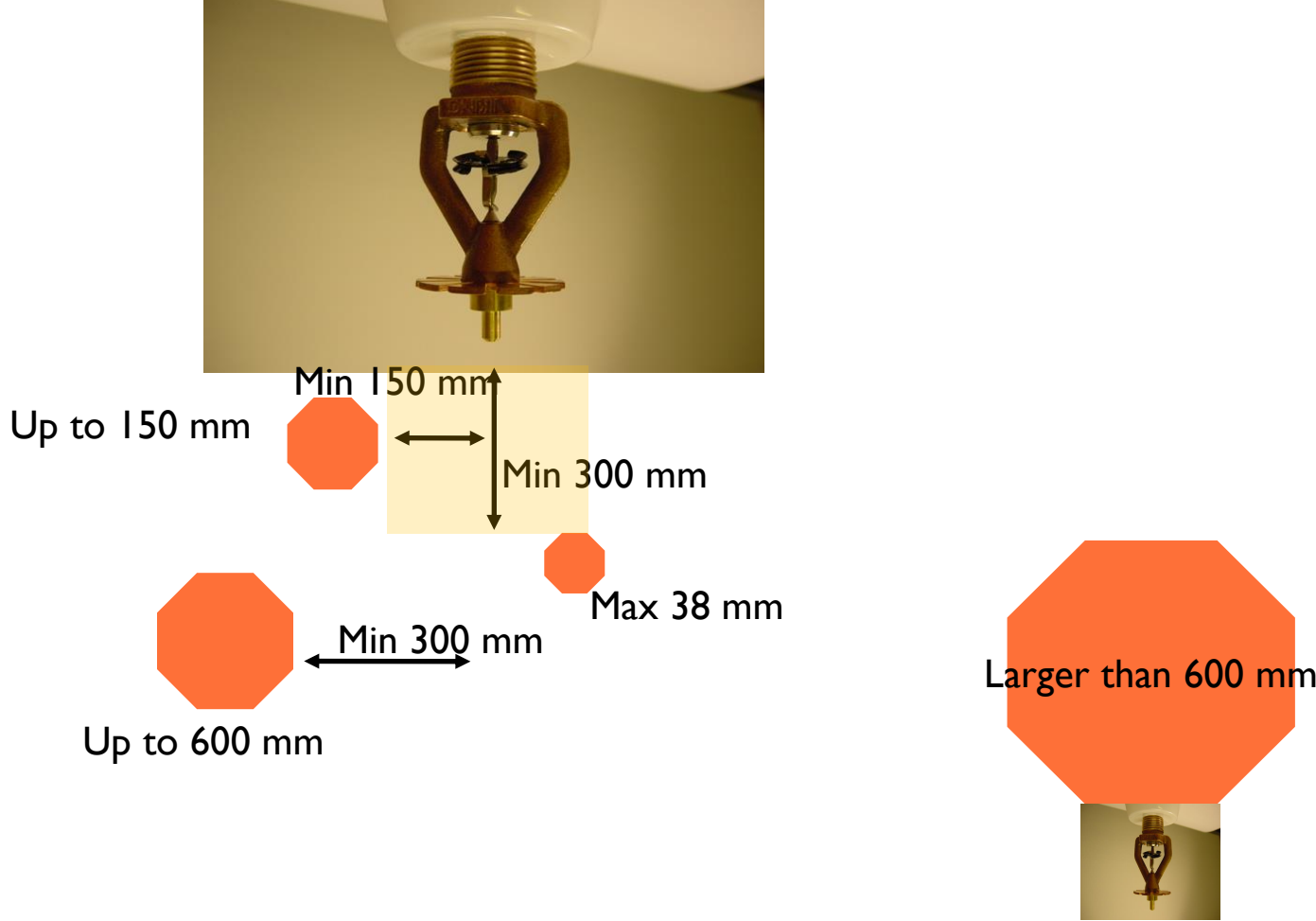
NFPA 13-2022: 14.2.11.2 ISOLATED OBSTRUCTIONS



NFPA 13-2019: 14.2.11.3 CONTINUOUS OBSTRUCTIONS BELOW ESFR



NFPA 13-2022: 14.2.11.3 CONTINUOUS OBSTRUCTIONS BELOW ESFR



14.2.10.1 Distance to ceiling



Pendent: K200 – K240 – **K400**

Minimum 150 mm

Maximum 350 mm



Pendent: K320 - K360 – **K480**

Minimum 150 mm

Maximum 450 mm

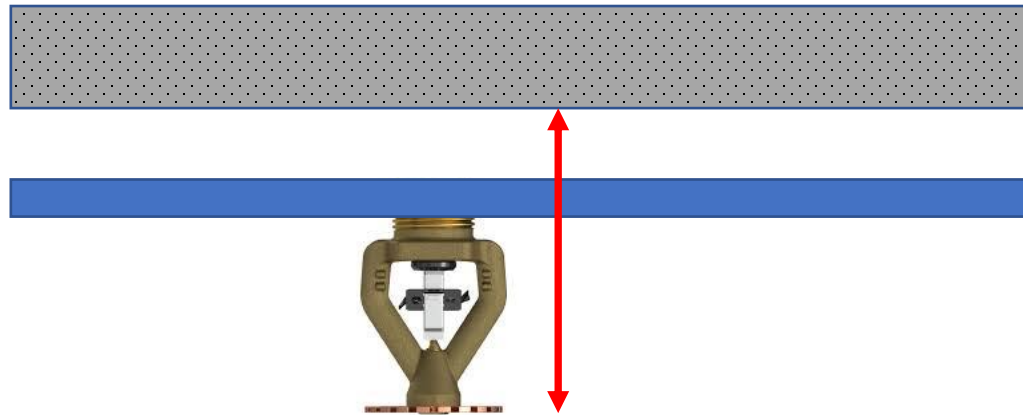


Upright: K200 – K240

Minimum 75 mm

Maximum 300 mm

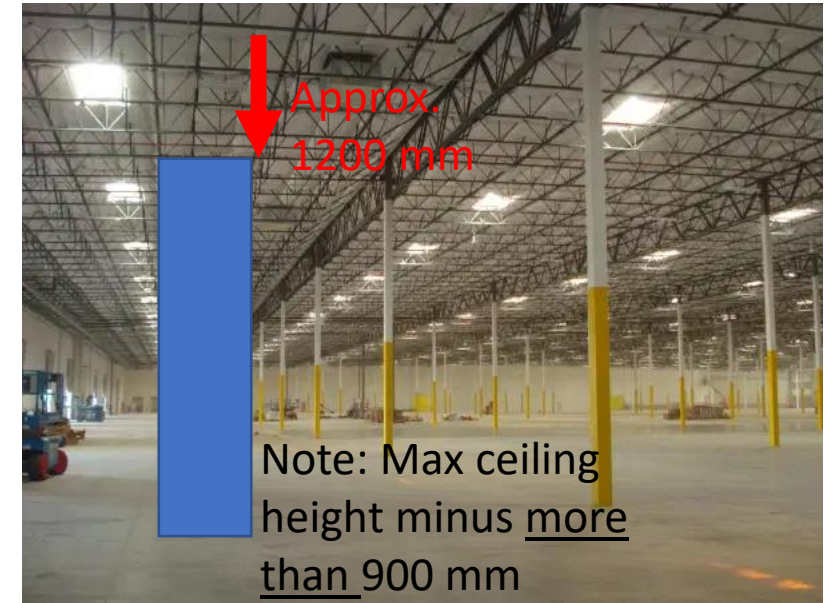
NOTE: Deflector –to-ceiling



Was rejected during the voting in June 2021

- For NFPA 13 ~~2022~~ a proposal was presented for the new K-factor of 400
- Would allow storage of Cartoned nonexpanded plastics, for a ceiling height of 16,8 m (and a 15,2 m storage height)– at 5,5 bar minimum pressure
- Design is limited to single- and double row racks – and therefore a minimum aisle width of 2,4 m

K28 (28.0) (K400)



Was rejected during the voting in June 2021

- For NFPA 13-2022 a proposal was presented for the new K-factor of 480
- Would allow storage of Cartoned nonexpanded plastics, for a ceiling height of 16,8 m (and a 15,2 m storage height) – at 3,8 bar minimum pressure
- Design is limited to single- and double row racks – and therefore a minimum aisle width of 1,8 m

K34 (33.6) (K480)



Table 23.3.1 ESFR Protection of Palletized and Solid-Piled Storage of Class I Through Class IV Commodities

Commodity	Maximum Storage Height		Maximum Ceiling/ Roof Height		Nominal K-Factor	Orientation	Minimum Operating Pressure	
	ft	m	ft	m			psi	bar
	20	6.1	25	7.6	14.0 (200)	Upright/pendent	50	3.4
					16.8 (240)	Upright/pendent	35	2.4
					22.4 (320)	Pendent	25	1.7
					25.2 (360)	Pendent	15	1.0
					14.0 (200)	Upright/pendent	50	3.4
					16.8 (240)	Upright/pendent	35	2.4

Class I, II, III, or IV, encapsulated and nonencapsulated (no open-top containers)

Table 23.4.2 ESFR Protection of Palletized and Solid-Piled Storage of Group A Plastic Commodities

Storage Arrangement	Commodity
Palletized and solid-piled storage (no open-top containers)	Cartoned nonexpanded plastic

Table 23.5.1 ESFR Sprinkler Protection of Rack Storage

Storage Arrangement	Commodity	Maximum Storage Height	
		ft	m
Single-row, double-row, and multiple-row racks (no open-top containers)	Class I, II, III, or IV, encapsulated or nonencapsulated	20	

Table 23.6.1 ESFR Protection of Rack Storage of Group A Plastic Commodities

Storage Arrangement	Commodity	Maximum Storage Height		Maximum Ceiling/ Roof Height		Nominal K-Factor	Orientation	Minimum Operating Pressure	
		ft	m	ft	m			psi	bar
Single-, double-, and multiple-row racks (no open-top containers)	Cartoned nonexpanded	20	6.1	25	7.6	14 (200)	Upright/pendent	50	3.4
						16.8 (240)	Upright/pendent	35	2.4
						22.4 (320)	Pendent	25	1.7
						25.2 (360)	Pendent	15	1
				30	9.1	14 (200)	Upright/pendent	50	3.4
						16.8 (240)	Upright/pendent	35	2.4
						22.4 (320)	Pendent	25	1.7
						25.2 (360)	Pendent	15	1
				35	11	14 (200)	Upright/pendent	75	5.2
						16.8 (240)	Upright/pendent	52	3.6
						22.4 (320)	Pendent	35	2.4
						25.2 (360)	Pendent	20	1.4
				40	12	16.8 (240)	Pendent	52	3.6
						22.4 (320)	Pendent	40	2.7
						25.2 (360)	Pendent	25	1.7
						14 (200)	Pendent*	NA	NA
				45	14	16.8 (240)	Pendent*	NA	NA
						22.4 (320)	Pendent	40	2.7
						25.2 (360)	Pendent	40	2.7
						14 (200)	Upright/pendent	50	3.4
30	9.1	16.8 (240)	Upright/pendent	35	2.4				
		22.4 (320)	Pendent	25	1.7				
		25.2 (360)	Pendent	15	1				
		14 (200)	Upright/pendent	60	4.1				

Commodity	Maximum ceiling / roof height (m)	ESFR Sprinklers – Pendent orientation Minimum operating pressure (bar)				ESFR Sprinklers – Upright orientation Minimum operating pressure (bar)	
		K200	K240	K320	K360	K200	K240
Class I through Class IV and Cartoned nonexpanded Group A Plastics	7,6	3,4	2,4	1,7	1,0	3,4	2,4
	9,1	3,4	2,4	1,7	1,0	3,4	2,4
	10,7	5,2	3,6	2,4	1,4	5,2	3,6
	12,2	-	3,6	-	1,7	-	-
	13,7	-	-	2,8	2,8	-	-
Cartoned expanded	7,6	3,4	2,4			3,4	2,4
	9,1	3,4	2,4			3,4	2,4
	10,7	-	-			-	-
	12,2	-	-			-	-
	13,7	-	-			-	-
Exposed nonexpanded	7,6	3,4	2,4				
	9,1	3,4	2,4				
	10,7	-	-				
	12,2	-	-	5,2	4,1		
	13,7	In-rack sprinklers required	-				
Exposed expanded	7,6						
	9,1				2,0 ^{f)}		
	10,7						
	12,2				4,1 ^{f)}		
	13,7						

One table for all types of commodity and for all storage configurations:

23.3.1

Protection of palletized, solid-piled, or rack storage of Class I through Class IV and Group A commodities shall be in accordance with [Table 23.3.1](#)

Only ceiling height restriction, no more any storage heights

Commodity	Maximum ceiling / roof height (m)	ESFR Sprinklers – Pendent orientation Minimum operating pressure (bar)				ESFR Sprinklers – Upright orientation Minimum operating pressure (bar)	
		K200	K240	K320	K360	K200	K240
Class I through Class IV and Cartoned nonexpanded Group A Plastics	7,6	3,4	2,4	1,7	1,0	3,4	2,4
	9,1	3,4	2,4	1,7	1,0	3,4	2,4
	10,7	5,2	3,6	2,4	1,4	5,2	3,6
	12,2	-	3,6	-	1,7	-	-
	13,7	-	-	2,8	2,8	-	-
Cartoned expanded	7,6	3,4	2,4			3,4	2,4
	9,1	3,4	2,4			3,4	2,4
	10,7	-	-			-	-
	12,2	-	-			-	-
	13,7	-	-			-	-
Exposed nonexpanded	7,6	3,4	2,4				
	9,1	3,4	2,4				
	10,7	-	-				
	12,2	-	-	5,2	4,1		
	13,7	In-rack sprinklers required	-				
Exposed expanded	7,6						
	9,1				2,0 ^{f)}		
	10,7						
	12,2				4,1 ^{f)}		
	13,7						

Commodity	Maximum ceiling / roof height (m)	ESFR Sprinklers – Pendent orientation Minimum operating pressure (bar)				ESFR Sprinklers – Upright orientation Minimum operating pressure (bar)	
		K200	K240	K320	K360	K200	K240
Class I through Class IV and Cartoned nonexpanded Group A Plastics	7,6	3,4	2,4	1,7	1,0	3,4	2,4
	9,1	3,4	2,4	1,7	1,0	3,4	2,4
	10,7	5,2	3,6	2,4	1,4	5,2	3,6
	12,2	-	3,6	-	1,7	-	-
	13,7	-	-	2,8	2,8	-	-

Commodity	Maximum ceiling / roof height (m)	ESFR Sprinklers – Pendent orientation Minimum operating pressure (bar)				ESFR Sprinklers – Upright orientation Minimum operating pressure (bar)	
		K200	K240	K320	K360	K200	K240
Cartoned expanded Group A Plastics	7,6	3,4	2,4	-	-	3,4	2,4
	9,1	3,4	2,4	-	-	3,4	2,4
	10,7	-	-	-	-	-	-
	12,2	-	-	-	-	-	-
	13,7	-	-	-	-	-	-

Commodity	Maximum ceiling / roof height (m)	ESFR Sprinklers – Pendent orientation Minimum operating pressure (bar)				ESFR Sprinklers – Upright orientation Minimum operating pressure (bar)	
		K200	K240	K320	K360	K200	K240
Exposed nonexpanded Group A Plastics	7,6	3,4	2,4	-	-	-	-
	9,1	3,4	2,4	-	-	-	-
	10,7	-	-	-	-	-	-
	12,2	-	-	5,2	4,1	-	-
	13,7	(In-rack sprinklers required)	-	-	-	-	-

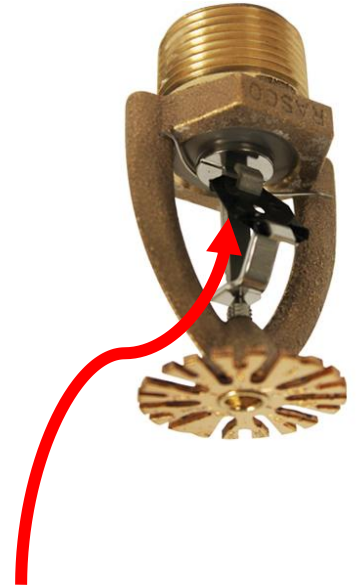
Commodity	Maximum ceiling / roof height (m)	ESFR Sprinklers – Pendent orientation Minimum operating pressure (bar)				ESFR Sprinklers – Upright orientation Minimum operating pressure (bar)	
		K200	K240	K320	K360	K200	K240
Exposed expanded Group A Plastics	7,6	-	-	-	-	-	-
	9,1	-	-	-	2,0 ^{b)}	-	-
	10,7	-	-	-	-	-	-
	12,2	-	-	-	4,1 ^{b) c)}	-	-
	13,7	-	-	-	-	-	-

b) Only for special design, with vertical barriers.

NOTE Incorrect reference to section 27.4, shall be 23.4

Exposed expanded plastics

- Before the 2016 edition, protection of exposed, expanded plastics in rack storage was "outside the scope" of NFPA 13
- As of NFPA 13-2016 a special protection scheme was introduced, with vertical barriers and K360@4,1 bar – for max 10,7 m storage height and 12,2 m ceiling height



For this particular design an "intermediate temperature sprinkler" is required. i.e. approx. 100°C

In addition to that, it was tested for a max 350 mm distance from deflector to ceiling

Exposed expanded plastics

- In NFPA 13-2016 the intended limitation of no more than 350 mm distance from deflector to ceiling was missed.
- In addition to that, an incorrect metric ceiling height was printed for one of the design options
- In NFPA 13-2019 the 350 mm, but instead one of the storage height/ceiling height options was omitted by mistake



Hopefully everything had now been included, in the 2022 edition...

Commodity	Maximum ceiling / roof height (m)	ESFR Sprinklers – Pendent orientation Minimum operating pressure (bar)				ESFR Sprinklers – Upright orientation Minimum operating pressure (bar)	
		K200	K240	K320	K360	K200	K240
Exposed expanded Group A Plastics	7,6	-	-	-	-	-	-
	9,1	-	-	-	2,0 ^{b)}	-	-
	10,7	-	-	-	-	-	-
	12,2	-	-	-	4,1 ^{b) c)}	-	-
	13,7	-	-	-	-	-	-

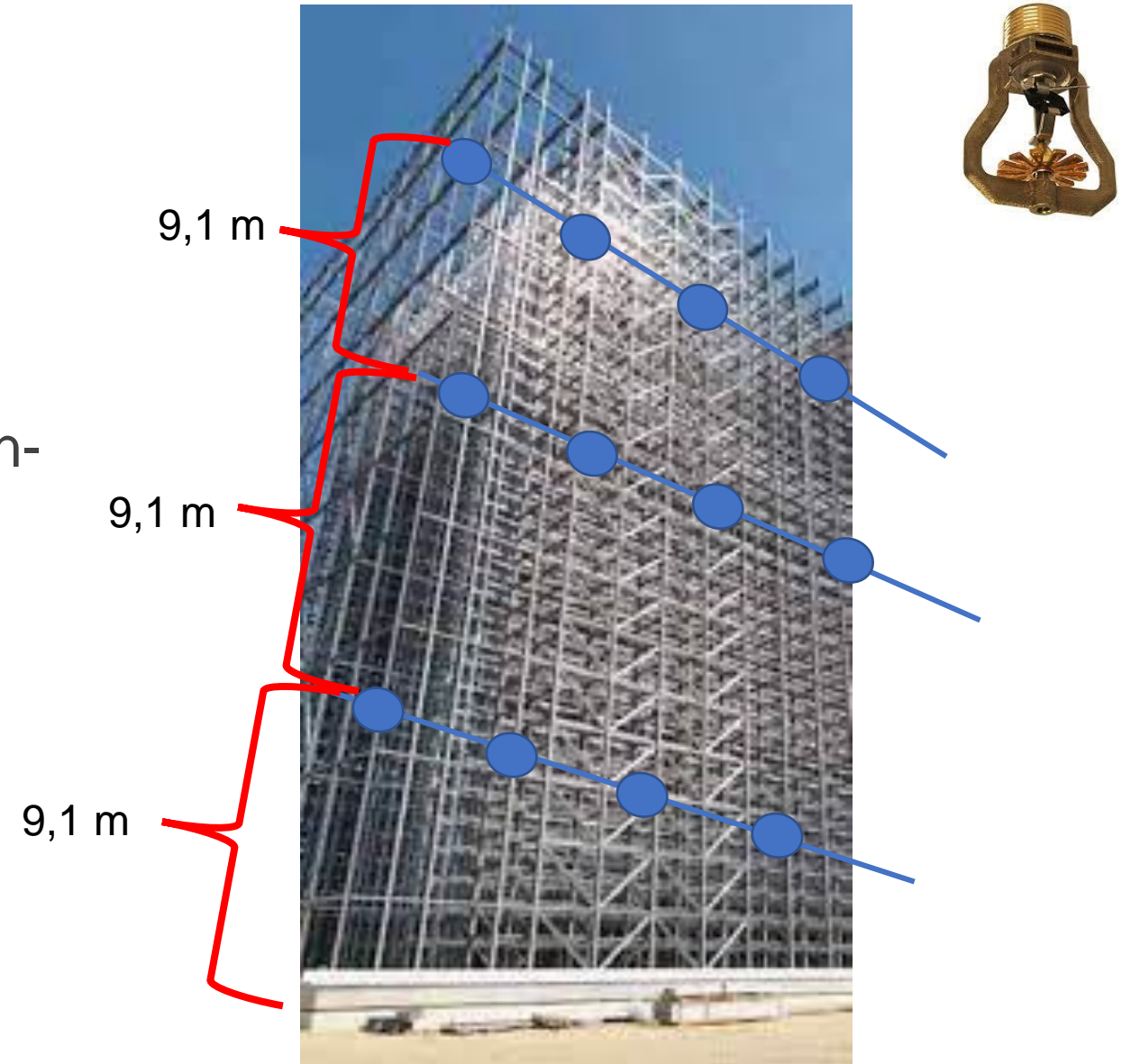
c) Only for solid piled and palletized storage with closed arrays

25.6 Three concepts for in-rack sprinkler solutions "independent of ceiling level sprinklers"

"Option 2a and 2b".

Class I-IV and Group A Plastics.
ESFR pendent sprinklers, K200 or
K320/ K360.

Maximum vertical distance between in-
rack sprinkler levels 9,1 m (Exposed
group A Plastics etc) or 12,2 m
(Cartoned nonexpanded or lower)



25.6 "Option 2".

ESFR pendent sprinklers, K200 or K320/ K360. Minimum flow 250/380/455 l/min; 4,5,6 or 5+5 sprinkler design



E.g. Exposed Group A Plastics, K320 or K360

Type of rack, depth	Mimimum flow (l/min)	Number of design sprinklers
Single row, $\leq 0,9\text{m}$	455	4
Single row, $>0,9\text{m}$ and $< 1,8\text{m}$	455	5
Double row	455	5+5
Multiple row	455	5+5

25.6 "Option 2".

2019 edition

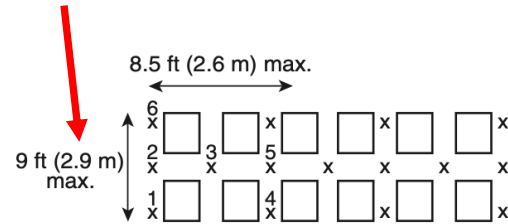


FIGURE 25.8.2.4(d) Plan View of In-Rack Sprinkler Arrangement for Open Double-Row Racks Up to 9 ft (2.7 m) Deep.

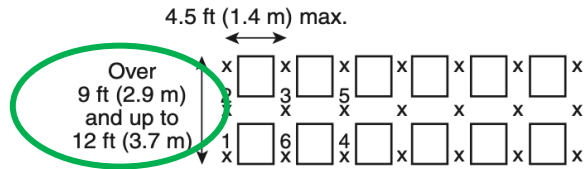


FIGURE 25.8.2.4(e) Plan View of In-Rack Sprinkler Arrangement for Open Double-Row Racks Up to 12 ft (3.7 m) Deep.

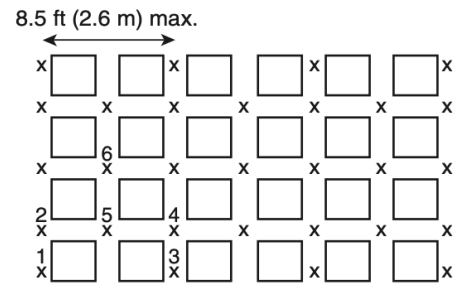


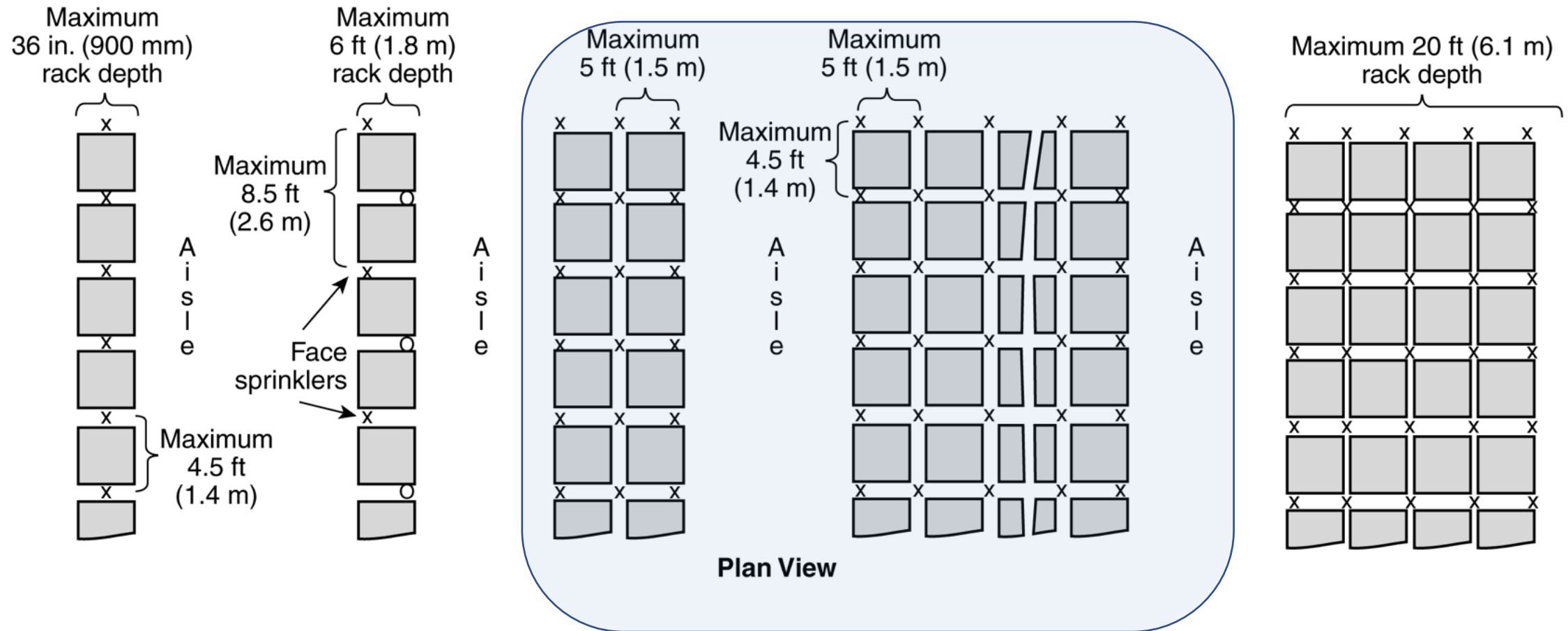
FIGURE 25.8.2.4(f) Plan View of In-Rack Sprinkler Arrangement for Open Multiple-Row Racks.

25.6 "Option 2".

2022 edition



ESFR pendent sprinklers, K200 or K320/ K360. Min 0,7, m, max 1,4m horizontal spacing



25.6 "Option 2".

2019 edition

2022 edition

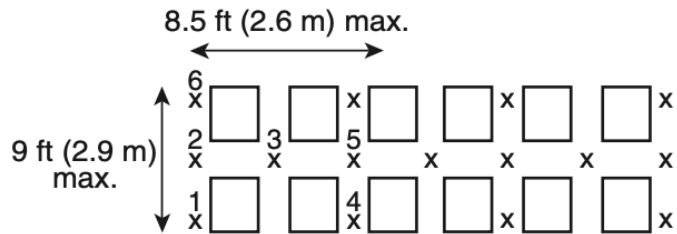


FIGURE 25.8.2.4(d) Plan View of In-Rack Sprinkler Arrangement for Open Double-Row Racks Up to 9 ft (2.7 m) Deep.

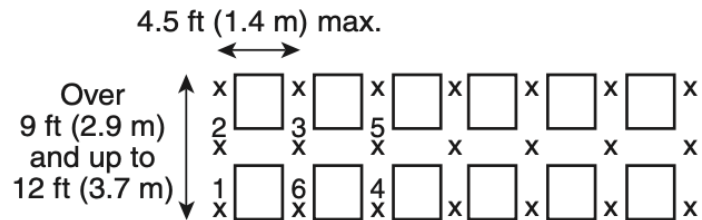
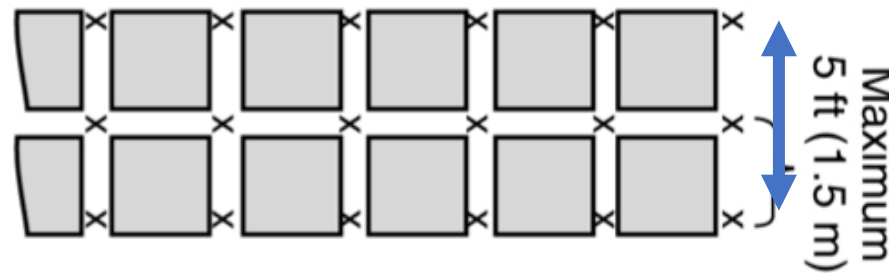
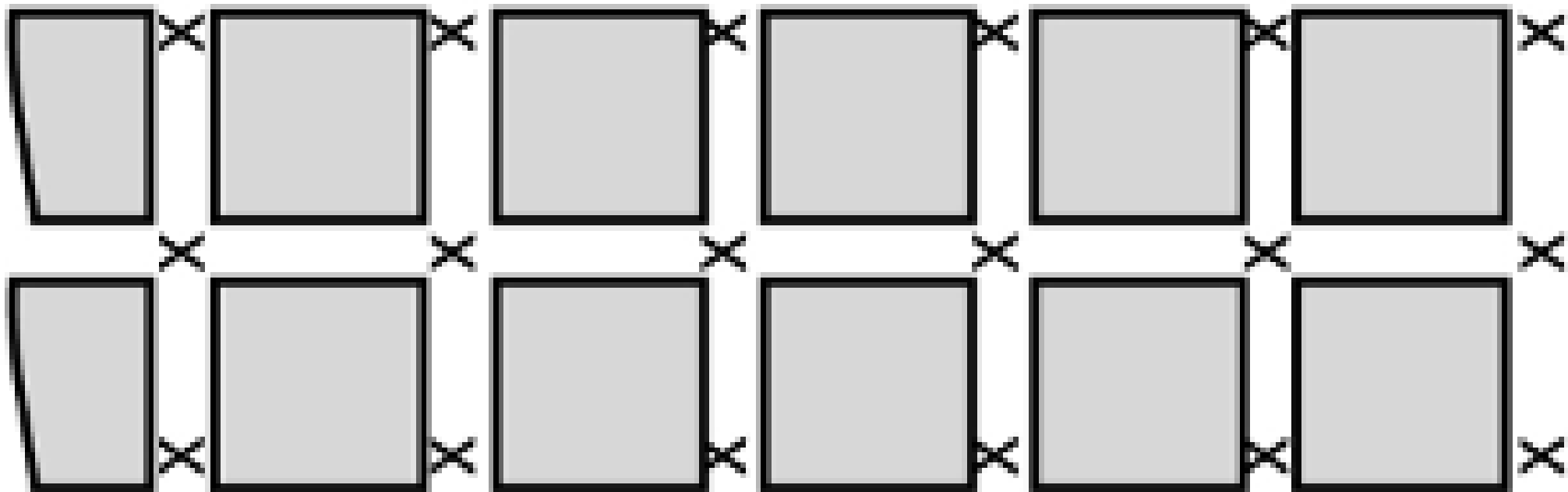
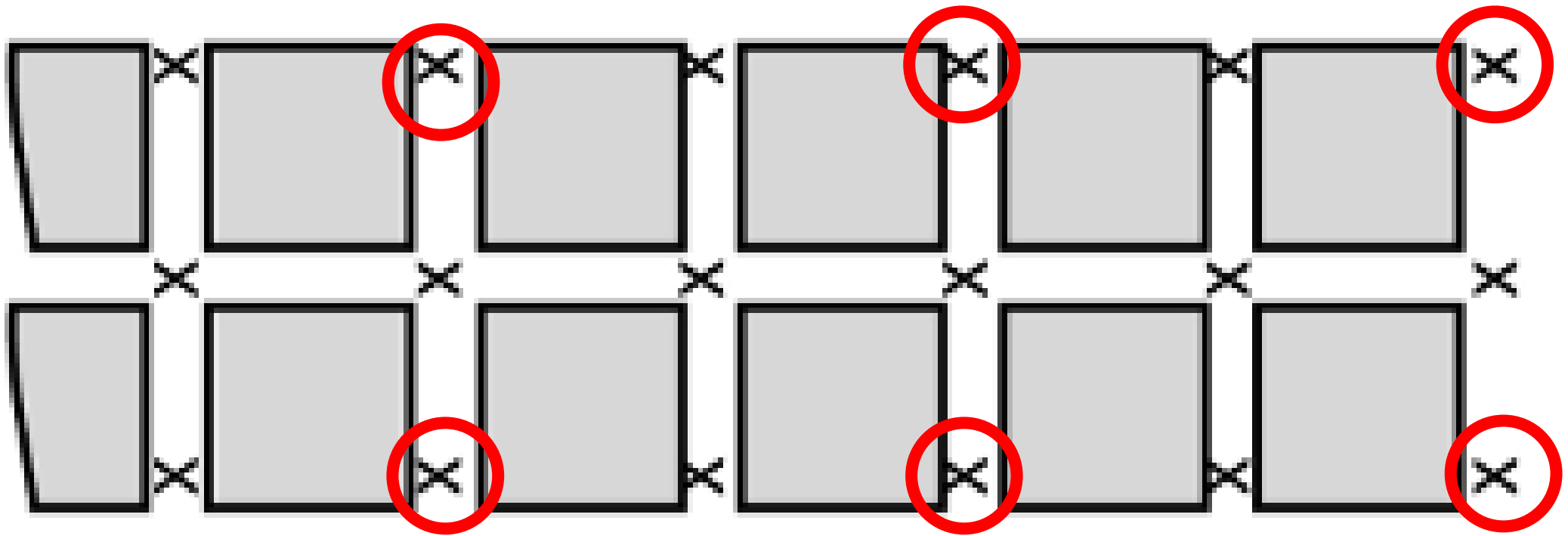


FIGURE 25.8.2.4(e) Plan View of In-Rack Sprinkler Arrangement for Open Double-Row Racks Up to 12 ft (3.7 m) Deep.



$0,45+1,5+1,5 + 0,45 = 3,9m?$





25.6 "Option 2".

2019 edition

2022 edition

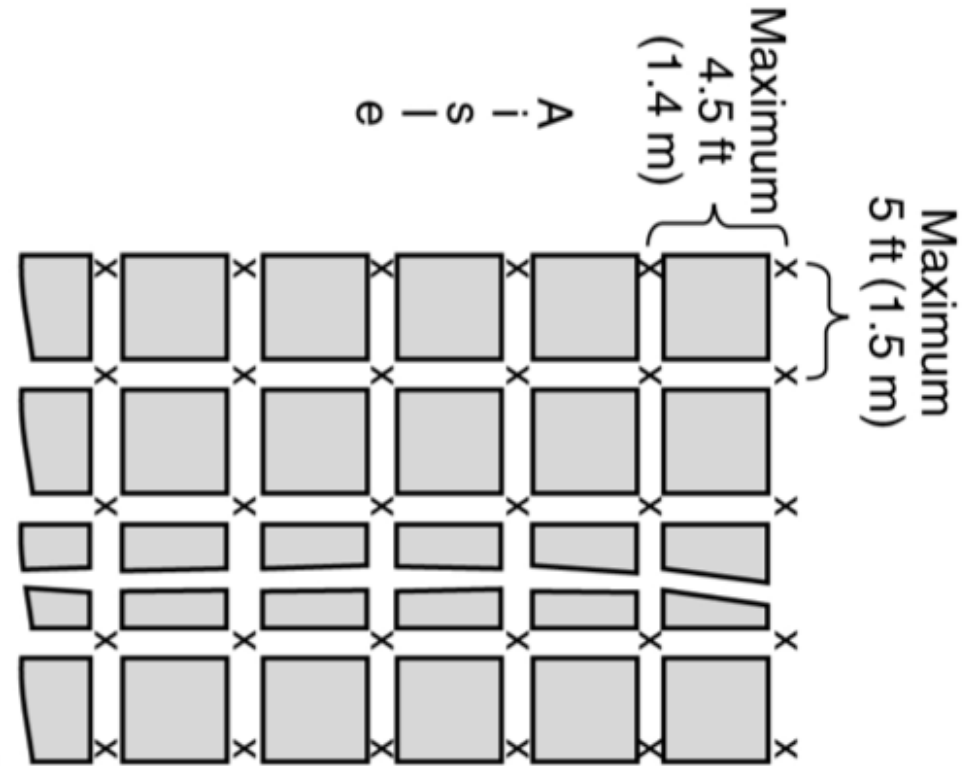
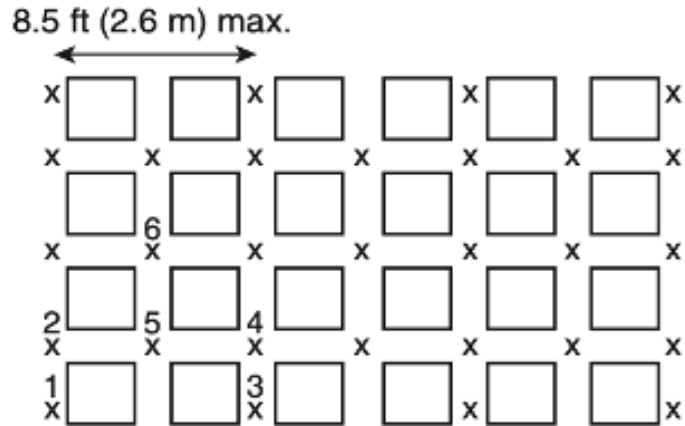
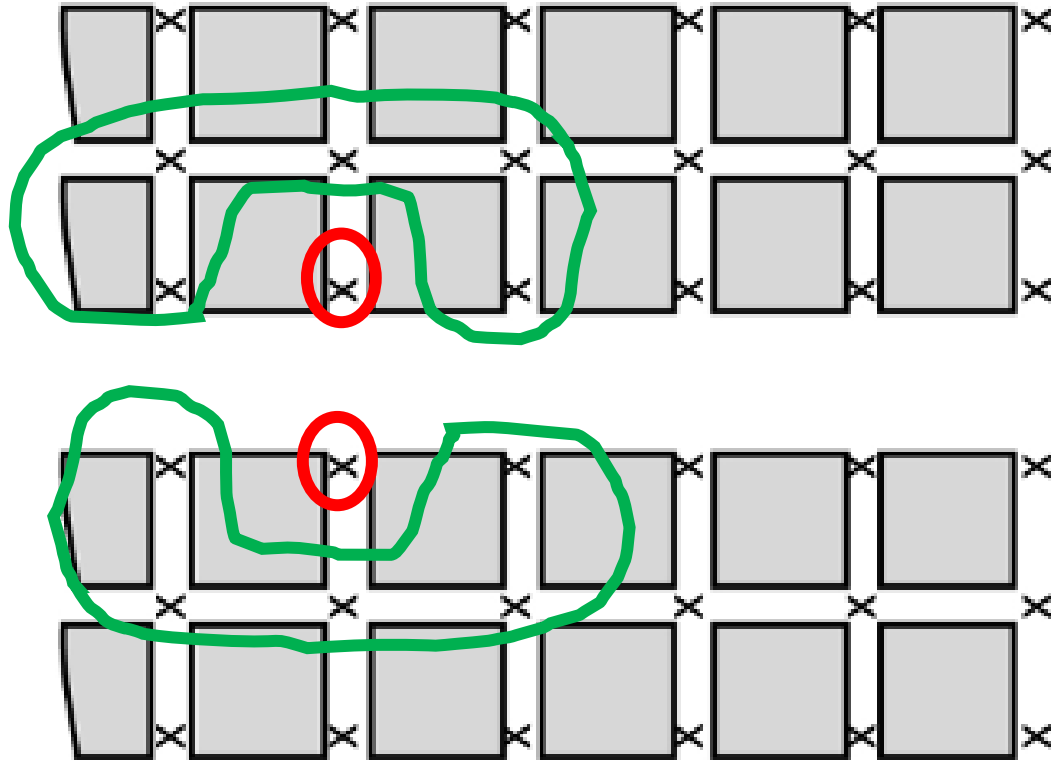


FIGURE 25.8.2.4(f) Plan View of In-Rack Sprinkler Arrangement for Open Multiple-Row Racks.

25.6 "Option 2".

E.g. Exposed Group A Plastics, K320 or K360, double row rack: 5 +5



Design according to EN 12845/CEA 4001

Hazard class	Density (mm(min))	Area of operation (m ²)	Duration (min)
LH	2,25	84	30
OH	5	72-360	60
HHS/HHP	7,5 - 30	260/300	90

Density/area curves: Occupancy hazards

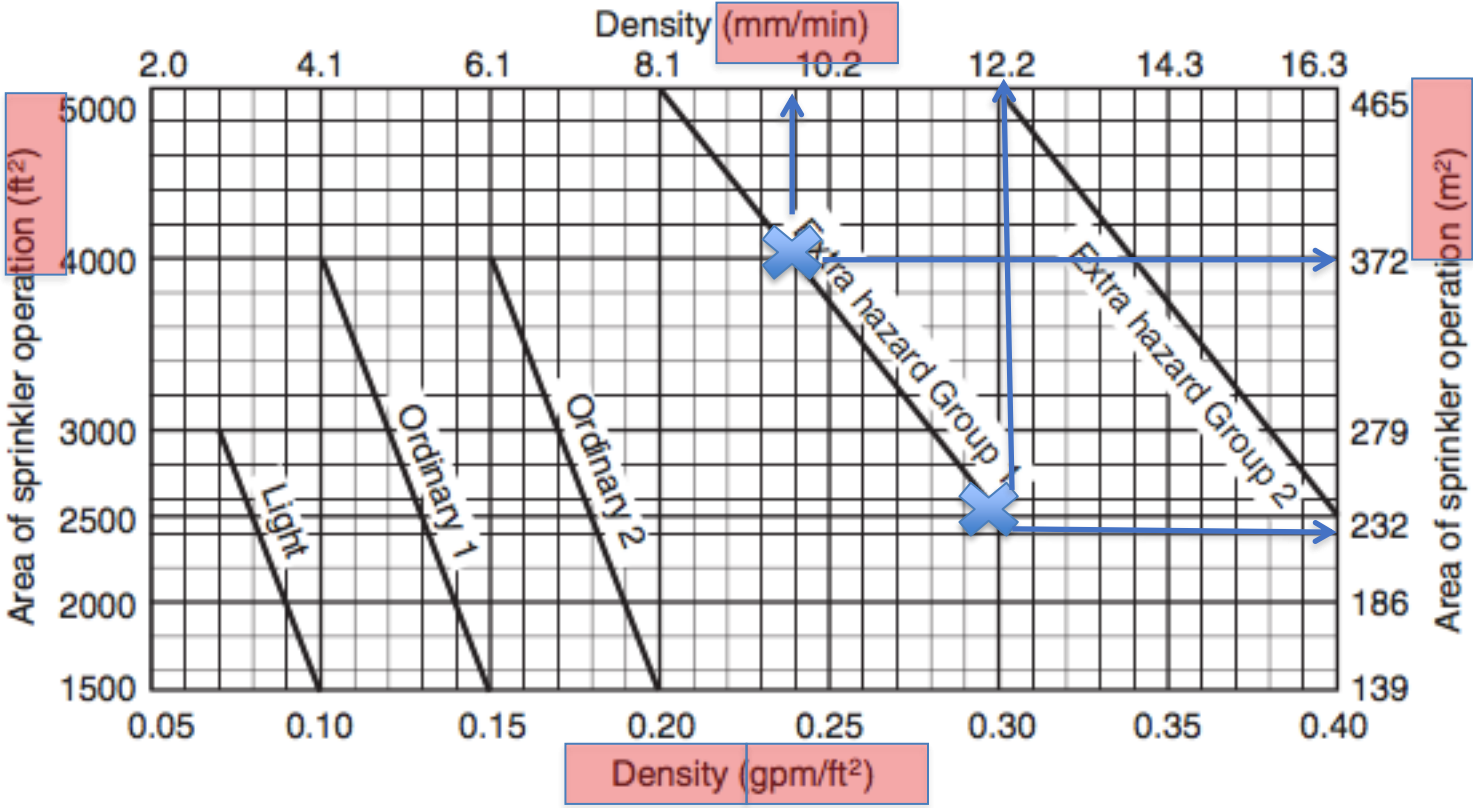
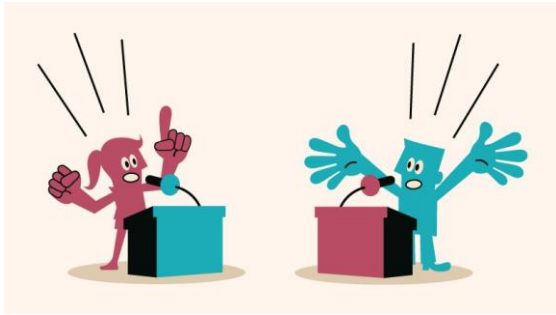


FIGURE 11.2.3.1.1 Density/Area Curves.

Density/area curves: BIG debate during the 2022 cycle



Occupancy hazard design for CMDA in NFPA 13-2022

19.2.3.1.1

The water demand for sprinklers shall be determined only from one of the following, at the discretion of the designer

- 1) For new systems, the density area selected from Table 19.2.3.1.1
- 2) For the evaluation or modification of existing systems, the density/area curves of figure 19.2.3.1.1
- 3) The room design method of section 19.2.3.3
- 4) Special design areas in accordance with 19.2.3.4

Table 19.2.3.1.1 Density/Area

Hazard	Density/Area [gpm/ft²/ft² (mm/min/m²)]
Light	0.1/1500 or 0.07/3000* (4.1/140 or 2.9/280)
Ordinary Group 1	0.15/1500 or 0.12/3000* (6.1/140 or 4.9/280)
Ordinary Group 2	0.2/1500 or 0.17/3000* (8.1/140 or 6.9/280)
Extra Group 1	0.3/2500 or 0.28/3000* (12.2/230 or 11.4/280)
Extra Group 2	0.4/2500 or 0.38/3000* (16.3/230 or 15.5/280)

*When required by 19.2.3.1.5.

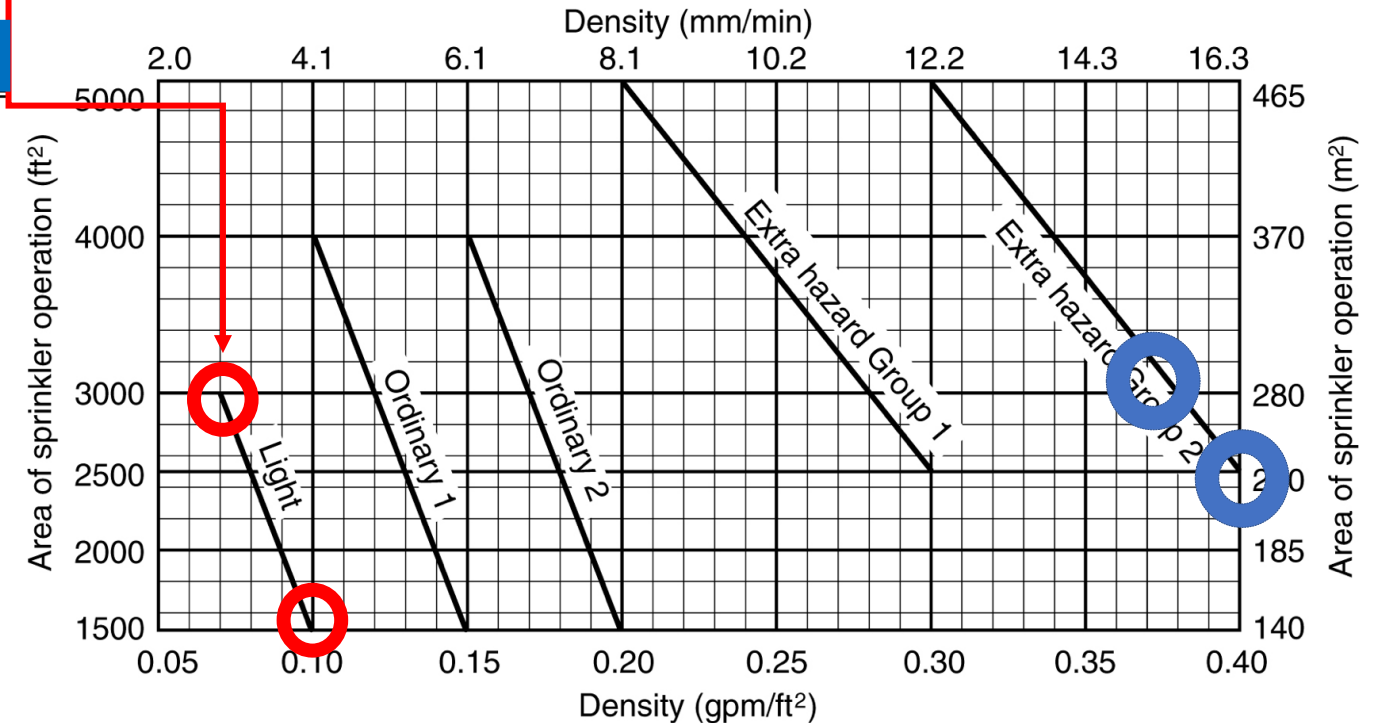
Occupancy hazard design for CMDA in NFPA 13-2022

Table 19.2.3.1.1 Density/Area

Hazard	Density/Area [gpm/ft ² /ft ² (mm/min/m ²)]
Light	0.1/1500 or 0.07/3000* (4.1/140 or 2.9/280)
Ordinary Group 1	0.15/1500 or 0.12/3000* (6.1/140 or 4.9/280)
Ordinary Group 2	0.2/1500 or 0.17/3000* (8.1/140 or 6.9/280)
Extra Group 1	0.3/2500 or 0.28/3000* (12.2/230 or 11.4/280)
Extra Group 2	0.4/2500 or 0.38/3000* (16.3/230 or 15.5/280)

*When required by 19.2.3.1.5.

Figure 19.2.3.1.1 Density/Area Curves for the Evaluation or Modification of Existing Systems.



20.3.1.3 – new "ranking" of commodity classification

- (1) Class I
- (2) Class II
- (3) Class III
- (4) Class IV
- (5) Cartoned nonexpanded plastic
- (6) Cartoned expanded plastic
- (7) Exposed nonexpanded plastic
- (8) Exposed expanded plastic

20.3.1.4

Protection criteria for commodities listed in [20.3.1.3](#) shall be permitted to protect lower commodities in the same list.