

Good Practices & Technologies for Storage Applications

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All Storage is not Equal

The World needs places to put “Stuff”



Commodity Classification

What is the material being stored and protected?

Is there plastic involved?

- Group A - most severe hazard
- Group B - similar to Class IV commodities
- Group C - similar to Class III commodities

Packaging

- Cartoned vs. Uncartoned (Exposed)
- Expanded vs. Unexpanded

Good Practice to avoid In racks

Unexpanded Group A Plastics



Most Common Application
Class I-IV and Group A plastics

Expanded Group A Plastics



Test Commodity

Expanded Polystyrene Trays Exposed

Special Storage



Idle Pallet Storage

- Un-reinforced plastic pallets

- Melt fairly easily in a fire and are less of a fire challenge
- Material
 - Polypropylene
 - high-density polyethylene



- Reinforced plastic pallets

- Hold their structure and integrity longer allowing air gaps to remain longer within the pallet, which fuels the flames and creates a more intense fire
- Material
 - Polypropylene
 - high-density polyethylene



- Classification by Listing

Method and Heights of Storage

Open Frame Racks?

- Single Row
- Double Row
- Multiple Row

Piled Storage

- Solid Pile(Stable or Unstable)
- Palletized
- Shelf(NOT SOLID)
- Bin Box

Good Practice to avoid...

Open Top Containers

Heights over 14.6M(48')

Solid Shelf

Keep Flu spaces in tact



Methods of Storing

Single Row Rack



Methods of Storing

Double Row Rack



Multiple Row Rack



How high is it being stored?

The height of storage is a primary factor in determining how much water will be required to protect it. Any storage above 3,65 m (12'-0") high is considered "high piled" storage.

NFPA and FM generally use graduated storage heights in 1,52m (5'-0") increments. 1,52m (5'-0") is considered a cube of storage.

Height of Building and stored Commodity are used together to gauge risk.

How high is the ceiling?

Height of ceiling is measured to the Deck(or base of insulation attached to the deck). Top of groove if >76mm(3")

NFPA and FM generally use graduated ceiling heights in 1,52m (5'-0") increments.

All storage fire tests are conducted in flat smooth ceilings.

Obstructed Construction?

Distance from Ceiling to Sprinkler Element < 330mm(13")

NFPA, UL and Factory Mutual – What is the difference?

NFPA and Factory Mutual (FM) have different design criteria for many storage arrangements.

Factory Mutual is an insurance underwriter and does not always require compliance with NFPA.

Underwriters Laboratory is a rating agency for many insurance companies and typically follows NFPA

Storage applications can be significantly affected based on who is the lead authority on the project

**Table 17.2.3.1 ESFR Protection of Rack Storage Without Solid Shelves of Plastics Commodities
Stored Up to and Including 25 ft (7.6 m) in Height**

| Storage Arrangement | Commodity | Maximum Storage Height | | Maximum Ceiling/Roof Height | | Nominal K-Factor | Orientation | Minimum Operating Pressure | | In-Rack Sprinkler Requirements |
|---|----------------------|------------------------|-----|-----------------------------|------|------------------|-----------------|----------------------------|-----|--------------------------------|
| | | ft | m | ft | m | | | psi | bar | |
| Single-, double-, and multiple-row racks (no open-top containers) | Cartoned nonexpanded | 20 | 6.1 | 25 | 7.6 | 14.0 (200) | Upright/pendent | 50 | 3.4 | No |
| | | | | | | 16.8 (240) | Upright/pendent | 35 | 2.4 | No |
| | | | | | | 22.4 (320) | Pendent | 25 | 1.7 | No |
| | | | | | | 25.2 (360) | Pendent | 15 | 1.0 | No |
| | | | | 40 | 12.2 | 14.0 (200) | Upright/pendent | 50 | 3.4 | No |
| | | | | | | 16.8 (240) | Upright/pendent | 35 | 2.4 | No |
| | | | | | | 22.4 (320) | Pendent | 25 | 1.7 | No |
| | | | | | | 25.2 (360) | Pendent | 15 | 1.0 | No |
| | | | | | | 14.0 (200) | Upright/pendent | 75 | 5.2 | No |
| | | | | | | 16.8 (240) | Upright/pendent | 52 | 3.6 | No |
| | | | | | | 22.4 (320) | Pendent | 35 | 2.4 | No |
| | | | | | | 25.2 (360) | Pendent | 20 | 1.4 | No |
| | | | | | | 16.8 (240) | Pendent | 52 | 3.6 | No |
| | | | | | | 22.4 (320) | Pendent | 40 | 2.8 | No |
| | | | | | | 25.2 (360) | Pendent | 25 | 1.7 | No |

K 200 (14) Pendent ESFR's are limited to 10,66m (35'-0") ceiling heights per UL and NFPA 13. The K 200 (14) were not able to pass a UL 6,09m (20'-0") clear fire test. The clear fire test is 6,09m (20'-0") of open space above the top of storage. The sprinkler was not able to pass fires with 12,19m *(40'-0") ceilings and 6,09m (20'-0") high storage.

K25.2 vs K22.4 ESFR Application Differences

FM Design Comparison from July 2015 release of FM 8-9

| | | FM K 320 (22.4) Design Criteria | | FM K 360 (25.2) Design Criteria | |
|-----------------|-----------------|---------------------------------|-------------------|---------------------------------|-------------------|
| Storage Height | Ceiling Height | Bar (Psi) | Flow | Bar (Psi) | Flow |
| 6,09m (20'-0") | 7,6m (25'-0") | 1,37 Bar (20 psi) | 379 lpm (100 gpm) | 1,37 Bar (20 psi) | 420 lpm (112 gpm) |
| 7,6m (25'-0") | 9,14m (30'-0") | 1,37 Bar (20 psi) | 379 lpm (100 gpm) | 1,37 Bar (20 psi) | 420 lpm (112 gpm) |
| 9,14m (30'-0") | 10,66m (35'-0") | 2,06 Bar (30 psi) | 466 lpm (123 gpm) | 2,06 Bar (30 psi) | 522 lpm (138 gpm) |
| 10,66m (35'-0") | 12,19m (40'-0") | 2,75 Bar (40 psi) | 568 lpm (150 gpm) | 2,75 Bar (40 psi) | 602 lpm (159 gpm) |
| 12,19m (40'-0") | 13,7m (45'-0") | 3,44 Bar (50 psi) | 598 lpm (158 gpm) | 3,44 Bar (50 psi) | 674 lpm (178 gpm) |

| | | NFPA/UL K 320 (22.4) Design Criteria | | NFPA/UL K 360 (25.2) Design Criteria | |
|-----------------|-----------------|--------------------------------------|-------------------|--------------------------------------|-------------------|
| Storage Height | Ceiling Height | Bar (Psi) | Flow | Bar (Psi) | Flow |
| 6,09m (20'-0") | 7,6m (25'-0") | 1,7 Bar (25 psi) | 420 lpm (112 gpm) | 1,03 Bar (15 psi) | 371 lpm (98 gpm) |
| 7,6m (25'-0") | 9,14m (30'-0") | 1,7 Bar (25 psi) | 420 lpm (112 gpm) | 1,03 Bar (15 psi) | 371 lpm (98 gpm) |
| 9,14m (30'-0") | 10,66m (35'-0") | 2,4 Bar (35 psi) | 495 lpm (132 gpm) | 1,37 Bar (20 psi) | 428 lpm (113 gpm) |
| 10,66m (35'-0") | 12,19m (40'-0") | 2,75 Bar (40 psi) | 534 lpm (141 gpm) | 1,7 Bar (25 psi) | 477 lpm (126 gpm) |
| 12,19m (40'-0") | 13,7m (45'-0") | 2,75 Bar (40 psi) | 534 lpm (141 gpm) | 2,75 Bar (40 psi) | 302 lpm (159 gpm) |

Table 3. Ceiling-Level Protection Guidelines for Class 4 and Cartoned Unexpanded Plastic Commodities in a Solid-Piled, Palletized, Shelf, or Bin-Box Storage Arrangement

Protection of Class 4 and Cartoned Unexpanded Plastic Commodities in Solid-Piled, Palletized, Shelf, and Bin-Box Arrangements; No. of AS @ psi (bar)

| Max. Ceiling Height, ft (m) | Wet System, Pendent Sprinklers, 160°F (70°C) | | | | | | | | | | Wet System, Upright Sprinklers, 160°F (70°C) | | | | | | | Dry System, Upright Sprinklers, 280°F (140°C) | | | |
|-----------------------------|--|---------------|---------------|---------------|---------------|---------------------------|-------------------|---------------|---------------|---------------|--|---------------|---------------|------------------|-------------------|---------------|---------------|---|---------------|---------------|---------------|
| | 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) | K19.6 (K280) | K25.2 (K360) |
| 15 (4.5) | 20 @ 7 (0.5) | 12 @ 50 (3.5) | 12 @ 35 (2.4) | 12 @ 20 (1.4) | 12 @ 20 (1.4) | 6 @ 20 (1.4) | 20 @ 7 (0.5) | 20 @ 7 (0.5) | 12 @ 16 (1.1) | 12 @ 7 (0.5) | 20 @ 7 (0.5) | 12 @ 50 (3.5) | 12 @ 35 (2.4) | 6 @ 20 (1.4) | 20 @ 7 (0.5) | 20 @ 7 (0.5) | 12 @ 20 (1.4) | 25 @ 7 (0.5) | 25 @ 7 (0.5) | 20 @ 30 (2.1) | 20 @ 7 (0.5) |
| 20 (6.0) | 15 @ 25 (1.7) | 12 @ 50 (3.5) | 12 @ 35 (2.4) | 12 @ 20 (1.4) | 12 @ 20 (1.4) | 6 @ 20 (1.4) | 15 @ 25 (1.7) | 15 @ 15 (1.0) | 12 @ 16 (1.1) | 12 @ 7 (0.5) | 15 @ 25 (1.7) | 12 @ 50 (3.5) | 12 @ 35 (2.4) | 6 @ 20 (1.4) | 15 @ 25 (1.7) | 15 @ 15 (1.0) | 12 @ 20 (1.4) | 20 @ 25 (1.7) | 20 @ 15 (1.0) | 20 @ 30 (2.1) | 20 @ 7 (0.5) |
| 25 (7.5) | 15 @ 50 (3.5) | 12 @ 50 (3.5) | 12 @ 35 (2.4) | 12 @ 20 (1.4) | 12 @ 20 (1.4) | 6 @ 20 (1.4) | 15 @ 50 (3.5) | 15 @ 35 (2.4) | 12 @ 16 (1.1) | 12 @ 10 (0.7) | 15 @ 50 (3.5) | 12 @ 50 (3.5) | 12 @ 35 (2.4) | 6 @ 20 (1.4) | 15 @ 50 (3.5) | 15 @ 22 (1.5) | 12 @ 20 (1.4) | 20 @ 50 (3.5) | 20 @ 22 (1.5) | 20 @ 30 (2.1) | 20 @ 10 (0.7) |
| 30 (9.0) | 20 @ 50 (3.5) | 12 @ 50 (3.5) | 12 @ 35 (2.4) | 12 @ 20 (1.4) | 12 @ 20 (1.4) | 6 @ 25 (1.7) | 20 @ 50 (3.5) | 20 @ 35 (2.4) | 12 @ 16 (1.1) | 12 @ 10 (0.7) | 20 @ 50 (3.5) | 12 @ 50 (3.5) | 12 @ 35 (2.4) | 6 @ 25 (1.7) | 20 @ 50 (3.5) | 20 @ 22 (1.5) | 12 @ 20 (1.4) | 25 @ 50 (3.5) | 25 @ 22 (1.5) | 25 @ 30 (2.1) | 25 @ 10 (0.7) |
| 35 (10.5) | | 12 @ 75 (5.2) | 12 @ 50 (3.5) | 12 @ 30 (2.1) | 12 @ 30 (2.1) | 8 @ 60 (4.1) ^a | | | 15 @ 25 (1.7) | 12 @ 30 (2.1) | | 12 @ 75 (5.2) | 12 @ 50 (3.5) | 8 @ 40 (2.8) | | | | | | | |
| 40 (12.0) | | 12 @ 75 (5.2) | 12 @ 50 (3.5) | 12 @ 40 (2.8) | 12 @ 40 (2.8) | | | | | 12 @ 30 (2.1) | | | | | | | | | | | |
| 45 (13.5) | | 12 @ 90 (6.2) | 12 @ 65 (4.5) | 12 @ 50 (3.5) | 12 @ 50 (3.5) | | | | | | | | | | | | | | | | |

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

Current Storage Product Selection Options

NFPA specifies (3) types of storage sprinklers:

Control Mode Sprinklers (CMDA)

Control Mode Specific Application (CMSA)

Early Suppression Fast Response (ESFR)

Factory Mutual(4th Type!) FM Simply started referring to sprinklers tested for storage as “Storage Sprinklers”.

Lessons Learned

More Pressure = More Water = Better Fire Protection?

Larger K factors are more efficient in storage applications

NFPA limits K factors based on ceiling density.

Factory Mutual requires that the minimum K factor at the ceiling is K 11.2.

Larger K factors produce larger water droplets that penetrate the fire plume and are more able to attack the base of the fire.

Smaller K factor sprinklers produce smaller water droplets that tend to be pushed up and away from the fire.



K 160 (11.2) Dry Barrel ELO pendent

FM approved

Designed for moderate ceiling heights of freezer that have Insulated ceilings and heated space above them.

Control Mode Sprinklers



K 240 (16.8) SR Upright sprinkler. Used almost exclusively for the tire storage areas of Costco and Sam's Club. Ideally used when density is above 18 mm/m² (.45 gpm/ft²)

Control Mode Sprinklers



K 360 (25.2) EC Upright sprinkler. Is referred to as CMDA and CMSA sprinkler. Developed for the protection of big box stores. Changes in FM 8-9 expand its use.

In –rack sprinklers (intermediate level sprinklers)

Alternate In-rack design by Factory Mutual from 8-9.
Changes in FM 8-9 now show how ESFR sprinklers can be installed as in-rack sprinklers and allow for greater separation of in-rack sprinklers and higher ceiling heights.

Table 16. Minimum Flow in the In-Rack Design

| <i>Max. Vertical IRAS Installation, ft (m)</i> | <i>Commodity Hazard</i> | <i>Min. K-factor</i> | <i>Min. Flow, from Most Remote In-Rack Sprinkler, gpm (L/min)</i> |
|--|---|----------------------|---|
| 30 (9.0) | Class 1 through 4 and Cartoned Unexpanded Plastic | 14.0 (200) | 65 (250) |
| | Cartoned Expanded Plastic | 14.0 (200) | 100 (380) |
| | Uncartoned Plastics | 22.4 (320) | 120 (455) |
| 40 (12) | Class 1 through 4 and Cartoned Unexpanded Plastic | 22.4 (320) | 120 (455) |

CMSA (Control Mode Specific Application)



K 160 (11.2) Upright, known as the High Challenge or Large Drop Sprinkler. It's protection schemes are commodity dependent. Use for rolled paper storage and freezer boxes. Ideal for Class 2 Commodities in freezers stored 7,6m (25'-0") high with a ceiling at 9,14 m (30'-0").



K 280 (19.6) Pendent. Lowest water requirement for 7,6m (25'-0") storage of cartoned non-expanded Group A plastic in a 9,14m (30'-0") building. Has more forgiving installation requirements than an ESFR.

VK 598 K 360 (25.2) SR UPRIGHT Sprinkler

Dry System Design Criteria for Class 1-111 Commodities - Solid Pile, Palletized, Shelf or Bin Box

| Storage Height | Ceiling Height | # of Sprinklers | Pressure |
|-----------------|-----------------|-----------------|-------------------|
| 12,19m (40'-0") | 13,7m (45'-0") | 12* | 3,44 Bar (50 psi) |
| 10,66m (35'-0") | 12,19m (40'-0") | 24** | 1,03 Bar (15 psi) |
| 9,14m (30'-0") | 10,66m (35'-0") | 20 | ,48 Bar (7 psi) |

Dry System Design Criteria for Class 1-111 Commodities - Open Fram Racks

| Storage Height | Ceiling Height | # of Sprinklers | Pressure |
|-----------------|-----------------|-----------------|-------------------|
| 12,19m (40'-0") | 13,7m (45'-0") | 12* | 3,44 Bar (50 psi) |
| 10,66m (35'-0") | 12,19m (40'-0") | 24** | 1,03 Bar (15 psi) |
| 9,14m (30'-0") | 10,66m (35'-0") | 25 | ,68 Bar (10 psi) |

* - Based on 20 second water delivery

** - Based on 25 second water delivery



- FM Approved
- Standard Response
- 25.2 (363) K Factor
- 1" NPT (25 mm)
- Glass Bulb
- 155, 175, 200, and 286°F temp ratings
- Max storage = 40 ft.
- Max ceiling = 45 ft.
- Protects up to Class III commodities
- 10 x 10' spacing
- Viking Tech Services will provide water delivery calculations upon request!

ESFR's (Early Suppression Fast Response)



K 200 (14) Pendent ESFR, the first ESFR. Basis of most research fire testing For ceiling only sprinkler protection. Now limited in ceiling height in NFPA, but not FM.



Upright ESFR, K 200 (14) or K 240 (16.8), the first Upright ESFR. Limited to 10,66 m (35'-0") ceilings. More forgiving to obstructions below them.



K 240 (16.8) pendent ESFR. Currently, most prevalent ESFR sprinkler installed. Efficient in water pressure and water flow.

ESFR's (Early Suppression Fast Response)



K 320 (22.4) Pendent ESFR. Has different design criteria between NFPA and FM. New criteria from FM makes it more efficient for than K 360 (25.2) ESFR.



K 360 (25.2) Pendent ESFR. First ESFR directed at elevations greater than 12,19 m (40'-0"). More specialized fire testing in the last 2 decades have been centered around the K 360 (25.2) ESFR.

Commodity Scale

| Commodity | In-Rack Storage | Piled, Palletized, & Bin Box Storage |
|--------------------------------------|---------------------------------|--------------------------------------|
| Class I | FM Table #7 | FM Table #2 |
| Class 2 | FM Table #7 | FM Table #2 |
| Class 3 | FM Table #7 | FM Table #2 |
| Class 4 | FM Table #7 | FM Table #3 |
| Cartoned Unexpanded Plastic | FM Table #8 | FM Table #3 |
| | Class I-IV and Group A Plastics | |
| Cartoned Expanded Plastic | FM Table #9 | FM Table #4 |
| Uncartoned Unexpanded Plastic | FM Table #10 | FM Table #5 |
| Uncartoned Expanded Plastic | FM Table #11 | FM Table #6 |

ESFR's K25/K22 ESFR Best Practice

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)

| 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, Pendent Sprinklers, 160°F (70°C) | | | | | | | | | | Wet System, Upright Sprinklers, 160°F (70°C) | | | | | | Dry System, Upright Sprinklers, 280°F (140°C) | | | | | |
| | 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) | K19.6 (K280) | K25.2 (K360) | |
| 15 (4.5) | 20 @ 7 (0.5) | 12 @ 50 (3.5) | 12 @ 35 (2.4) | 12 @ 20 (1.4) | 12 @ 20 (1.4) | 6 @ 25 (1.7) | 20 @ 7 (0.5) | 20 @ 7 (0.5) | 12 @ 16 (1.1) | 12 @ 7 (0.5) | 20 @ 7 (0.5) | 12 @ 50 (3.5) | 12 @ 35 (2.4) | 6 @ 25 (1.7) | 20 @ 7 (0.5) | 20 @ 7 (0.5) | 12 @ 20 (1.4) | 25 @ 7 (0.5) | 25 @ 7 (0.5) | 20 @ 30 (2.1) | 20 @ 7 (0.5) | |
| 20 (6.0) | 15 @ 25 (1.7) | 12 @ 50 (3.5) | 12 @ 35 (2.4) | 12 @ 20 (1.4) | 12 @ 20 (1.4) | 6 @ 25 (1.7) | 15 @ 25 (1.7) | 15 @ 15 (1.0) | 12 @ 16 (1.1) | 12 @ 7 (0.5) | 15 @ 25 (1.7) | 12 @ 50 (3.5) | 12 @ 35 (2.4) | 6 @ 25 (1.7) | 15 @ 25 (1.7) | 15 @ 15 (1.0) | 12 @ 20 (1.4) | 20 @ 25 (1.7) | 20 @ 15 (1.0) | 20 @ 30 (2.1) | 20 @ 7 (0.5) | |
| 25 (7.5) | 15 @ 50 (3.5) | 12 @ 50 (3.5) | 12 @ 35 (2.4) | 12 @ 20 (1.4) | 12 @ 20 (1.4) | 6 @ 25 (1.7) | 15 @ 50 (3.5) | 15 @ 35 (2.4) | 12 @ 16 (1.1) | 12 @ 10 (0.7) | 15 @ 50 (3.5) | 12 @ 50 (3.5) | 12 @ 35 (2.4) | 6 @ 25 (1.7) | 15 @ 50 (3.5) | 15 @ 22 (1.5) | 12 @ 20 (1.4) | 20 @ 50 (3.5) | 20 @ 22 (1.5) | 20 @ 30 (2.1) | 20 @ 10 (0.7) | |
| 30 (9.0) | | 12 @ 50 (3.5) | 12 @ 35 (2.4) | 12 @ 20 (1.4) | 12 @ 20 (1.4) | 6 @ 30 (2.1) | | | 12 @ 16 (1.1) | 12 @ 10 (0.7) | | 12 @ 50 (3.5) | 12 @ 35 (2.4) | 6 @ 30 (2.1) | | | 12 @ 20 (1.4) | | | 25 @ 30 (2.1) | 25 @ 15 (1.0) | |
| 35 (10.5) | | 12 @ 75 (5.2) | 12 @ 50 (3.5) | 12 @ 30 (2.1) | 12 @ 30 (2.1) | 8 @ 60 (4.1) ^a | | | 15 @ 25 (1.7) | 12 @ 30 (2.1) | | 12 @ 75 (5.2) | 12 @ 50 (3.5) | 8 @ 40 (2.8) | | | | | | | | |
| 40 (12.0) | | 12 @ 75 (5.2) | 12 @ 50 (3.5) | 12 @ 40 (2.8) | 12 @ 40 (2.8) | | | | | 12 @ 30 (2.1) | | | | | | | | | | | | |
| 45 (13.5) | | | | 12 @ 50 (3.5) | 12 @ 50 (3.5) | | | | | | | | | | | | | | | | | |

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

ESFR's (Early Suppression Fast Response)



K 240 (16.8) Dry Pendent ESFR. Natural evolution to larger K factor. More efficient pressure usage for same application as K 200 (14) ESFR.

K 400 (28) Spec App ESFR



Will protect 13,1m (43'-0") storage where the ceiling is 14,6m (48'-0").

Class I-IV and Un-expanded, cartoned Group A plastics

Listed for 1,82m (6'-0") aisles

Low starting pressure at 2,4 Bar (35 psi)



- 1. Minimum thrust pressure can't be ignored.**
- 2. Large K factors make large water droplets.**
- 3. Very Large K factors make large water droplets, but require a lot Water.**
- 4. Very large K factors might be used to push over the 15,2 m (50'-0") barrier, but we will require higher pressure and might need more than (12) sprinkler design areas.**



BULLETIN

CARE AND HANDLING
OF SPRINKLERS

SPRINKLERS ARE FRAGILE – HANDLE WITH CARE!

USE THE FOLLOWING PRECAUTIONS

General Handling and Storage:

- Store sprinklers in a cool, dry place.
- Protect sprinklers during storage, transport, handling, and after installation.
- Use the original shipping containers. DO NOT place sprinklers loose in boxes, bins, or buckets.
- Keep sprinklers separated at all times. DO NOT allow metal parts to contact sprinkler operating elements.

For Pre-Assembled Drops:

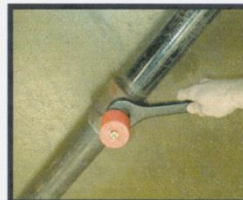
- Protect sprinklers during handling and after installation.
- For recessed assemblies, use the protective sprinkler cap (Viking Part Number 10364).

Sprinklers with Protective Shields or Caps:

- DO NOT remove shields or caps until after sprinkler installation and there no longer is potential for mechanical damage to the sprinkler operating elements.
- Sprinkler shields or caps MUST be removed BEFORE placing the system in service!
- Remove the sprinkler shield by carefully pulling it apart where it is snapped together.
- Remove the cap by turning it slightly and pulling it off the sprinkler.

Sprinkler Installation:

- DO NOT use the sprinkler deflector or operating element to start or thread the sprinkler into a fitting.
- Use only the designated sprinkler head wrench. Refer to the current sprinkler technical data page to determine the correct wrench for the model of sprinkler used.
- DO NOT install sprinklers onto piping at the floor level.
- Install sprinklers after the piping is in place to prevent mechanical damage.
- Take care not to over-tighten the sprinkler or damage its operating parts.
- DO NOT attempt to remove drywall, paint, etc., from sprinklers.

CORRECT
(original container used)INCORRECT!
(sprinklers placed loose in box)CORRECT
(sprinklers protected with caps)INCORRECT!
(protective caps not used)CORRECT
(piping is in place at the ceiling)INCORRECT!
(sprinkler at floor level)CORRECT
(special installation wrenches)INCORRECT!
(designated wrench not used)

WARNING: Any sprinkler with a loss of liquid from the glass bulb or damage to the fusible element should be destroyed. Never install sprinklers that have been dropped, damaged, or exposed to temperatures exceeding the maximum ambient temperature allowed. Sprinklers that have been painted in the field must be replaced per NFPA 13. Protect sprinklers from paint and paint overspray in accordance with the installation standards. Do not use adhesives or solvents on sprinklers or their operating elements.

Refer to the appropriate technical data page for complete care, handling, and installation instructions. Data pages are included with each shipment from Viking or Viking distributors. They can also be found in your Viking Technical Data Book and on the Web site at www.vikingcorp.com.



Thank You