In-rack sprinkler protection

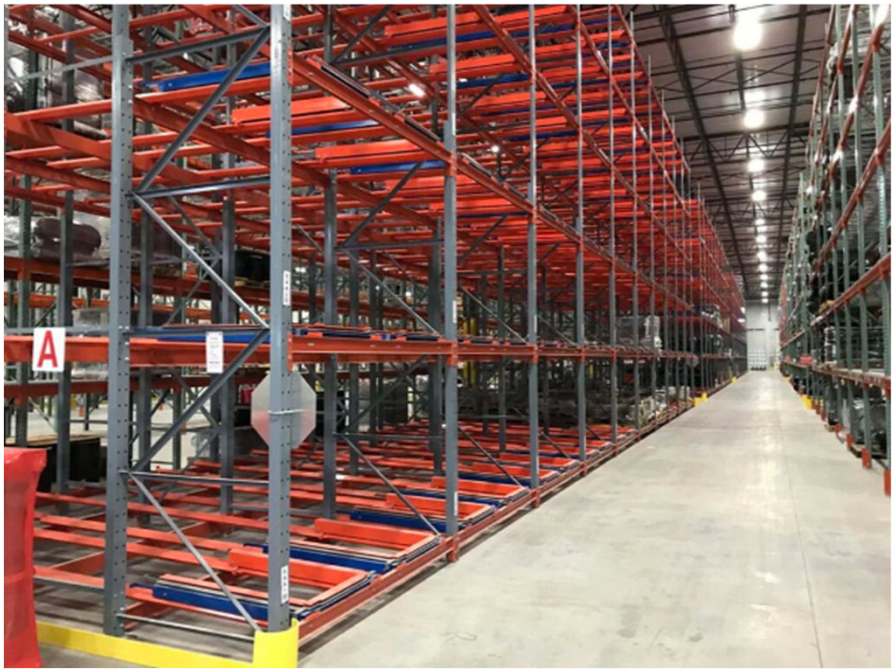
9&10 June 2026

What we will review

- Definitions
- Position of in-rack sprinklers
- Alternative in-rack schemes
- Fire Protection Scheme 8-9A
- Workshop

When do we need In-Rack sprinklers?

- When there is no ceiling only protection available.
  - Height of the building
  - Special commodities
  - Solid shelves or Open Top Containers in the racks
  - Available water supply
  - Existing weak ceiling protection
- Change of commodity.
  - Production area to storage
  - Change of commodity CUP to UUP or worse
  - Introducing new hazards e.g. Li-ion batteries

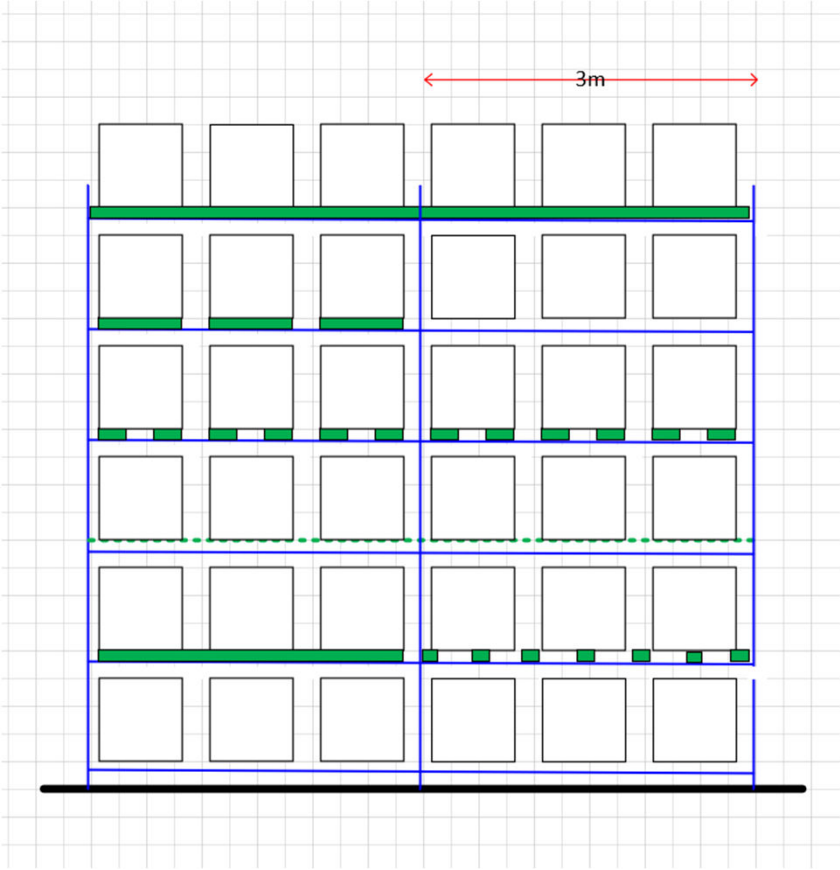


Definition of racks

- Single row rack (SRR):
  - Depth maximum 1.8m.
  - Aisle between racks minimum 1.2m
- Double row racks (DRR):
  - Depth >1.8m and <3.7m
  - Aisle between racks minimum 1.2m
- Multiple row racks (MRR):
  - If not per definition of SRR or DRR.

Shelves within Racking

- Racks with continuous solid shelves likely to need in-rack sprinklers at every tier
- Solid shelves up to 6m^2 likely to need some in-rack sprinklers
- Solid shelves up to 2m^2 acceptable without additional in-racks provided flues are acceptable
- 70% open mesh can span flues without compromising them
- Slatted shelves where the slats block flues likely to be treated as solid shelves

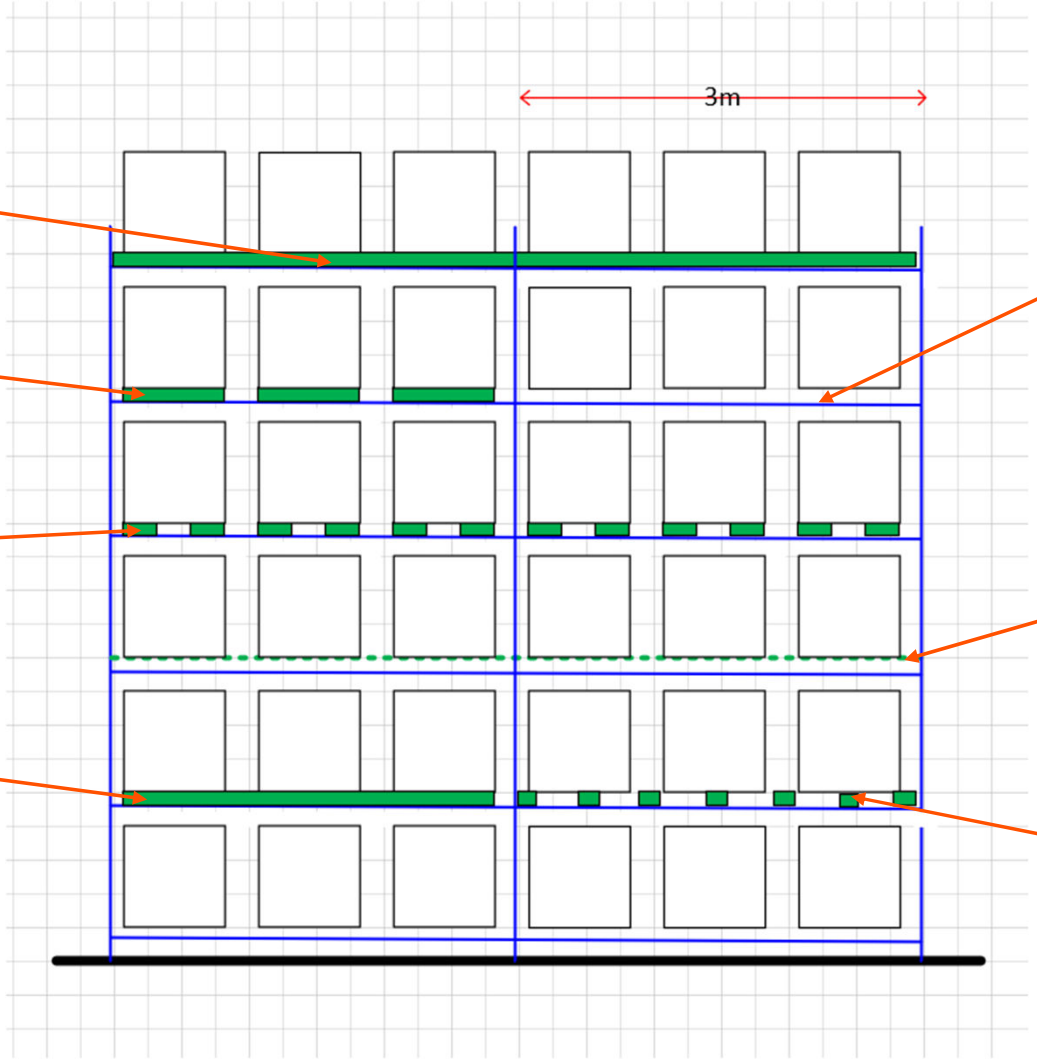


Continuous Solid Shelf

Solid shelf less than $2m^2$, not blocking flues

Slatted shelves not blocking flues

$2m^2 <$ Solid Shelf $< 6m^2$

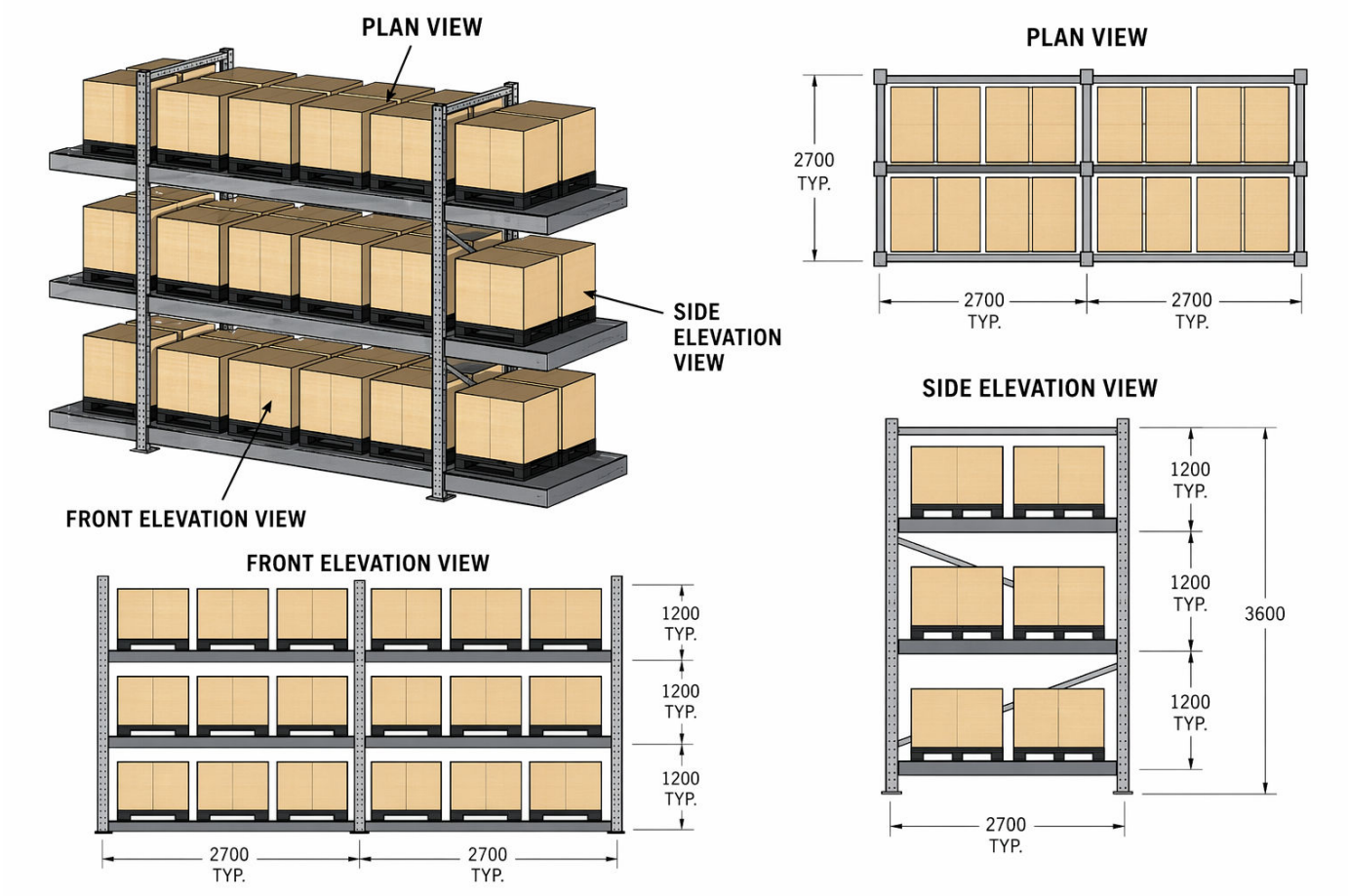


No shelf

Mesh shelf more than 70% open

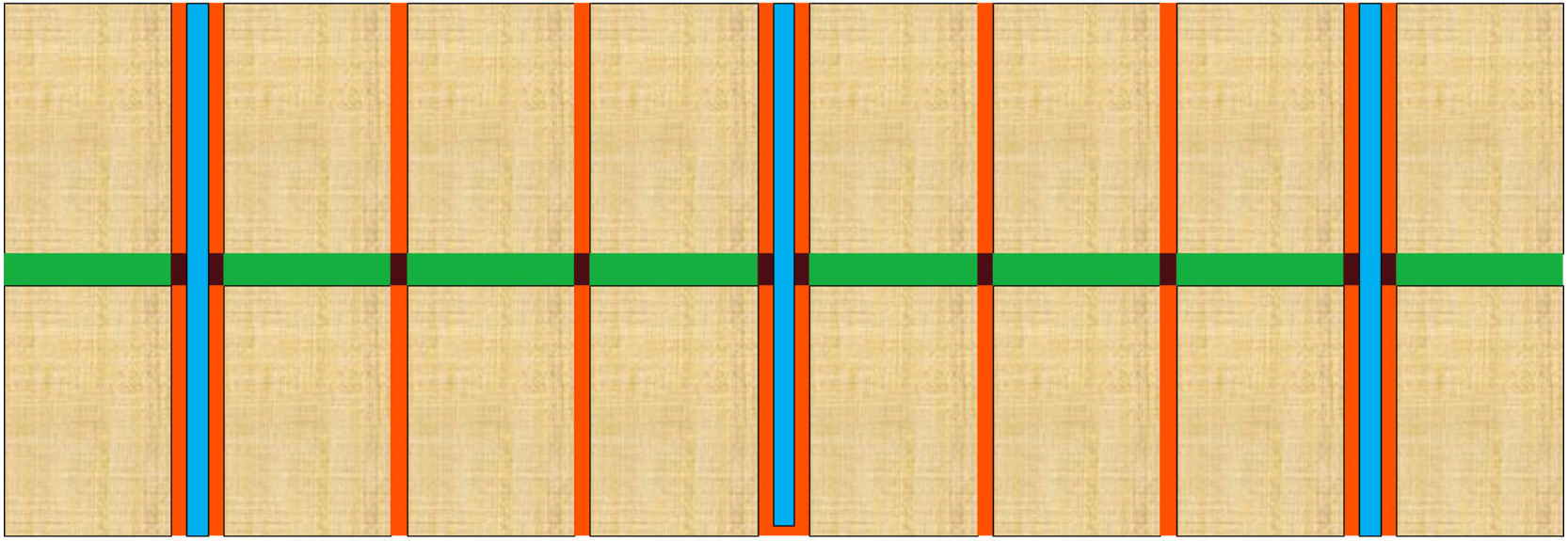
Slatted shelf blocking flues

Rack storage views



Rack storage characteristics

Rack uprights, Transversal flue spaces, Longitudinal flue space, Flue space intersections



Double-Row Rack Storage - Plan View

Flue spaces for in-rack sprinklers

- Same as for racks without in-rack sprinklers
- Flue spaces not required for the level directly above the in-rack sprinklers.

Rack Storage - Flues

- Flues provide a path for heat to quickly get to ceiling sprinklers
- They provide a path for sprinkler water down to the fire
- Blocked, irregular or flues that are too small may mean treating racks as if they have solid shelves
  - In-racks at every tier

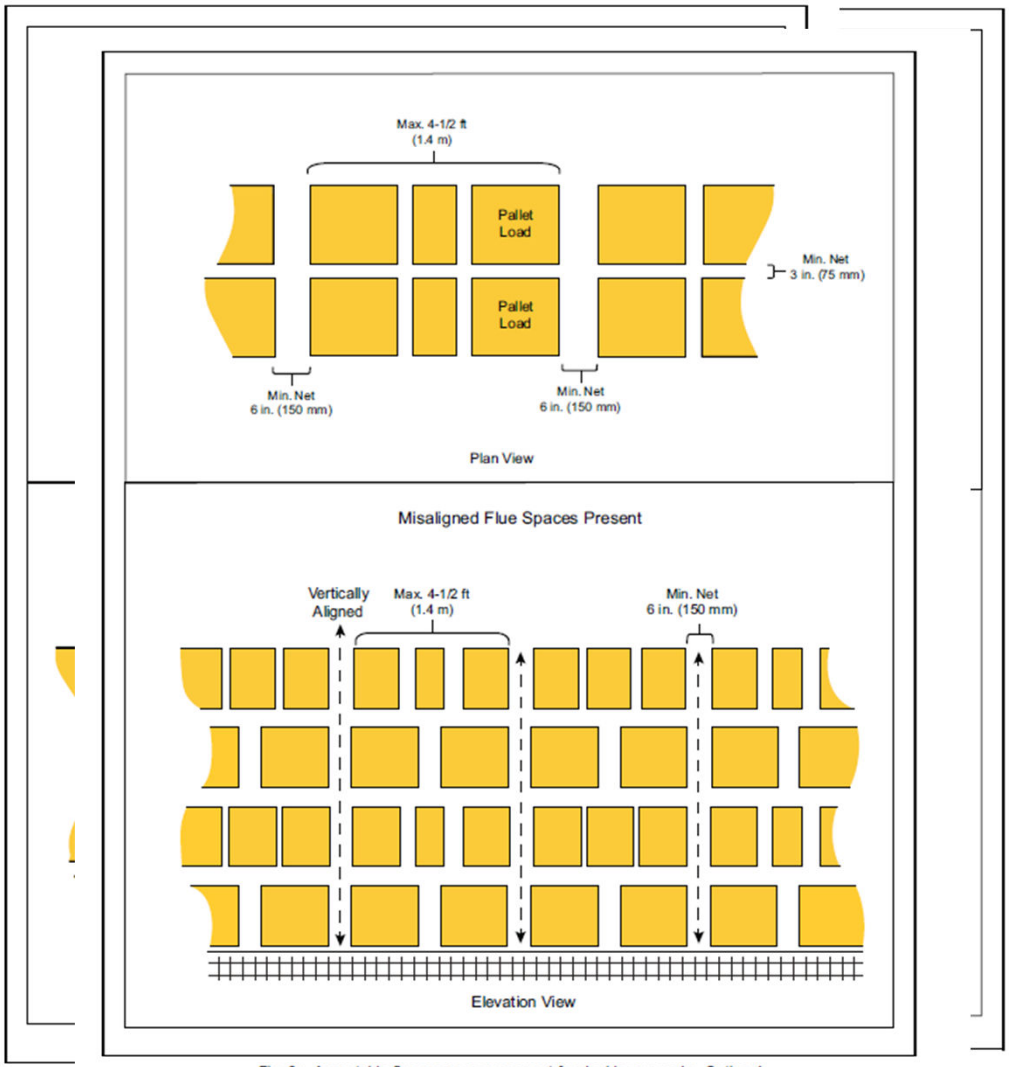


Fig. 2g. Acceptable flue space arrangement for double-row racks, Option 4

Multi-Row Rack Flues

- Need 150mm flues in each direction
  - Not usually possible with push through or roll through rack
- Or limit depth of rack to 6m with 2.4m aisles
- Otherwise treat as racks with solid shelves
- Recent testing has confirmed the exposure
- EN12845 does not really cover MRR
  - Requirement for additional lines of in-racks every 3.2m of width
  - Likely to leave every other flue completely unprotected

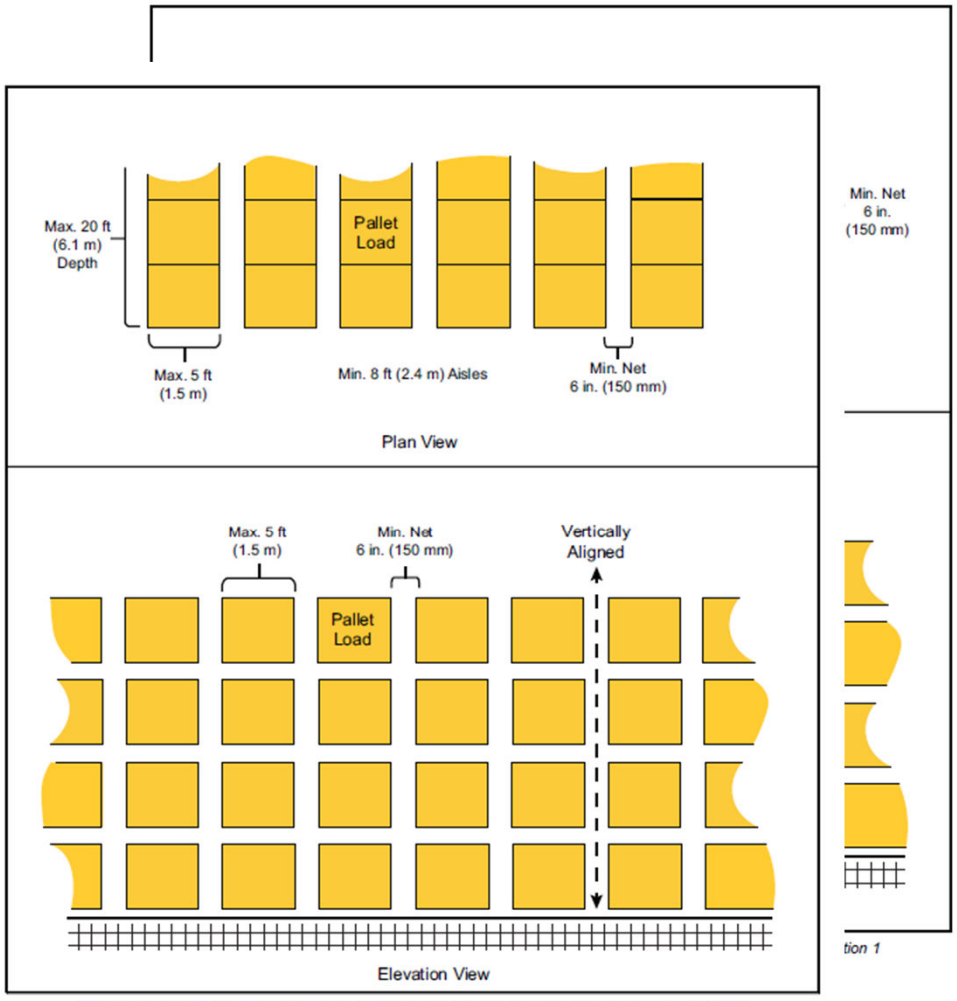
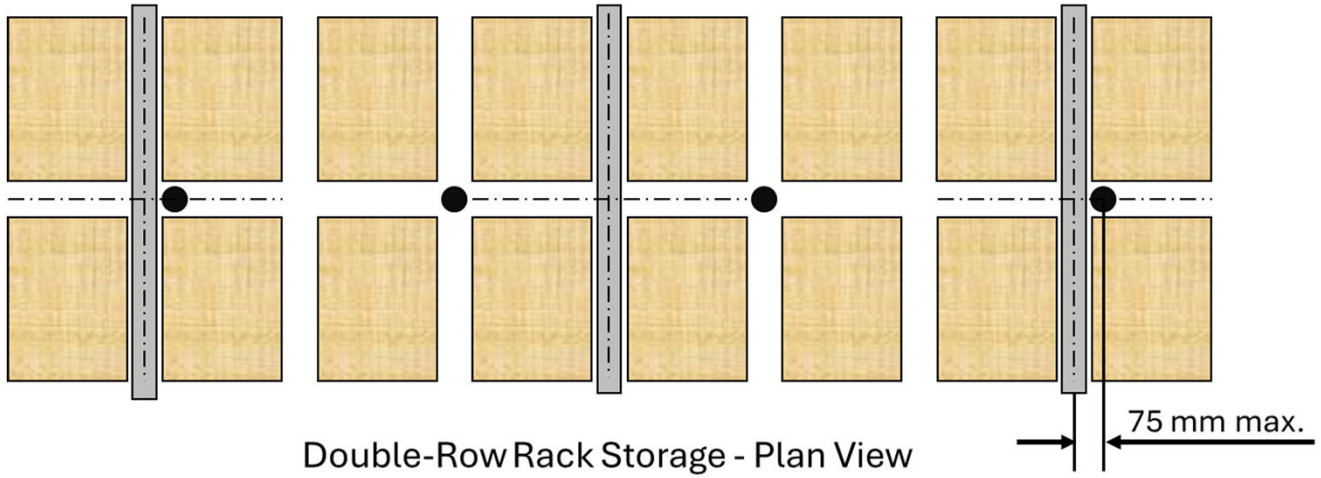


Fig. 2i. Acceptable transverse flue space arrangement for open-frame multiple-row racks, Option 2

In-rack sprinkler position

- Use FM Approved components
- Locate in-rack sprinklers within rack array
- Don’t place in-rack sprinklers directly behind rack uprights
- Locate in-rack sprinklers in longitudinal flue not more than 75 mm away from transversal flue intersections to be protected



Double-Row Rack Storage - Plan View

In-rack sprinkler position

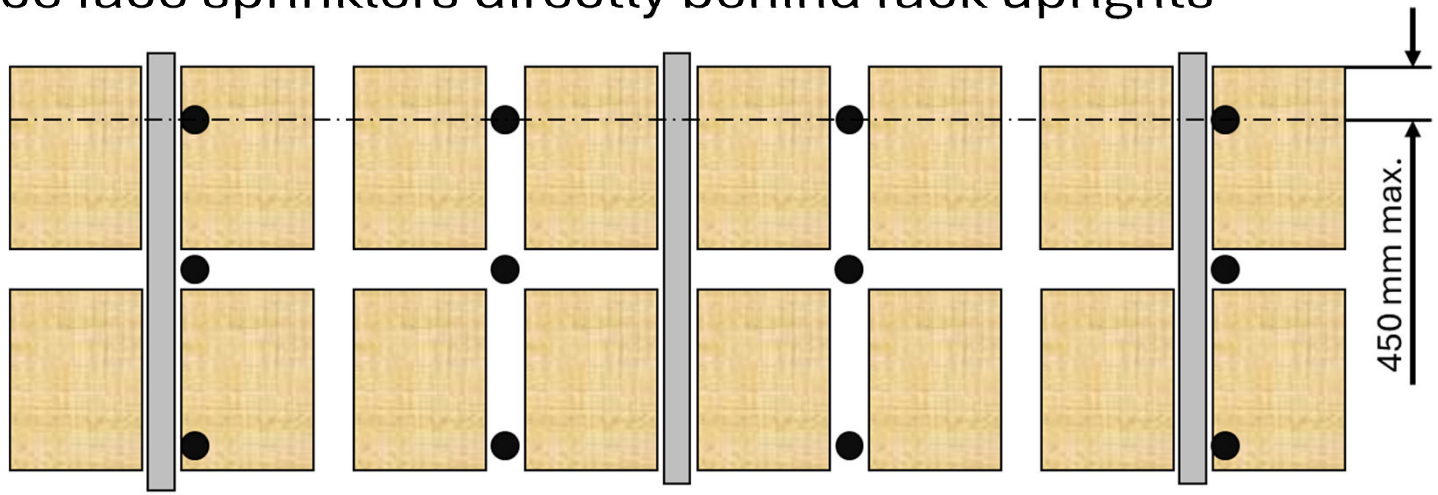
- Position in-rack sprinklers at or just below bottom of horizontal support members.
- Ensure minimum 150 mm clearance to top of storage, if in-rack sprinklers are not provided at every transverse flue space.

Rack storage - front elevation view)

In-rack sprinkler position

Face sprinklers

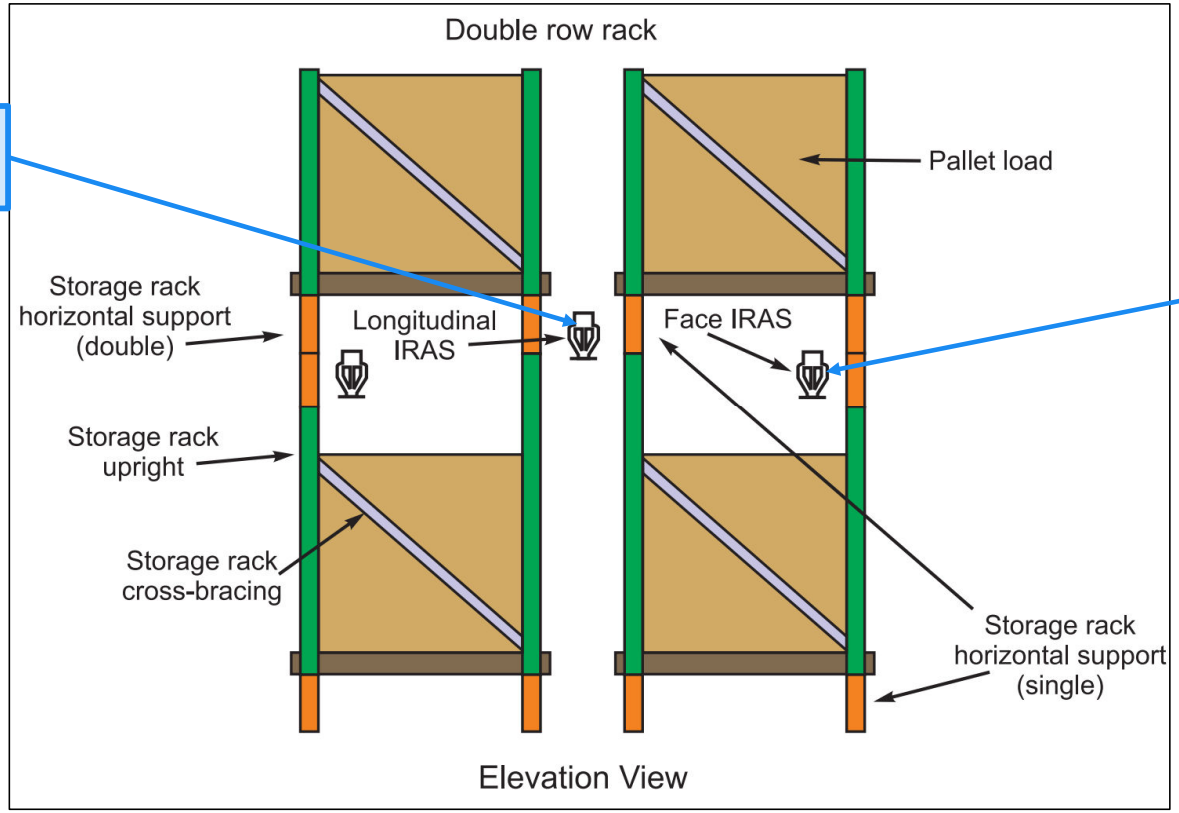
- Locate face sprinklers within transversal flues
- Locate face sprinklers not more than 450 mm away from the face of the rack
- Don’t place face sprinklers directly behind rack uprights



Double-Row Rack Storage - Plan View

In-rack sprinkler position

Even or slightly under the horizontal rack member



- Min. 75 mm from horizontal rack member
- Max. 450 mm from storage face
- Max 75 mm above horizontal rack member

What can go wrong?

- 150 mm clearance not maintained
- In-rack sprinklers obstructed
- Pipe routing and sprinklers prone to mechanical damage
- Sprinklers outside of the footprint
- No flue spaces.

What information is needed for the installation?

Position of sprinkler.	Maximum Horizontal spacing.	Maximum vertical increments	Type of sprinkler.	Minimum flow/pressure of sprinkler
• Longitudinal sprinklers or Longitudinal and face sprinklers.	• Sprinklers in every flue or every other flue	• Every 1.5m, 3m, 9m, 12m	• K factor, temperature rating, QR or SR	• From 85 to 455 l/min depending on commodity and type of sprinkler

The FM consultant can provide the information including the ceiling protection specification

Horizontal in-rack spacing will depend on:

The type of rack (single-row, double-row, or multiple-row) being protected (fig.5-7),

The commodity being protected,

Whether open-top containers are present,

The maximum ceiling height of the storage area,

Whether a minimum 6 in. (150 mm) vertical clearance is provided between the top of storage and the in-rack sprinkler deflector, and

Whether horizontal barriers are to be installed.

Width of the rack:

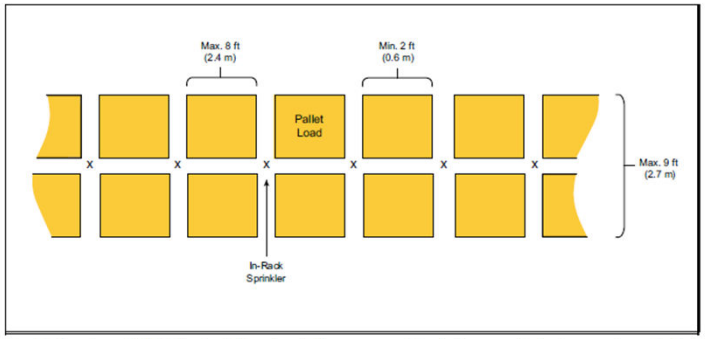


Fig. 12. Plan view of IRAS(E) horizontal in-rack sprinkler arrangement for double-row racks having a maximum depth of 9 ft (2.7 m)

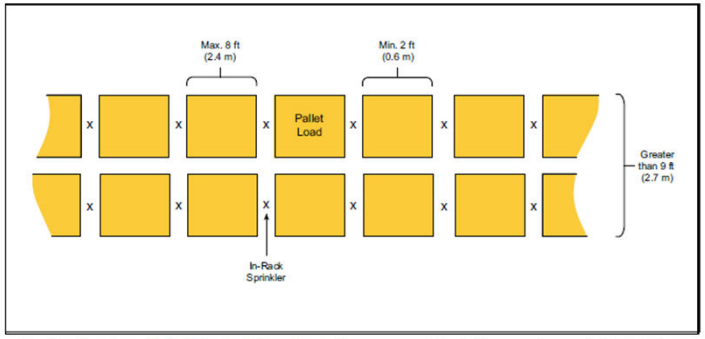


Fig. 12a. Plan view of IRAS(E) horizontal in-rack sprinkler arrangement for double-row racks over 9 ft (2.7 m) deep

Vertical increments depend on:

Same as horizontal spacing using fig.15

- Open top Containers
- Solid shelves
- Commodity hazard
  - Class 3 max.
  - Cartonned unexpanded plastic
  - Cartonned expanded plastic
  - Un-cartonned plastic

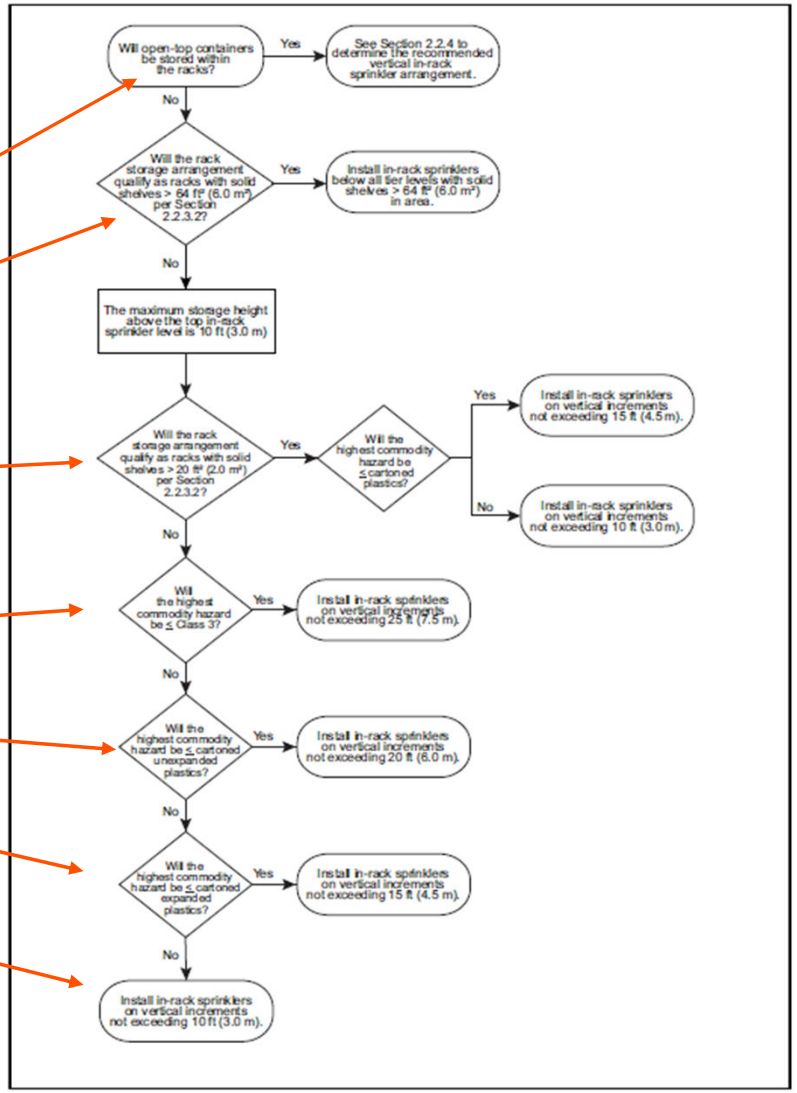
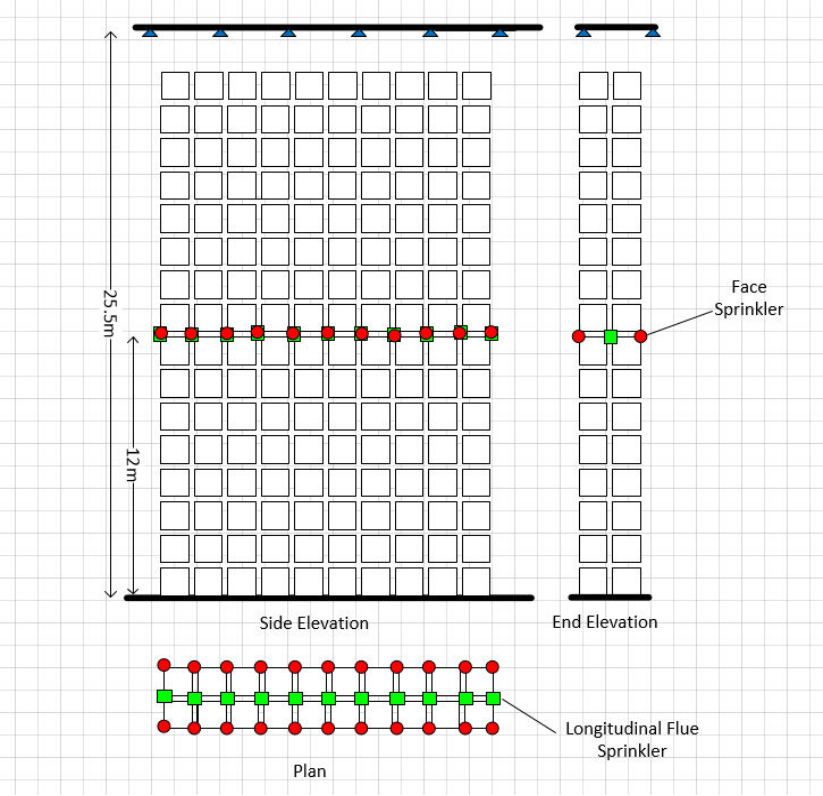


Fig. 15. Recommended vertical in-rack sprinkler increments

FM Alternative In-Rack Schemes

- Traditional in-rack designs typically have sprinklers at 3 m vertical intervals
- Alternative in-rack schemes can use up to 12 m vertical spacing
- Can be used for all commodities covered by FM Property Loss Prevention Data Sheet 8-9 but not open top combustible containers or racks with solid shelves
- Large sprinklers in flue and at face in every transverse flue
- Typical design for uncartoned unexpanded plastics
  - 10 sprinkler heads at 455 lpm/sprinkler head (5 sprinkler heads each side of an aisle)
  - 9 m vertical intervals
- Treat top level of in-rack sprinklers as the “floor” for the purposes of designing the ceiling system

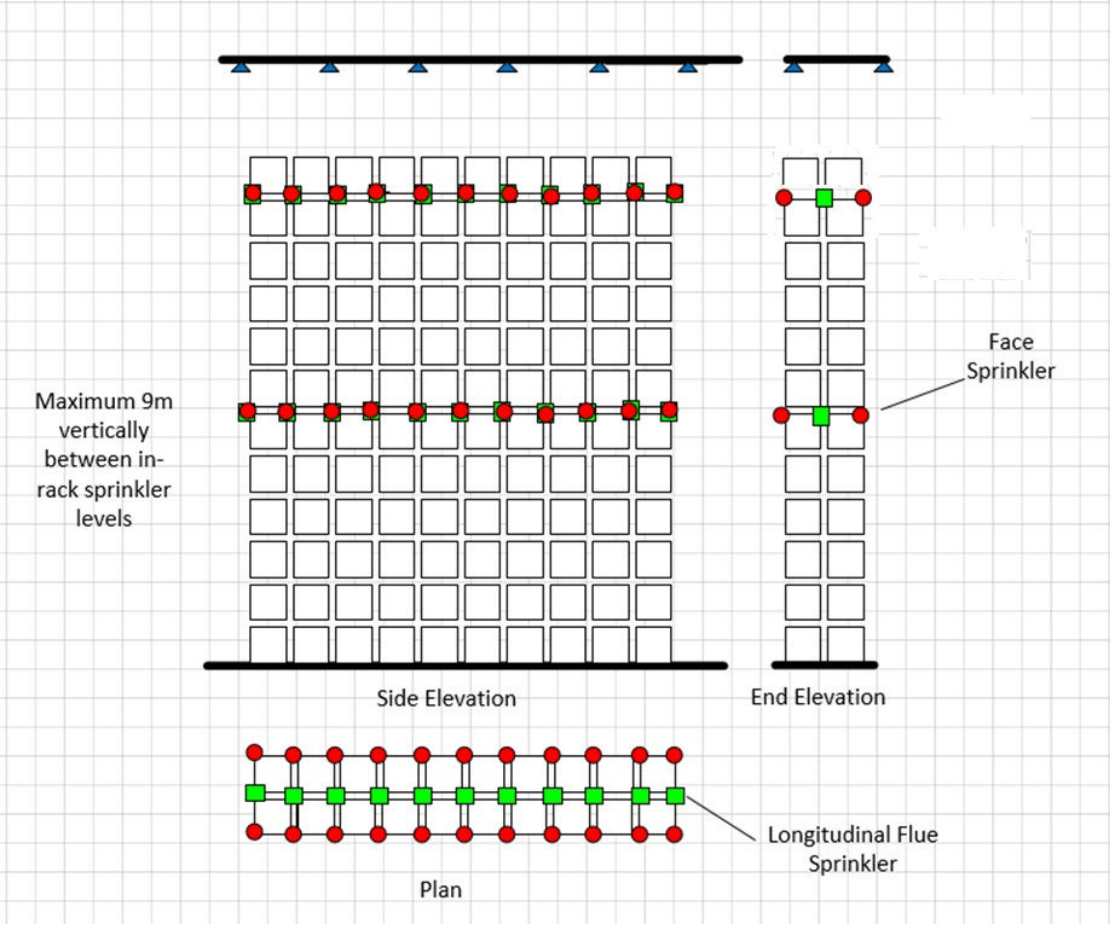
Typical Layout for Cartoned Unexpanded Plastics and Lower Hazard Commodities



Future Proof!

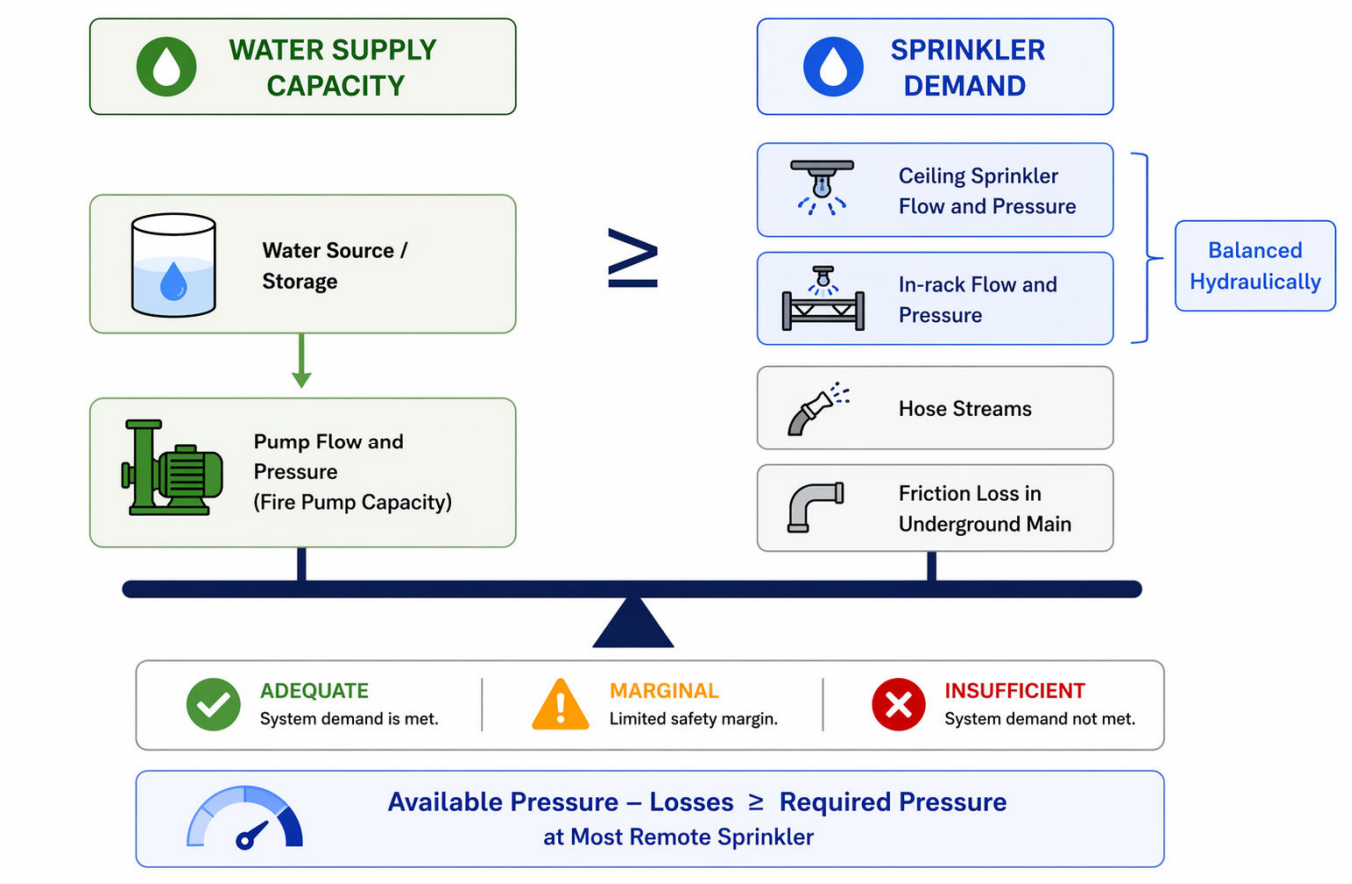
- Design for the worst case, not for the most common. If CUP, can you trust it will be like this in the future?
- How does the storage look like in other warehouses?

Typical Layout for Uncartoned Plastics and Cartoned Expanded Plastics




IRAS at 30 ft
IRAS at 40 ft
Time = 00:00
FM Global

Sprinkler system hydraulic balance



Fire Protection Scheme 8-9A

- Dedicated rack storage for higher commodity storage
- Water supply capacity not designed for In-rack with ceiling sprinkler demand simultaneously
- Weak ceiling design
- See fig 16 and 18 for SRR and MRR
- Open frame racks

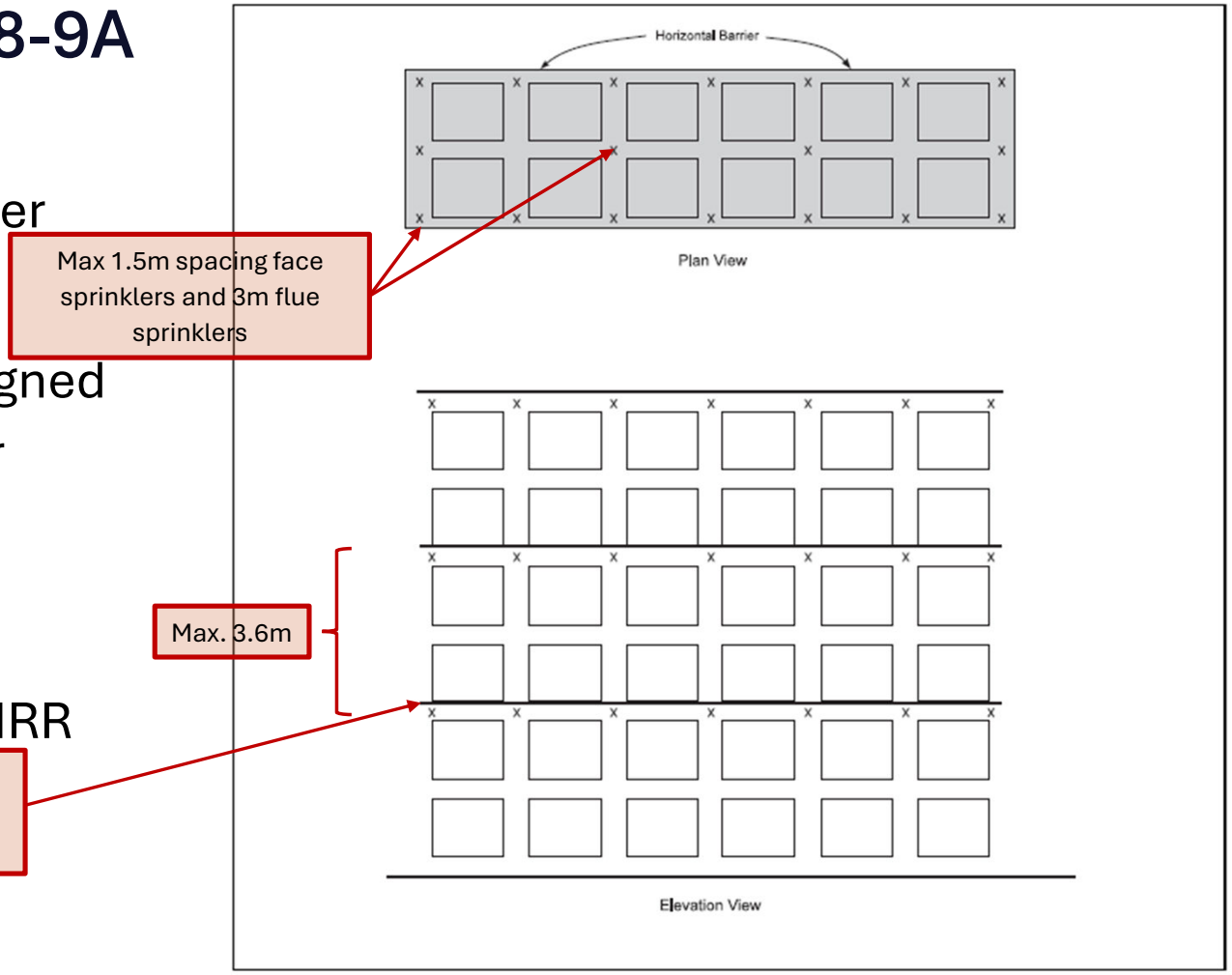


Fig. 17. Fire Protection Scheme 8-9A within double-row racks

Advantages of Scheme 8-9A

- No need to balance ceiling and in-rack demand
- Ceiling design based on surrounding commodity and not included in the hydraulic design of the racks
- Design 230l/min for 6 sprinklers in single row and 8 in double or multiple row racks
- Hose allowance 950l/min

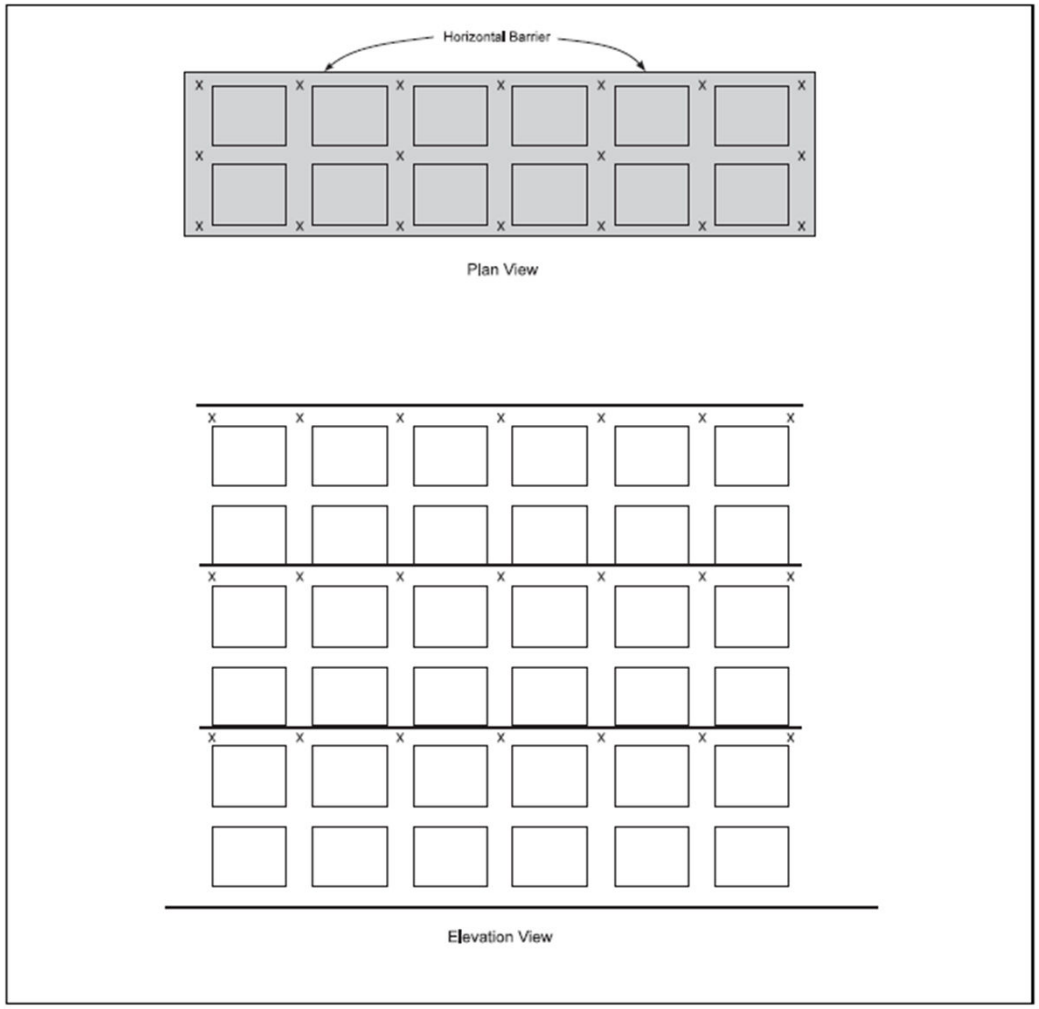


Fig. 17. Fire Protection Scheme 8-9A within double-row racks

Workshop

Rack protection:

Building 28 m high

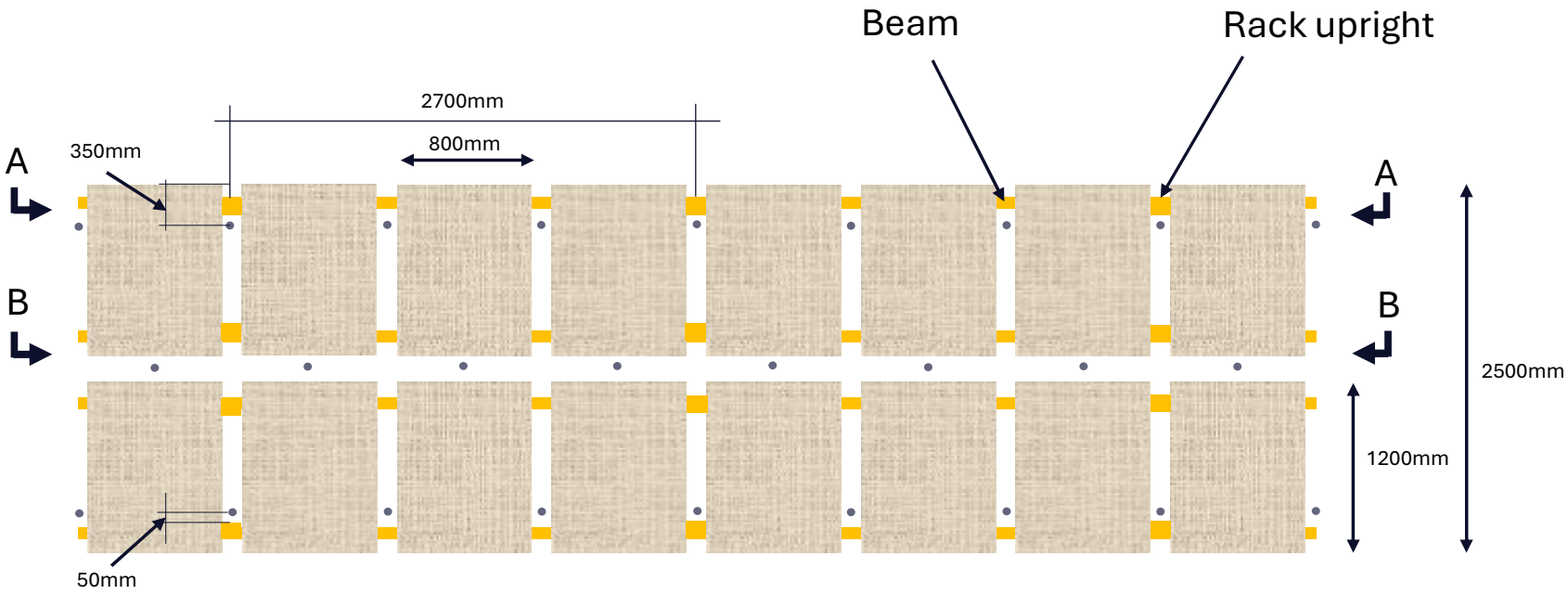
Double Row racks 25.2 m high, 18 tiers

Storage of uncartoned unexpanded plastics

Design per Fig 13 and vertical increments of max 3 meters

Review if the following is correct:

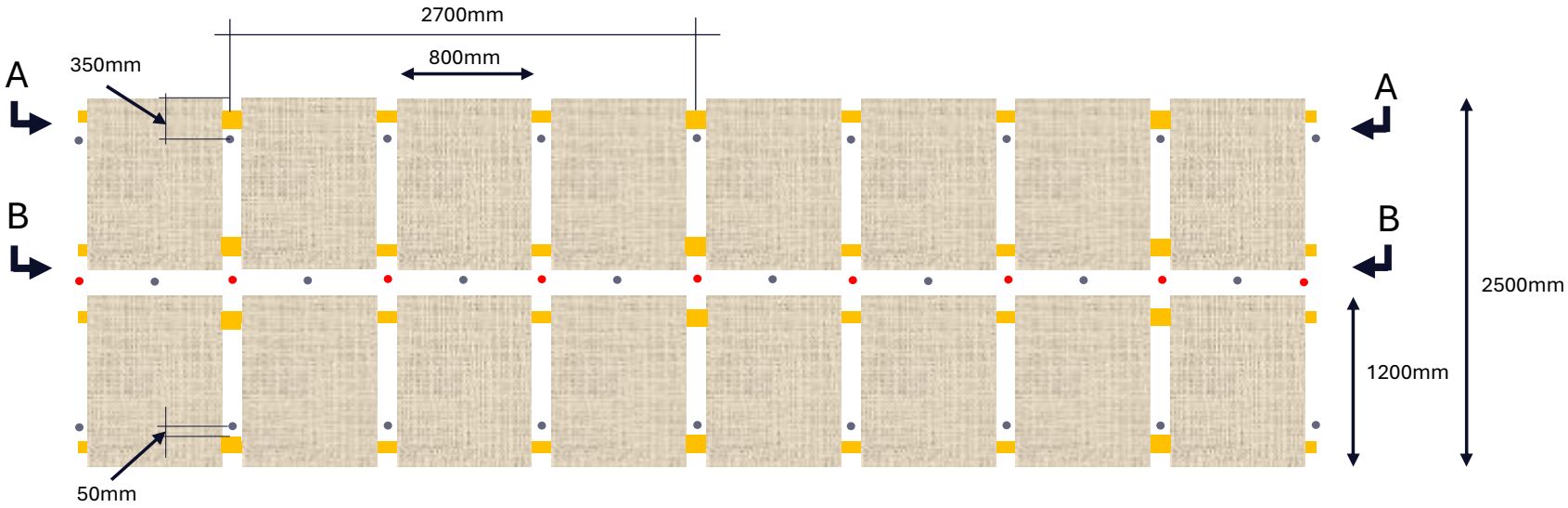
- Spacing?
- Position?
- Flues?


Beam
Rack upright
2700mm
800mm
350mm
A
B
A
B
2500mm
1200mm
50mm

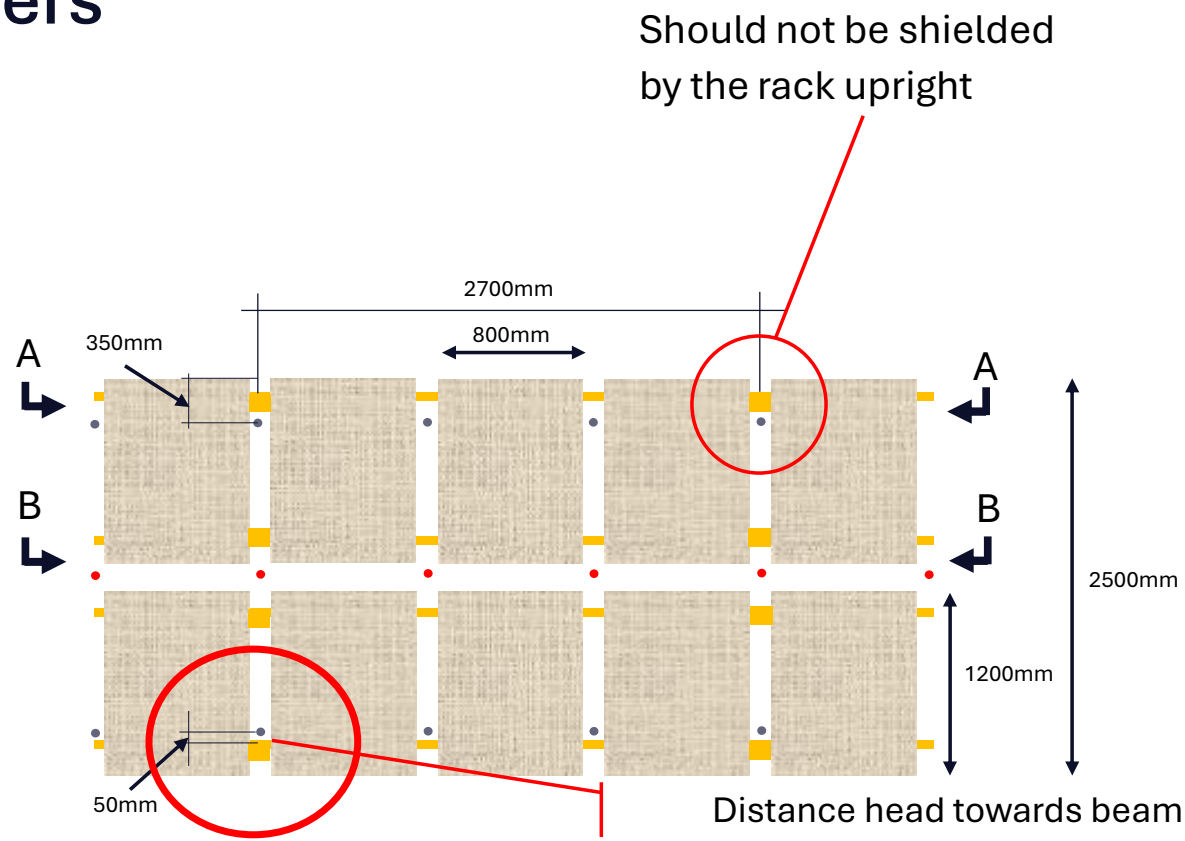
AA section

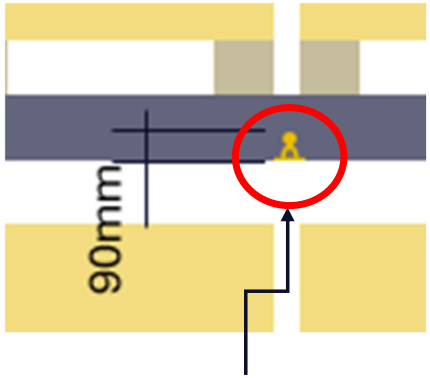
BB section

Answers



Answers


Should not be shielded
by the rack upright
2700mm
800mm
350mm
A
B
A
B
2500mm
1200mm
50mm
Distance head towards beam is less than 75 mm,


90mm
Deflector should be max.
75mm above the bottom of the
beam (face sprinkler)

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