

Open-Top Combustible Containers – Hazards and Protection

Fire Sprinkler International

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RESILIENCE IS A CHOICE.

Open-Top Combustible Containers



Rack Storage



Palletized / Solid-Pile



Top-Load ASRS



Mini-Load ASRS

Open-Top Combustible Containers

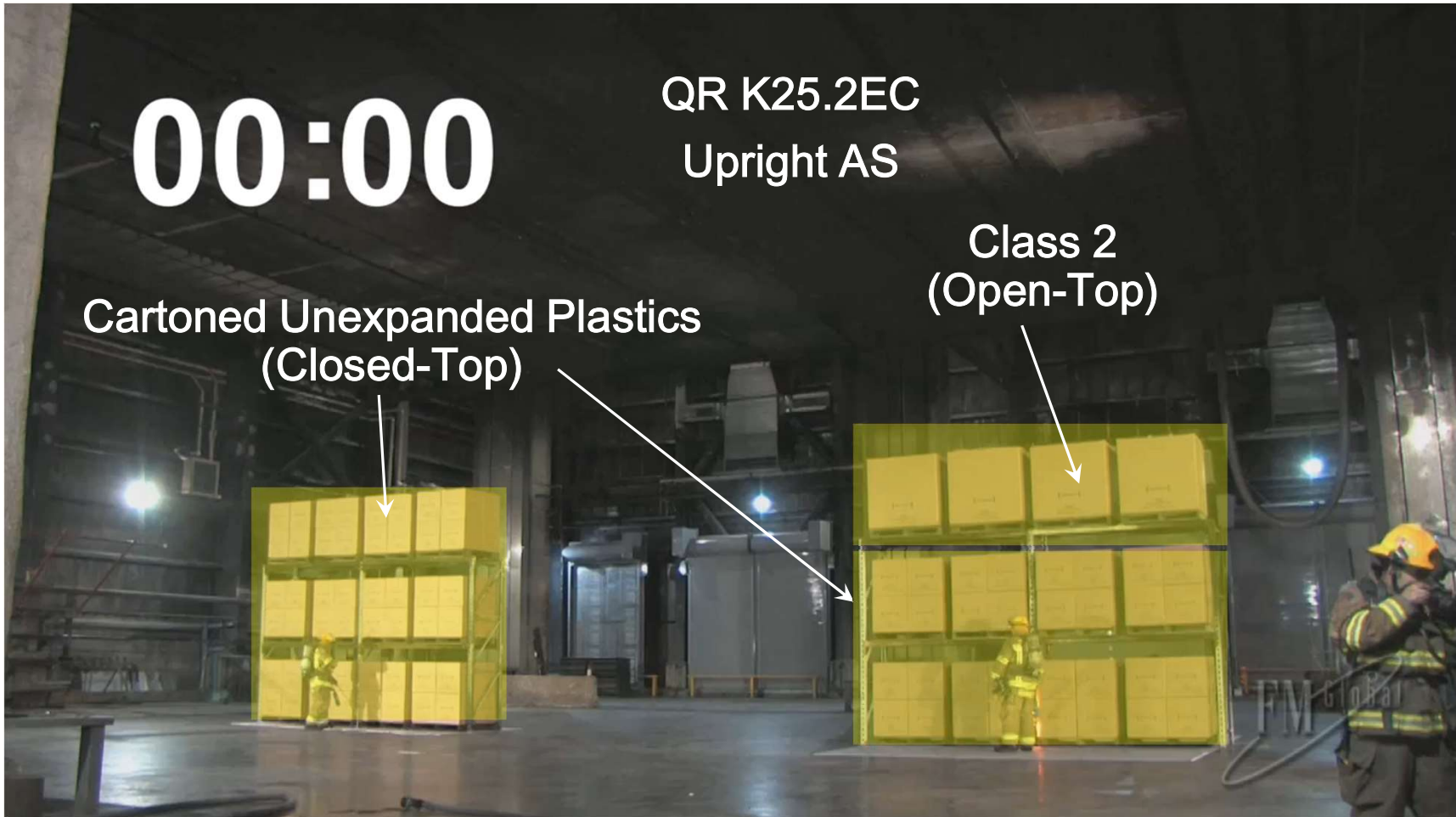


00:00

QR K25.2EC
Upright AS

Cartoned Unexpanded Plastics
(Closed-Top)

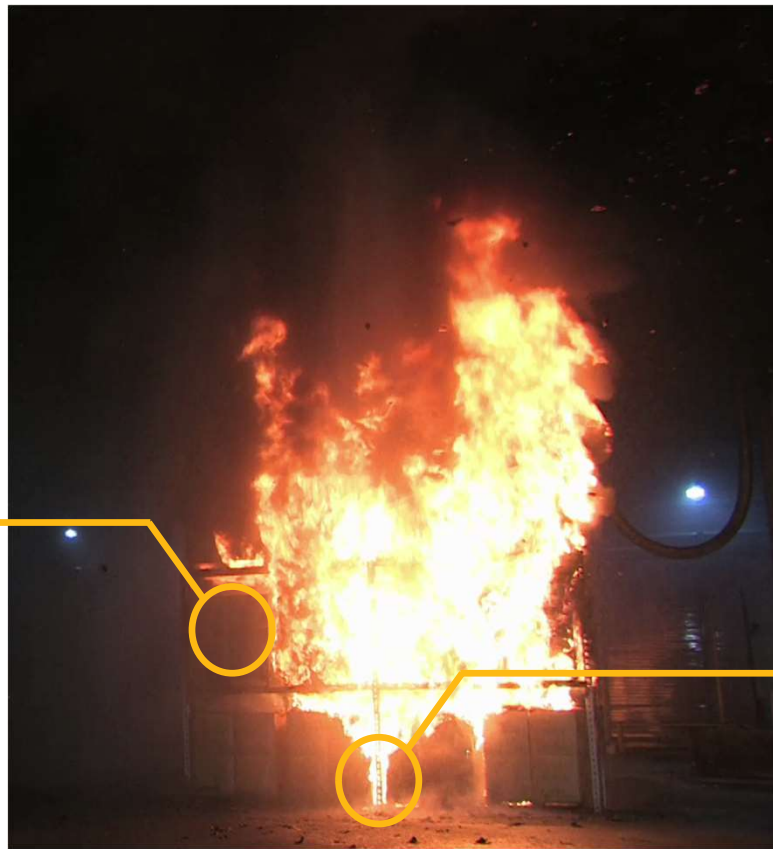
Class 2
(Open-Top)



Open-Top Combustible Containers



Different materials, same result



Delays water penetration

Current FM Global Data Sheet 8-9 Guidance

Rack Storage

- Storage over 10 ft high
- In-rack sprinklers recommended

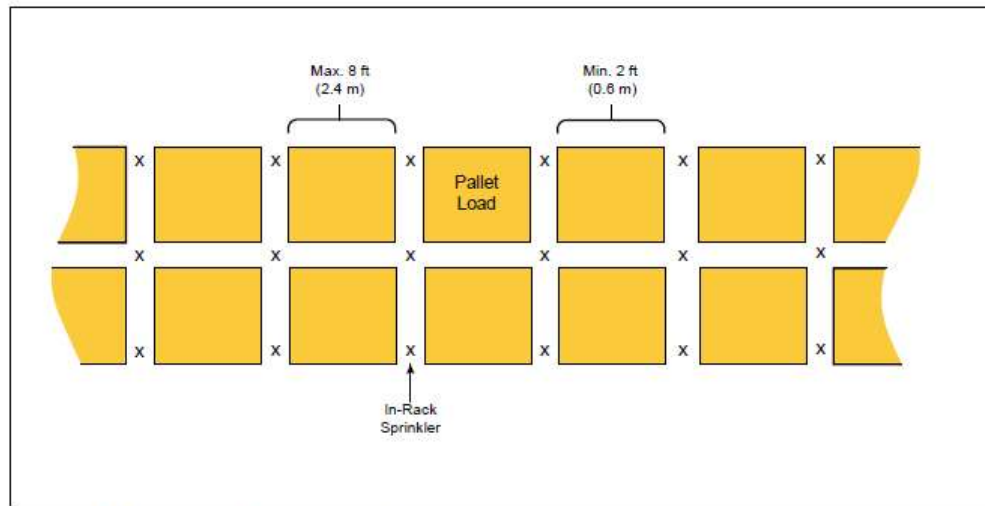


Fig. 13. Plan view of IRAS(E) horizontal in-rack sprinkler arrangement for double-row racks (face and flue)

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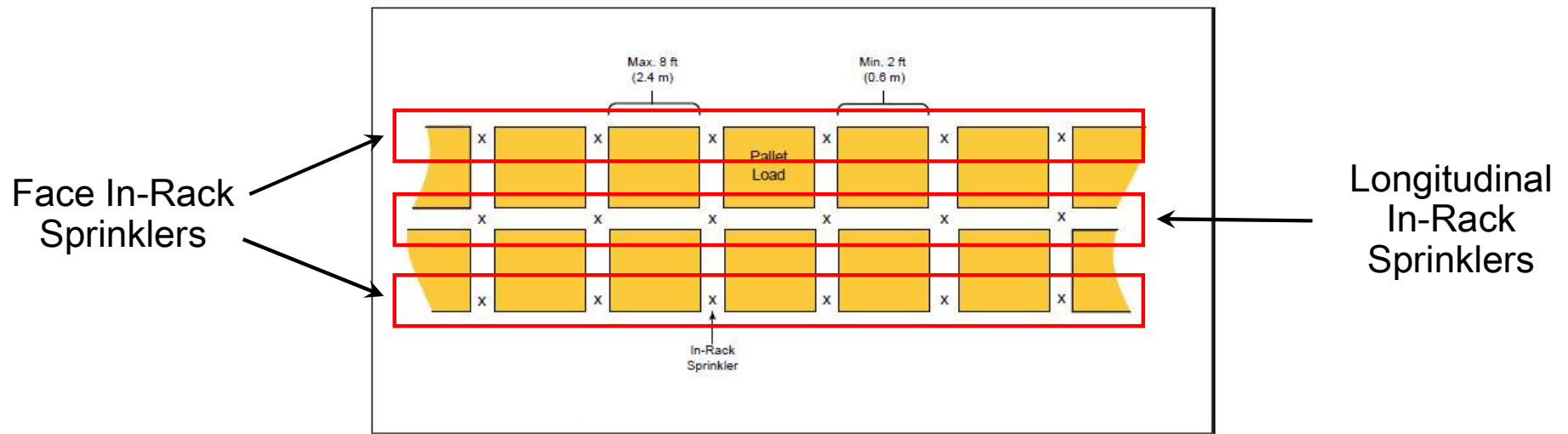


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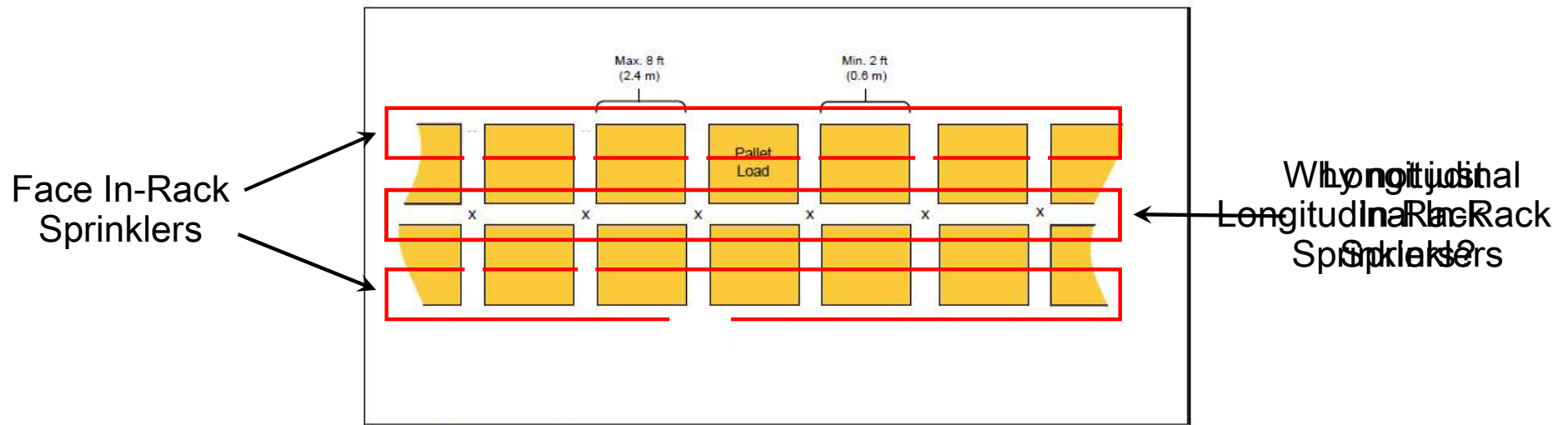
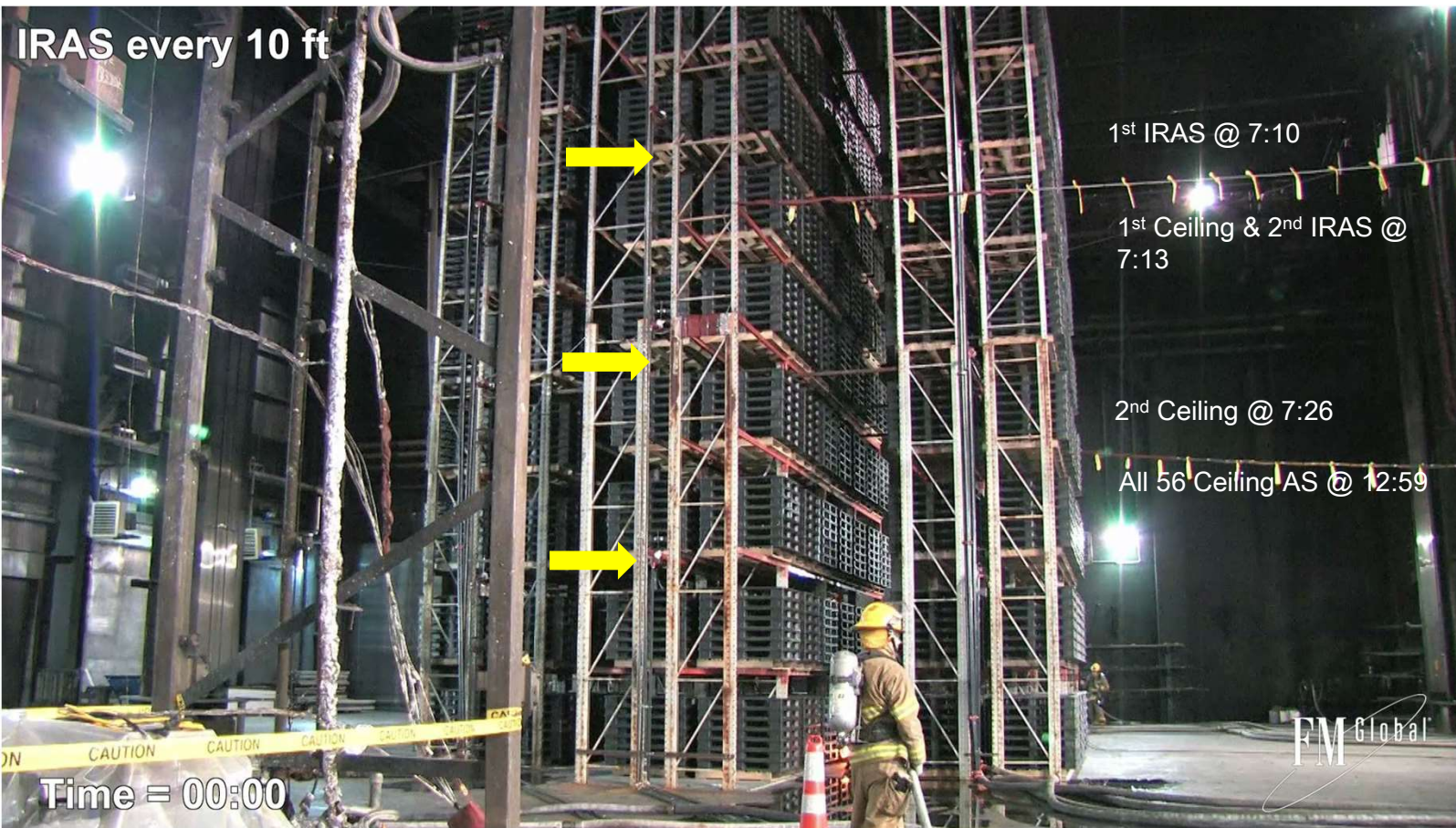


Fig. 13. Plan view of IRAS(E) horizontal in-rack sprinkler arrangement for double-row racks (face and flue)

Open-Top Combustible Containers



IRAS every 10 ft

1st IRAS @ 7:10

1st Ceiling & 2nd IRAS @ 7:13

2nd Ceiling @ 7:26

All 56 Ceiling AS @ 12:59

Time = 00:00

In-Rack Sprinklers:

- K5.6 (K80)
- 165°F (70°C)
- **Quick response**
- 30 gpm (115 L/min)
- 4 ft (1.2 m) horiz.
- 10 ft (3.0 m) vert.

Test Commodity:

**Uncartoned
Unexpanded Plastics**

Successful test limits the number of ceiling sprinklers that open

Open-Top Combustible Containers



Reducing the Open-Top Container Hazard



Possible to reduce
the hazard of an
open-top container?

Hazard Evaluation for Ceiling Protection



Water application apparatus

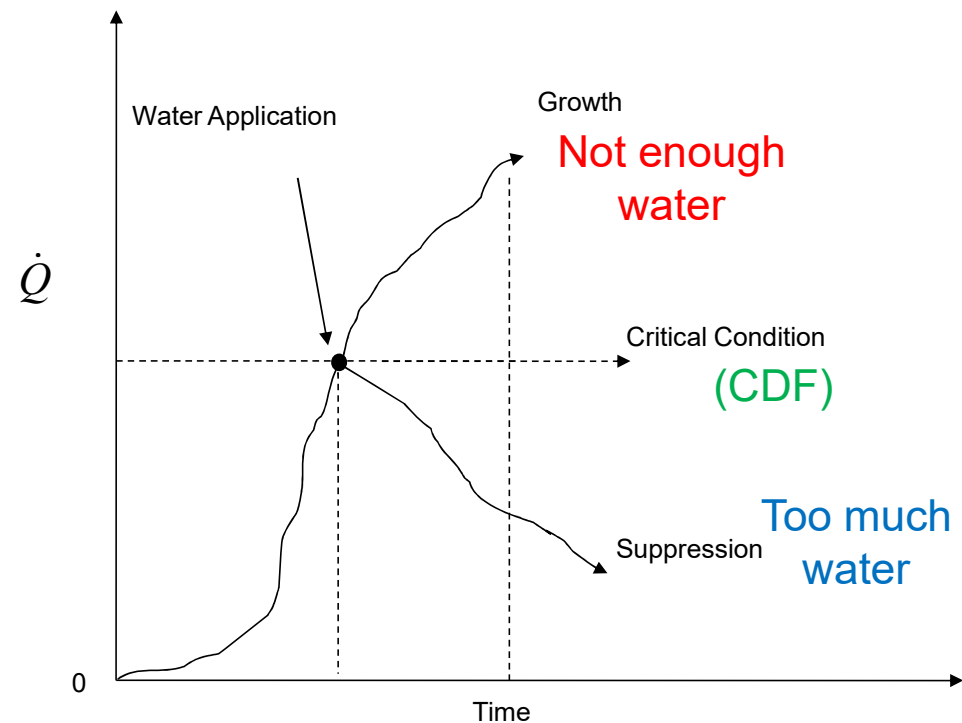
Non-vented containers

Storage rack

Critical Delivered Flux

“CDF” = Critical Delivered Flux

The amount of water when applied to burning commodity under the WAA that creates a steady-state heat release rate



Much Higher Hazard Than Ordinary Commodities



Class 2



Cartoned
Unexpanded Plastic



Uncartoned
Unexpanded Plastic



OTCC



Critical Delivered Flux

Class 3



Cartoned Expanded
Plastic

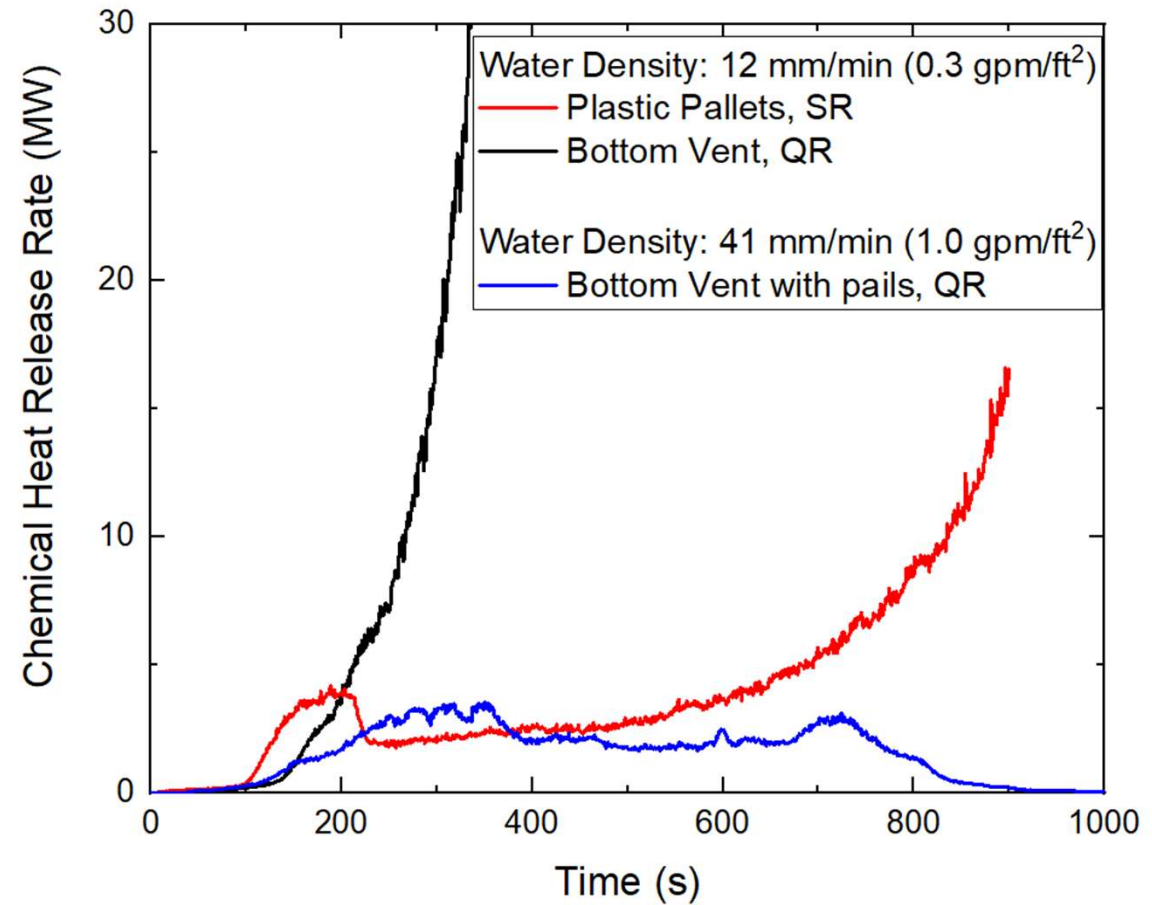
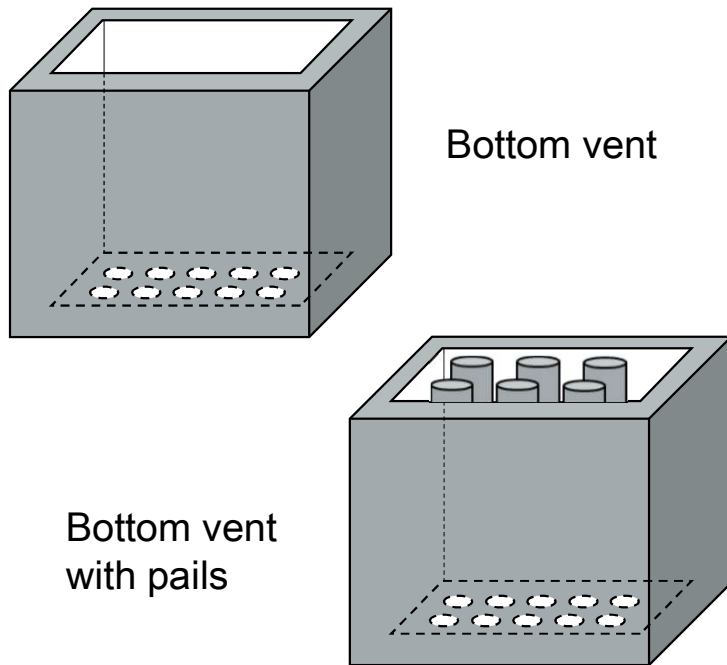


Uncartoned
Expanded Plastic



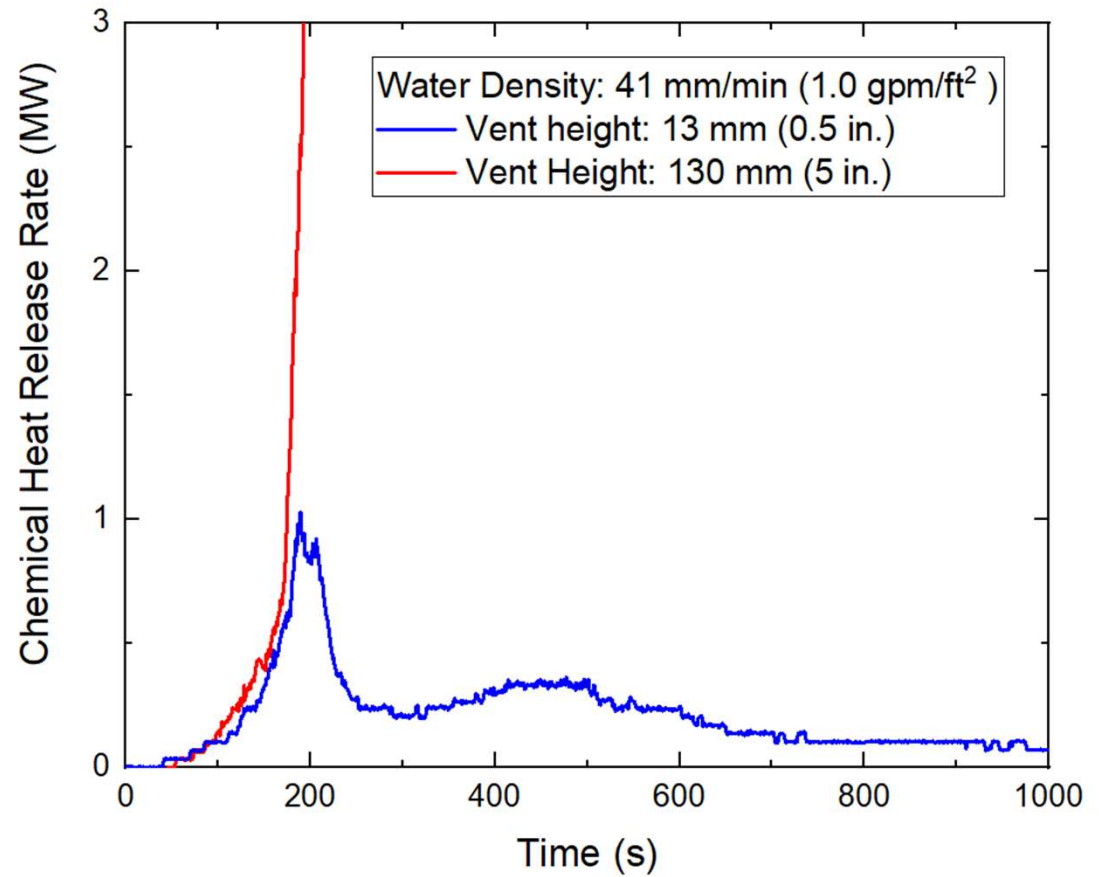
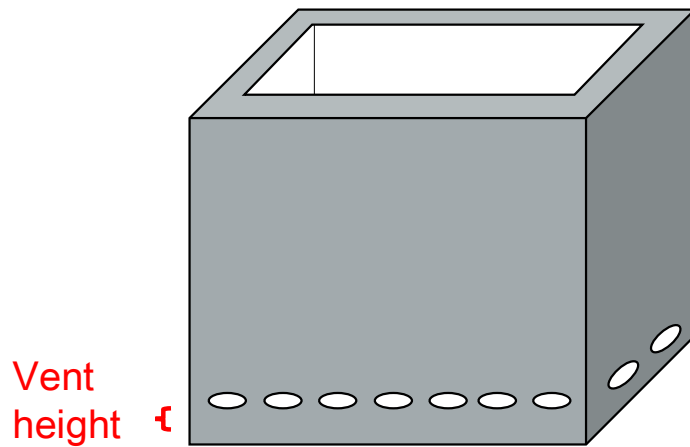
How About Bottom-Vented Containers?

OTCC with bottom vents (no water collection) can produce higher hazard than plastic pallets



Vents on Side Walls

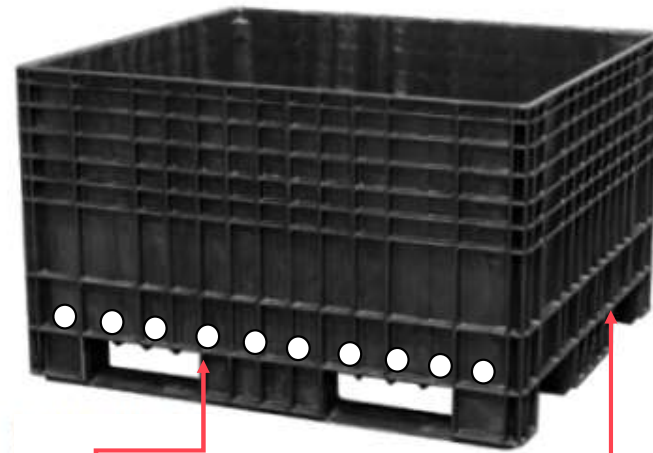
Vents on side wall reducing water collection provide significant fire protection benefits



Introducing Adequately Vented Containers



Inadequate Water-
Vented Hinges



Adequate Water-
Vented Holes

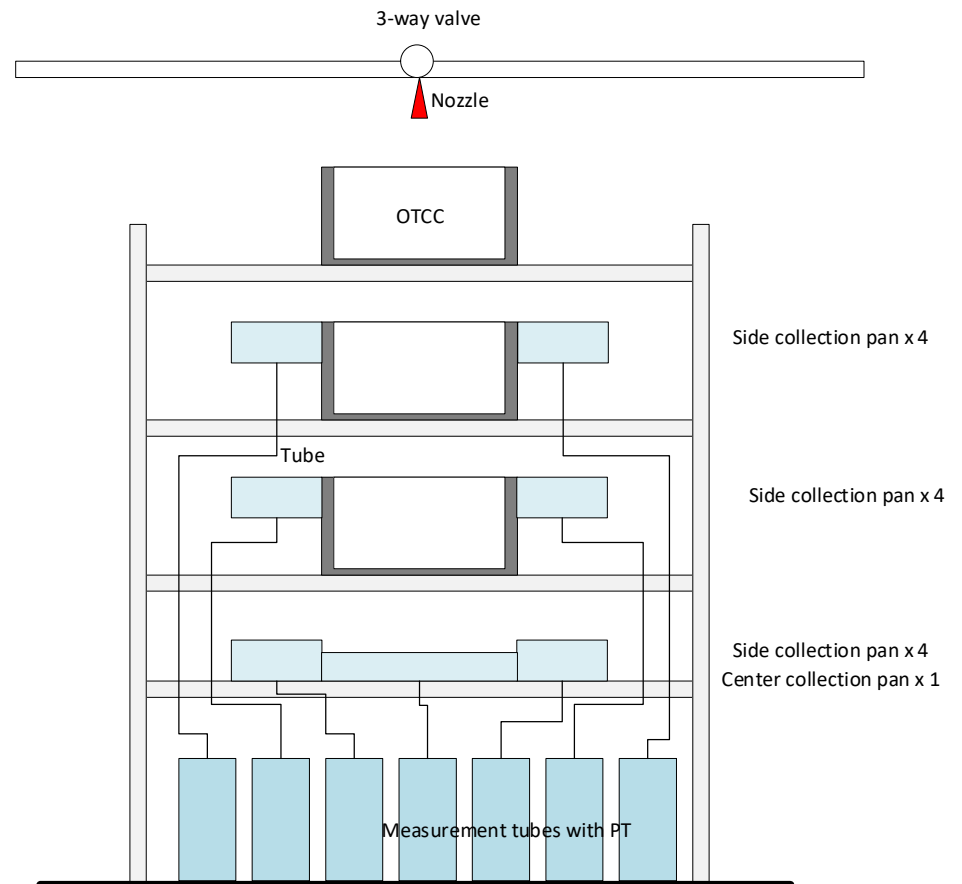
Timely: how far from the bottom
Sufficient: how much of opening area
Effective: how much of coverage (locations)

Evaluating Vented Containers: Water Transport



Results:

- Adding water becomes less and less effective
- No water collection in container required (i.e., 0 mm venting)



Evaluating Vented Containers: Fire Suppression



Intermediate-scale Testing for vented containers

- UUP protection in standard storage rack: 1.5 m (5 ft) tier height
- > UUP protection in non-standard storage rack: 1.1 m (3.5 ft) tier height

UUP: Uncartoned unexpanded plastic, plastic pallets
UUP protection: FM Global Property Loss Prevention Data Sheets 8-9: Storage of Class 1, 2, 3, 4 and Plastic Commodities

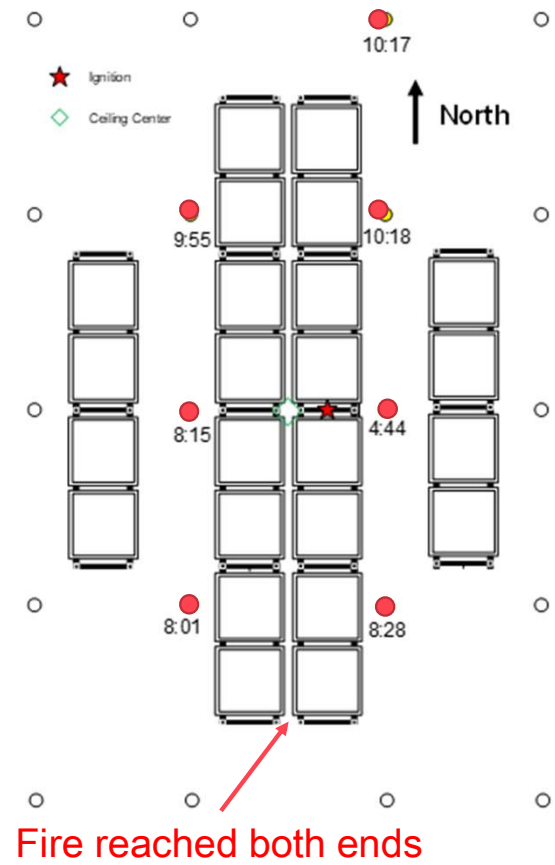
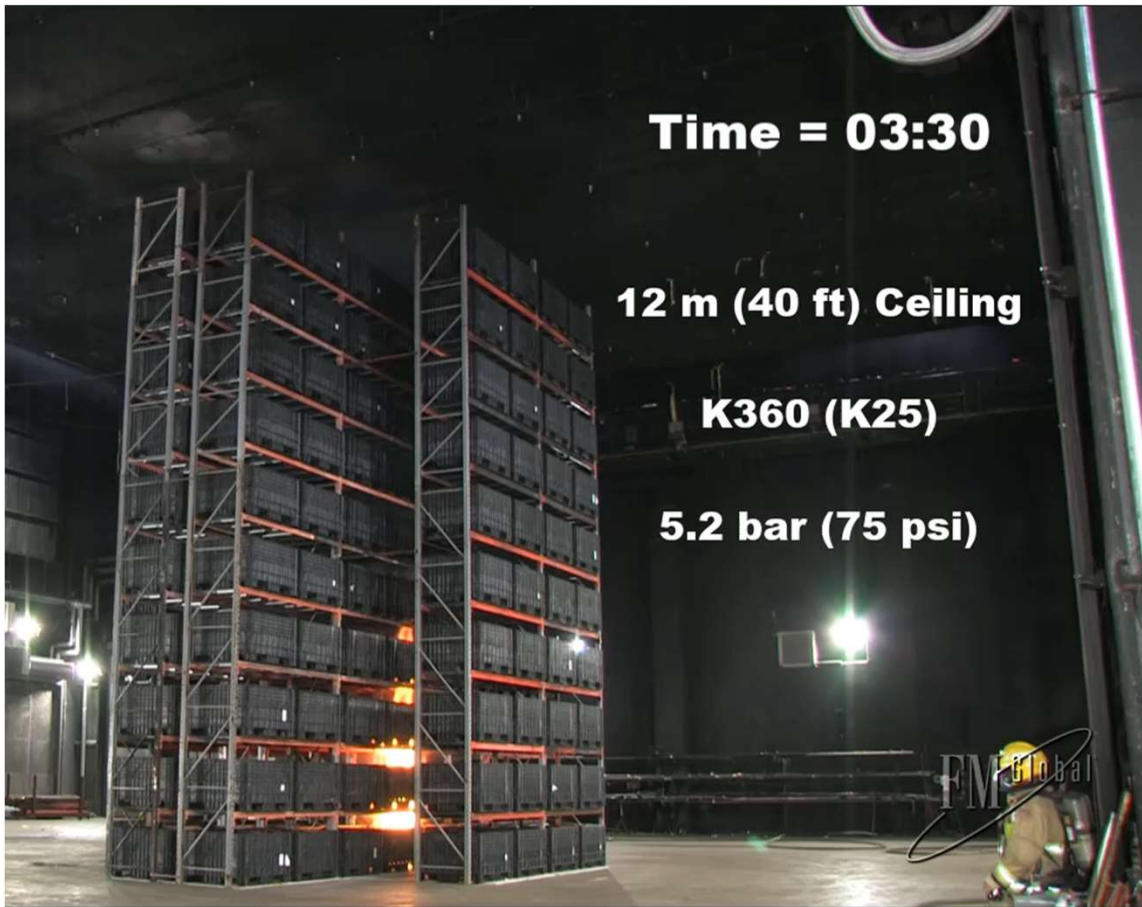


Water Application Apparatus

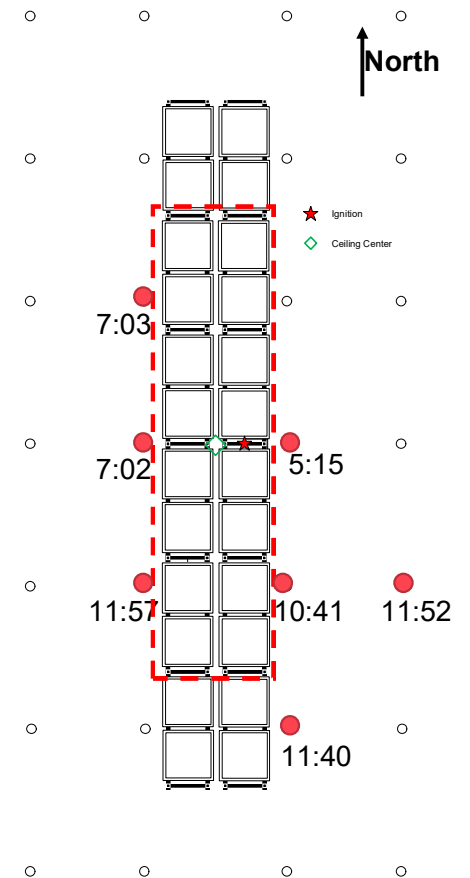
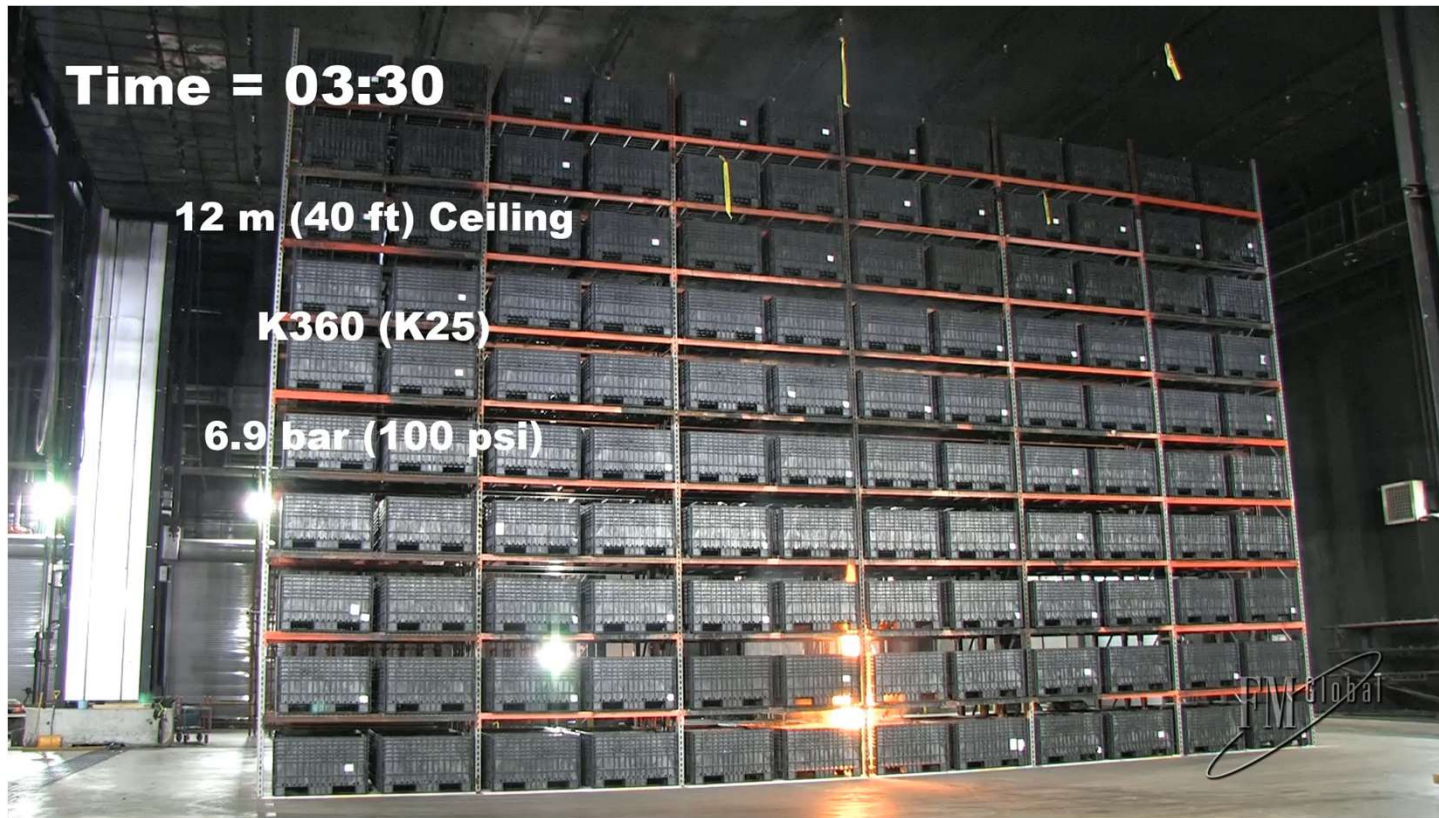
Vented Containers

Standard /
Non-standard
tier height

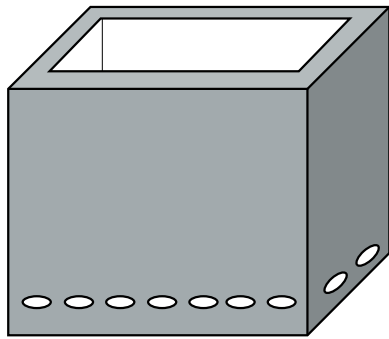
Large-Scale Test 1



Large-Scale Test 2



Conclusions

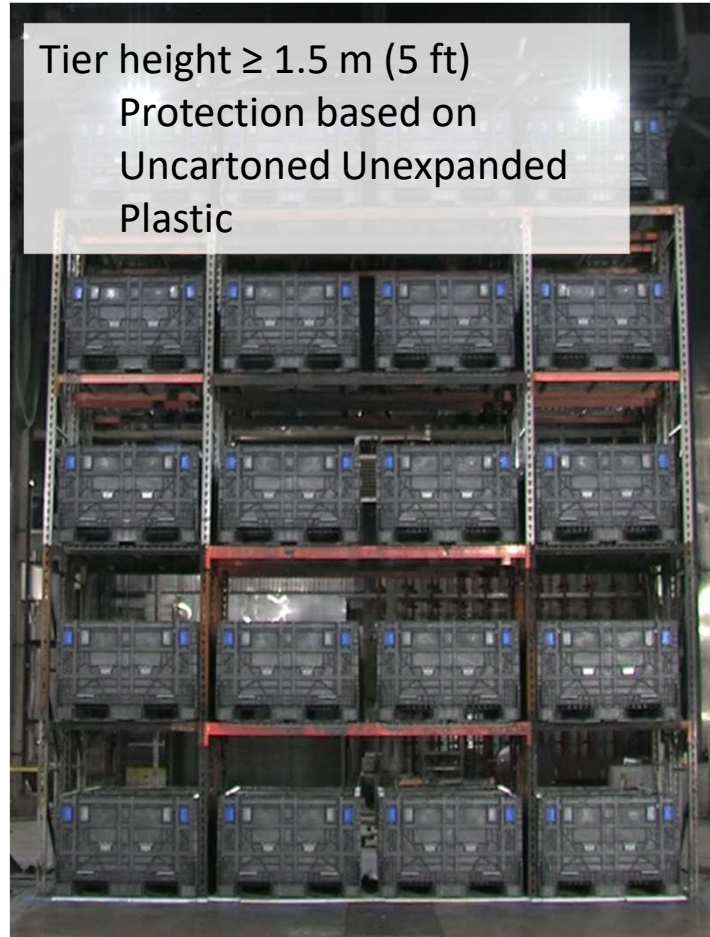


Vented Open-top Containers

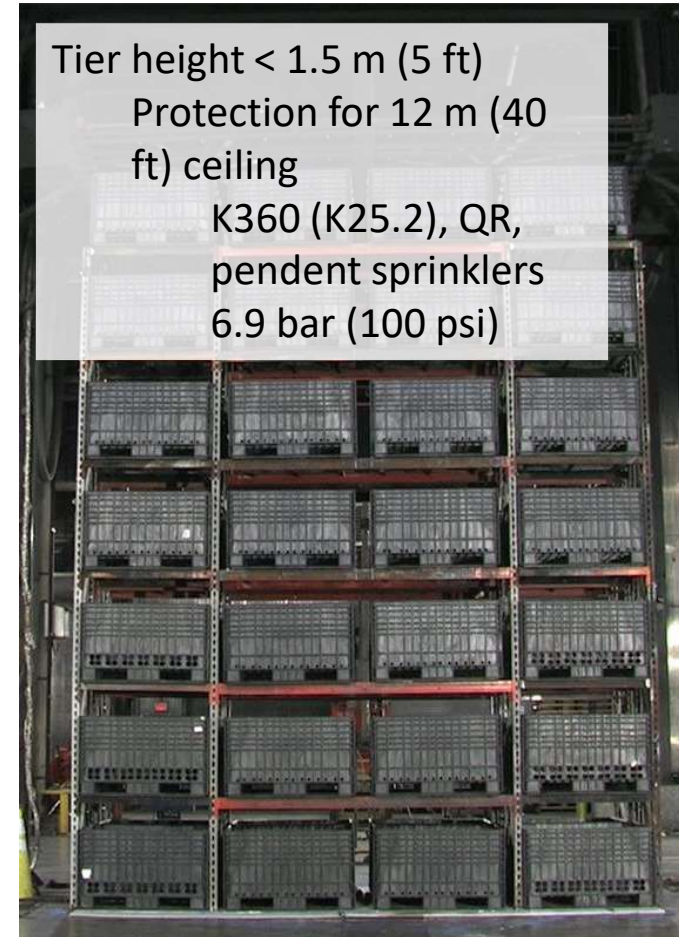


Member of the FM Global Group

Tier height ≥ 1.5 m (5 ft)
Protection based on
Uncartoned Unexpanded
Plastic



Tier height < 1.5 m (5 ft)
Protection for 12 m (40
ft) ceiling
K360 (K25.2), QR,
pendent sprinklers
6.9 bar (100 psi)





Thank You. Any Questions

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