

Fire Test Protocols for Water Mist System Protection of Non-Storage Occupancies, Hazard Category 2 (HC-2) and Hazard Category 3 (HC-3)

Jonathan Carpenter, FM Approvals
Hong-Zeng (Bert) Yu, FM Global Research

IWMA Conference
October 23 & 24, 2019
Berlin

- ***FM Global Property Loss Prevention Datasheet 3-26, Fire Protection for Nonstorage Occupancies***
 - Document includes protection recommendations for Nonstorage Occupancies
 - Design tables included for sprinkler design demands for each hazard category including HC-1, HC-2, and HC-3
 - Includes protection recommendations for water mist systems with reference to FM Approved water mist systems for the protection of Nonstorage occupancies, hazard category 1 (HC-1)
 - Currently water mist systems are not recommended (or FM Approved) for HC-2 and HC-3

Background



Table 1. Hazard Categories Based on Predominant Occupancy

<i>Hazard Category</i>	<i>Predominant Occupancy</i>
HC-1	<p>Areas with light overall combustible loading with limited combustibles used in processes, or operations of low hazard. This includes combustible furnishings that are typically noncontinuous in well-subdivided areas. This hazard category does not include any incidental storage of plastics, or plastics used in the construction of walls and/or ceilings.</p> <p>Examples include residential, offices, noncombustible manufacturing, and hospitals.</p>
HC-2	<p>Areas with moderate continuous combustible loading with combustibles in processes, or operations of moderate hazard due to limited quantities of plastics or ignitable liquids.</p> <p>Examples include manufacturing, such as machine shops, woodworking, and electronic assembly, as well as retail, theatres, and food production.</p>
HC-3	<p>Areas with generally continuous heavier combustible loading with limited quantities of ignitable liquids and/or heavier amounts of plastics.</p> <p>Examples include plastic manufacturing, vehicle manufacturing and assembly, and printing plants.</p>

- Reference FM Global Data Sheet 3-26
- For further specific examples of occupancy classifications refer to Tables 4 & 5 in 3-26

- ***Develop water mist system test protocols for Nonstorage Occupancies, Hazard Category 2 and 3 (HC-2 and HC-3)***

Fuel Packages



Class 2 Commodity
(EUR Commodity Category I)



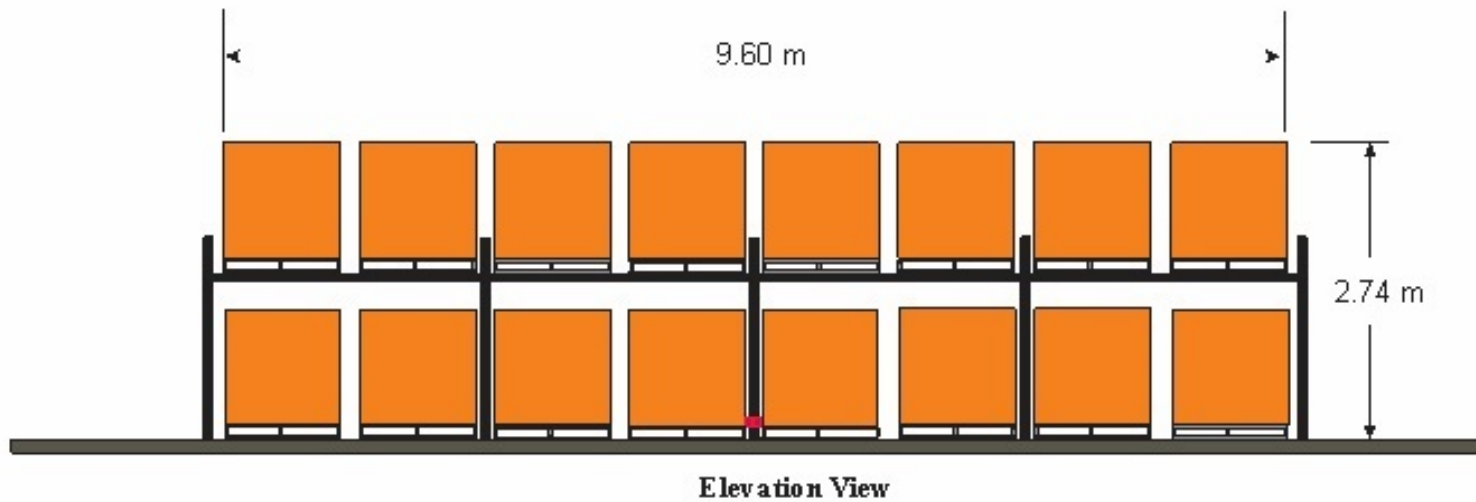
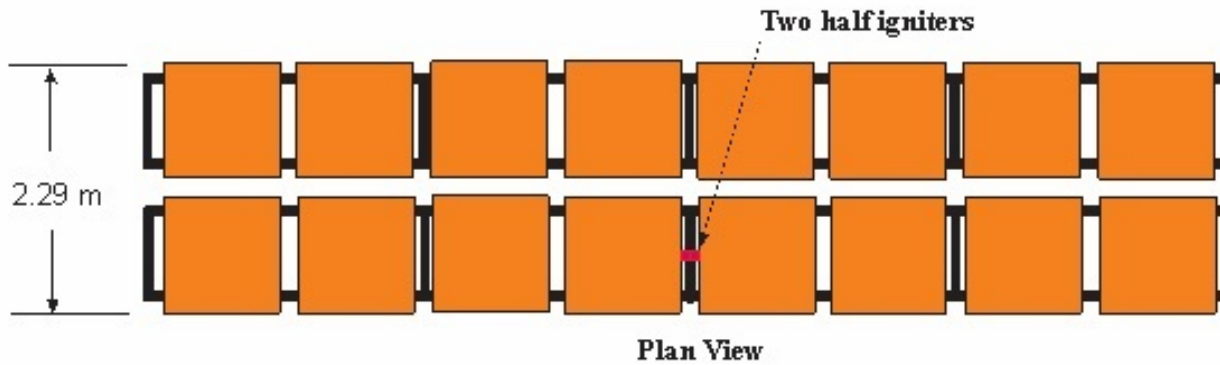
FM Global HC-2 Fire Hazard:
Class 2 commodity storage up
to 3.05 m high

Cartoned Expanded Polystyrene (CEP)
(EUR Commodity Category IV)

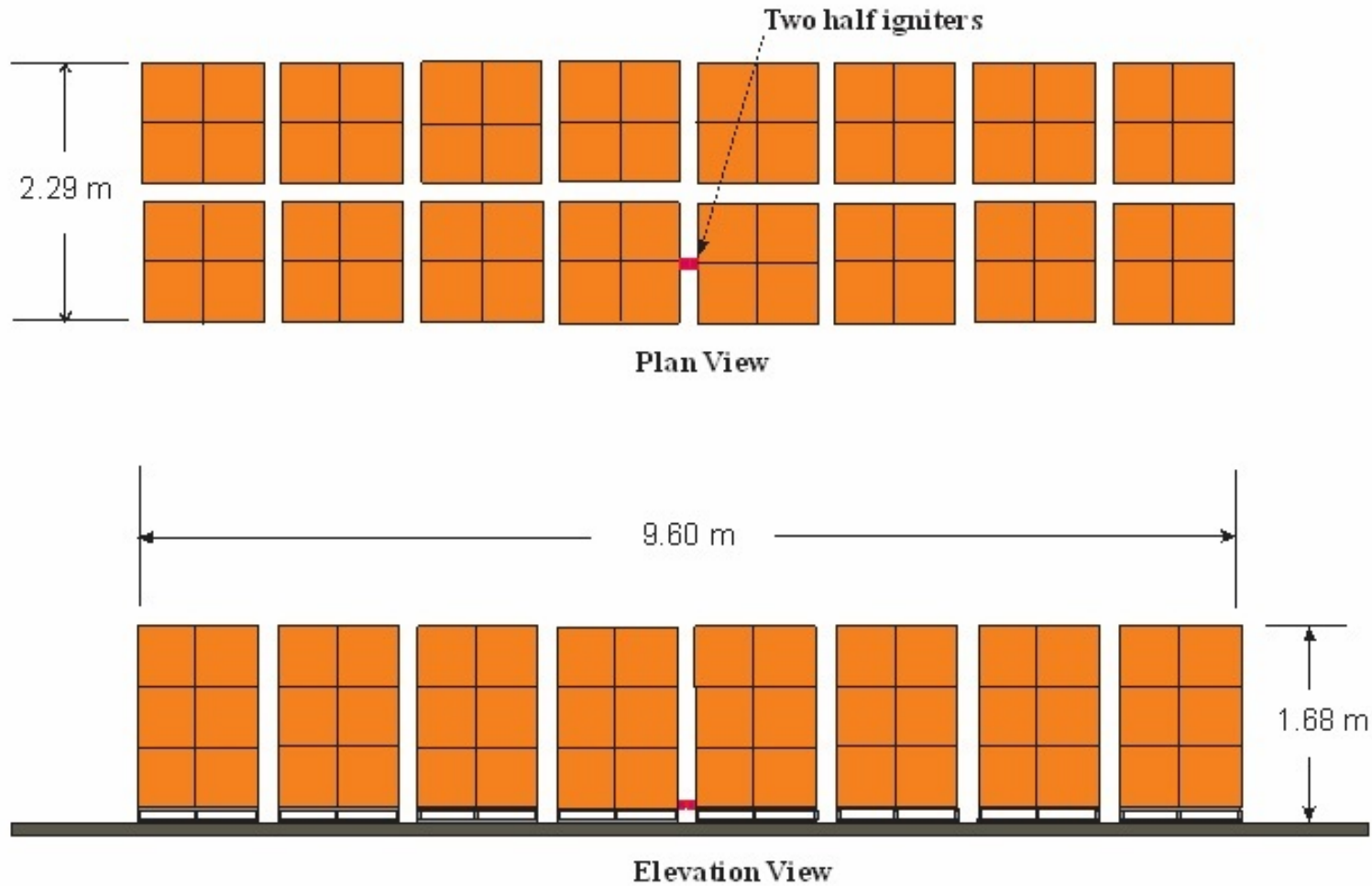


FM Global HC-3 Fire Hazard:
CEP commodity storage up to
1.52 m high

HC-2 Fuel Array



HC-3 Fuel Array



HC-2 Fuel Array



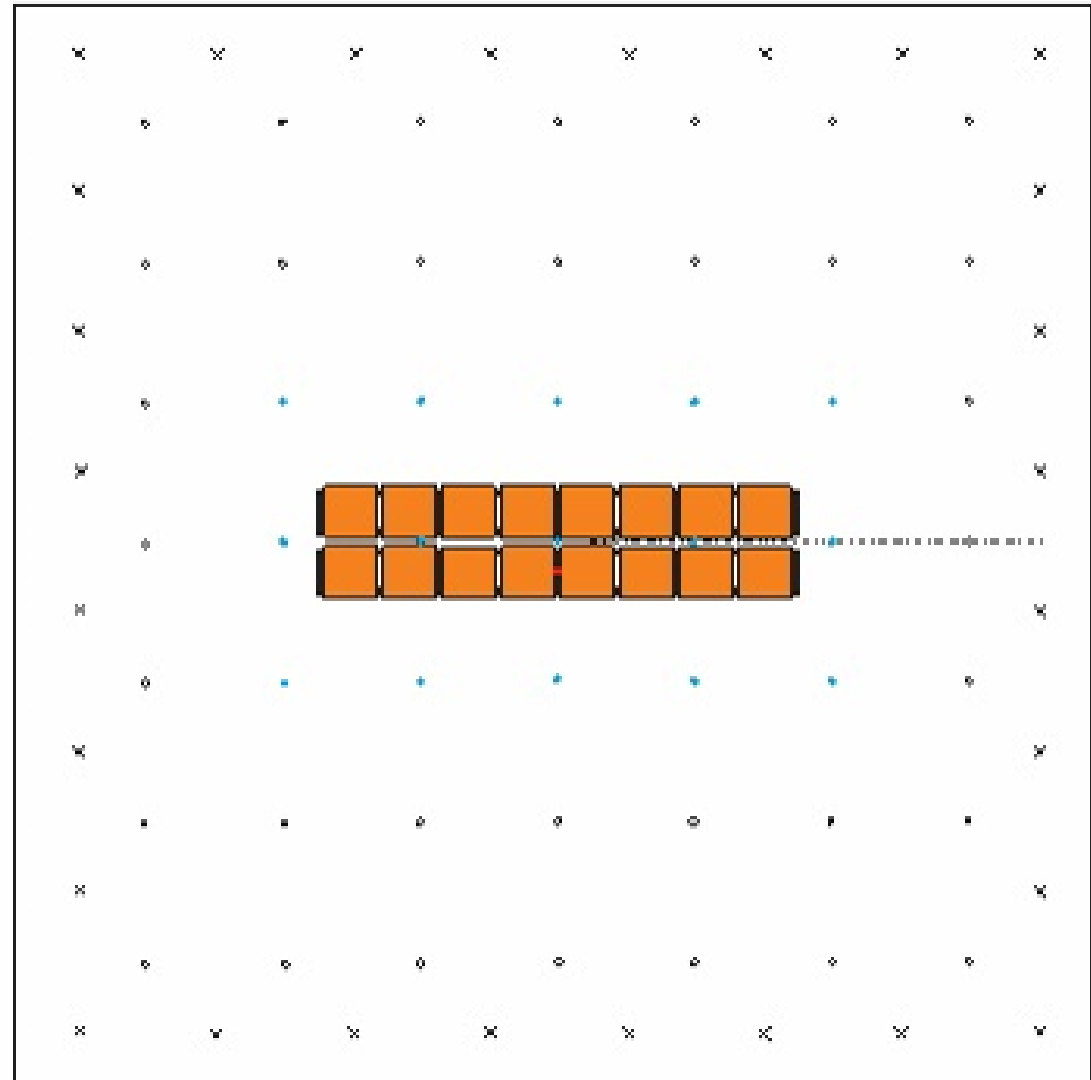
Anticipated Fire Test Scenarios

- ***All tests conducted at maximum ceiling height specified by the manufacturer in 5 ft (1.5 m) increments***
 - Ignition under one nozzle – maximum spacing
 - Ignition between four nozzles – maximum spacing
 - Ignition under one nozzle – minimum spacing
- ***Minimum ceiling height limit to be verified by spray overlap at minimum height based on spray coverage assessment***

Fire Test Specifications



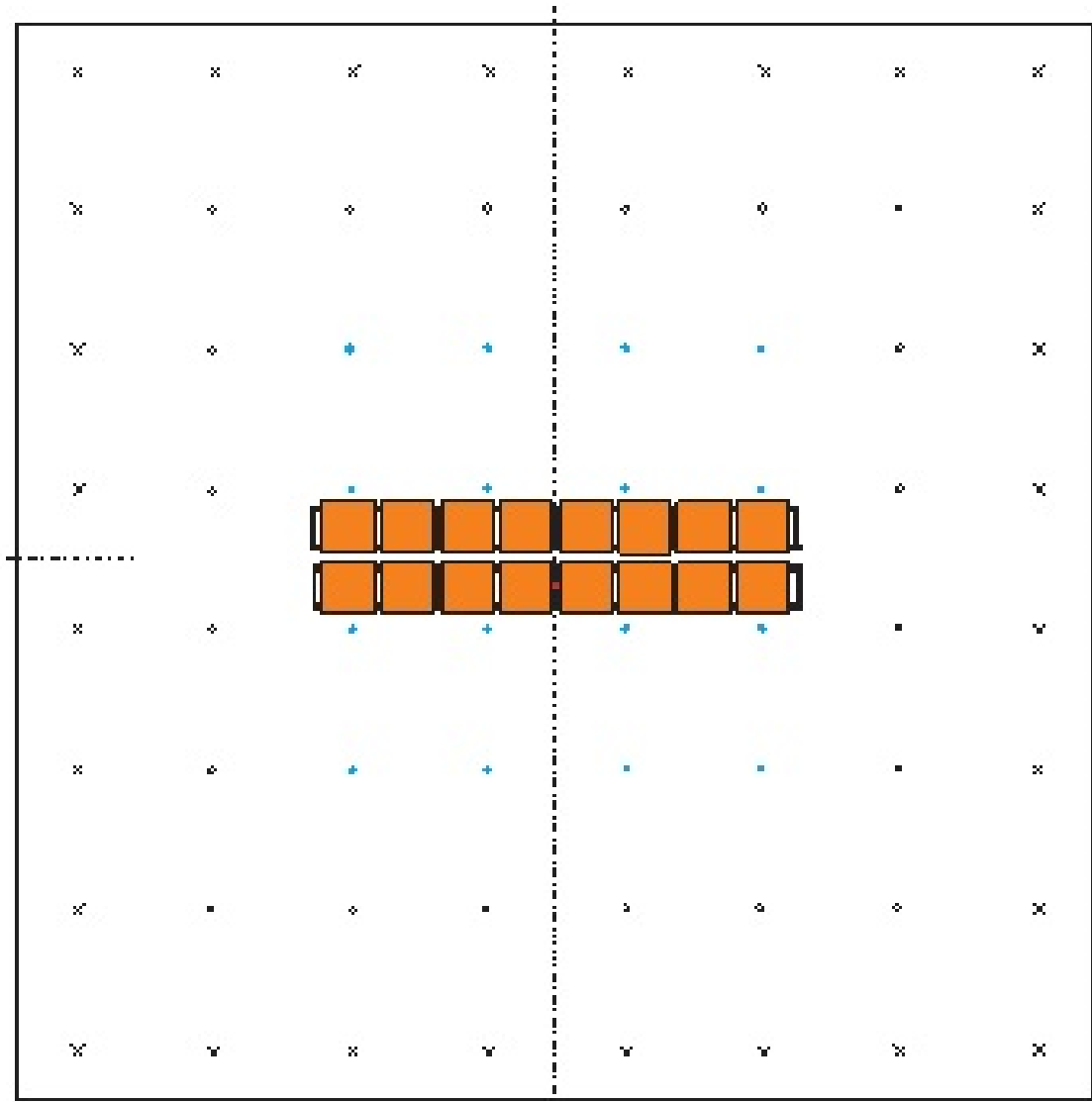
Ignition Under
One Nozzle



Plan View

Fire Test Specifications

Ignition Between
Four Nozzles



Plan View

Additional Notes

- ***If multiple temperature ratings are requested tests will be required at both minimum and maximum operating element temperature***
 - Quick Response (QR) will be required
- ***Target arrays will be added to both the HC-2 & HC-3 fuel packages to evaluate potential fire spread.***

Acceptance Criteria

- ***All tests will be conducted for 30 minutes followed by manual extinguishment***
 - The main fuel array cannot burn to either end
 - The target fuel array cannot burn through nor burn to either end
 - Temperatures of steel angle, installed at ceiling level above ignition, cannot exceed 538°C

System Design

- *Design area (or # of nozzles) to be based on worst case nozzle operations during testing with a 50% SF*
- *Design area for HC-2 & HC-3 each based on their own scenarios or...*
- *Manufacturer can elect to use HC-3 design for HC-2 (less tests but lose ability to optimize for HC-2)*
- *All nozzle specifications and locations used during testing will be “you get what you test.”*

Still Being Discussed...

- *If HC-2 and/or HC-3 testing is passed in open area scenarios with automatic nozzles the protection can be used in enclosed areas using deluge protection (open nozzles)*
- *Possibility to conduct HC-2 and HC-3 testing in an enclosure using a deluge system to optimize performance for smaller enclosed protection areas*
 - Fuel packages would need to be based on footprint of enclosure
 - Opening size and location would need to be determined

Still Being Discussed...

- *Water mist system availability*
 - Water mist system availability study is being conducted to understand the availability of various water mist systems
 - Intent is to compare to traditional sprinkler system availability
 - Important to understand with water mist being used as sole protection for higher hazard occupancies

Fire Test Examples (Development)



HC-2, 6.1-m Ceiling, Ignition Between Four



1:28



2:25



4:54



9:10



15:03



post test
(25 min)

Fire Test Examples (Development)



HC-2, 7.6-m Ceiling, Ignition Between Four



1:13



3:38



7:33



11:02



15:18



23:32

Video Test Specifications

- Deluge Protection w/ 4 nozzles
 - Flow released when “dummy” nozzles located 2.16 m (7.1 ft) radially from ignition at ceiling level operated
- Ceiling Height: 9.1 m (30 ft)
- Nozzle Spacing: 3.05 by 3.05 m (10 by 10 ft)
- Total Flow: 300 lpm (80 gpm)
- Nominal Application Density: 8.1 mm/min (0.2 gpm/ft²)

Fire Test Examples (Development)



- Water mist system fire test scenarios for nonstorage occupancies, hazard category 2 and 3 (HC-2 & HC-3) have been developed.
- A bit of further work on some finer details remains to be done.
- The intent is the new test protocols will be published in the next revision of FM Approvals Standard, Class 5560, Water Mist Systems which is expected end of 2020/early 2021.

Thank you for your attention!

