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MHEC Loss Control Workshop

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Global Risk Consultants



251+ Professionals Worldwide

Presentation Title: Sprinkler Protection in the 21st Century

**Speakers: Thomas Arch & Mario Harpel - GRC, Kelly
Weston & Neil Cochenour - Marsh**



Sprinkler Protection in the 21st Century

- Sprinkler design standards are continuing to evolve and become more engineering based. Sprinklers have evolved from a few standardized types to highly specialized applications. How does sprinkler technology in 2011 vary from the sprinkler standards in the 1900's and what are the future trends?



Sprinkler Protection in the 21st Century

- 1812** · British inventor Sir William Congreve patented a manual sprinkler system using perforated pipes along the ceiling. When someone noticed a fire, a valve outside the building could be used to send water through the pipes.
- 1860** · Barnabas Wood patented the first basic sprinkler.
- 1864** · Henry Parmelee made modifications and produced the first practical automatic sprinkler.
- 1881** · Frederick Grinnell patented the first sensitive automatic sprinkler and incorporated it with a tooth-edged deflector and ½-inch orifice.
- 1895** · The NFPA was founded in Boston. The NFPA set standards for automatic sprinklers and by 1899 requirements became uniform throughout the United States and Canada.
- 1933** · The NFPA released the first guide to fire departments regarding the proper use of sprinkler systems.



Sprinkler Protection in the 21st Century

Early
Upright
Sprinkler

1/2" Orifice



Sprinkler Protection in the 21st Century

Note holes in
deflector



Sprinkler Protection in the 21st Century

Early sprinklers were based on:

- Standard water supply and
- 2-3-5 pipe design.....

- This means:



Sprinkler Protection in the 21st Century

- 40 to 50 psi pressure (100 foot tall city water tank)
- 2 heads on a 1" branch line
- 3 heads on a 1 ¼ " line
- 5 heads on a 1 ½ " line



Sprinkler Protection in the 21st Century

- Basic sprinkler hydraulics

$$Q = K \times \sqrt{P}$$

- Flow = K factor x sq. rt. of pressure
- $5.6 \times 6.55 = 36$ g.p.m. from the first head
- 2-3-5 design extended back to supply



Sprinkler Protection in the 21st Century

- So what happened in the 1960's?
 - 1. Plastics
 - 2. The fork lift
 - 3. Carpeting, foam cushions, synthetic finishes
 - 4. Flammable liquids



Sprinkler Protection in the 21st Century

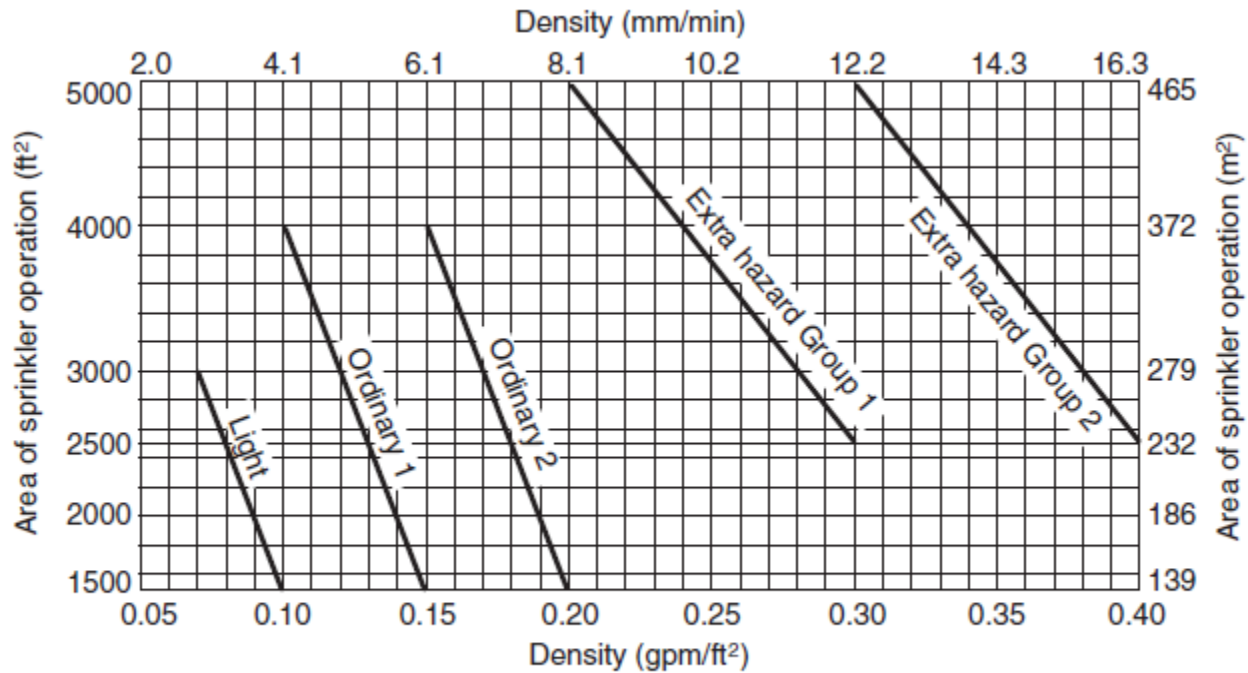


FIGURE 11.2.3.1.1 Density/Area Curves.



Sprinkler Protection in the 21st Century

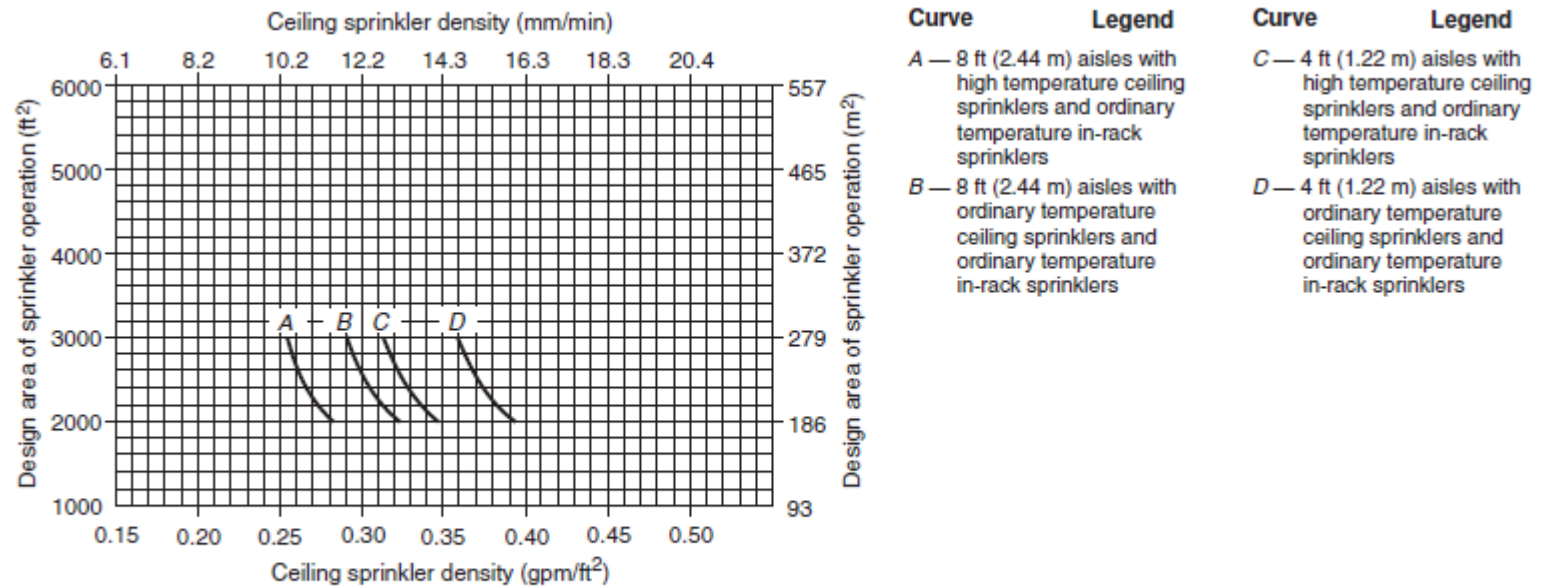


FIGURE 16.2.1.3.2(f) Single- or Double-Row Racks — 20 ft (6.1 m) High Rack
Storage — Sprinkler System Design Curves — Class III Encapsulated Commodities — Conventional Pallets.

Sprinkler Protection in the 21st Century

- Evolving research started to consider what factors impacted test results.
- Thermal sensitivity (RTI, response time index)
- Sprinkler position (orientation)
- Obstructions
- Droplet size
- Fire plume velocity
- Ceiling slope
- Smoke and heat vents
- Ceiling heights
- Draft curtains
- Ceiling design (pockets)



Sprinkler Protection in the 21st Century

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Sprinkler Protection in the 21st Century

- Grinnell ESFR 25
 $K = 25.2$

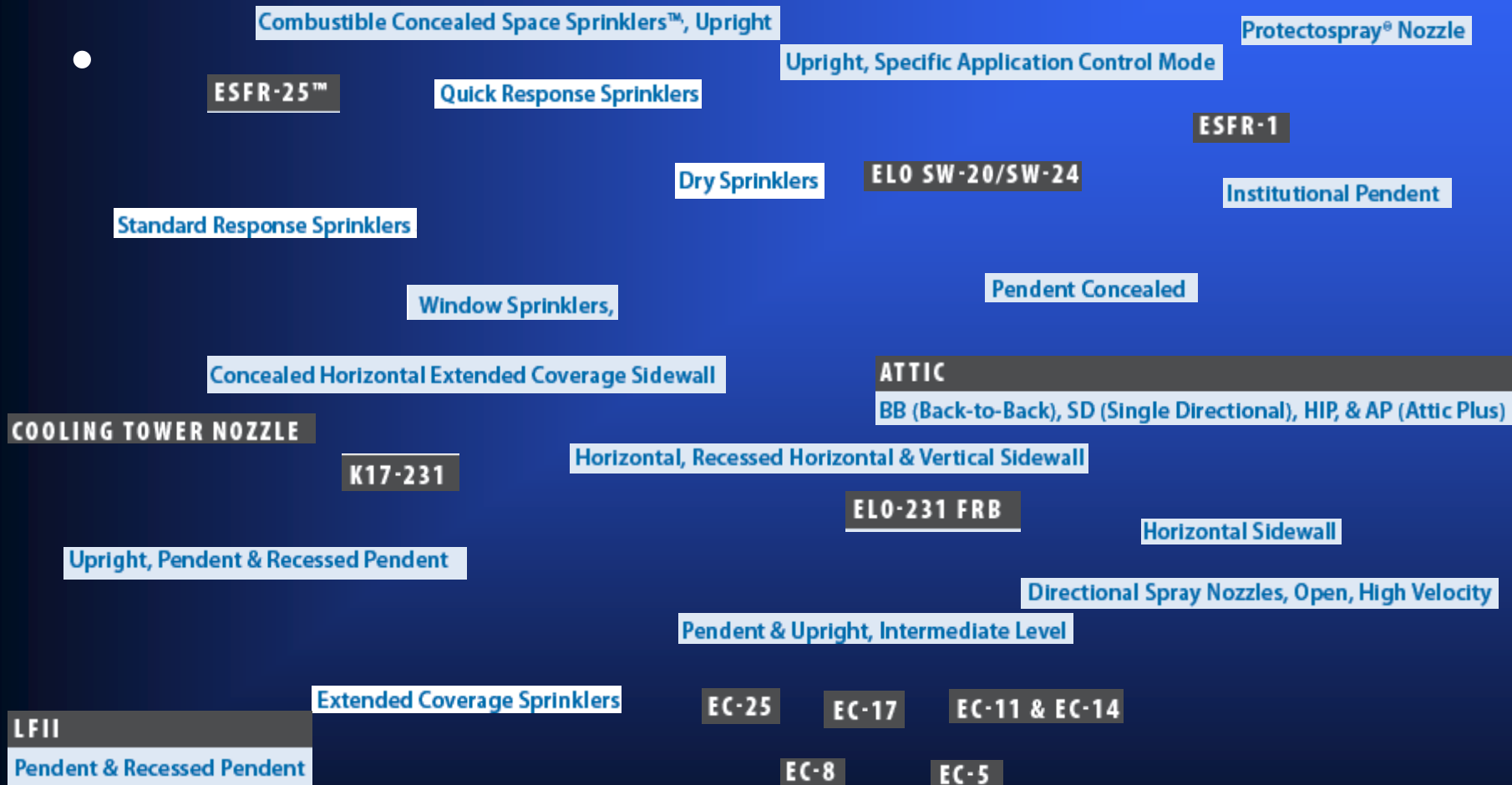


Sprinkler Protection in the 21st Century

- Jump ahead to 2011
- Ceiling design of 12 heads at 50 psi
- $Q = K \times \sqrt{P}$
- Flow = 22.5 x 7.07
- 159 gpm!



Sprinkler Protection in the 21st Century



Sprinkler Protection in the 21st Century

- Early systems – 2-3-5 pipe schedules
- 1970's – Hydraulically calculations
- 1989 – First edition of 13R (Residential Sprinklers)
- 1990 – ESFR sprinklers



Sprinkler Protection in the 21st Century

- 2000 – Performance Based Design
- "Performance-based design" is an engineering approach to fire protection design based on (1) established fire safety goals and objectives, (2) analysis of fire scenarios, and (3) quantitative assessment of design alternatives against the fire safety goals and objectives using engineering tools, methodologies, and performance criteria (SFPE, 2000).



Sprinkler Protection in the 21st Century

- 2010 – Where are we headed?
 - FM Data Sheet 2.0 (Installation Guidelines for Automatic Sprinklers)
 - FM Data Sheet 8-9 (Storage of Class 1,2,3,4 AND PLASTIC COMMODITIES)



Sprinkler Protection in the 21st Century

- **FM Data Sheet 2.0**
 - The maximum area of coverage for a sprinkler system is limited only by the hydraulic requirements of the sprinkler system's design for the occupancy being protected.
 - The terms "Control Mode Density Area (CMDA)," "Control Mode Specific Application (CMSA)," and "Suppression Mode" are no longer used to describe sprinklers.
 - The terms "Storage," "Nonstorage," and "Special Protection" are now used to describe sprinklers



Sprinkler Protection in the 21st Century

- FM Data Sheet 8-9 Storage – March '10
- Protection reorganized into five categories:
 - Class I, II, III
 - Class IV and Cartoned, Unexpanded Plastics
 - Cartoned Expanded Plastic
 - Uncartoned, Unexpanded Plastic
 - Uncarted, Expanded Plastic



Sprinkler Protection in the 21st Century

- FM Data Sheet 8-9 Storage , cont.
- All protection options for a given commodity and storage arrangement – 1 table!
- Single design format, i.e. number of sprinklers @ minimum operating pressure
- The following are no longer considered:
 - Storage height
 - Aisle width



Sprinkler Protection in the 21st Century

Table 8. Ceiling-Level Protection Guidelines for Class 4 and Cartoned Unexpanded Plastic Commodities in Open-Frame Rack Storage Arrangements

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				
	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 @ 25 (1.7)	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)	10 @ 7 (0.5)	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 @ 15 (1.0)
20 (6.0)	15 @ 20 (1.4)	12 @ 50 (3.5)	12 @ 35 (2.4)	12 @ 25 (1.7)	12 @ 20 (1.4)	6 @ 25 (1.7)	15 @ 20 (1.4)	15 @ 15 (1.0)	12 @ 16 (1.1)	12 @ 7 (0.5)	15 @ 20 (1.4)	12 @ 50 (3.5)	12 @ 35 (2.4)	8 @ 15 (1.0)	15 @ 20 (1.4)	15 @ 10 (0.7)	12 @ 20 (1.4)	20 @ 20 (1.4)	20 @ 10 (0.7)	20 @ 30 (2.1)	20 @ 15 (1.0)
25 (7.5)	15 @ 50 (3.5)	12 @ 50 (3.5)	12 @ 35 (2.4)	12 @ 25 (1.7)	12 @ 20 (1.4)	6 @ 25 (1.7)	15 @ 50 (3.5)	15 @ 35 (2.4)	12 @ 16 (1.1)	12 @ 15 (1.0)	15 @ 50 (3.5)	12 @ 50 (3.5)	12 @ 35 (2.4)	8 @ 40 (2.8)	15 @ 50 (3.5)	15 @ 25 (1.7)	12 @ 20 (1.4)	20 @ 50 (3.5)	20 @ 20 (1.4)	20 @ 30 (2.1)	20 @ 15 (1.0)
30 (9.0)		12 @ 50 (3.5)	12 @ 35 (2.4)	12 @ 25 (1.7)	12 @ 20 (1.4)	6 @ 30 (2.1)			12 @ 16 (1.1)	12 @ 15 (1.0)		12 @ 50 (3.5)	12 @ 35 (2.4)	12 @ 35 (2.4)		20 @ 25 (1.7)	12 @ 20 (1.4)		35 @ 20 (1.4)	35 @ 30 (2.1)	35 @ 15 (1.0)
35 (10.5)		12 @ 75 (5.2)	12 @ 50 (3.5)	12 @ 35 (2.4)	12 @ 30 (2.1)	6 @ 40 (2.8)			15 @ 25 (1.7)	12 @ 30 (2.1)		12 @ 75 (5.2)	12 @ 50 (3.5)								
40 (12.0)		12 @ 75 (5.2)	12 @ 50 (3.5)	12 @ 45 (3.1)	12 @ 40 (2.8)				12 @ 30 (2.1)												
45 (13.5)				12 @ 50 (3.5)	12 @ 50 (3.5)																

*K25.2 utilizes 80 - 100 sq.ft spacing....design area as little as 600 square feet or less.....still need a fire pump?

Sprinkler Protection in the 21st Century

- Other options?
 - Clean Agent Extinguishing Systems
 - Early Warning Smoke Detection



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- Questions?





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Thank You!