Not All Sprinkler Systems Are Created Equally

NFPA 13/13R AND 13D

UNDERSTANDING KEY DESIGN DIFFERENCES

Presented by

MAINE DEPARTMENT OF PUBLIC SAFETY

BUREAU OF BUILDING CODES AND STANDARDS

Course Goal

Explain the differences among the NFPA fire sprinkler design standards and how to apply them in concert with the building codes.

Research NFPA fire sprinkler standards for specific details.

Discussion

What do you need to know about the differences among NFPA 13/13R/13D?

Why are you here?

Learning Objectives

At the end of the course, you should be able to:

1. Explain fire sprinkler system design evolution
2. Explain key differences among three NFPA fire sprinkler design standards
3. Apply appropriate design standard to corresponding building code projects

Prerequisite Knowledge

- Fire sprinkler operations
- Maine Uniform Building and Energy Code
  - IBC/IRC
- NFPA 1, *Fire Code*
- NFPA standards development process

Course Layout

Module	Scope
1	Sprinkler Evolution
2	Design Criteria
3	Design Approaches
4	Materials/Components
5	Special Occupancies
6	Building Code Applications
7	Review and Post-Test

PRE-TEST

Activity

1. NFPA 13 allows copper tube to be used in pipe schedule fire sprinkler systems protecting high hazard occupancies.

   True or False

Activity

2. How many nationally recognized sprinkler design standards exist?
    a) One
    b) Two
    c) Three
    d) Four

Activity

3. The first patented automatic sprinkler was created by:

   a) Benjamin Franklin
   b) Cosmo C. Anderson
   c) Henry S. Parmalee
   d) Paul A. Demers

Activity

4. Warehouses storing products more than 12 feet high on racks, shelves or pallets can be protected by sprinkler systems designed in accordance with:
   a) NFPA 13
   b) NFPA 13D
   c) NFPA 13E
   d) NFPA 13R

Activity

5. A sprinkler manufacturer's proprietary 5- or 6-character identification scheme for automatic sprinklers is called:
   a) QRS
   b) SIN
   c) PDQ
   d) A27

Activity

6. Fire sprinkler systems installed in residential occupancies require sprinklers to be installed in all combustible spaces.

True or False

Activity

7. Which of the following area/density values will deliver the most water?
   a) 0.10/2,000
   b) 0.15/2,000
   c) 0.215/1,500
   d) 0.185/2,000

Activity

8. Valves controlling water supplies on NFPA 13R-designed systems have to be electronically supervised.

   True or False

Activity

9. The water supply for a fire sprinkler system designed in accordance with NFPA 13R has to last how long?

   a) 30 minutes

   b) 45 minutes

   c) 60 minutes

   d) 120 minutes

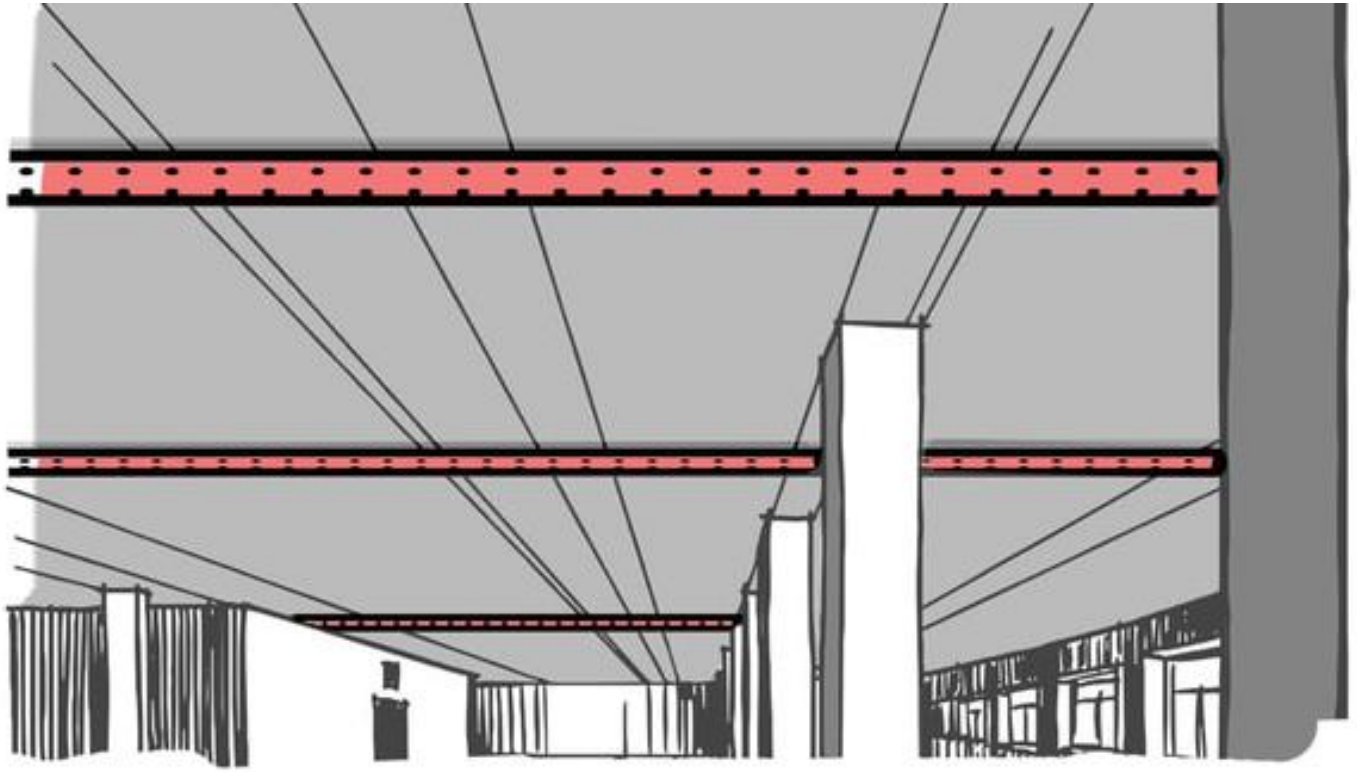
Activity

10. Which of the following sprinkler design standards is most suitable for the building we are currently in?
    a) NFPA 13
    b) NFPA 13D
    c) NFPA 13R
    d) “It depends …”

SPRINKLER EVOLUTION

MODULE NO. 1

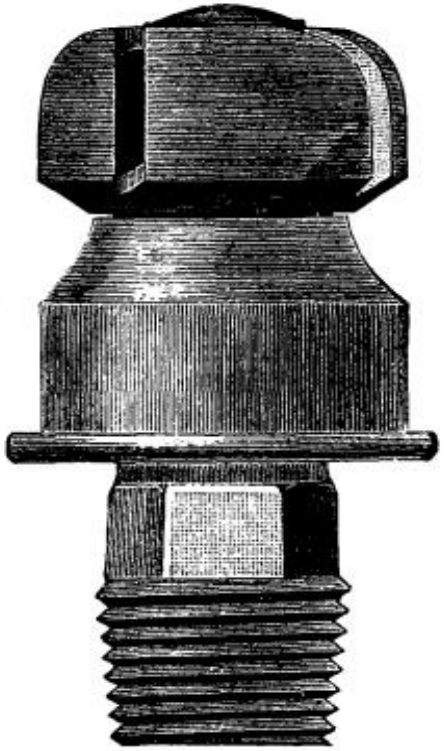
1860's Perforated Pipe

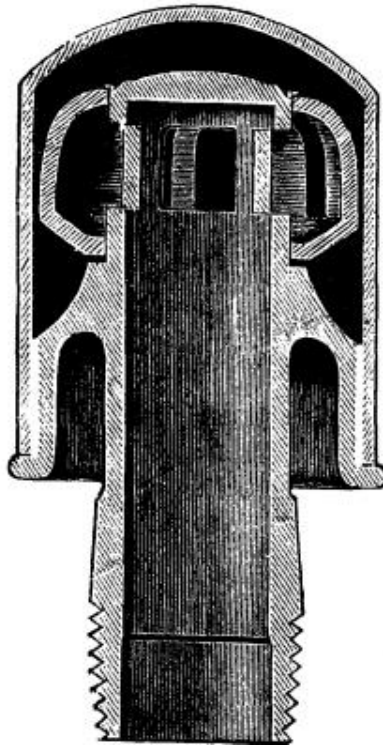


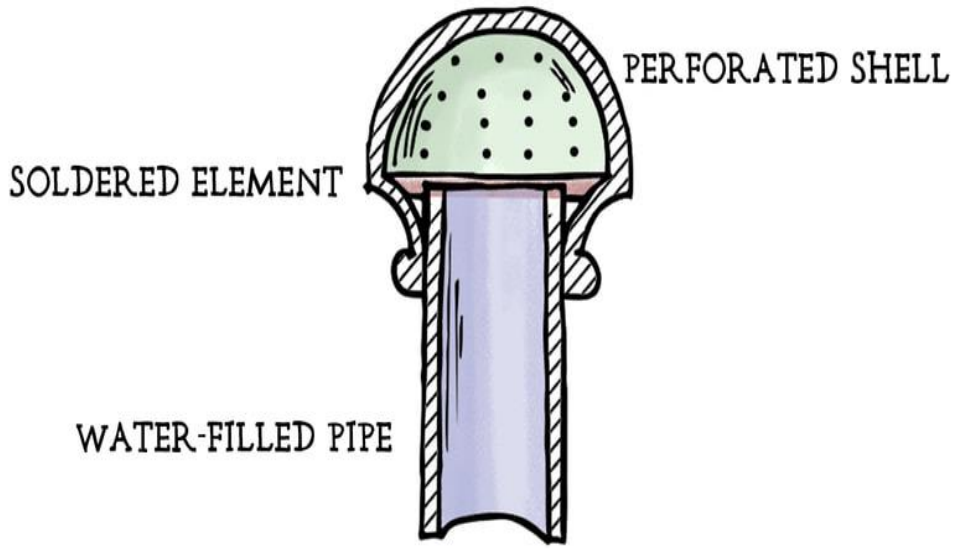
Courtesy: MeyerFire.com

PERFORATED PIPE MANUAL SPRINKLER SYSTEMS

1878 Parmalee Closed Sprinklers







HENRY S. PARMELEE'S AUTOMATIC SPRINKLER

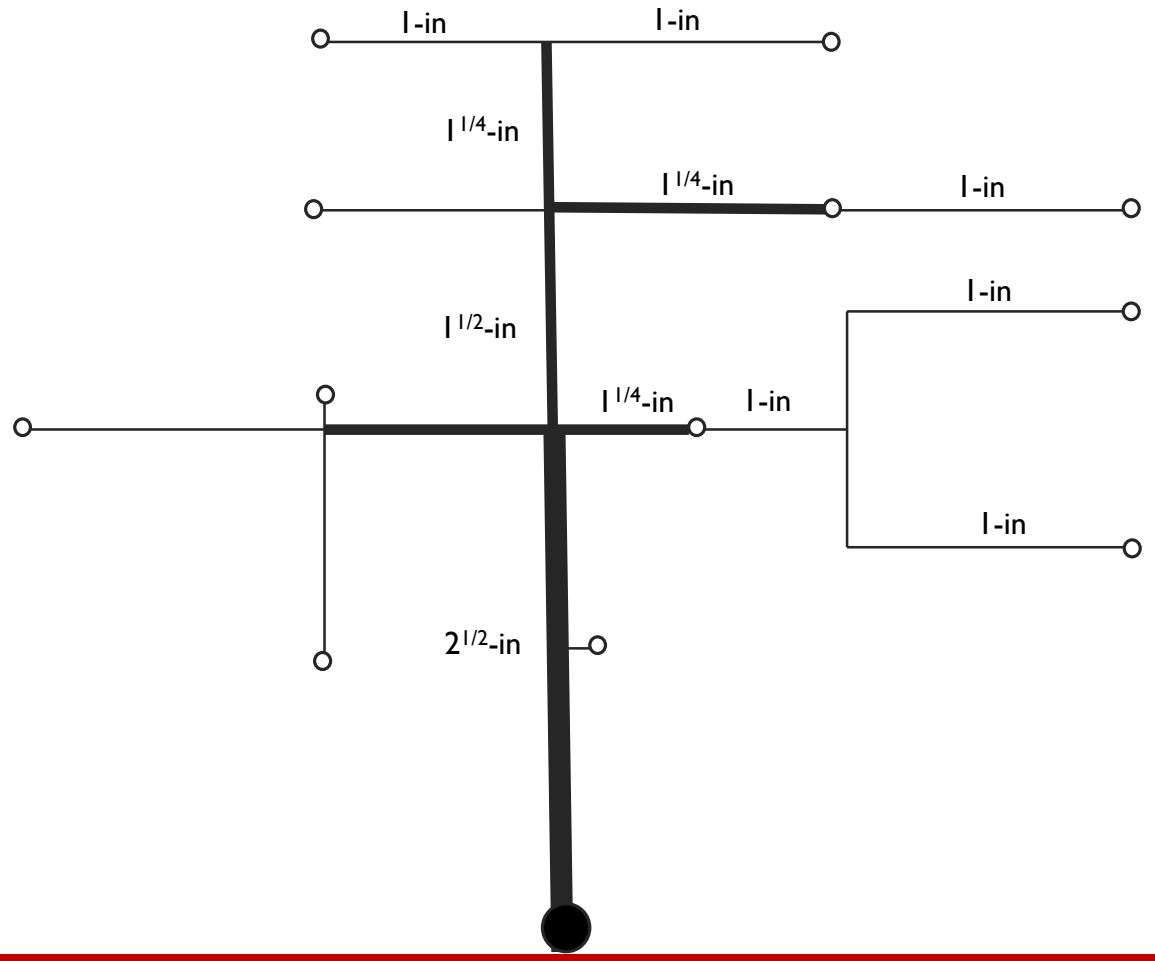
System Design Evolution

- 1896 -- NFPA 13 "Rules and Regulations of the National Board of Fire Underwriters for Sprinkler Equipments, Automatic and Open Systems as Recommended by the National Fire Protection Association"
  - Pipe schedule design

Pipe Schedule Design

Steel		Copper	
Pipe Size (in.)	Sprinklers Served	Pipe Size (in.)	Sprinklers Served
¾	1	¾	1
1	2	1	2
1 ¼	3	1 ¼	3
1 ½	5	1 ½	5
2	10	2	12
2 ½	30	2 ½	40
3	60	3	80
3 ½	100	3 ½	115

Pipe Schedule



Light Hazard
Schedule 40 B.I.

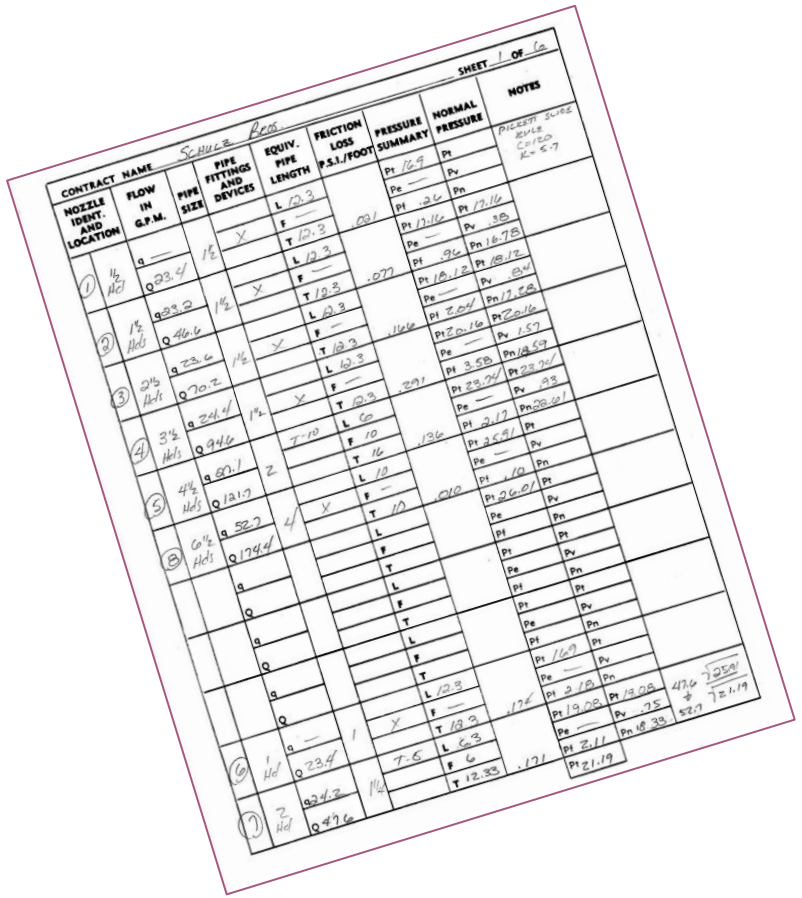
Discussion

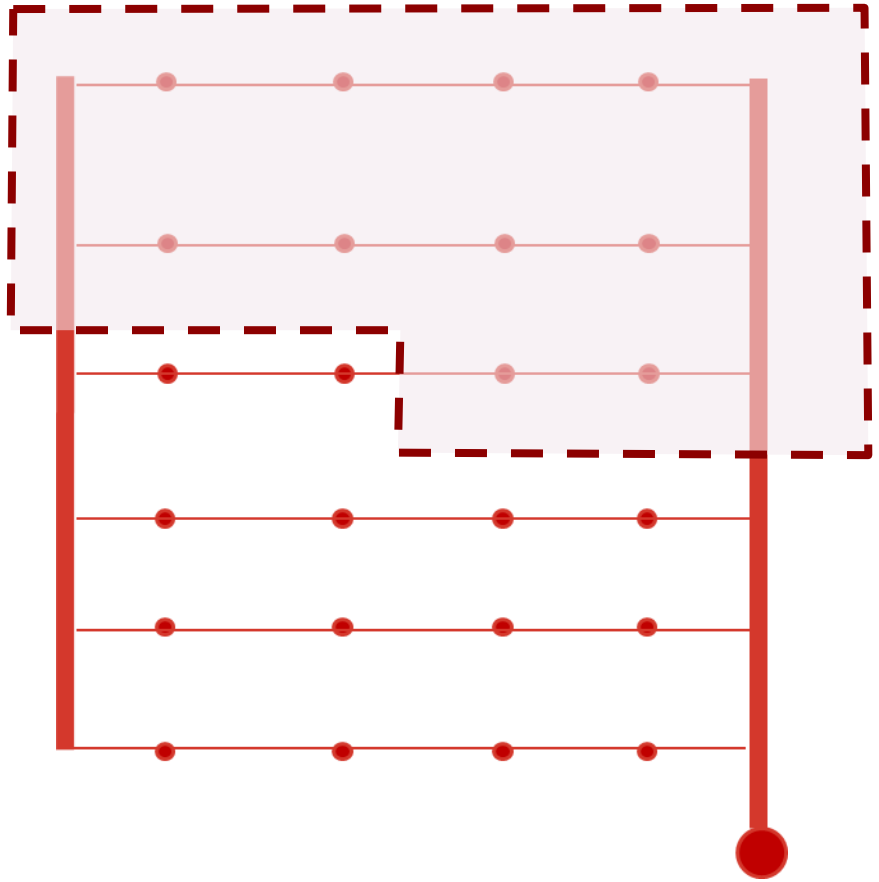
What are the benefits and drawbacks to pipe schedule design?

System Design Evolution

- NFPA 13 -- "Standard for the Installation of Sprinkler Systems"
  - 1972 hydraulic design

Hydraulic Design



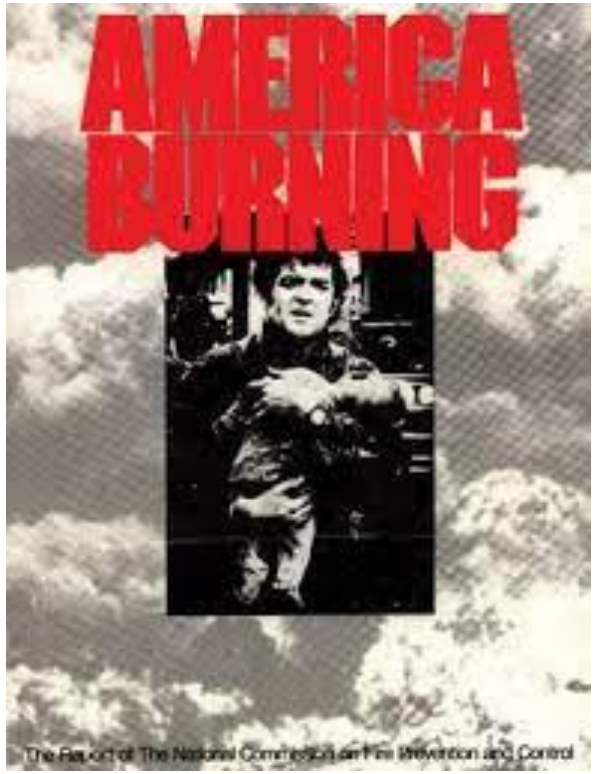


Light Hazard
Schedule 40 B.I.

Discussion

What are the benefits and drawbacks to hydraulic design?

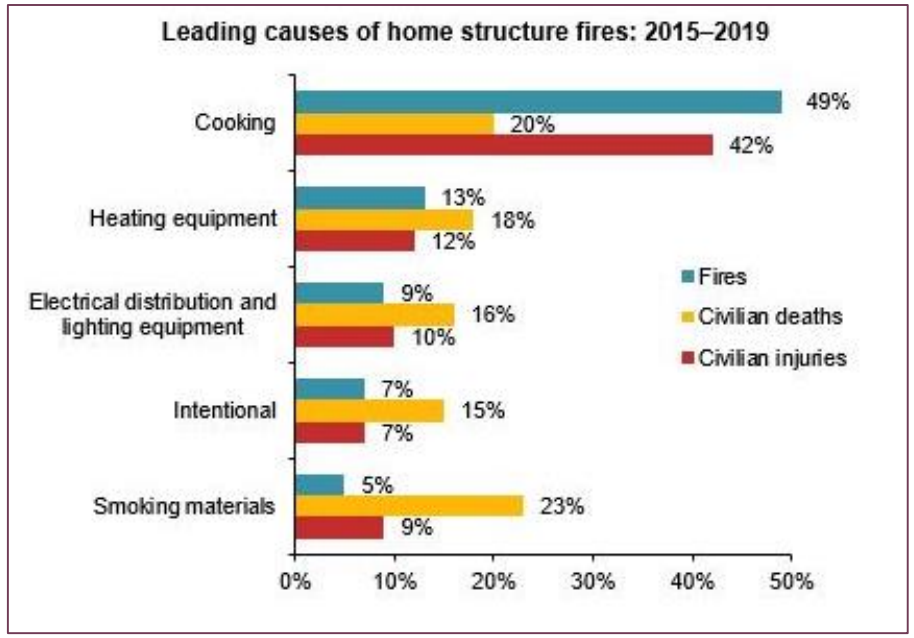
System Design Evolution



- 1973 -- "America Burning"
  - National Commission on Fire Prevention and Control
  - US Fire Administration

- 1973 -- NFPA 13D "Standard for the Installation of Sprinkler Systems in One- and Two-Family Dwellings and Manufactured Homes"
  - Residential sprinklers

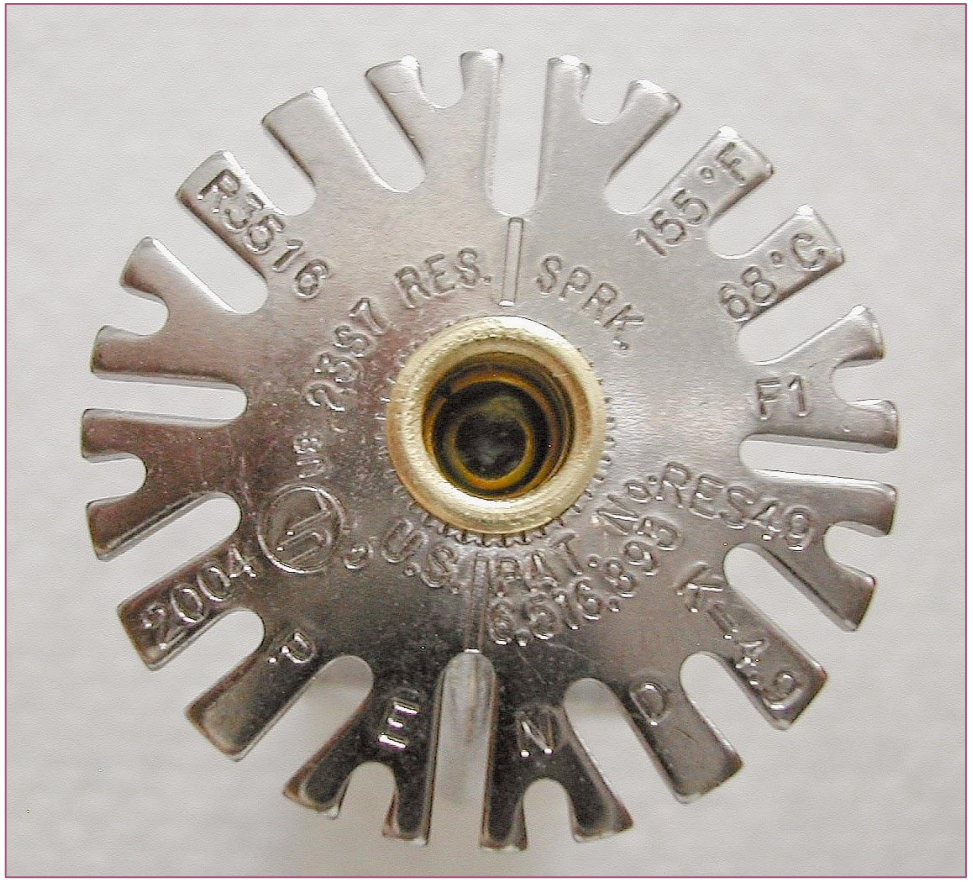
Statistics and Markets

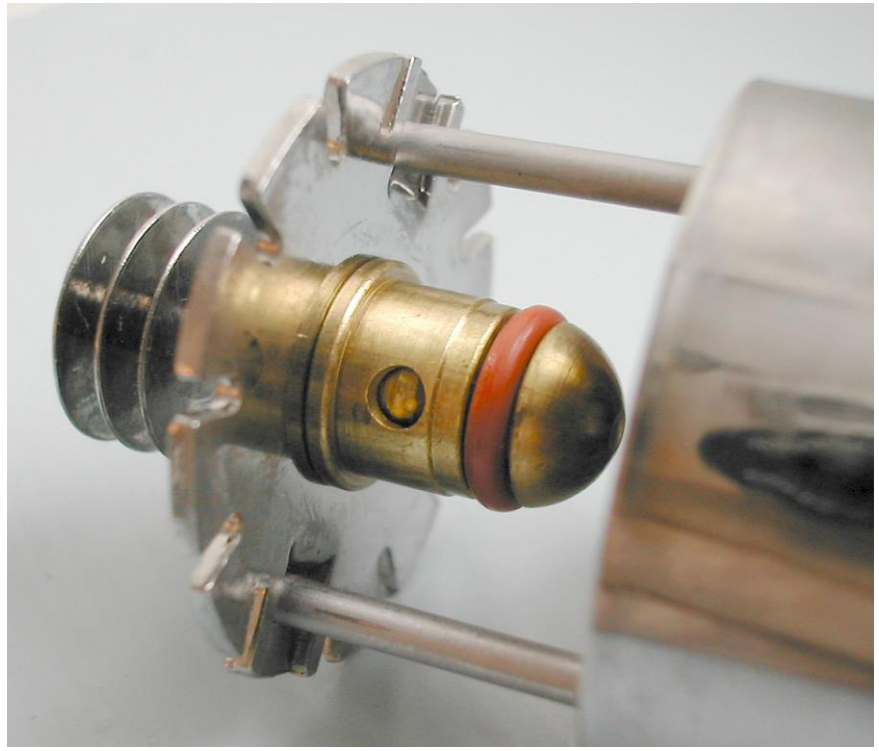


Source: NFPA.org

- Locations where most fatal fires start
  - Kitchen, heating spaces, bedrooms, living rooms
- Reduce costs
  - Less expensive pipe = less labor cost
  - Smaller pipe, fewer controls and fewer sprinklers = lower material costs
  - Less water demand = smaller water supplies

Residential Sprinklers

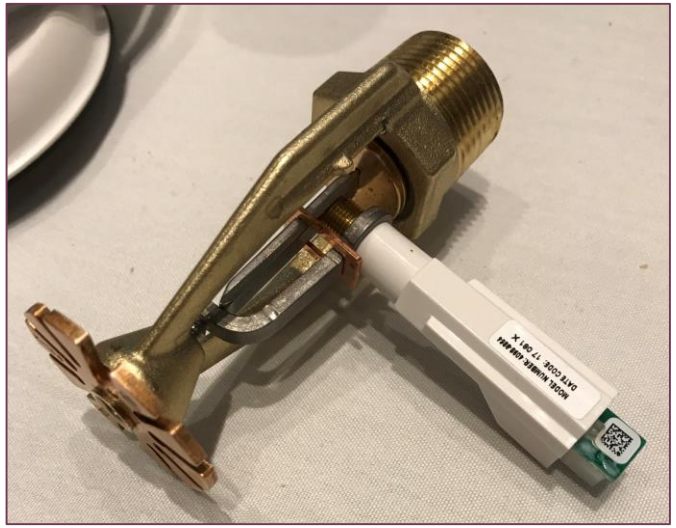




System Design Evolution

- 1991 -- NFPA 13R "Standard for the Installation of Sprinkler Systems in Residential Occupancies up to and Including Four Stories in Height"
  - Now "Standard for the Installation of Sprinkler Systems in Low-Rise Residential Occupancies"
    - Residential and quick response sprinklers

E-Sprinklers



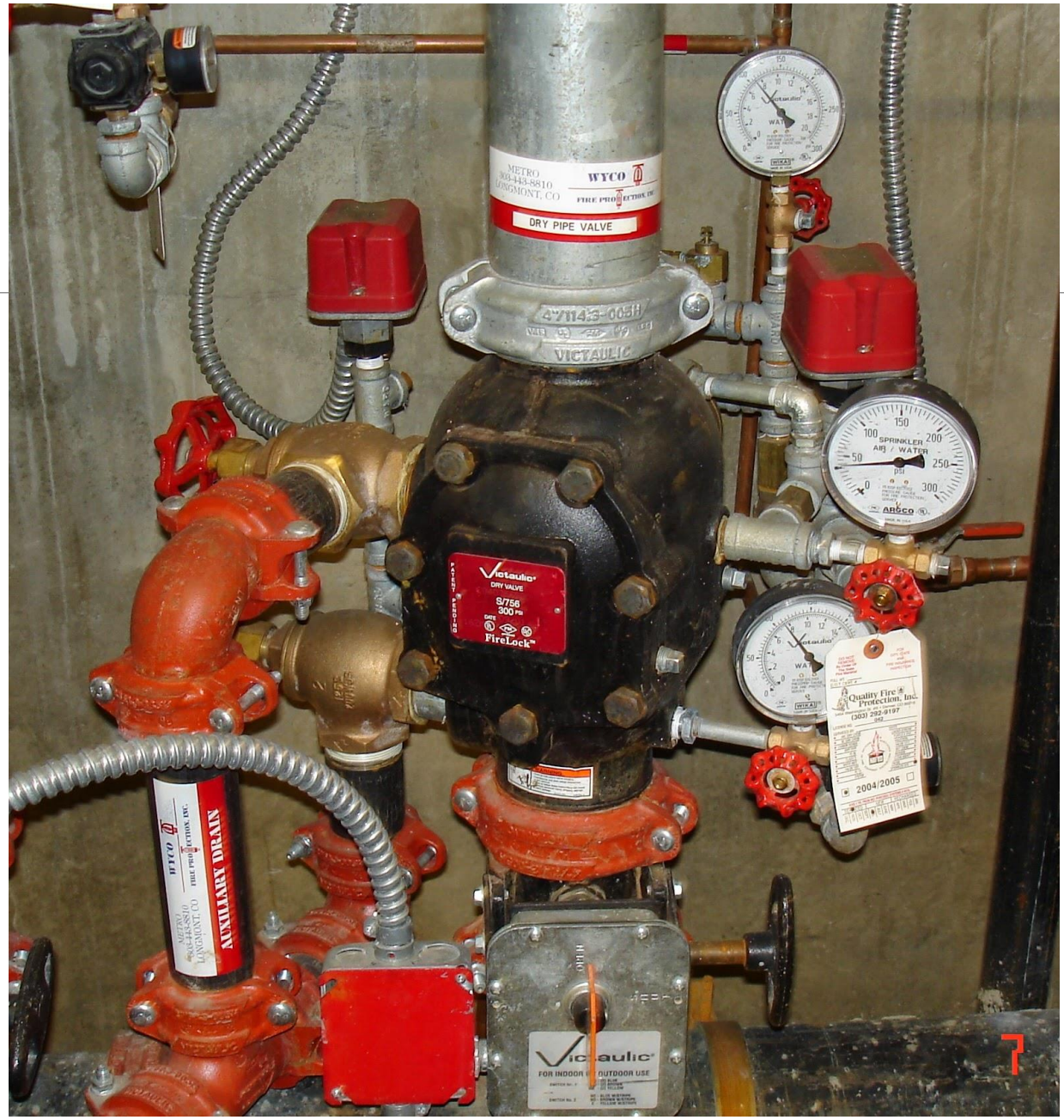
DESIGN CRITERIA

MODULE NO. 2

NFPA 13

NFPA 13D

NFPA 13R



Codes and Standards

Play a significant role in life safety and fire protection

- Understanding their use and appropriate application is key

Image courtesy: gilbertlodge.com

Codes and Standards

- *Maine Uniform Building and Energy Code*
  - *International Building Code*
- *NFPA 1, Fire Code*
- *International Residential Code*

Codes and Standards

Where adopted and/or enforced,

- building and fire codes set requirements for automatic fire sprinkler protection.
- NFPA sets design and installation standards.
  - *International Residential Code* has a prescriptive design for one- and two-family dwellings.

Codes and Sprinklers

- Required for
  - life safety (including fire fighters),
  - property protection,
  - special hazard control, and,
  - environmental protection.


2520
2518

Property Protection or Life Safety?

NFPA 13 - Property Protection

- Design intent: wet contents or extinguish*
- Accomplished by
  - Sprinkler coverage
  - Amount and pattern
  - Water supply
  - Control or suppression mode
  - Also effective for life safety
- UL 199/1767

* Special application ESFR: Early-Suppression Fast-Response

NFPA13R/NFPA 13D - Life Safety

- Design intent: prevent flashover
- Accomplished by
  - Sprinkler coverage
  - Amount and pattern
  - Water supply
  - Control mode
- UL 199

Property Protection/Life Safety

- Not an "either/or" proposition
  - Sprinklers designed for life safety can be effective for property protection.
  - Sprinklers designed for property protection are proved effective for life safety.

Sprinkler Design Standards

IBC	NFPA	Application
§903.3.1.1	13	All, except where 13R or 13D allowed
§903.3.1.2	13R	Multi-family residential not exceeding four stories or 60 feet in height
§903.3.1.3	13D	One- and two-family dwellings and townhouses
IRC R§313	P2904	

IBC Design Alternatives

	Design Standard		
Design Feature	NFPA 13	NFPA 13R	NFPA 13D/ P2904
Increasing the allowable height of buildings by one story or 20 feet.	X		
Increasing the allowable height of multi-family residential buildings to 60 feet.		X	
Increasing the allowable area of some buildings by up to 300%.	X		
Allowing some buildings to have unlimited floor area.	X		

IBC Design Alternatives (cont'd)

Source: www.nfsa.org

Common alternatives include:

- Elimination of fire-resistive separation
  - Fire-rated *corridors*
  - *Incidental uses*
- Egress design ty
  - Extended *travel distance*
  - Decreased exit separation
  - Elimination of *areas of refuge*

Property Protection/Life Safety

	Design Standard		
Design Feature	NFPA 13	NFPA 13R	NFPA 13D/ P2904
Places of public assembly with a fire area more than 12,000 ft^2 or an occupant load more than 300.	X		
Elementary and high schools with a fire area >12,000 ft^2.	X		
Mercantile operations with a fire area more than 12,000 ft^2.	X		
Woodworking operations more than 2,500 ft^2.	X		

Property Protection/Life Safety

	Design Standard		
Design Feature	NFPA 13	NFPA 13R	NFPA 13D/ P2904
Facilities where care or supervision is provided to those who cannot escape without physical assistance, including prisons and ambulatory care facilities	X		
Assisted living facilities, group homes, halfway houses, alcohol and drug centers and similar uses	X	X	
Hazardous operations and hazardous materials storage facilities.	X		

Property Protection/Life Safety

	Design Standard		
Design Feature	NFPA 13	NFPA 13R	NFPA 13D/ P2904
Warehouses storing materials on racks or in piles more than 12 feet high.	X		
Multi-family residential buildings such as apartments, dormitories, hotels, congregate living facilities or residential board and care facilities.	X	X	
Where required or allowed, one- and two-family dwellings, manufactured homes, and townhomes.			X

Discussion

Based solely on what you see, which NFPA sprinkler design standard is most suitable for this building?

DESIGN APPROACHES

MODULE NO. 3

Fire Control Concepts

- Control mode
  - Keep fire from spreading until fire fighters can extinguish it
    - NFPA 13D – One-/two-family and townhouses
    - NFPA 13R – Mid-rise multi-family
    - NFPA 13 – All except "storage" occupancies
- Suppression mode
  - Extinguish fire through automatic operation
    - Early Suppression – Fast Response (ESFR) sprinklers

System Types

Type		Application/Feature	Standard(s)
Wet pipe		Default "preferred" type Where temperature ≥ 40°F can be maintained	13D, 13R, 13
	Anti-freeze	Freezer rooms, cold storage, loading docks	13D, 13R, 13
	Foam-Water	Aircraft hangars, flamm/com liquid storage	13
Dry pipe		Cold storage, loading docks, outdoors	13D, 13R, 13
Pre-action		Requires other detection (smoke, IR/UV, heat, beam) Computer rooms, high-value products	13D, 13R, 13
Deluge		All sprinklers open Requires other detection (smoke, IR/UV, heat, manual) Explosives production, aerosol filling	13

Sprinkler Orientation: All standards

Upright

Pendent

Horizontal Sidewall

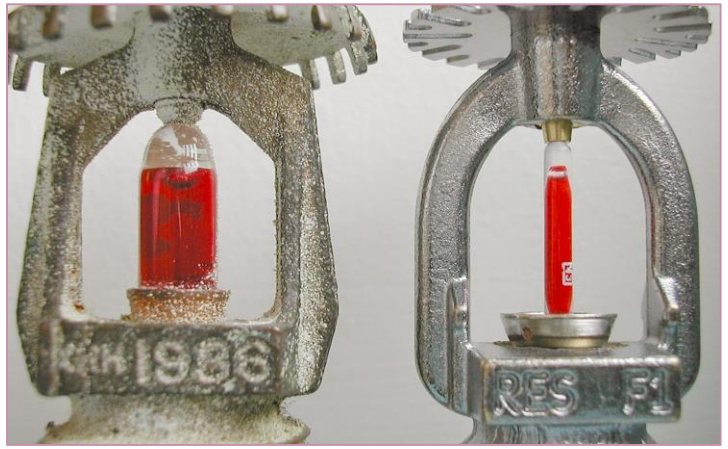
Sprinkler Types

- Standard spray
- Control Mode/Density Application
- Control Mode/Specific Application
- Corrosion resistant
- Dry sprinkler
- ESFR
- Extended coverage
- Special sprinkler

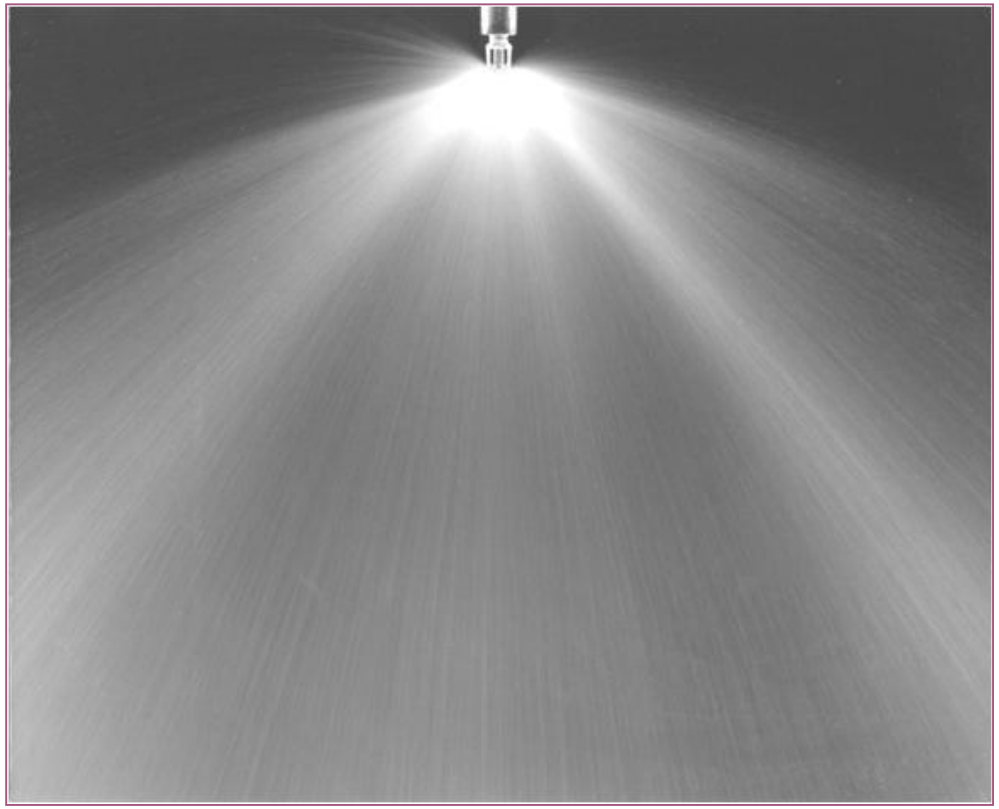
- Institutional sprinklers
- Intermediate/In-rack
- Old style/conventional
- Open sprinkler
- Pilot line detector
- Ornamental/decorative
- Quick response
- Residential

Response Time Index (RTI)

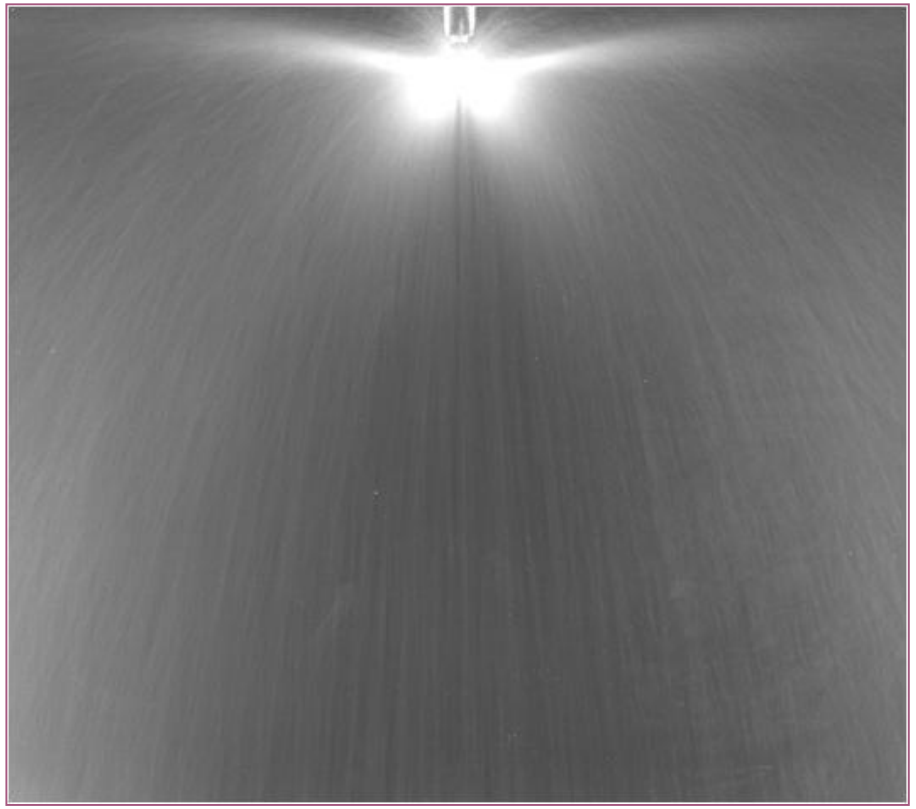
Category	RTI (meters/second)$^{1/2}$	RTI (feet/sec) $^{1/2}$
Fast response, QR and residential	50 or less	90 or less
Standard response	80 or more	145 or more



Water Distribution Pattern



Control/Suppression Mode: Property Protection



Control Mode: Residential

Courtesy: Tyco Fire Suppression & Building Products

Sprinkler ID Number (SIN)

- Sprinkler manufacturer's proprietary 5- or 6-character identification for:
  - Manufacturer
  - K-factor
  - Application (use)
  - Response characteristics
- Refer to manufacturer's technical literature for guidance

Occupancy Classifications

Hazard Class	Examples from NFPA 13 Annex A	Standards
Light	Office, classroom, residential and adjacent corridors, museums, hospitals, care facilities, restaurant seating areas, unused attics	13D/13R/13
Ordinary 1	Automobile parking and show rooms, beverage manufacturing, electronic plants, laundries, porte cocheres	13
Ordinary 2	Chemical plants – ordinary, feed mills, metal working, mercantile, pulp and papermaking, plastics fabrication, repair garages, tire repair	13
Extra 1	Combustible hydraulic fluid use areas, plywood and particleboard production, printing with flammable inks, upholstering with plastic foams	13
Extra 2	Asphalt saturating, open oil quenching, plastics manufacturing, car stackers and car lift systems	13

Discussion

What examples can you share when hazard classifications were misapplied?

NFPA 13 Sprinkler Coverage

Unless specifically exempted, protect all combustible spaces

EXAMPLES

- Concealed spaces < 6-in deep
- Vertical pipe chases < 10 ft^2
- Concealed spaces filled with combustible insulation
- Concealed spaces in engineered wood i-joists fireblocked into 160 ft^3 spaces
- Concealed spaces entirely fire retardant-treated wood construction
- Some residential applications

NFPA 13 Residential Omissions

- §9.2.4 Bathrooms
  - Except limited care facilities and nursing homes, or,
  - Bathrooms opening directly onto public corridors or means of egress
- Closets and pantries < 24 sq. ft.
- §12.1.1
  - Dwelling units and adjacent corridors may use residential sprinklers

NFPA 13D/13R Residential Omissions

- Attics
- Garages and carports
- Chases and elevator shafts
- Open porches or balconies
- I-Codes require
  - Muti-family Group R balconies/decks
  - Open-ended corridors

NFPA 13D/13R Residential Omissions

- Bathrooms less than 55 ft^2
- Closets/pantries less than 24 ft^2
  - Walls/ceilings
    - N/C or limited combustible materials
- Open attached porches
- Floor/ceiling assemblies

Water Supply Options: All Standards

- Must be “automatic” and from a "reliable" source
- Municipal authority, private provider, or source of adequate capacity
  - Service size
  - Dedicated supply
  - Combined supply
- Pond, lake, reservoir
  - Fire pump assembly

Water Supplies

- Sum of:
  - System demand
    - Water required to meet hydraulic demand for specific time
  - Hose Streams
    - Water for fire suppression
    - Not required for NFPA 13D/13R

Water Supplies: NFPA 13 Volume and Duration

Hazard Class	System Design* (gpm)	Hose Streams (gpm)	Duration
Light	150-225	100	30
Ordinary 1	225-400	250	60-90
Ordinary 2	300 - 600		
Extra 1	750 -- 1,000	500	90-120
Extra 2	1,000- 1,500		

* Examples only: Based on 20,000 sq. ft – varies by system design

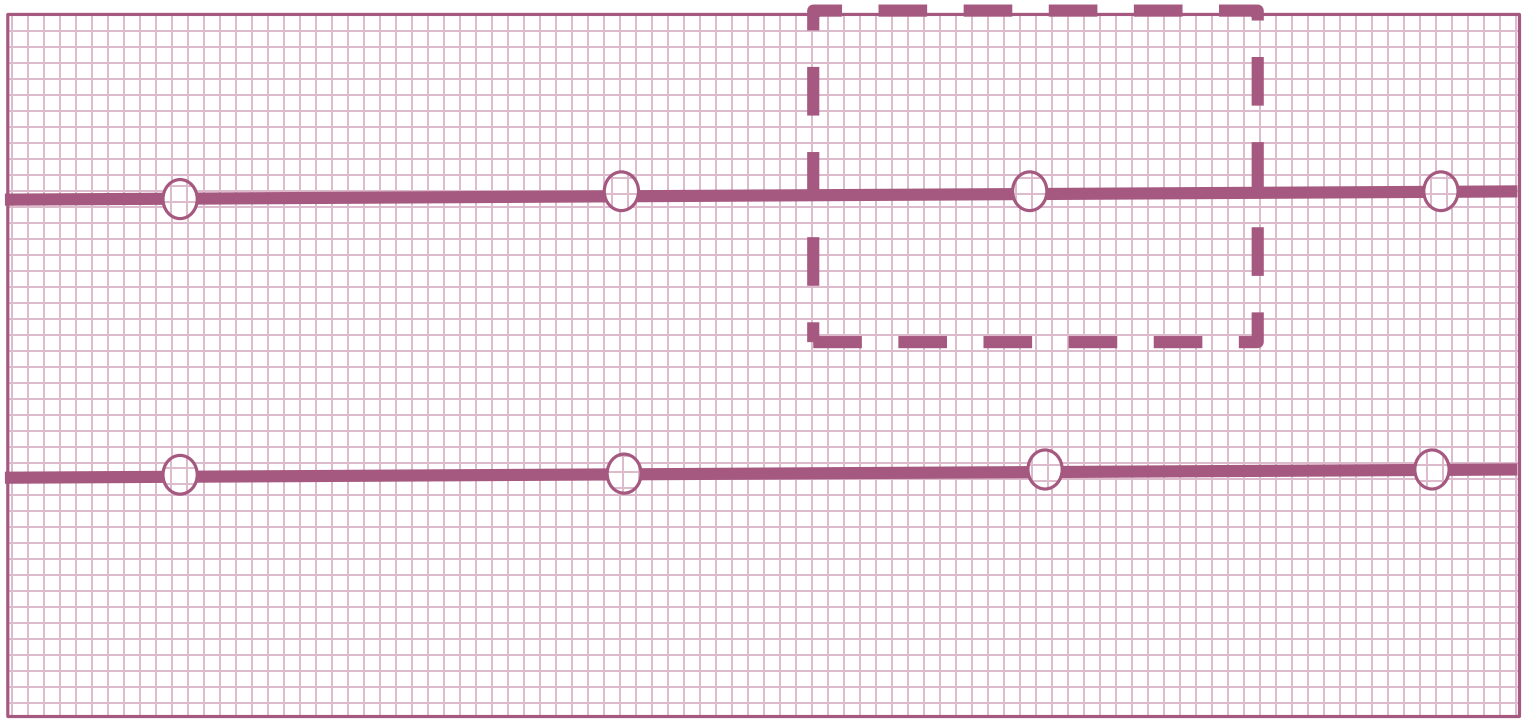
Design Criteria (Water Supply)

Standard	Water Supply Duration (gpm/minutes)	Hose Stream Allowance (Manual)	Total Water Supply
NFPA13D/P2904*	7-10 min	Zero	--
Example	13 x 1 x 7	--	91 gal.
	13 x 2 x 10	--	260 gal.
NFPA 13R	30	Zero	--
Example	13 x 4 x 30	--	1,260 gal.
NFPA 13	60-90	250	System demand + hose stream
Example	60 x 252 gpm* = 15,210	60 x 250 gpm = 15,000	30,210 gal.

*Typical sprinkler demand for mercantile occupancy.

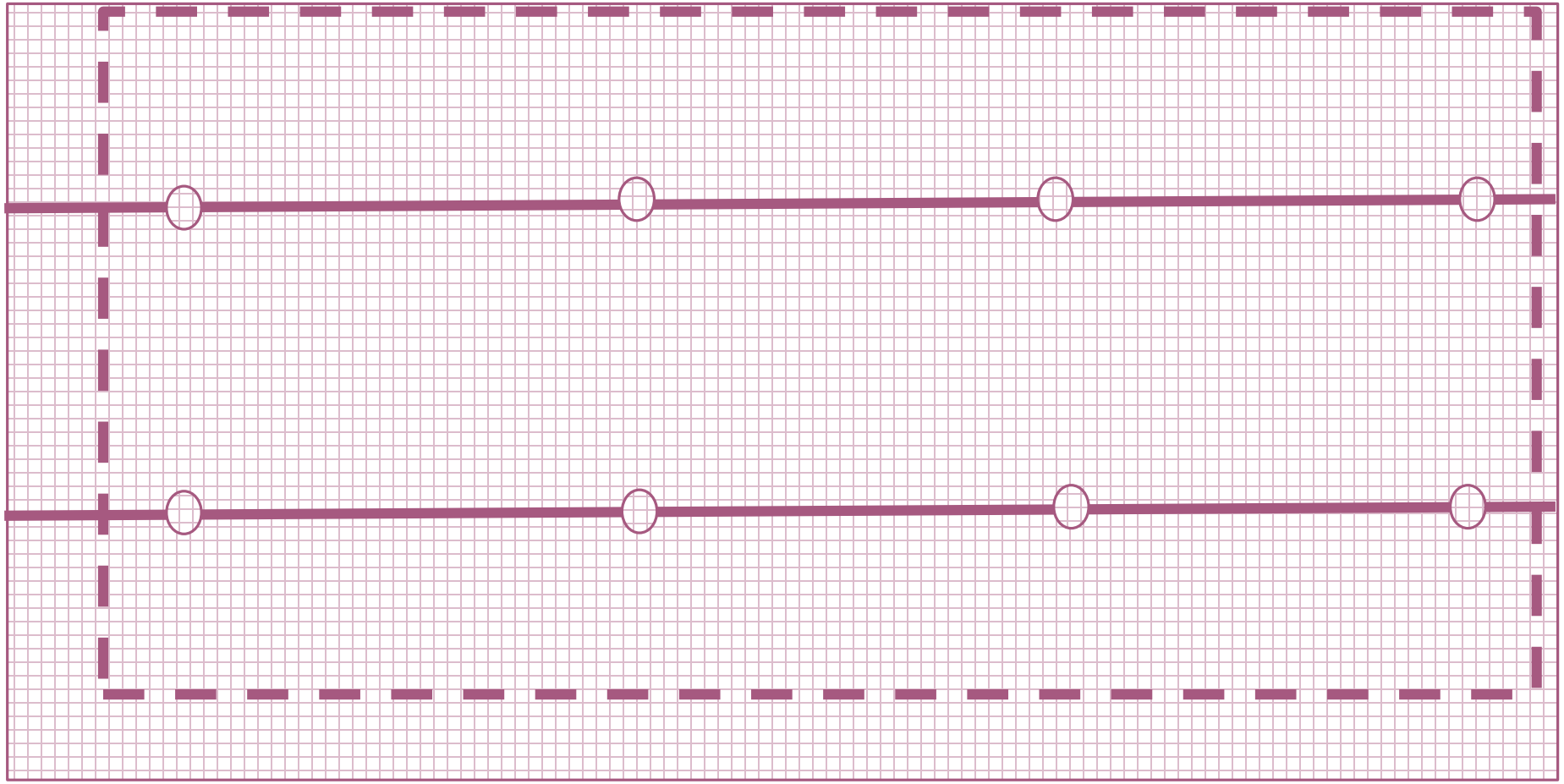
Area/Density

- Quantity of water distributed over specific design area
  - Described as "gpm/sq. ft."



Plan View

Area/Density

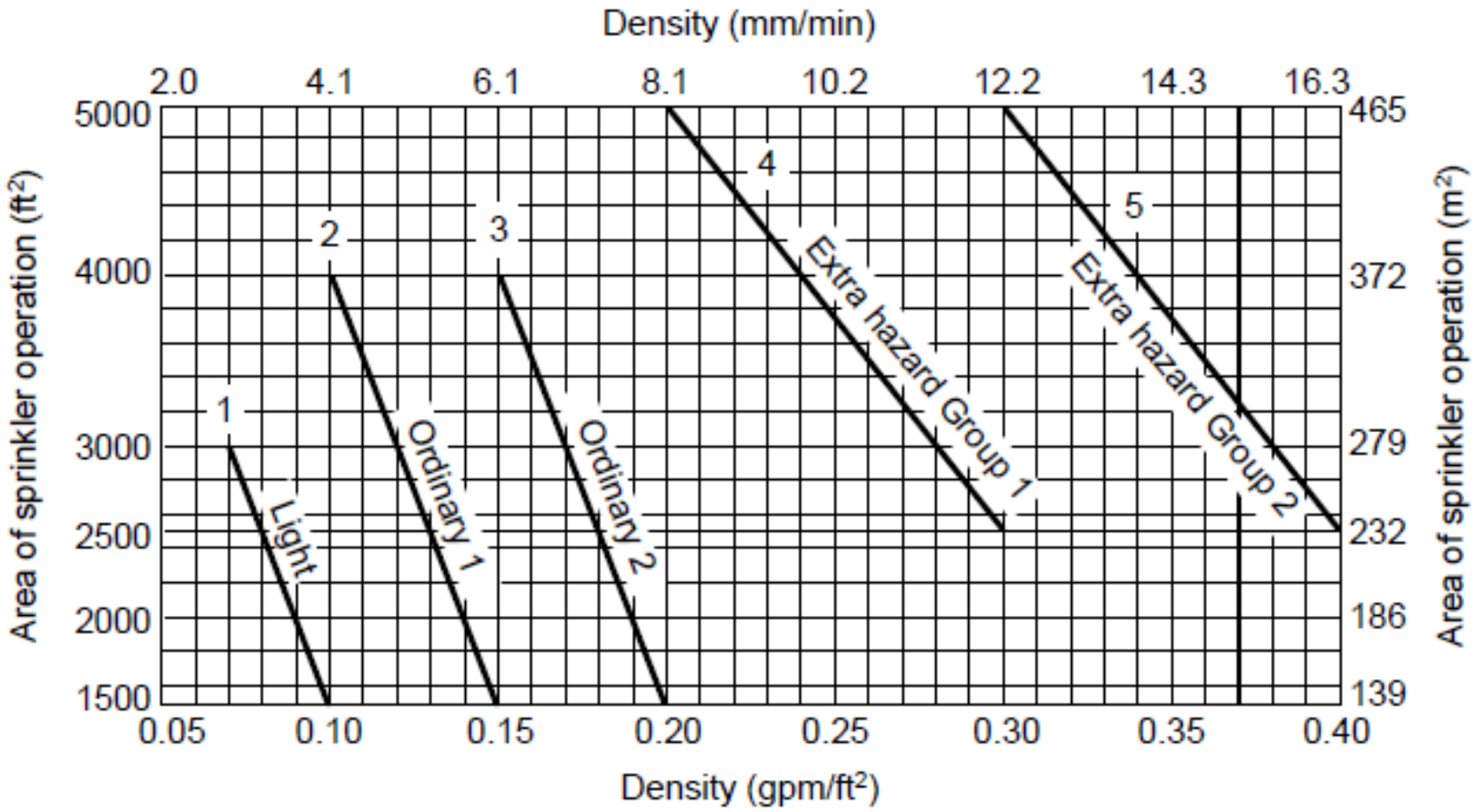


Plan View

Area/Density

Hazard Class	Density Range (gpm)	Application Area (sq. ft)
NFPA 13D, 13R and 13		
Residential	0.05	Entire living space and adjacent corridors
NFPA 13		
Light	0.07 – 0.10	1,500 – 3,000
Ordinary 1	0.10 – 0.15	1,500 – 4,000
Ordinary 2	0.15 – 0.20	3,000 – 4,000
Extra 1	0.20 – 0.30	2,500 – 5,000
Extra 2	0.30 – 0.40	2,500 – 5,000

Area/Density

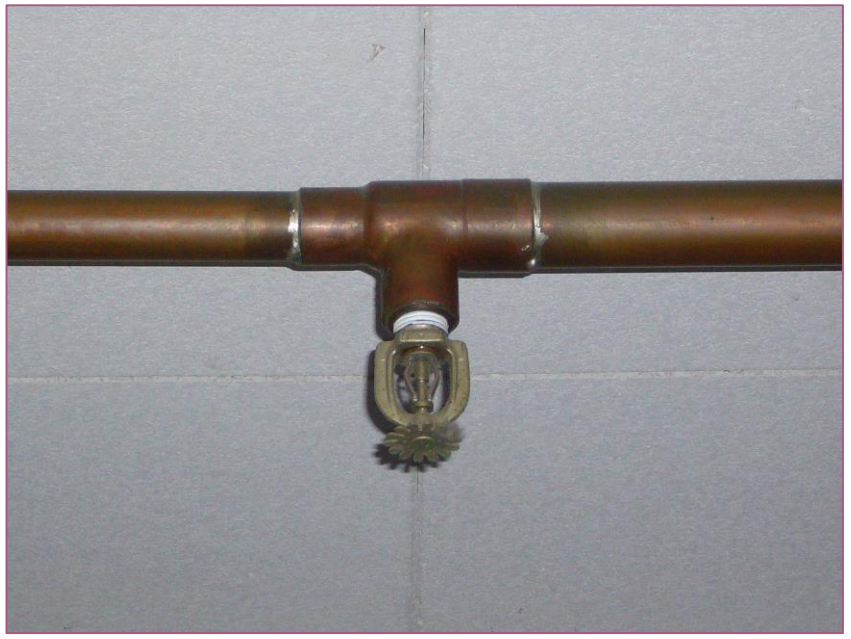


MATERIALS/ COMPONENTS

MODULE NO. 4

Materials/Components (All Standards)

Residential
Light Hazard
Ordinary, Group 1 (with limits)



Light Hazard
Ordinary Hazard

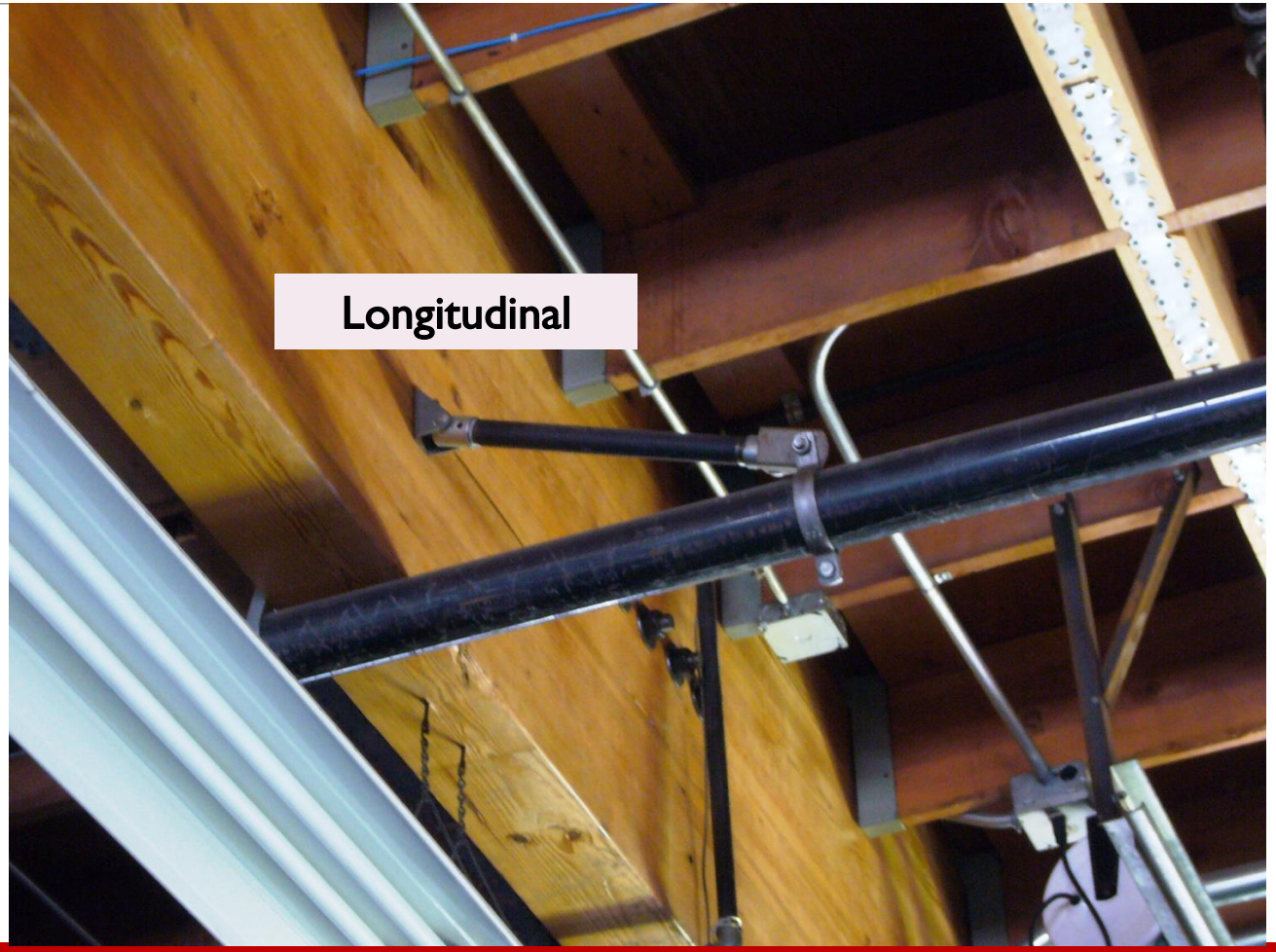
All Hazard Classes

Hangers/Supports (All Standards)

Seismic Bracing (NFPA 13 Only)

Four-way top of riser

Lateral



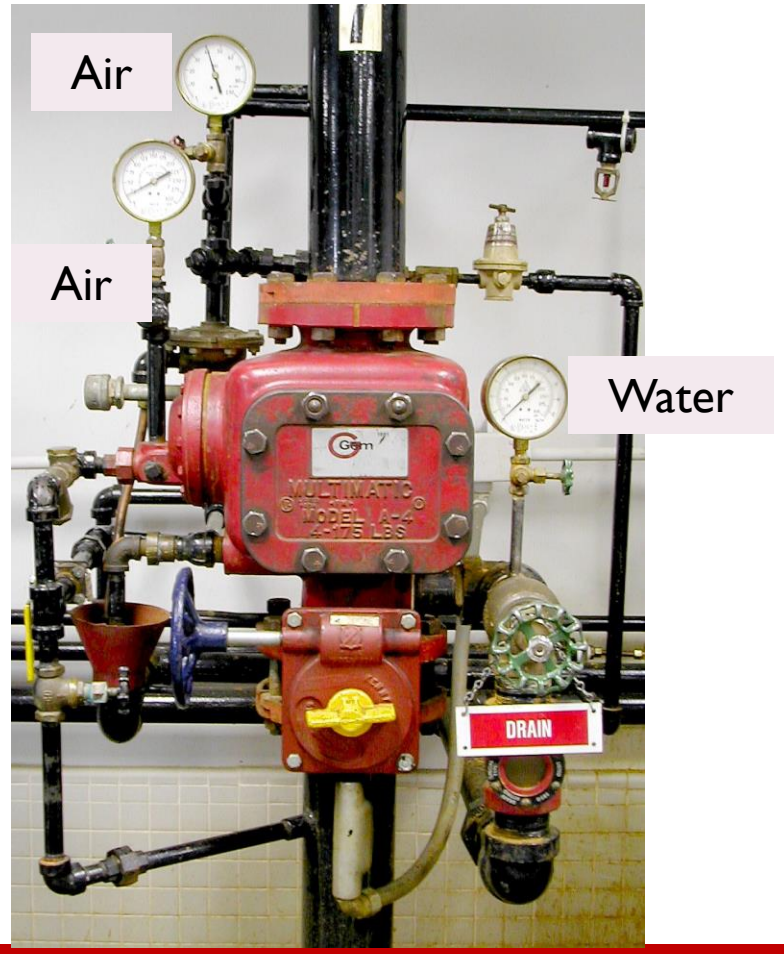
Longitudinal

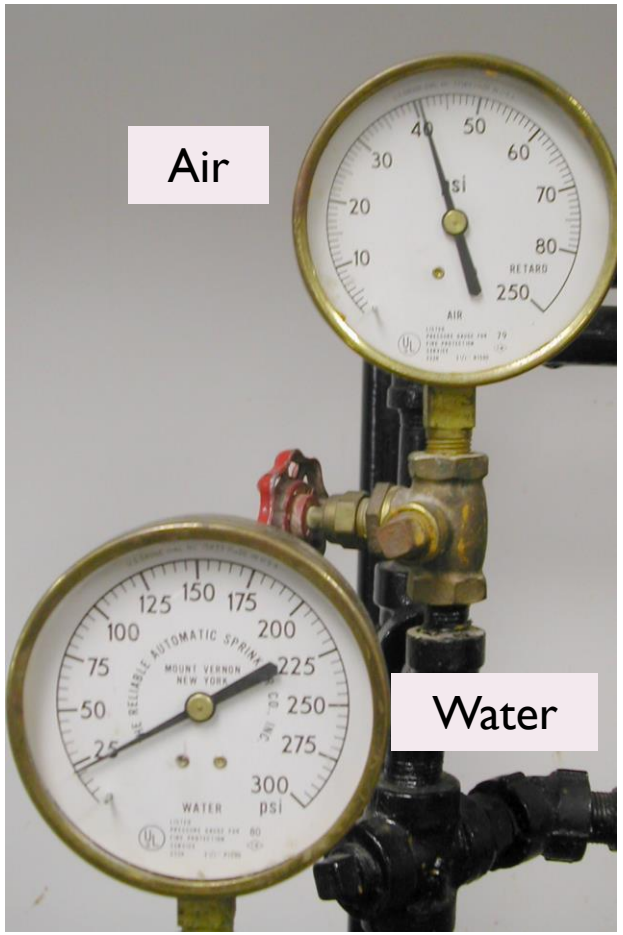
Control Valves

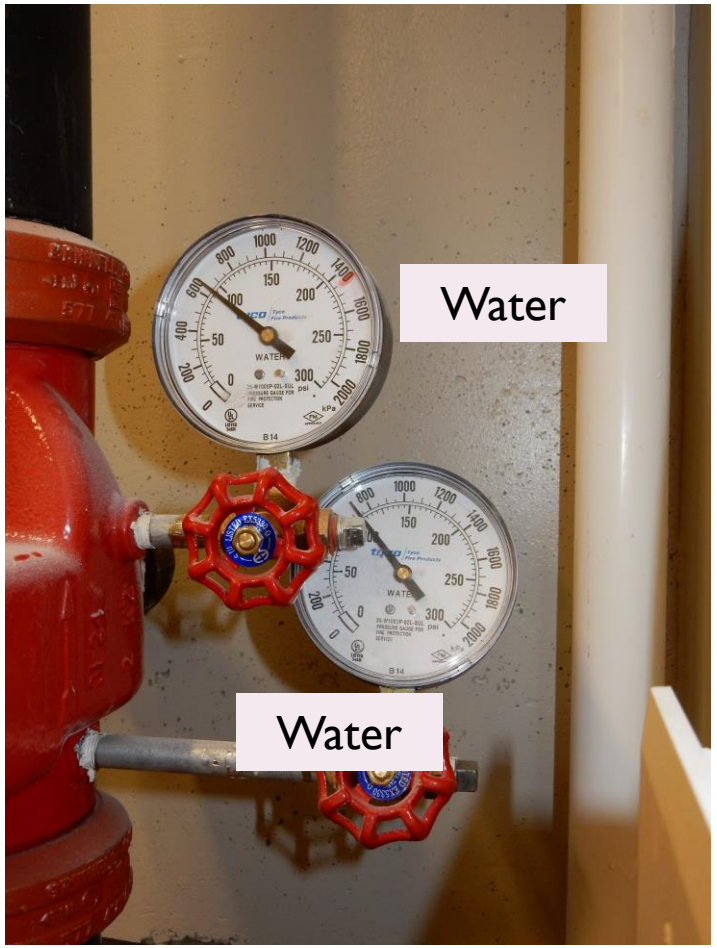
NFPA 13D/13R

NFPA 13

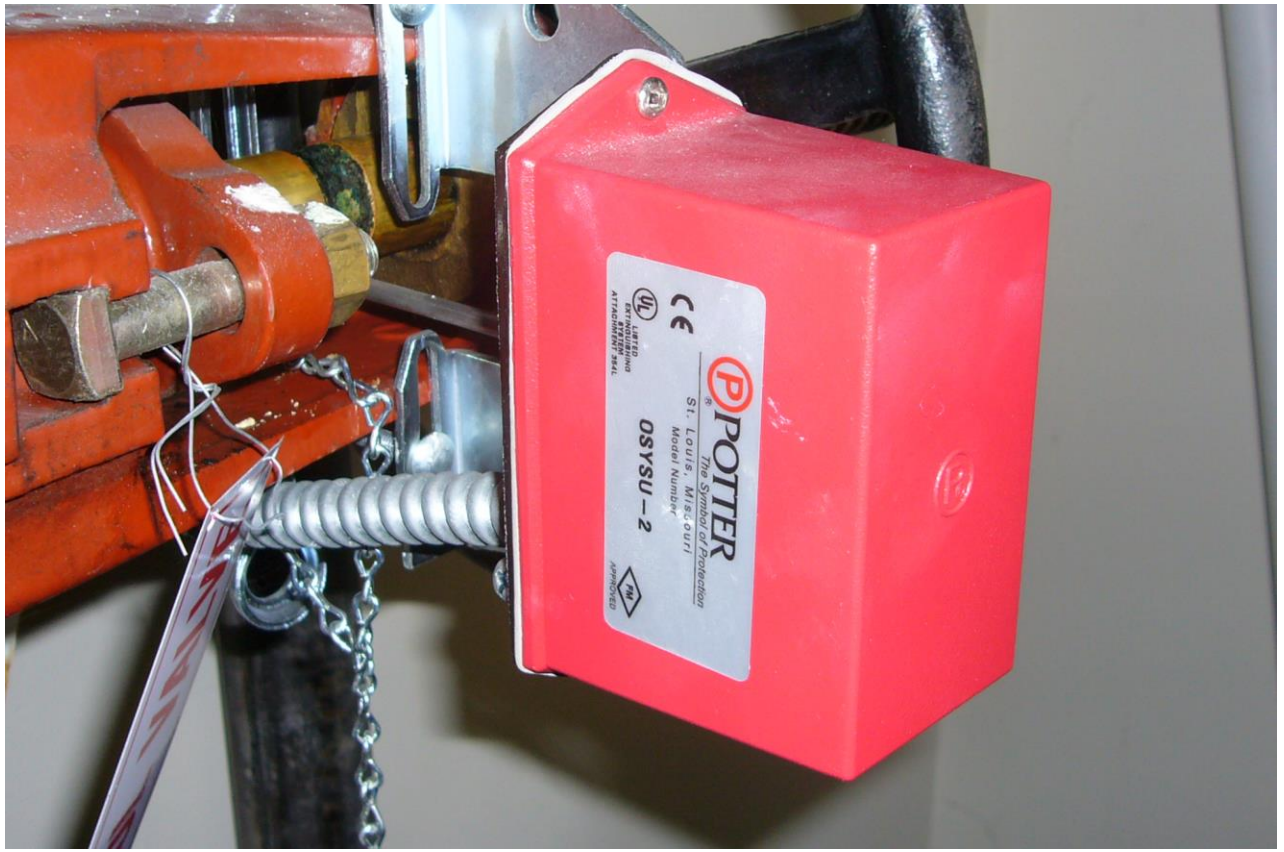
Gauges (NFPA 13/13R Only)







Supervision (NFPA 13 and 13R)



SPECIAL OCCUPANCIES

MODULE NO. 5

Residential Occupancies

- Dwelling
- Dwelling unit
- Sleeping unit
- Manufactured home

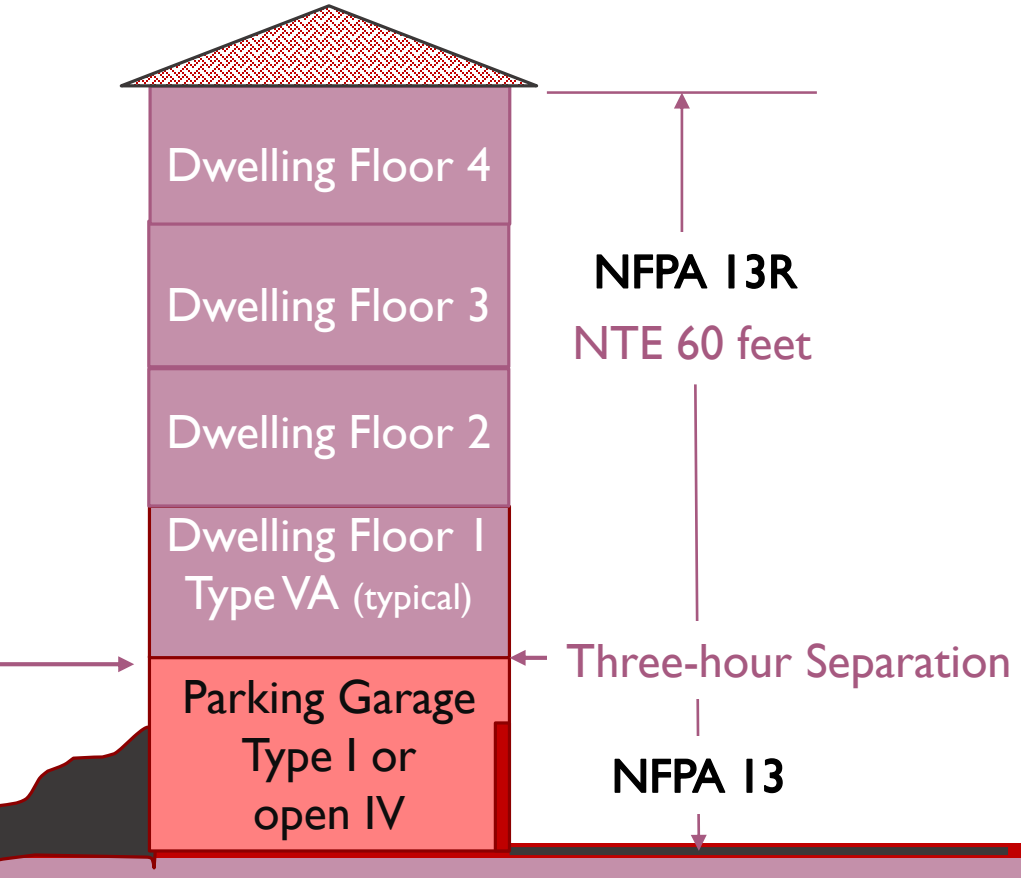
Residential Occupancies

- Modular construction
- Residential occupancies
- National Fire Protection Association (NFPA)
  - International Residential Code (IRC) definitions
    - Group homes
    - Assisted living
- Townhouse

IBC §903.2.8 Residential Sprinkler Designs

Occupancy	Examples	Sprinkler Design
R-1, R-2, R-4	Exceed allowable area or height	NFPA 13
R-3	No more than two dwelling units Congregate care Dormitories	NFPA 13D
R-4	Alcohol/drug centers Group homes Halfway houses	NFPA 13D or NFPA 13R
R-4, Condition 1	Cognitive ability to act	NFPA 13D
R-4, Condition 2	Understand limited verbal/ physical commands	NFPA 13R

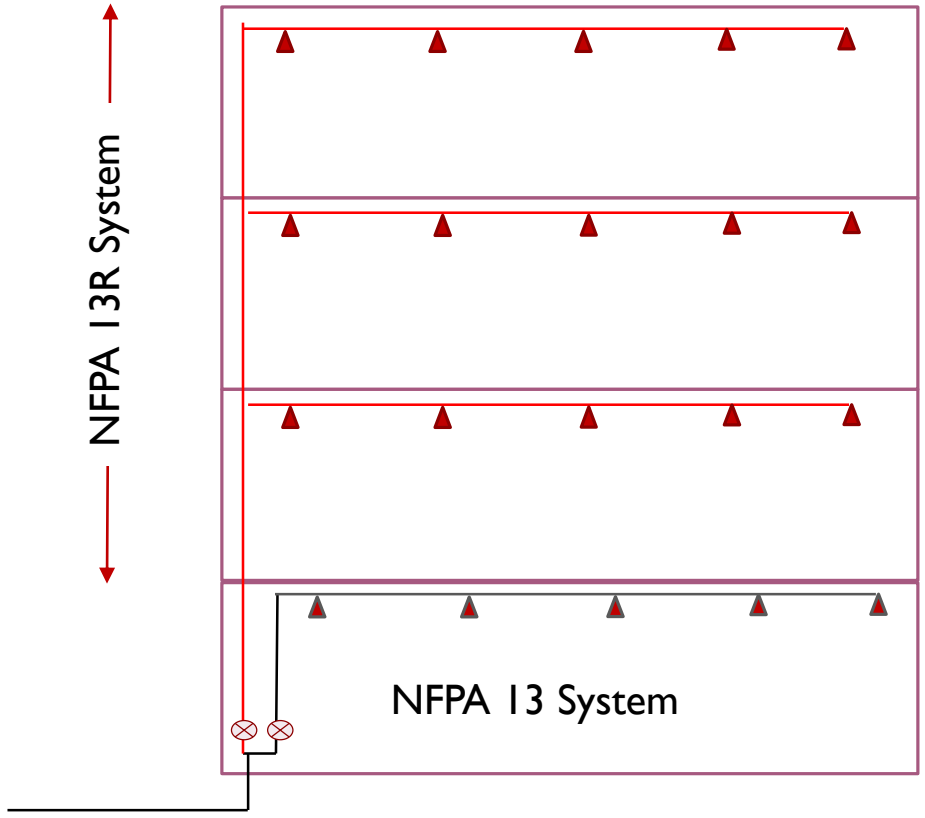
Low-rise Podium Buildings (NFPA 13 and13R)



Courtesy: Josh Bergeron - Salisbury Post

Discussion

Do NFPA 13 and 13R "systems" require separate water connections and risers?

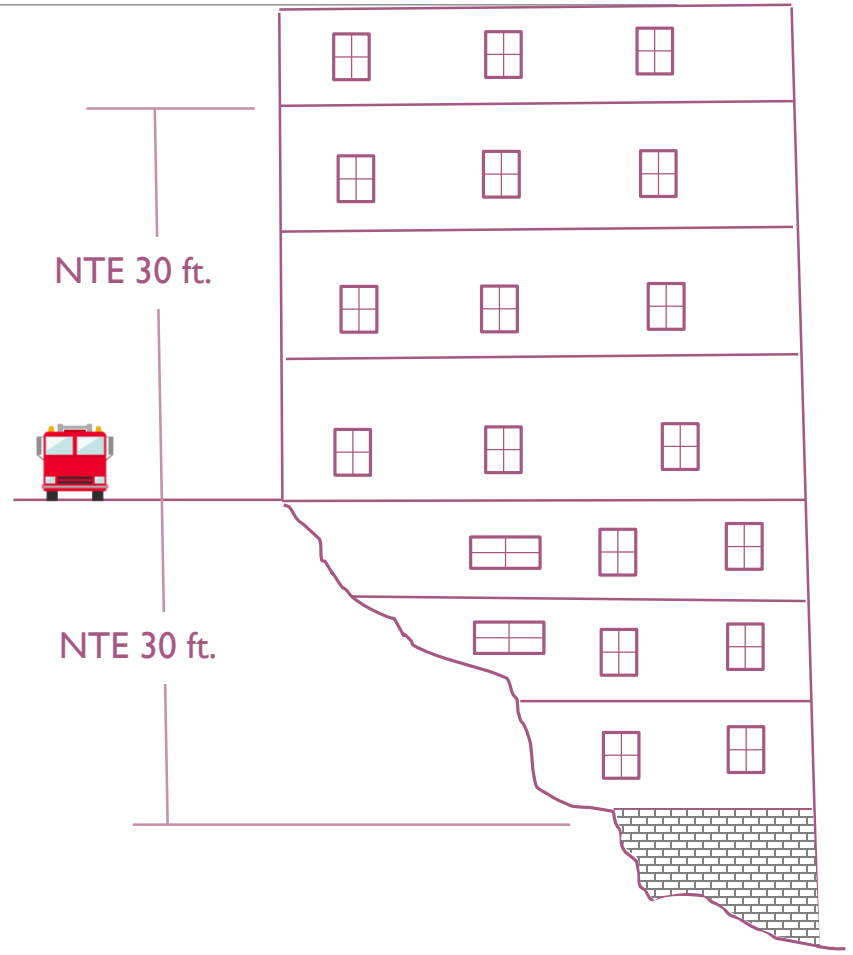


Elevation View

IBC §903.3.1.2 - NFPA 13R

Where Group R meets all the following conditions:

- Four stories or fewer above grade plane,
- Highest story floor level is 30 feet or less above the lowest level of fire department vehicle access, and,
- Lowest story floor level is 30 feet or less below the lowest level of fire department vehicle access.



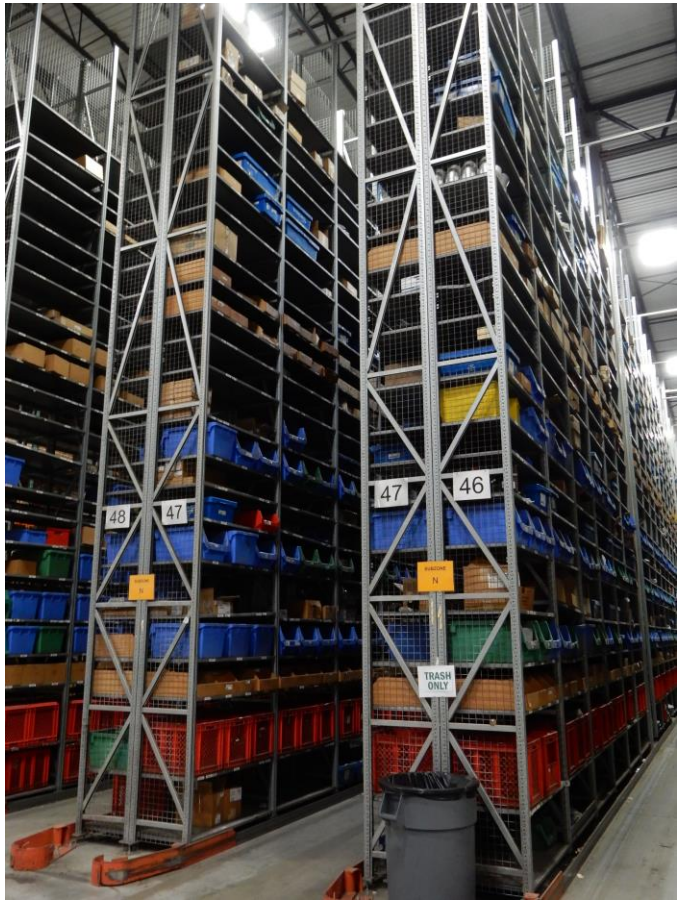
Residential Five or More Stories- NFPA 13

Courtesy: Common Edge

- IBC §504
  - Additional story
- IBC §505
  - Additional 20 feet

Storage Occupancies (NFPA 13 Chapters 20-25)

- General
- High-piled based on CMSA/ESFR sprinklers
  - Racks
  - Shelves
  - Solid-piled
  - Palletized



Special Applications (NFPA 13: Chapter 26)

- Flammable/combustible liquids
- Aerosols
- Spray painting
- Ovens and furnaces
- Tire storage
- Aircraft hangars
- Laboratories using chemicals
- Animal housing facilities
- Light water nuclear power plants
- Hyperbaric chambers
- Water cooling towers
- Motion picture and television soundstages
- Protecting cultural resources
- Telecommunication facilities
- Compressed gases and fluids

INTERNATIONAL BUILDING CODE APPLICATIONS

MODULE NO. 6

202- *Fire Area*

- Aggregate floor area enclosed and bounded by fire walls, fire barriers, exterior walls or fire-resistance-rated horizontal assemblies.
  - Includes floor area without enclosing walls where floor or roof above.

Courtesy Jim Wright – Webberville, MI

IBC Chapter 9 *Fire Areas*

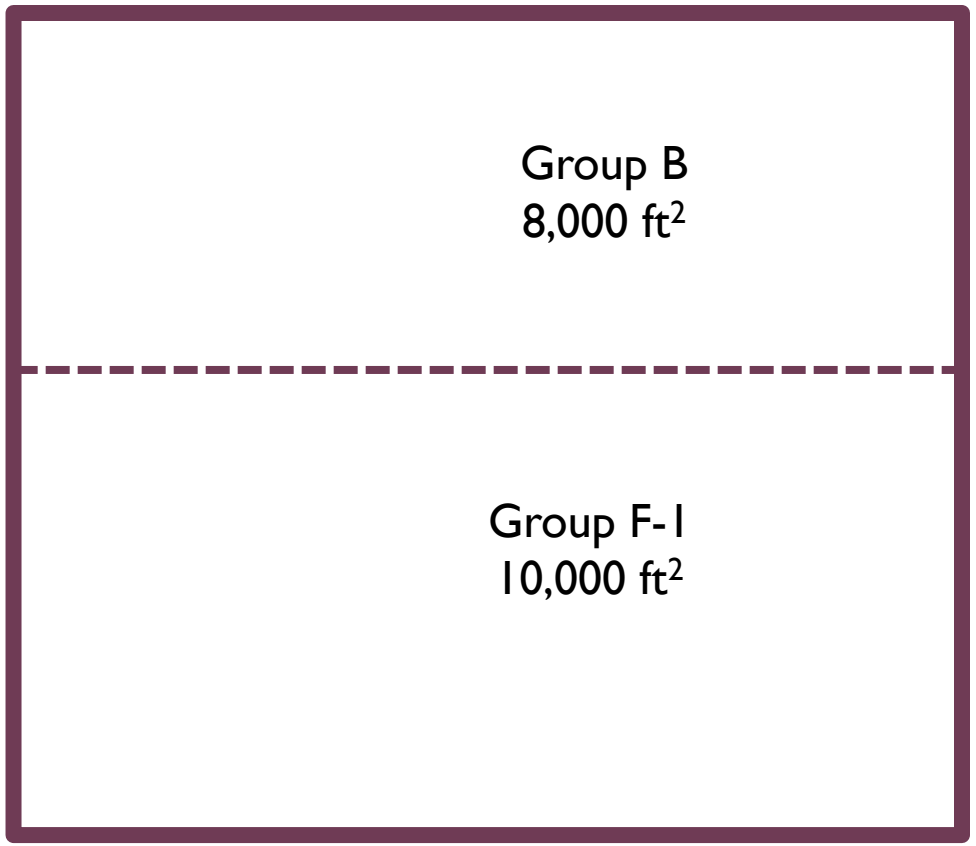
- Dual purpose:
  - Establish need for sprinkler systems required by IBC/IFC §903.2.
  - Provide alternative to omit sprinklers.
- Fire barrier or horizontal assembly separations
  - IBC Table 707.3.10

IBC §901.7 - *Fire Area* Separation

Table 707.3.10	
Occupancy Group	Fire-Resistance Rating (hours)
H-1, H-2	4
F-1, H-3, S-1	3
A, B, E, F-2, H-4, H-5, I, M, R, S-2	2
U	1

Different from Table 504.8: Occupancy Separations

Example 1 - NFPA 13: *Fire Areas*



Given:

- 18,000 ft^2 mixed occupancy
- Non-sprinklered

Question:

What is the required fire barrier rating to omit sprinklers?

NFPA 13: *Fire Areas* – Example 2

Given:

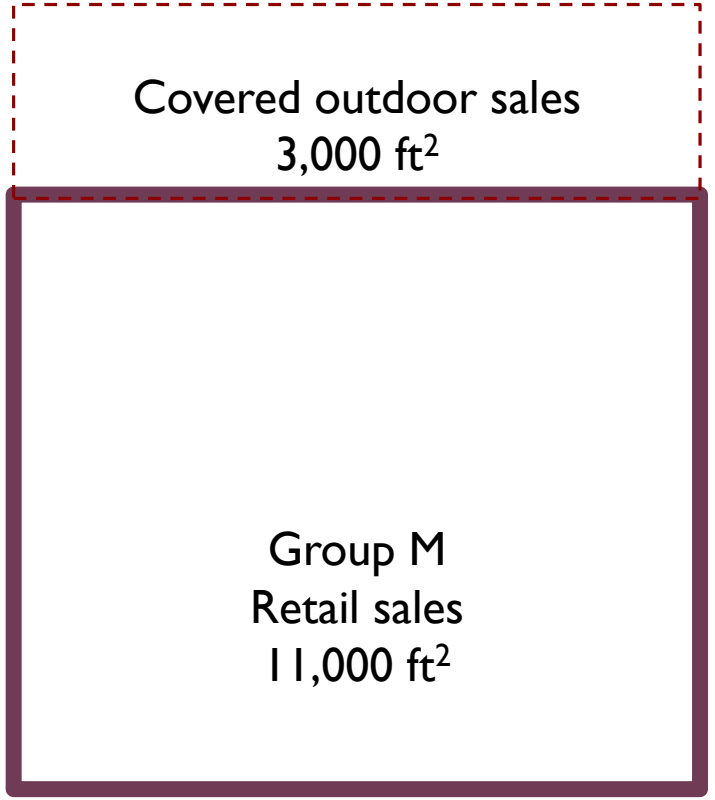
- Group M occupancy with covered outdoor sales area

Question No. 1:

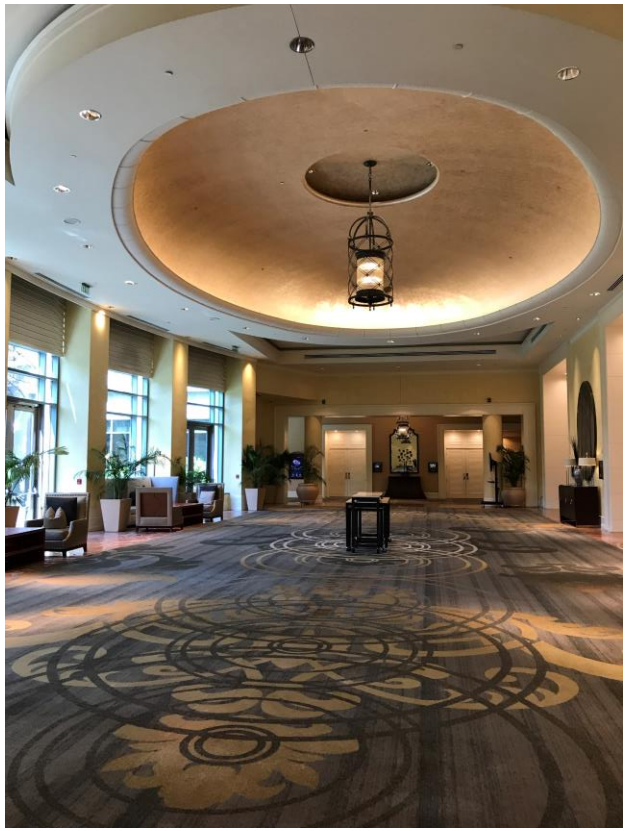
- Is a sprinkler system required?

Question No. 2

- What rated fire barrier could be installed to omit sprinklers?



IBC §903.2.1 – §903.2.10.1 Occupancy Classification



Sprinkler standard selection varies:

- Building or portion,
- Occupancy,
- Story and all stories below/above,
  - Including level of exit discharge
- Fire area, or,
- Specific hazard rooms or areas

§903.2.6 Group I

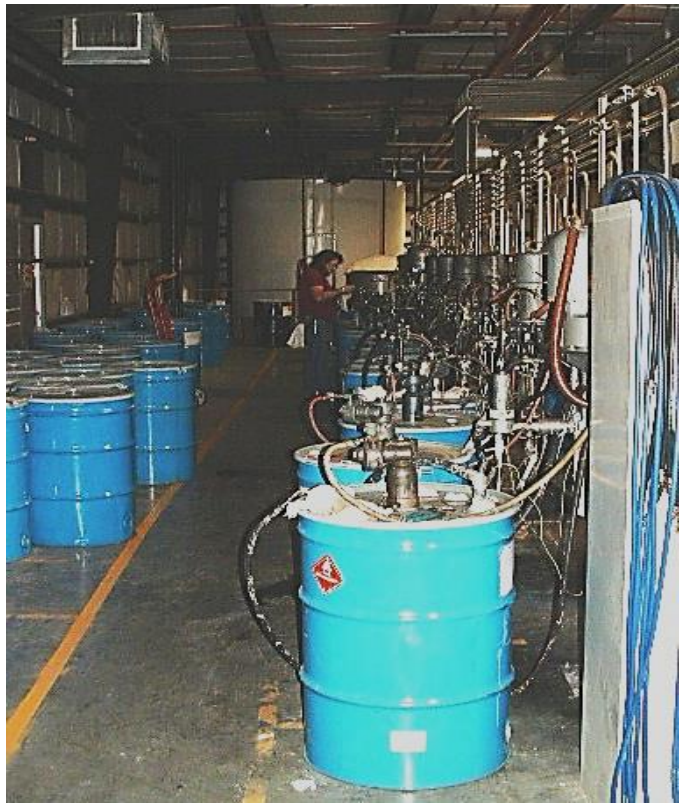
Any building with a Group I *fire area:* NFPA 13

- Except I-4 daycare where:
  - On level of exit discharge, and
  - Every care room least one door directly to the exterior
- Group I-1, Condition 1: NFPA 13R design allowed
  - Assisted living
  - Group homes/Halfway houses
  - Residential board and care

§903.2.4 Group F-1: NFPA 13

Condition
Fire area exceeds 12,000 ft^2
Fire area four or more stories above grade plane
Aggregate fire areas exceed 24,000 sq. ft.
Upholstered furniture/mattress manufacture exceeds 2,500 ft^2

§ 903.2.5 Building with Group H Occupancy: NFPA 13

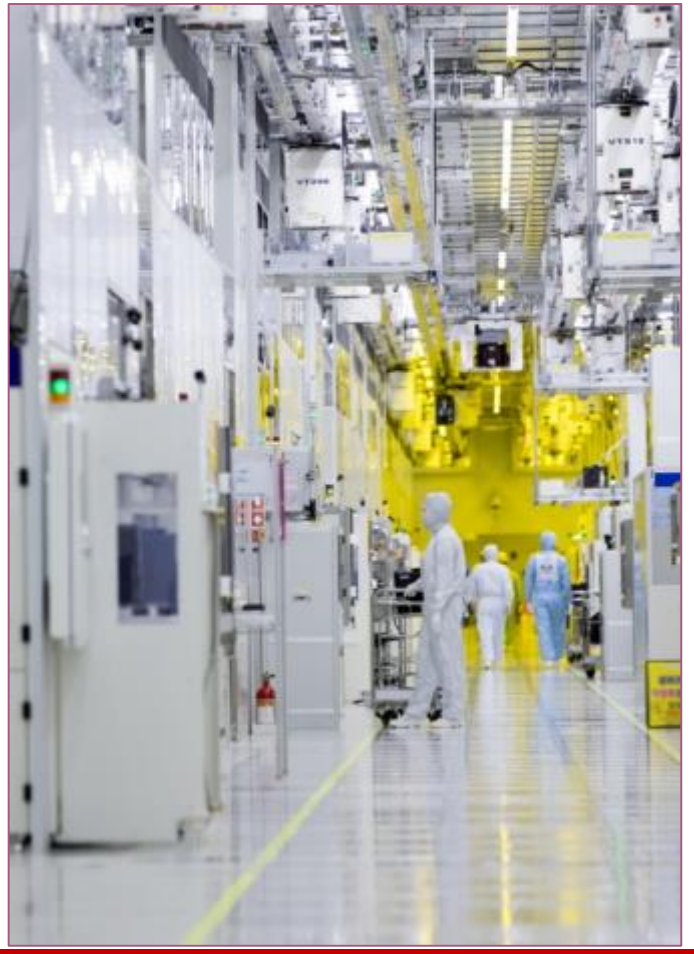


- §903.2.5.3 - Cellulose nitrate film or pyroxylin plastics manufactured, stored or handled >100 lbs.

§ 903.2.5.2 Group H-5: NFPA 13

Special design criteria

Location	Hazard Class
Fabrication areas	Ordinary Hazard Group 2
Service corridors	Ordinary Hazard Group 2
Storage rooms without dispensing	Ordinary Hazard Group 2
Storage rooms with dispensing	Extra Hazard Group 2
Corridors	Ordinary Hazard Group 2



Courtesy: Samsung Global Newsroom

§ 903.2.7 Group M: NFPA 13

Throughout building where:

Condition
Fire area exceeds 12,000 ft^2
Fire area four or more stories above grade plane
Aggregate fire areas exceed 24,000 sq. ft.
Upholstered furniture/mattress display exceeds 5,000 ft^2
High piled or rack storage (IFC Chapter 32)

§903.2.9 Group S-1:NFPA 13

Condition
Fire area exceeds 12,000 ft^2
Fire area four or more stories above grade plane
Aggregate fire areas exceed 24,000 sq. ft.
Upholstered furniture/mattress storage exceeds 2,500 ft^2
High piled or rack storage (IFC Chapter 32)
Commercial motor vehicle storage exceeds 5,000 ft^2
Tire storage more than 20,000 ft^3

§ 903.2.9.1 Group S-1 Repair Garages: NFPA 13

Throughout building where:

Condition
Two or more stories and fire area exceeds 10,000 ft^2
One story and fire area exceeds 12,000 ft^2
Building with repair garage serving vehicles parked in basement
Commercial motor vehicle repair exceeds 5,000 ft^2

202- *Commercial Motor Vehicle*

Transport passengers or property where:

- Gross vehicle weight rating 10,000 pounds or more, or,
- Designed to carry 16 or more passengers (including driver)

Discussion

Would you consider this motor vehicle storage and/or repair?

§903.2.9.1 Group S-2 Parking Garages: NFPA 13

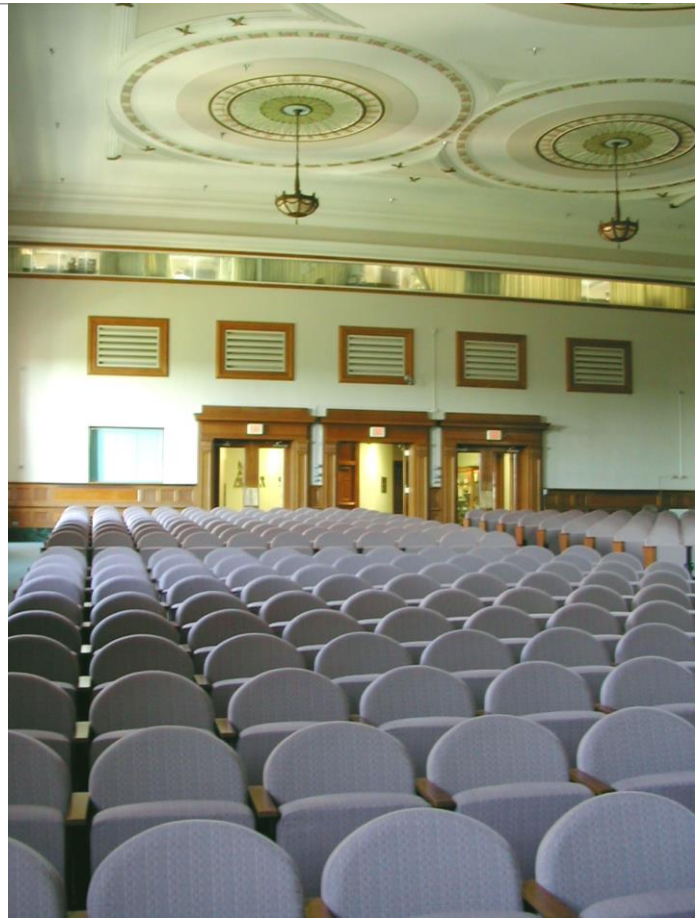
Throughout building where:

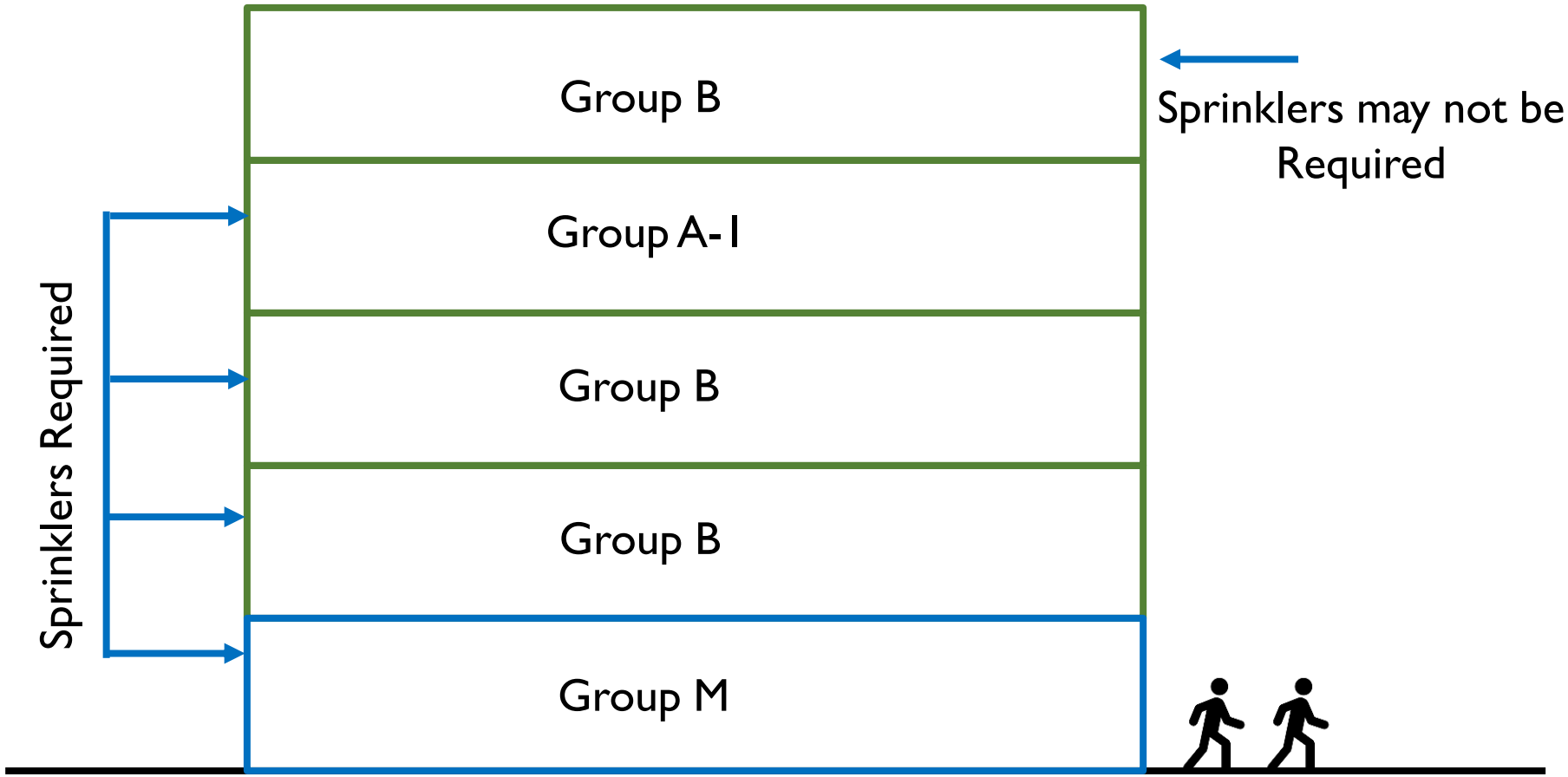
Condition
Enclosed garage fire area exceeds 12,000 ft^2
Enclosed garage fire area located beneath different occupancy group
Open or enclosed commercial motor vehicle storage fire area exceeds 5,000 ft^2

§ 903.2.1.1 Group A-1: NFPA 13

Throughout *story*

Condition
Fire area 12,000 ft^2
Occupant load 300 or more
On floor other than level of exit discharge
Multi-theater complex
Protect occupancy and all levels from exit discharge




Group B
Group A-1
Group B
Group B
Group M
Sprinklers Required
Sprinklers may not be Required

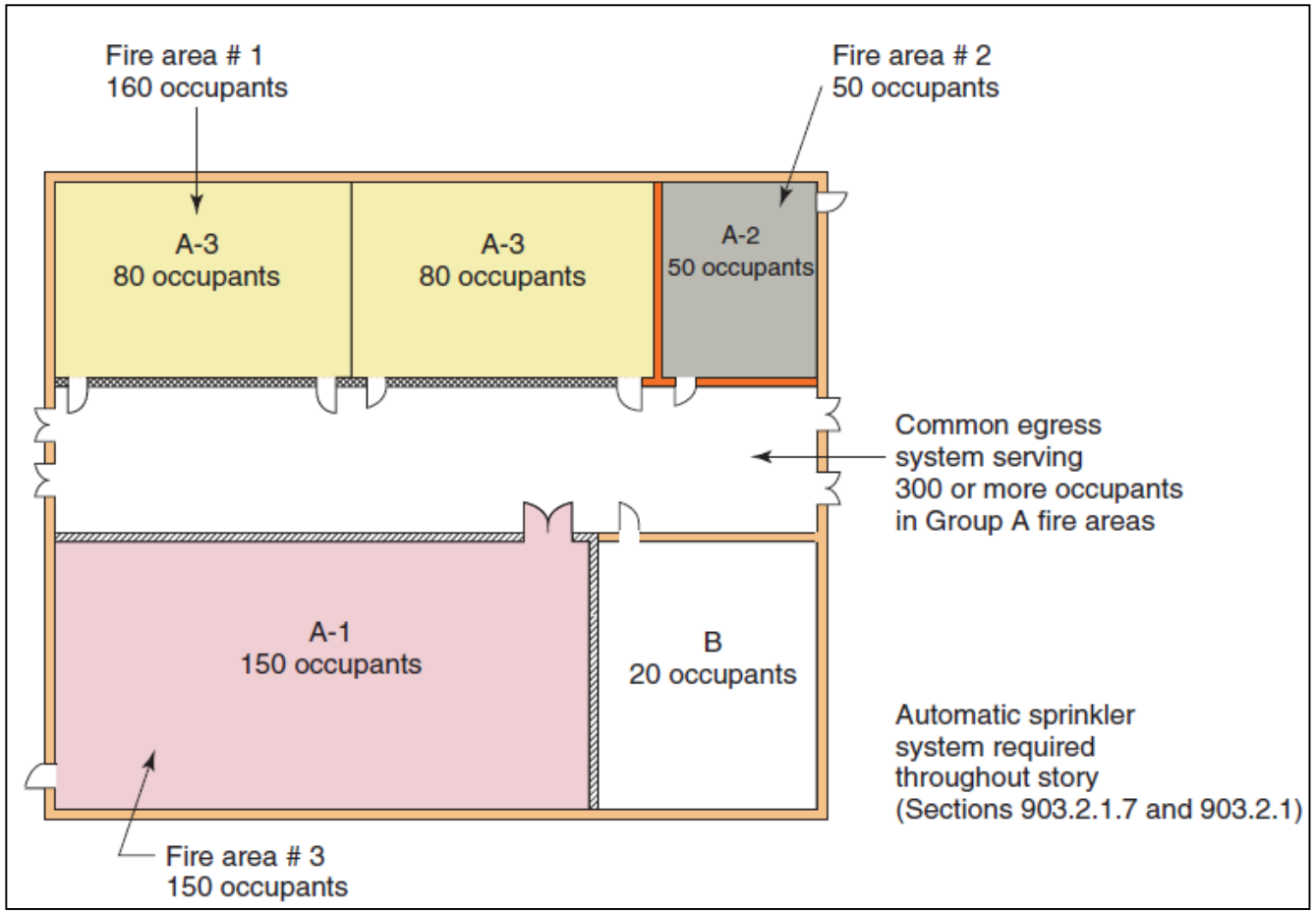
§ 903.2.1.2 Story: Groups A-2, A-3 and A-4: NFPA 13

Group	Fire Area Exceeds	Occupant Load	Condition
A-2	5,000 ft^2	100 or more	Level other than exit discharge
A-3/A-4	12,000 ft^2	300 or more	
Protect occupancy and all levels from exit discharge			

§ 903.2.1.6 Group A – Rooftop: NFPPA 13

Group	Occupant Load
A-2	100 or more
A-1/A-3/A-4	300 or more
Protect all levels from exit discharge up	
Not required on Type I or II open parking garage	

§903.2.1.7 Fire Areas: Groups A-1 through A-4: NFPA 13

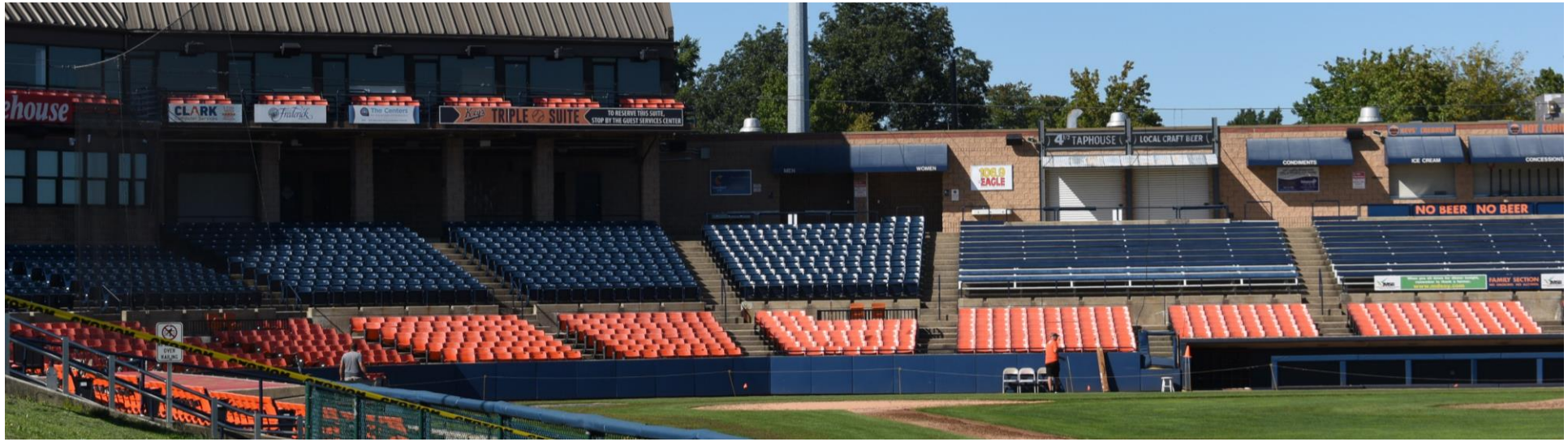


- Sprinklers required in Group A fire areas where multiple fire areas:
  - Share exit or exit access components, and,
  - Combined occupant load is 300 or more

§ 903.2.1.5 A-5: Accessory Uses: NFPA 13

Enclosed spaces under grandstands and bleachers where:

- Enclosed area does not exceed 1,000 ft^2 and space is <u>not</u> one-hour separated, or,
- Enclosed area exceeds 1,000 ft^2



§903.2.2 Group B Ambulatory Care: NFPA 13

Story where either of following conditions exist at any time:

- Four or more patients incapable of self-preservation, or
- One or more patient at other than *level of exit discharge* incapable of self-preservation
  - Coverage on all stories below care level to:
    - Nearest level of exit discharge, and,
    - Level of exit discharge, and,
    - Any floor below level of exit discharge.

§903.2.3 Occupancy: Group E: NFPA 13

Fire Area Exceeds	Occupant Load	Location
12,000 ft^2	300 or more	Level other than exit discharge

- If located below discharge level, sprinkler protection not required if every classroom has at least one exterior exit door at ground level

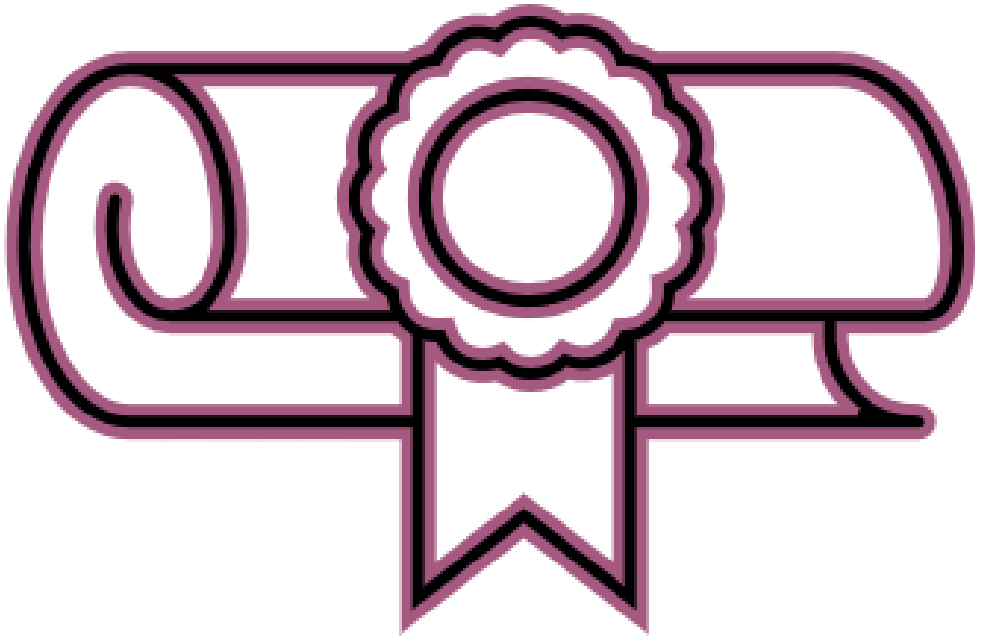
§ 903.2.4.1 Fire Area: F-1 Woodworking: NFPA 13

Woodworking operations over 2,500 ft^2

- Generate finely divided combustible waste, or
- Use finely divided combustible materials

REVIEW AND POST-TEST

MODULE NO. 6



Summary

You should be able to:

1. Explain fire sprinkler system design evolution
2. Explain key differences among three NFPA fire sprinkler design standards
3. Apply appropriate design standard to corresponding building code projects

Activity

1. NFPA 13 allows copper tube to be used in pipe schedule fire sprinkler systems protecting high hazard occupancies.

   True or False

Activity

2. How many nationally recognized sprinkler design standards exist?
    a) One
    b) Two
    c) Three
    d) Four

Activity

3. The first patented automatic sprinkler was created by:

   a) Benjamin Franklin
   b) Cosmo C. Anderson
   c) Henry S. Parmalee
   d) Paul A. Demers

Activity

4. Warehouses storing products more than 12 feet high on racks, shelves or pallets can be protected by sprinkler systems designed in accordance with:
   a) NFPA 13
   b) NFPA 13D
   c) NFPA 13E
   d) NFPA 13R

Activity

5. A sprinkler manufacturer's proprietary 5- or 6-character identification scheme for automatic sprinklers is called:
   a) QRS
   b) SIN
   c) PDQ
   d) A27

Activity

6. Fire sprinkler systems installed in residential occupancies require sprinklers to be installed in all combustible spaces.

True or False

Activity

7. Which of the following area/density values will deliver the most water?
   a) 0.10/2,000
   b) 0.15/2,000
   c) 0.215/1,500
   d) 0.185/2,000

Activity

8. Valves controlling water supplies on NFPA 13R-designed systems have to be electronically supervised.

   True or False

Activity

9. The water supply for a fire sprinkler system designed in accordance with NFPA 13R has to last how long?

   a) 30 minutes

   b) 45 minutes

   c) 60 minutes

   d) 120 minutes

Activity

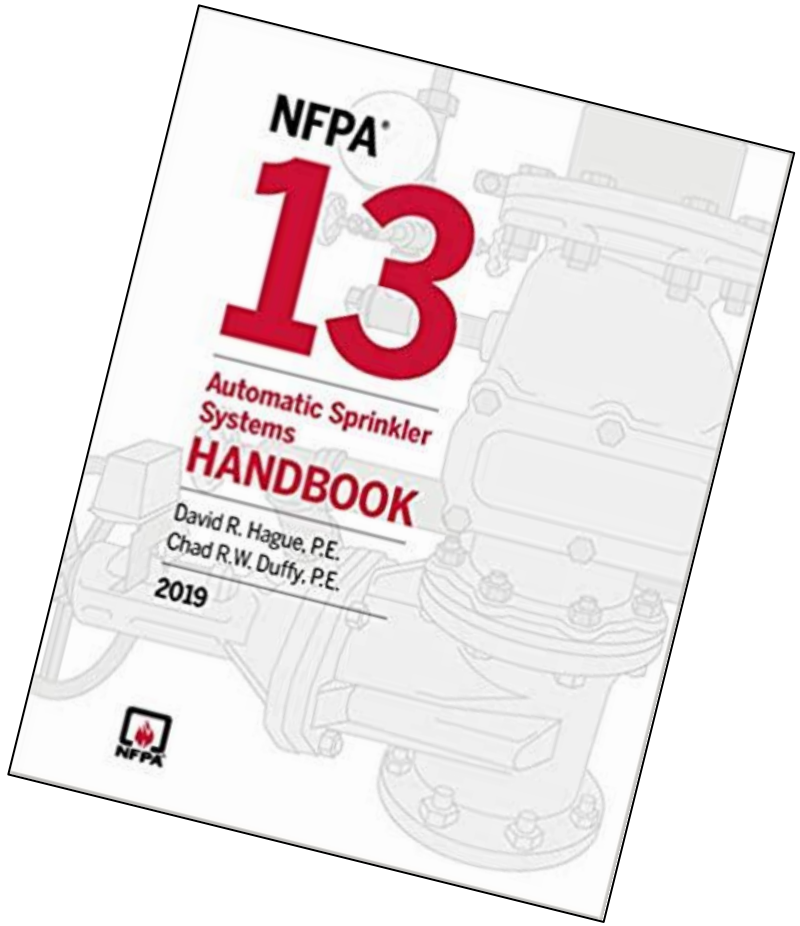
10. Which of the following sprinkler design standards is most suitable for the building we are currently in?
    a) NFPA 13
    b) NFPA 13D
    c) NFPA 13R
    d) "It depends …"

Questions or Comments?

References

- National Fire Protection Association
  - NFPA 13 Fire Sprinkler Systems
  - NFPA 13R
  - NFPA 13D

- *International Building Code* (2021 Edition)



Additional Resources

National Fire Academy

- R0263 Commercial Fire Sprinkler Systems Plan Review (5-day)
- F/O/W 0142 Residential Fire Sprinkler Plan Review (2-day)
- Q0218 Testing and Evaluation of Water Supplies for Fire Protection (Online)

Contact: https://www.usfa.fema.gov/nfa/

Additional Resources

International Code Council® courses

- "IBC and IFC Use of Fire Sprinkler and Alarm Systems"
- "IBC Fire and Life Safety Principles"
- "IFC Fire Protection Systems"

ICC® Contract Seminar Coordinator: 888-422-7233, ext. 33821

Additional Resources

- American Fire Sprinkler Association: www.firesprinkler.org
- National Fire Sprinkler Association: www.NFSA.org
- International Fire Service Training Institute: www.ifsta.org

Additional Courses

This training program has been provided by the Maine Bureau of Building Codes and Standards.

For additional information and training requests, contact

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For more grant program information, contact FEMA Grants.