2021 IFC® and IBC Fire Protection and Life Safety Systems

Based on the 2021 International Fire Code® IFC®) and 2021 International Building Code® (IBC®)

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Presenter Instructions

- Many of these slides contain animation and graphics
- When reviewing this presentation, you should utilize the "slide show presentation mode" or in the "reading view"
  - This will allow you to become aware of the animation and graphics on the slides
  - Click the "View" in the header, then click "Reading View" in the "Presentation Views" group
- Slides which contain animation will have one or more dots at the bottom left corner of the slide. For example, there are 6 dots at the bottom of this slide
- Each dot represents a "click" which is needed for animation on the slide before the next slide will appear
- With each "click," as an animation occurs, a dot will also disappear
- When all the dots are gone, the next "click" will take you to the next slide
- Also note, "FCO" will be used to designate the Fire Code Official

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ACTIVITY

Welcome

- Instructor Introduction
- Exits
- Breaks and Schedule
- Cell Phones
- Student Introductions

3

Description

- This seminar is designed to guide participants through the 2021 IFC requirements related to fire protection systems (Chapter 9)
- These requirements include:
  - Fire sprinkler systems
  - Fire-extinguishing systems
  - Standpipe systems
  - Fire alarm systems
  - Automatic detection systems
  - Smoke control/exhaust systems
  - Other fire protection devices and equipment

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Goal

- Participants will be able to apply key provisions regarding fire protection systems in the 2021 IFC to aid in code application, administration and enforcement

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Objectives

- Upon completion, participants will be better able to:
  - Define key terms
  - Explain why a fire protection system must conform to code criteria and referenced standards
  - Determine where and when fire protection systems are required
  - Explain the principles of how a fire protection system detects and manages a fire
  - Understand the relationship between the code (IFC/IBC) and the referenced standards

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Prerequisite Understanding

- Occupancy classifications are based on the use and character of the building
- Many code requirements are based on the occupancy classification

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Module 1

Fire Protection Systems

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Fire Protection Systems

REFER TO CODE BOOK

2021 IFC
§202
Page 2-12

- Definition of a Fire Protection System:

  Approved devices, equipment and systems or combinations of systems used to detect a fire, activate an alarm, extinguish or control a fire, control or manage smoke and products of a fire or any combination thereof.

- Given this definition, a fire protection system is required to perform certain functions

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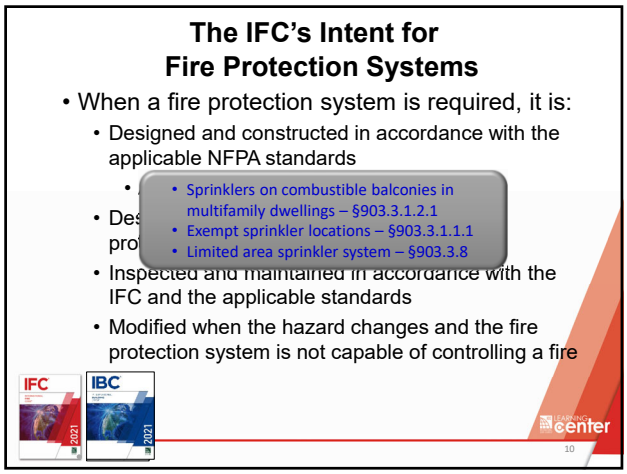

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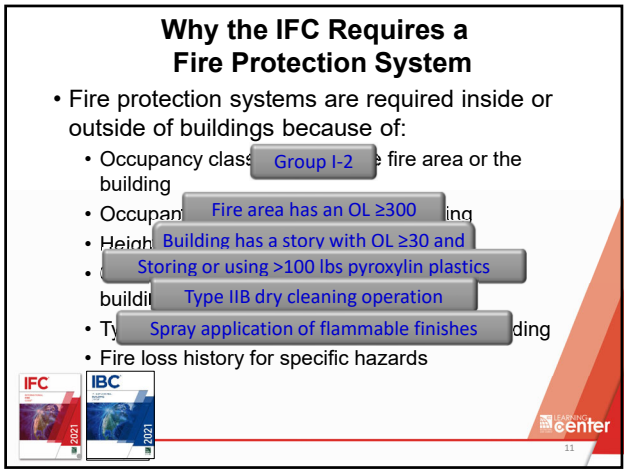

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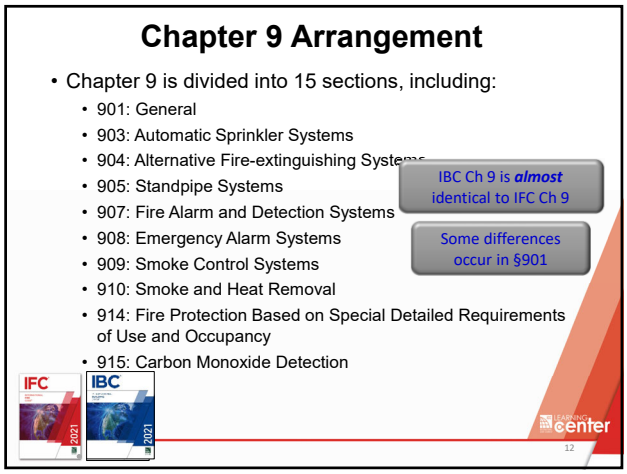

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General Provisions §901

Provision	IFC Section	IBC Section
Construction documents	901.2	–
Permits	901.3	–
Installation	901.4	901.2
Modifications	–	901.3
Threads	–	901.4
Acceptance testing	901.5	901.5
Inspection, testing and maintenance	901.6	901.3
Fire areas	901.4.3	901.7
Pump and riser room size	–	901.8
Systems out of service	901.7	–
Removal of or tampering with equipment	901.8	–
Termination of monitoring service	901.9	–
Recall of fire protection components	901.10	–

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Construction Documents §901.2

- FCO are authorized to require the submittal, review and approval of design drawings and calculations for fire protection systems
- A contractor's statement of compliance can be required
  - Documents must show that the system complies with the:
    - Plans
    - Applicable standard
    - Manufacturer's instructions

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Required vs Nonrequired §901.4.1 and §901.4.2

- Required fire protection and life safety systems must comply with the code and the applicable standards
- Nonrequired fire protection and life safety systems must ***ALSO*** comply with the code and the applicable standards
  - Wherever, any code modification or allowance is made as a result of sprinklers, the system becomes a required system

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Additional Fire Protection Systems §901.4.4

- Where the FCO deems a hazard to be of a unique nature or unduly difficult for fire department access, additional fire protection features can be required

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Pump and Riser Room §901.4.7

- Pump room or riser room is not required, but, if provided, they must have adequate room for service
  - Following manufacturer's specifications
- Ability to remove largest piece of equipment and reinstall

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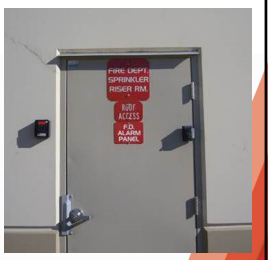
Pump and Riser Room §901.4.7.1 – 901.4.7.4

- Access
- Marking on Access Doors
  - Approved Sign
  - Min height – 2"
  - Min Stroke width – ½ in
- Environment
  - ≥ 40^0 F
- Lighting



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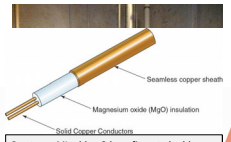
Fire Pumps §913

- Must meet NFPA 20 requirements
- Pump room maintained >40°F
- Cables and circuits protected by 2-HR construction or UL 2196
- IBC §913.2.1: 1-HR separation, 2-HR in high-rise, or ≥50'
- Class II fuel supply is not included in MAQ if it meets IFC §605.4.2.2



Pyrotenax MI cable—2-hour fire-rated cable

Graphic courtesy of Pentair Thermal Management

IFC §605.4.2.2:
- ≤660 gallon
- ≤3,000 gallon if in PAST and room is sprinklered

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Installation Acceptance Testing §901.5

- Before a fire protection system can be approved it must be tested
- Fire protection systems must be accepted and approved based on the applicable NFPA fire protection system standards

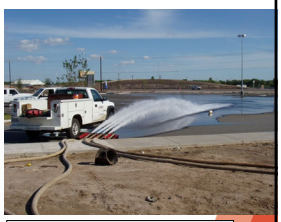

Photo courtesy of Protection Development Inc.

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Systems Out of Service §901.7

- Fire protection system impairment is a critical event that must be reported to the FCO
- Impairment of fire protection systems requires:
  - An individual be designated as the impairment coordinator
  - A plan of action for the impa


No. 11500

FIRE PROTECTION SYSTEM OR COMPONENT OUT OF SERVICE

Impairment coordinator:
- Responsible for all work
- Notify FD of the status
- Ensure system is restored

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Important Terms

- Two important definitions must be reviewed and understood
- Several thresholds for requirements are based on these definitions
  - Level of exit discharge (LED)
  - Fire area

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Level of Exit Discharge

2021 IFC §202 Page 2-10

- Definition of Level of Exit Discharge :
  The story at the point at which an exit terminates and an exit discharge begins.
- A building can have more than one level of exit discharge

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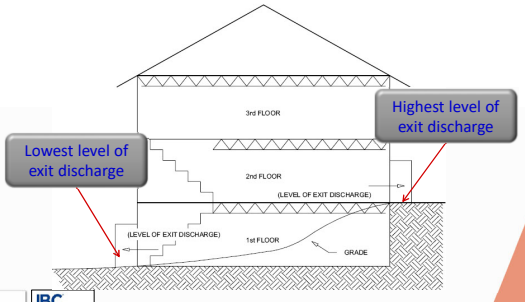
Level of Exit Discharge



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Fire Area

2021 IFC
§202
Page 2-12

- Definition of Fire Area:

The aggregate floor area enclosed and bounded by *fire walls*, *fire barriers*, *exterior walls* or *horizontal assemblies* of a building. Areas of the building not provided with surrounding walls shall be included in the fire area if such areas are included within the horizontal projection of the roof or floor next above.

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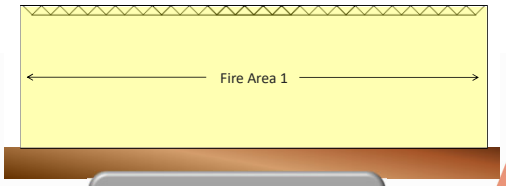
Fire Area Bounded by Exterior Walls



A building constructed with or without fire-resistant materials or assemblies is a fire area

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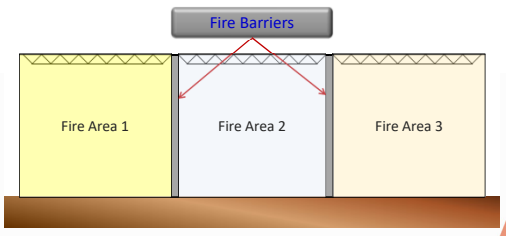
Fire Area Compartmentalized Using Fire Barriers



A building divided using fire-resistant assemblies can have one or more fire areas

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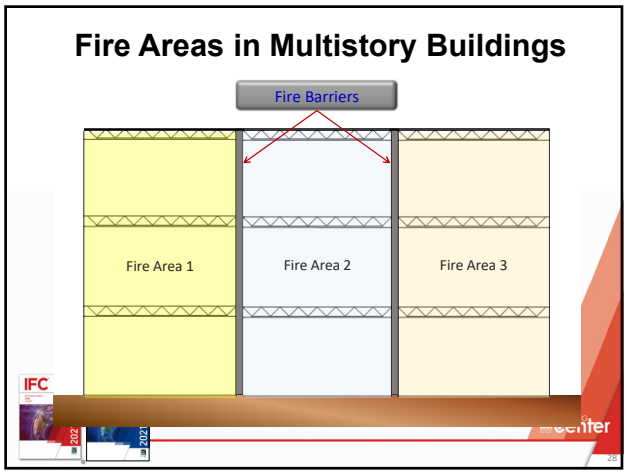

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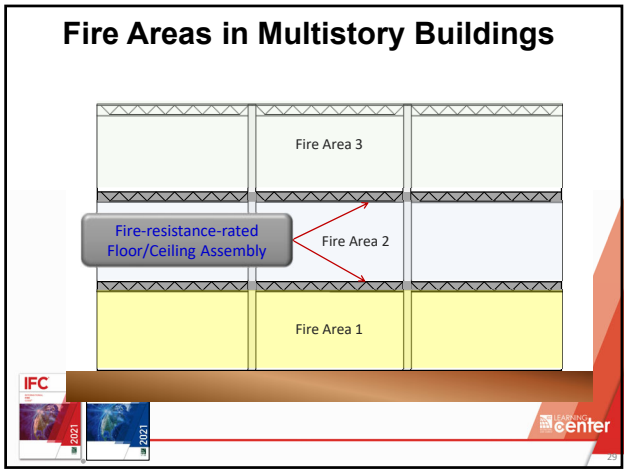

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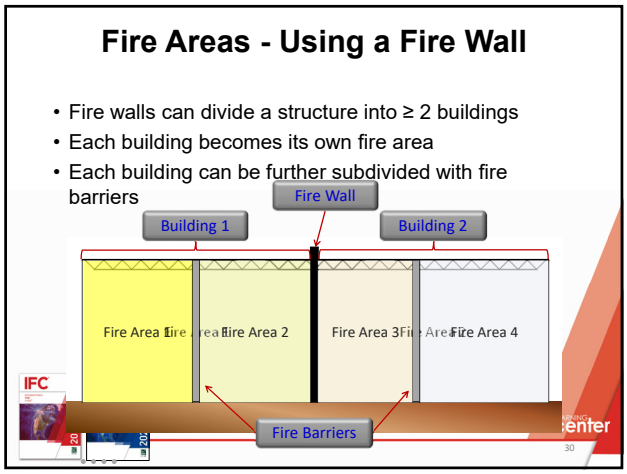

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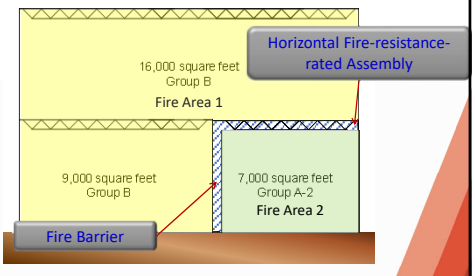
How Many Fire Areas?



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Fire Area Application
IFC §901.4.4, IBC §901.7

2021 IFC §901.4.4 Page 9-1

- **Fire areas.** Where buildings, or portions thereof, are divided into *fire areas* so as not to exceed the limits established for requiring a *fire protection system* in accordance with this chapter, such *fire areas* shall be separated by *fire barriers* constructed in accordance with §707 of the IBC or *horizontal assemblies* constructed in accordance with §711 of the IBC, or both, having a fire-resistance rating of not less than that determined in accordance with §707.3.10 of the *International Building Code*.

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IBC Table 707.3.10

2021 IBC Table 707.3.10 Page 7-12

Fire-resistance Rating Requirements for Fire Barrier Assemblies or Horizontal Assemblies Between Fire Areas

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

NOTE: a fire area must be at least 1-HR fire-resistance-rated construction
But in most cases, 1-HR is not adequate

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IBC Table 508.4

2021 IBC Table 508.4 Page 5-13

Required Separation of Occupancies (hours)

Occupancy Group	A, E		I-1, I-3, I-4		I-2		R[a]		F-2, S-2[a], U		B[a], F-1, M, S-1		H-1		H-2		H-3, H-4		H-5	
	S	NS	S	NS	S	NS	S	NS	S	NS	S	NS	S	NS	S	NS	S	NS	S	NS
A, E	N	N	1	2	2	NP	1	2	N	1	1	2	NP	NP	3	4	2	3	2	NP
I-1[a], I-3, I-4	1	2	N	N	2	NP	1	NP	1	2	1	2	NP	NP	3	NP	2	NP	2	NP
I-2	2	NP	2	NP	N	N	2	NP	2	NP	2	NP	NP	NP	3	NP	2	NP	2	NP
R[a]	1	2	1	NP	2	NP	N	N	1[c]	2[c]	1	2	NP	NP	3	NP	2	NP	2	NP
F-2, S-2[b], U	N	1	1	2	2	NP	1	2	N	N	1	2	NP	NP	3	4	2	3	2	NP
B[a], F-1, M, S-1	1	2	1	2	2	NP	1	2	1	2	N	N	NP	NP	2	3	1	2	1	NP
H-1	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP	N	NP	NP	NP	NP	NP	NP	NP
H-2	2	4	3	NP	3	NP	3	NP	3	4	2	3	NP	NP	N	NP	1	NP	1	NP
H-3, H-4	2	3	2	NP	2	NP	2	NP	2	3	1	2	NP	NP	1	NP	1[d]	NP	1	NP
H-5	2	NP	2	NP	2	NP	2	NP	2	NP	1	NP	NP	NP	1	NP	1	NP	N	NP

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IBC Table 706.4

2021 IBC Table 706.4 Page 7-10

Fire Wall Fire-resistance Ratings

GROUP	FIRE-RESISTANCE RATING (hours)
A, B, E, H-4, I, R-1, R-2, U	3[a]
F-1, H-3[b], H-5, M, S-1	3
H-1, H-2	4[b]
F-2, R-3, R-4, S-2	2

a. In Type II or V construction, walls shall be permitted to have a 2-hour *fire-resistance rating*.

b. For Group H-1, H-2 or H-3 buildings, also see Sections 415.7 and 415.8

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Design and Installation Requirements §903.3

- Before reviewing the IFC requirements for fire sprinkler systems, it is important to understand:
  - The various standards applicable to fire sprinkler system design
  - The relationship between the code and the standard

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Design and Installation Requirements §903.3

- NFPA publishes 3 standards governing the design, installation, testing and maintenance of fire sprinkler systems:
  - §903.3.1.1 – NFPA 13, *Installation of Sprinkler Systems*
  - §903.3.1.2 – NFPA 13R, *Installation of Sprinkler Systems in Low-Rise Residential Occupancies*
  - §903.3.1.3 – NFPA 13D, *Sprinkler Systems for One- and Two-Family Dwellings and Manufactured Homes*

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Application Matrix of the Sprinkler Design Standards

System Feature	Sprinkler Standard		
	NFPA 13	NFPA 13R	NFPA 13D or IRC §P2904
Extent of Protection	Throughout the building	Occupied spaces	Occupied spaces
Design Intent	Life Safety & Property Protection	Life Safety	Life Safety
Applicability	All Occupancies	Group R up to 4-stories or 60'	1- & 2-family dwellings & Townhomes
Design Methods	Pipe schedule; Control mode – discharge density/design area; Control mode – specific application; Suppression mode	4 sprinklers per compartment	2 sprinklers per compartment
Sprinklers	All listed & approved types	Listed Residential	Listed Residential
Minimum H_2O Supply Duration	30 to 120 minutes	30 Minutes	7 or 10 Minutes

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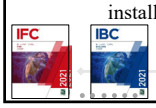
"Installed Throughout"

- IFC Table 1017.2 *Exit Access Travel Distance*, Footnote c
  - Buildings equipped throughout with an automatic sprinkler system in accordance with §903.3.1.1.
- IFC Table 5003.1.1(1) *MAQ per Control Area*, Note d
  - Maximum allowable quantities shall be increased 100 percent in buildings equipped throughout with an approved automatic sprinkler system in accordance with §903.3.1.1.
- IBC Table 506.2 *Allowable Area*, Note S1
  - S1 = Buildings a maxi… …e equipped throughout … installed in accordanc…

What does "equipped throughout" or "installed throughout" mean?



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"Installed Throughout"

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  - Maximum allowable quantities shall be increased 100 percent in buildings equipped throughout with an approved automatic sprinkler system in accordance with §903.3.1.1.
- IBC Table 506.2 *Allowable Area*, Note S1
  - S1 = Buildings a maximum of one story above grade plane equipped throughout with an automatic sprinkler system installed in a

What does "equipped throughout" or "installed throughout" mean?

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"Installed Throughout"

- Under the design of NFPA 13, are ***all*** areas in the building protected with sprinklers?

NO
- Attic spaces <6" high
- Concealed spaces without combustible construction

NO
- Attic spaces without fuel-fired equipment
- Small bathrooms

So which design provides for fire sprinklers "installed throughout"?

- Attic s
- Small
- Small closets with noncombustible wall covering

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"Installed Throughout"

- §903.3.1.1 states:

  Where the provisions of this code require that a building or portion thereof be equipped throughout with an automatic sprinkler system in accordance with this section, sprinklers shall be installed throughout in accordance with NFPA 13 except as provided in Sections 903.3.1.1.1 and 903.3.1.1.2.

"Installed throughout" means that sprinklers are installed throughout the building in all locations as required by the design standard and the code

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"Installed Throughout"

903.3.1.1.1 Exempt locations. Automatic sprinklers shall not be required in the following rooms or areas where such rooms or areas are protected with an approved automatic fire detection system in accordance with §907.2 that will respond to visible or invisible particles of combustion. Sprinklers shall not be omitted from a room merely because it is damp, of fire-resistance-rated construction or contains electrical equipment.

1. A room where the application of water, or flame and water, constitutes a
2. A ro
3. Gen
4. Roo
5. Fire
6. Mach

associated with occupant evacuation elevators designed in accordance with §3008 of the IBC.

- These provisions are not found in NFPA 13
- These provisions are less restrictive than NFPA 13
- §102.7.1 – code provisions take precedence over the standard

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Fire Protection Systems

ACTIVITY

Given: 89,000 ft² Group S-1 warehouse. The fire sprinkler system was designed to protect rack storage of Class III commodities in double row racks 24' high. The original tenant moved out of the building and the new tenant is storing Class IV commodities.

- What section would apply to ensure the automatic sprinkler system is adequately protecting these new commodities?

§901.4

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Fire Protection Systems

ACTIVITY

2. Is an anhydrous ammonia detection system in a refrigeration machinery room a fire protection system?

NO
§202 Definition of "Fire Protection System"

3. Which of the following wall assemblies is ***not*** a method to separate fire areas?

A. Fire wall
B. Fire partition
C. Fire barrier
D. Horizontal assembly

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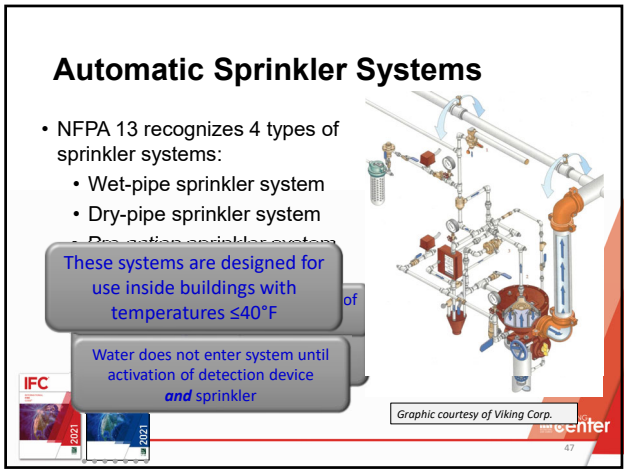

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Allowed Increases Based on Fire Sprinkler Systems

Code Section	Modification	NFPA 13	NFPA 13R	NFPA 13D
IBC 504.3 & 504.4	Building Height	Yes	No	No
IBC 506.2	Building Area	Yes	No	No
IBC 507.4, 507.5 & 507.7	Unlimited building area for certain occupancies	Yes	No	No
IFC 503.1.1	Increased distance from building to FD access road	Yes	Yes	Yes
IFC 507.5.1	Hydrant spacing increased to 600'	Yes	Yes	No
IFC 1017.2	Exit access travel distance	Yes	Yes	No
IFC Table 5003.1.1(1) & (2)	100% increase in MAQ for certain hazardous materials	Yes	No	No
IFC Table 5003.11.1	100% increase in the MAQ for nonflammable solid and nonflammable and noncombustible liquid hazardous materials in Group M & S	Yes	No	No
IFC Table 5704.3.4.1	100% increase in the MAQ for flammable and combustible liquids in Group M & S	Yes	No	No

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Allowed Reductions Based on Fire Sprinkler Systems

Code Section	Modification	NFPA 13	NFPA 13R	NFPA 13D
IBC 403.2.1	Reduction in shaft rating in high-rise buildings	Yes	No	No
IBC 404.2	Decorations in, and use of, atriums	Yes	No	No
IBC Table 508.4	Separation of occupancies	Yes	No	No
IBC 705.8.5	Vertical separation of openings	Yes	Yes	No
IBC 708.3	Fire-resistance rating of fire partitions	Yes	No	No
IBC 708.4.2	Draftstopping in attics of Group R-1 & R-2	Yes	Yes	No
IFC Table 803.3	Reduction in flame spread rating for interior finish	Yes	Yes	No
IFC 907.2	Manual fire alarm boxes in Group A, B, E, F, M, R-1, R-2 & R-4	Yes	Yes	No
IFC 1007.1.1	Separation of exits	Yes	Yes	No
IFC Table 1020.1	Corridor walls in means of egress	Yes	Yes	No
IFC 1028.1	Exit discharge	Yes	Yes	No
IFC Table B105.1(1)	50% reduction in fire flow for Group R-3 & R-4 and 1- and 2-family dwellings	Yes	Yes	Yes
IFC Table B105.2	75% reduction in fire flow	Yes	Yes	Yes

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Design Criteria in NFPA 13

- Pipe schedule method
- Control mode – density/design area method
  - This includes residential and quick-response sprinklers
- Control mode – specific application method
  - These designs are generally limited to storage applications or special sprinklers
- Suppression mode method
  - Limited to Early Suppression Fast-Response (ESFR) sprinklers

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Types of Sprinklers

- NFPA 13 recognizes several different types of sprinklers configured for upright, pendent or sidewall installation
  - Early Suppression Fast-Response (ESFR)
  - Extended Coverage
  - Quick-Response Extended Coverage
  - Quick-Response (QR)
  - Residential
  - Standard Spray
  - Special
  - Specific Application Control Mode

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Special Sprinklers
NFPA 13 §8.4.8

- Special sprinklers have been evaluated & listed for performance in specific conditions:
  - Fire tests related to the intended hazard
  - Spray pattern distribution with respect to obstructions and wetting of walls and floors
  - Evaluation of the sprinkler's thermal sensitivity
  - Sprinkler performance under horizontal or sloped ceilings
  - Area of design
  - Allowable clearance to ceilings

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Automatic Fire Sprinklers
Data Sheet

- Sprinkler data sheets generally contain:
  - Sprinkler selection criteria for residential, light hazard, ordinary hazard, extra hazard, special designs and storage applications
  - Minimum design pressure
  - Minimum or maximum clearances from the sprinkler to the hazard
  - Installation requirements based on the selected sprinkler
  - The SIN (Sprinkler Identification Number)

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Manufacturer Data Sheet

VIKING® TECHNICAL DATA

MICROMATIC® STANDARD RESPONSE UPRIGHT SPRINKLER, VK100 (K5.6)

The Viking Corporation, 210 N Industrial Park Drive, Hastings MI 49058
Telephone: 269-945-9501 Technical Services: 877-384-5464 Fax: 269-818-1680 Email: techsvcs@vikingcorp.com

1. DESCRIPTION

The Viking Micromatic® Standard Response Upright VK100 Sprinkler is a small, thermosensitive, glass-bulb spray sprinkler available in several different finishes and temperature ratings to meet design requirements. The special Polyester and Electroless Nickel PTFE (ENT) coatings can be used in decorative applications where colors are desired. In addition, these coatings have been investigated for installation in corrosive atmospheres and are listed/approved as corrosion resistant as indicated in the Approval Charts. (Note: FM Global approves the ENT coating as corrosion resistant. FM Global has no approval classification for Polyester coatings as corrosion resistant.)
Viking standard response sprinklers may be ordered and/or used as open sprinklers (glass bulb and pip cap assembly removed) on deluge systems. Refer to Ordering Instructions.

2. LISTINGS AND APPROVALS

cULus Listed: Category VNIV
FM Approved: Classes 2001, 2002, 2015, 2017, 2043

NOTE: Other International approval certificates are available upon request.
Refer to Approval Chart 1 and UL Design Criteria on pages cULus Listing requirements, and refer to Approval Chart 2 and FM Design Criteria for FM Approval requirements that must be followed.

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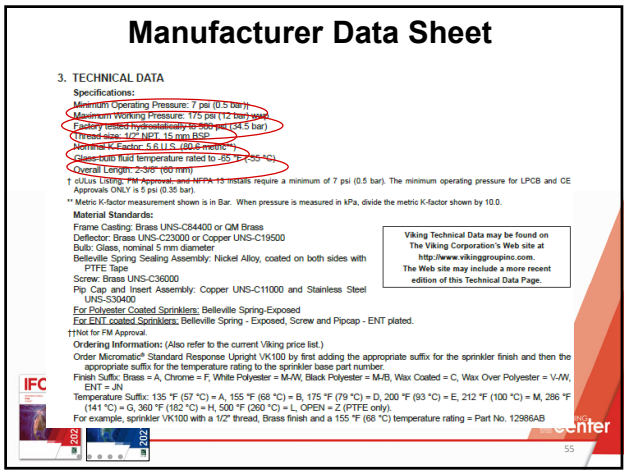

Manufacturer Data Sheet

3. TECHNICAL DATA

Specifications:

Minimum Operating Pressure: 7 psi (0.5 bar)†
Maximum Working Pressure: 175 psi (12 bar) WWP
Factory tested hydrostatically to 500 psi (34.5 bar)
Thread size: 1/2" NPT, 15 mm BSP
Nominal K-Factor: 5.6 U.S. (80.6 metric)**
Glass bulb fluid temperature rated to -65 °F (-55 °C)
Overall Length: 2-3/8" (60 mm)

† cULus Listing, FM Approval, and NFPA 13 installs require a minimum of 7 psi (0.5 bar). The minimum operating pressure for LPCB and CE Approvals ONLY is 5 psi (0.35 bar).

** Metric K-factor measurement shown is in Bar. When pressure is measured in kPa, divide the metric K-factor shown by 10.0.

Material Standards:

Frame Casting: Brass UNS-C84400 or QM Brass
Deflector: Brass UNS-C23000 or Copper UNS-C19500
Bulb: Glass, nominal 5 mm diameter
Belleville Spring Sealing Assembly: Nickel Alloy, coated on both sides with PTFE Tape
Screw: Brass UNS-C36000
Pip Cap and Insert Assembly: Copper UNS-C11000 and Stainless Steel UNS-S30400
For Polyester Coated Sprinklers: Belleville Spring-Exposed
For ENT coated Sprinklers: Belleville Spring - Exposed, Screw and Pipcap - ENT plated.

Viking Technical Data may be found on The Viking Corporation's Web site at http://www.vikinggroupinc.com. The Web site may include a more recent edition of this Technical Data Page.

††Not for FM Approval.

Ordering Information: (Also refer to the current Viking price list.)

Order Micromatic® Standard Response Upright VK100 by first adding the appropriate suffix for the sprinkler finish and then the appropriate suffix for the temperature rating to the sprinkler base part number.
Finish Suffix: Brass = A, Chrome = F, White Polyester = M-W, Black Polyester = M-/B, Wax Coated = C, Wax Over Polyester = V-W, ENT = JN
Temperature Suffix: 135 °F (57 °C) = A, 155 °F (68 °C) = B, 175 °F (79 °C) = D, 200 °F (93 °C) = E, 212 °F (100 °C) = M, 286 °F (141 °C) = G, 360 °F (182 °C) = H, 500 °F (260 °C) = L, OPEN = Z (PTFE only).
For example, sprinkler VK100 with a 1/2" thread, Brass finish and a 155 °F (68 °C) temperature rating = Part No. 12986AB

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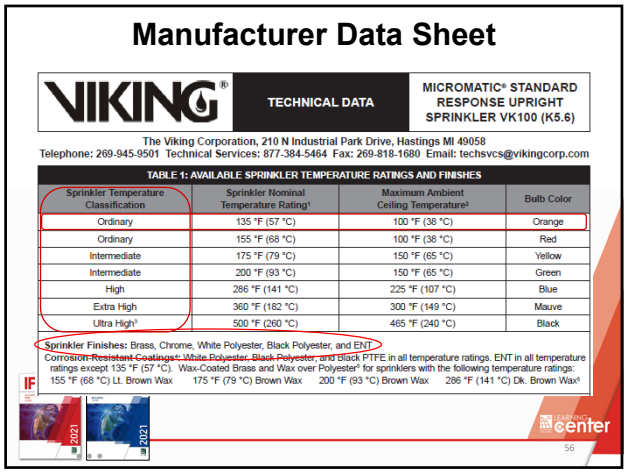

Manufacturer Data Sheet

VIKING® | TECHNICAL DATA | MICROMATIC® STANDARD RESPONSE UPRIGHT SPRINKLER VK100 (K5.6)

The Viking Corporation, 210 N Industrial Park Drive, Hastings MI 49058
Telephone: 269-945-9501 Technical Services: 877-384-5464 Fax: 269-818-1680 Email: techsvcs@vikingcorp.com

TABLE 1: AVAILABLE SPRINKLER TEMPERATURE RATINGS AND FINISHES

Sprinkler Temperature Classification	Sprinkler Nominal Temperature Rating[1]	Maximum Ambient Ceiling Temperature[2]	Bulb Color
Ordinary	135 °F (57 °C)	100 °F (38 °C)	Orange
Ordinary	155 °F (68 °C)	100 °F (38 °C)	Red
Intermediate	175 °F (79 °C)	150 °F (65 °C)	Yellow
Intermediate	200 °F (93 °C)	150 °F (65 °C)	Green
High	286 °F (141 °C)	225 °F (107 °C)	Blue
Extra High	360 °F (182 °C)	300 °F (149 °C)	Mauve
Ultra High[3]	500 °F (260 °C)	465 °F (240 °C)	Black

Sprinkler Finishes: Brass, Chrome, White Polyester, Black Polyester, and ENT

Corrosion-Resistant Coatings: White Polyester, Black Polyester, and Black PTFE in all temperature ratings. ENT in all temperature ratings except 135 °F (57 °C). Wax-Coated Brass and Wax over Polyester[4] for sprinklers with the following temperature ratings:
155 °F (68 °C) Lt. Brown Wax 175 °F (79 °C) Brown Wax 200 °F (93 °C) Brown Wax 286 °F (141 °C) Dk. Brown Wax[5]

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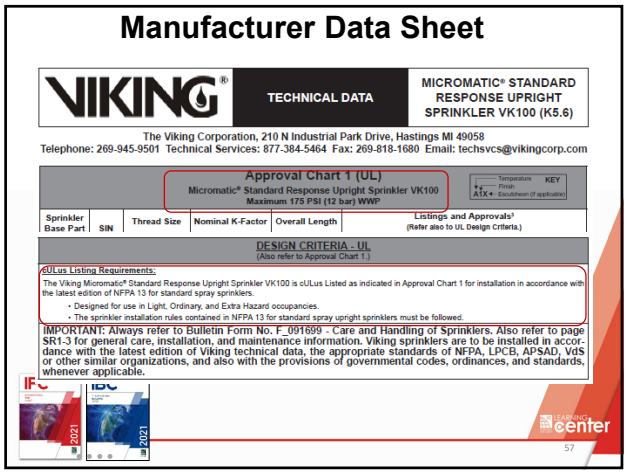

Manufacturer Data Sheet

VIKING® | TECHNICAL DATA | MICROMATIC® STANDARD RESPONSE UPRIGHT SPRINKLER VK100 (K5.6)

The Viking Corporation, 210 N Industrial Park Drive, Hastings MI 49058
Telephone: 269-945-9501 Technical Services: 877-384-5464 Fax: 269-818-1680 Email: techsvcs@vikingcorp.com

Approval Chart 1 (UL)
Micromatic® Standard Response Upright Sprinkler VK100
Maximum 175 PSI (12 bar) WWP

KEY: Temperature, Finish, A1X4 - Escutcheon (if applicable)

Sprinkler Base Part	SIN	Thread Size	Nominal K-Factor	Overall Length	Listings and Approvals[1] (Refer also to UL Design Criteria.)

DESIGN CRITERIA - UL
(Also refer to Approval Chart 1.)

cULus Listing Requirements:

The Viking Micromatic® Standard Response Upright Sprinkler VK100 is cULus Listed as indicated in Approval Chart 1 for installation in accordance with the latest edition of NFPA 13 for standard spray sprinklers.

- Designed for use in Light, Ordinary, and Extra Hazard occupancies.
- The sprinkler installation rules contained in NFPA 13 for standard spray upright sprinklers must be followed.

IMPORTANT: Always refer to Bulletin Form No. F_091699 - Care and Handling of Sprinklers. Also refer to page SR1-3 for general care, installation, and maintenance information. Viking sprinklers are to be installed in accordance with the latest edition of Viking technical data, the appropriate standards of NFPA, LPCB, APSAD, VdS or other similar organizations, and also with the provisions of governmental codes, ordinances, and standards, whenever applicable.

57

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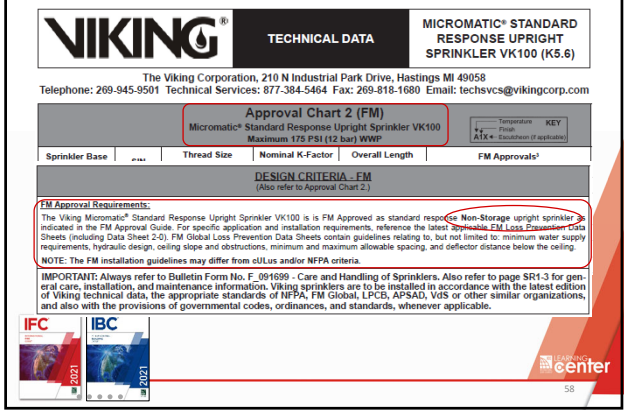
Manufacturer Data Sheet


VIKING® TECHNICAL DATA — MICROMATIC® STANDARD RESPONSE UPRIGHT SPRINKLER VK100 (K5.6)

The Viking Corporation, 210 N Industrial Park Drive, Hastings MI 49058
Telephone: 269-945-9501 Technical Services: 877-384-5464 Fax: 269-818-1680 Email: techsvcs@vikingcorp.com

Approval Chart 2 (FM)
Micromatic® Standard Response Upright Sprinkler VK100
Maximum 175 PSI (12 bar) WWP

KEY: Temperature, Finish, A1X = Escutcheon (if applicable)

Sprinkler Base		Thread Size	Nominal K-Factor	Overall Length	FM Approvals[3]

DESIGN CRITERIA - FM
(Also refer to Approval Chart 2.)

FM Approval Requirements:

The Viking Micromatic® Standard Response Upright Sprinkler VK100 is is FM Approved as standard response Non-Storage upright sprinkler as indicated in the FM Approval Guide. For specific application and installation requirements, reference the latest Applicable FM Loss Prevention Data Sheets (including Data Sheet 2-0). FM Global Loss Prevention Data Sheets contain guidelines relating to, but not limited to: minimum water supply requirements, hydraulic design, ceiling slope and obstructions, minimum and maximum allowable spacing, and deflector distance below the ceiling.

NOTE: The FM installation guidelines may differ from cULus and/or NFPA criteria.

IMPORTANT: Always refer to Bulletin Form No. F_091699 - Care and Handling of Sprinklers. Also refer to page SR1-3 for general care, installation, and maintenance information. Viking sprinklers are to be installed in accordance with the latest edition of Viking technical data, the appropriate standards of NFPA, FM Global, LPCB, APSAD, VdS or other similar organizations, and also with the provisions of governmental codes, ordinances, and standards, whenever applicable.

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Automatic Sprinkler Systems

- Does IBC/IFC §1020.4 allow an increase the length of a dead-end corridor in a Group R-1 occupancy when an NFPA 13R automatic fire sprinkler system is installed?

  NO
  Only NFPA 13 system, even in Group R
  §1020.4

- What prescriptive method of design is permitted for the design of an automatic sprinkler system?

  Pipe schedule

IFC 2021 IBC 2021 LEARNING center 59

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Automatic Sprinkler Systems

3. What is RTI and what range of RTI is required for a sprinkler to be either fast response, quick response or residential?

   RTI = Response Time Index
   RTI of 50 – 80

4. What type of fire sprinkler system is designed for all sprinklers to flow simultaneously?

   Deluge sprinkler system

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Required Fire Sprinklers

- Fire sprinklers requirements are based on:
  - Occupancy classification
  - Size of fire area containing a specific occupancy
  - Occupant load in a specific occupancy
  - Floor level of the specific occupancy
  - Specific operation occurring in the building
  - Modification of other code requirements

- Group H-5
- Group F-1 fire area >12,000 ft²
- Group A-2 with OL ≥100
- Group A-3 on a level other than the LED
- High-piled storage
- Height/Area
  Travel distance
  Haz Mat quantities

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Fire Sprinkler System Installation

- The area to be protected by sprinklers is dependent on the occupancy classification

Occupancy Classification	Fire Area	Occupancy	Entire Floor[1]	Entire Building
A-1, A-2, A-3, A-4				
A-5				
B Ambulatory Care Faci				
F				
H-1, H-2				
H-5				
I				
M				
R				X
S	X			X

[1] The fire sprinkler system is installed on

[2] Fire sprinklers are required in concession … d other … where woodworking occurs with an area of 2,501-12,000 ft²

Bottom line – read the code requirements carefully

IFC 2021 2021 LEARNING center 63

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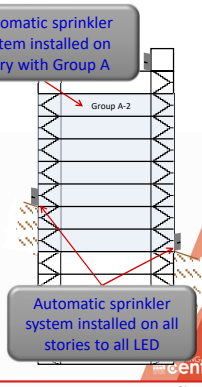
Fire Sprinklers in Group A

- Where fire sprinklers are required in a Group A occupancy located on a story other than LED, fire sprinklers must be installed on all stories leading to all levels of exit discharge that are used by the Group A occupancy

§903.2.1.1, 903.2.1.2, 903.2.1.3, 903.2.1.4.



64

64

Group A-1 §903.2.1.1

- Fire sprinklers required and throughout all stories from the Group A-1 occupancy to and including the levels of exit discharge serving that occupancy where one of the following conditions exists:
  - Fire area >12,000 ft²
  - Fire area has an OL ≥300
  - Fire area is located on a level other than LED
  - Fire area contains a multi-theater complex

65

65

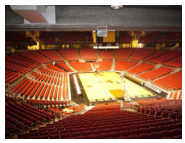
Group A-2 §903.2.1.2

- Fire sprinklers required and throughout all stories from the Group A-2 occupancy to and including the levels of exit discharge serving that occupancy where one of the following conditions exists:
  - Fire area >5,000 ft²
  - Fire area has an OL ≥100
  - Fire area is located on a level other than LED

66

66

Group A-3 & A-4
§903.2.1.3, §903.2.1.4



- Fire sprinklers required and throughout all stories from the Group A-3, A-4 occupancy to and including the levels of exit discharge serving that occupancy where one of the following conditions exist:
  - Fire area >12,000 ft²
  - Fire area has OL ≥300
  - Fire area is located on a level other than LED

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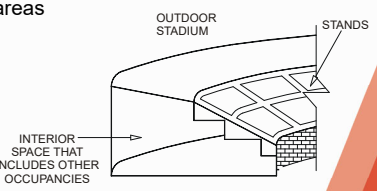
Group A-5
§903.2.1.5

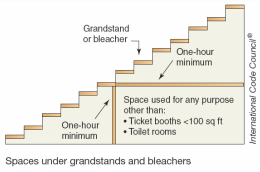
- Fire sprinklers required in the following areas in excess of 1,000 ft² that are accessory to stadiums or arenas:
  - Concession areas
  - Retail areas
  - Press boxes



68

Group A-5
§903.2.1.5.1

- **903.2.1.5.1 Spaces under grandstands or bleachers.**
- Enclosed spaces under *grandstands* or *bleachers* shall be equipped with an *automatic sprinkler system* in accordance with Section 903.3.1.1 where either of the following exist:
- 1. The enclosed area is 1,000 square feet (93 m2) or less and is not constructed in accordance with Section 1029.1.1.1.
- 2. The enclosed area exceeds 1,000 square feet (93 m2).

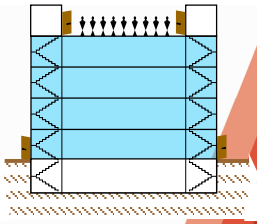


Spaces under grandstands and bleachers

69

Assembly Occupancies on Roofs §903.2.1.6

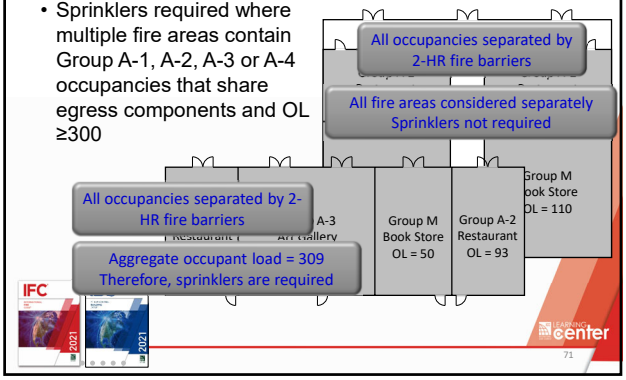
- Fire sprinklers are required on all floors between an occupied roof and the LED discharge where assembly uses occur on the rooftop and:
  - OL >100 for Group A-2, or
  - OL >300 for other Group A occupancies



70

Multiple Group A Fire Areas §903.2.1.7

- Sprinklers required where multiple fire areas contain Group A-1, A-2, A-3 or A-4 occupancies that share egress components and OL ≥300



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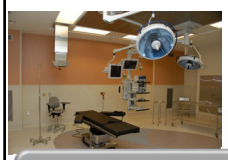
Ambulatory Care Facilities §903.2.2



How do you determine the number of care recipients?

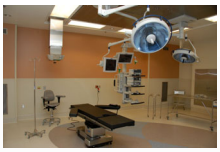
Count the beds

- Fire sprinklers required on floors with a Group B Ambulatory Care Facility when:
  - ≥4 care recipients incapable of self-preservation
  - ≥1 care recipients incapable of self-preservation on a floor other than LED

§903.3.2 requires the installation of QR or residential sprinklers throughout smoke compartments containing treatment rooms

72

Ambulatory Care Facilities §903.2.2



- In buildings where ambulatory care is provided on levels other than the *level of exit discharge*, an *automatic sprinkler system* shall be installed throughout the entire floor as well as all floors below where such care is provided, and all floors between the level of ambulatory care and the nearest *level of exit discharge*, the *level of exit* discharge, and all floors below the *level of exit discharge*.
- **Exception:** Floors classified as an open parking garage are not required to be sprinklered.

73

73

Group E §903.2.3

- Fire sprinklers required in the occupancy when one of the following conditions exist:
  1. Fire area >12,000 ft²
  2. All portions below LED
     - Sprinklers ***not*** required in areas below LED where each classroom has at least one exterior exit door at ground level
  3. The Grou[illegible]nt load of ≥300

74

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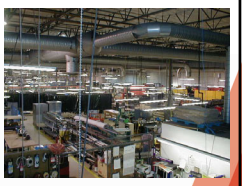
Group F-1 §903.2.4

- Fire sprinklers required throughout the building where one of the following conditions exist:
  - Fire area >12,000 ft²
  - Fire area is >3 stories above grade
  - Aggregate fire areas >24,000 ft²
  - Used for manufacture of upholstered furniture or mattresses >2,500 ft²



75

75

Woodworking Operations §903.2.4.1

- Fire sprinklers required throughout the building where ***both*** of the following conditions exist:
  - Fire area >2,500 ft²
  - The process generates finely divided waste or uses finely divided combustible materials

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Group H §903.2.5

- Fire sprinklers required in all Group H occupancies
- §5004.5 requires systems to meet Ordinary Hazard Group 2 criteria, at minimum with 3,000 ft² design area
  - 0.17 gpm/ft²
  - Many materials require more water

- Flammable & combustible liquids
- Flammable & pyrophoric gases
- Level 2 & 3 aerosols
- Organic peroxides
- Oxidizers

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Group H-5 §903.2.5.2

- Fire sprinklers required throughout the building
- IFC Table 903.2.5.2 establishes minimum design criteria for automatic sprinklers based on the location in the building

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Group I §903.2.6

- Fire sprinklers required throughout the building
- §903.2.6 allows the installation of NFPA 13R systems in Group I-1 Condition 1
- §903.3.2 requires the installation of QR or residential sprinklers in:
  - All areas of smoke compartments containing care recipient sleeping units in Group I-2
  - Sleeping units in Group I-1

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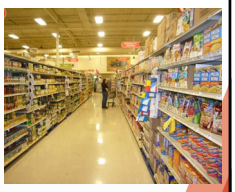
Group M §903.2.7

- Fire sprinklers required throughout the building where one of the following conditions exist:
  - Fire area >12,000 ft²
  - Fire area >3 stories above grade
  - Aggregate fire areas >24,000 ft²
  - Used for display and sale of upholstered furniture or mattresses >5,000 ft²



80

Group R §903.2.8

- Fire sprinklers required throughout the building for all Group I occupancies
- NFPA 13D systems in Group R-3, R-4 Condition 1 and care facilities with ≤5 clients
- NFPA 13R systems in Group R-4 Condition 2
- §903.3.2 requires the installation of QR or residential sprinklers in dwelling units and sleeping

1- & 2-family dwellings and townhomes built under the IRC are sprinklered in accordance with the IRC or NFPA 13D

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Pedestal/Podium Construction
IBC §510.4

- Group R occupancies with parking beneath
- Depending on the construction and the building's height and area, the design of the sprinkler system may be based on NFPA 13, 13R or a combination of NFPA 13 and 13R

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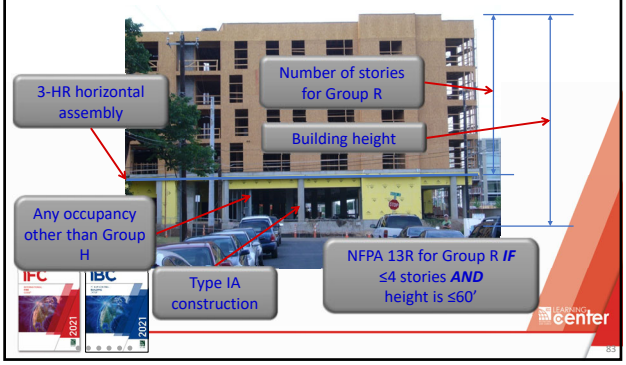
Pedestal/Podium Construction



83

Pedestal/Podium Construction

84

Group S-1
§903.2.9

- Fire sprinklers required throughout the building where one of the following conditions exist:
  - Fire area >12,000 ft²
  - Fire area is >3 stories above grade
  - Aggregate fire areas >24,000 ft²
  - Used for storage of upholstered furniture or mattresses >2,500 ft²
  - The storage of commercial trucks or buses when the fire area is >5,000 ft²

85

Group S-1 Repair Garages
§903.2.9.1

- Fire sprinklers required throughout the building when one of the following conditions exist:
  - Building is 1 story ***and*** fire area >12,000 ft²
  - Building is ≥ 2 stories ***and*** fire area >10,000 ft²
  - Repair garage is located in a basement
  - Repair garage for commercial trucks or buses and the fire area is >5,000 ft²

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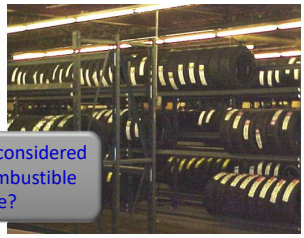
Group S-1 Storage of Tires
§903.2.9.2

- Fire sprinklers required when:
  - Fire area >20,000 cubic feet



Would this be considered high-piled combustible storage?

87

Group S-2 Enclosed Parking Garage §903.2.10

- Fire sprinklers required when :
  - Fire area >12,000 ft²
  - Parking garage is located beneath another occupancy

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Basements and Stories without Openings §903.2.11.1

- Fire sprinklers required on every story, including basements, where floor area >1,500 ft² ***UNLESS***:
  - Openings are provided on at least wall with 1 opening within each 50' of wall, and
  - Openings are separated ≤50'
  - Travel distance to exterior openings ≤75'
  - Each opening has minimum dimension ≥30"

- Frequently applied to basements
- Also applies to above grade stories

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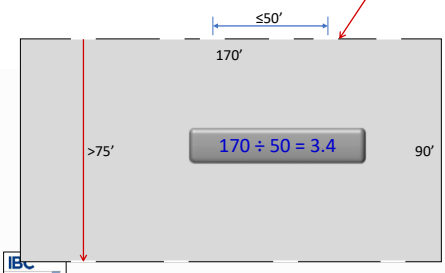
Basements and Stories without Openings §903.2.11.1

Each opening ≥20 ft²

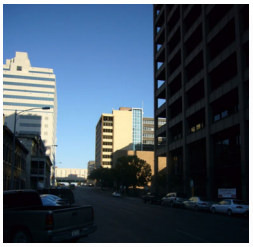


90

90

Buildings ≥55' in Height §903.2.11.3

- Fire sprinklers required in buildings having a story ≥55' above the LLFDVA with OL ≥30



91

91

Other Hazards §903.2.11.4

- Fire sprinkler required in hazardous exhaust ducts with a diameter ≥10"
- If used for conveying a corrosive atmosphere, sprinklers must be listed for the atmosphere
- Listed flexible hose sprinklers are special sprinklers with pressure & flow calculated in accordance with NFPA 13, §11.2.3.4.3

Photograph courtesy of Flexhead Inc.

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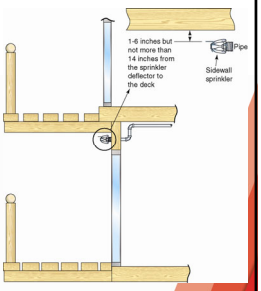
Balconies and Decks §903.3.1.2.1

- Addition to NFPA 13R
- Fire sprinklers required on balconies, decks and patios in Type V construction with a roof or deck above
- The sprinklers must be installed 1" – 6" below a structural member and ≤14" below the deck above



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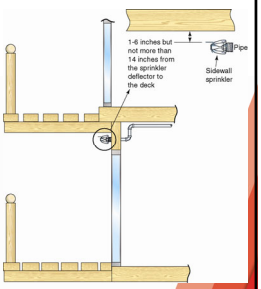
Balconies and Decks §903.3.1.2.1

- Exterior balconies, decks and ground floor patios of dwelling units and sleeping units are constructed in accordance with Section 705.2.3.1, Exception 3 of the *International Building Code*.



94

Sprinkler Protection of Group R Attic Spaces §903.3.1.2.3

In buildings of Type III, IV or V construction that are designed under the special provisions for pedestal buildings, attics not otherwise required to be sprinklered are now further regulated if the roof assembly is located more than 55 feet above the lowest level of fire department vehicle access. Where such a pedestal building condition exists, the attics shall be:

Provided with sprinkler protection, or Constructed using noncombustible construction, or Constructed using fire-retardant-treated wood, or Filled with noncombustible insulation. The required conditions are generally consistent with those previously established for Group R-4, Condition 2 occupancies.

95

Sprinkler System Supervision §903.4

- Water-flow switches, pressure switches and valves that control the water supply for a fire sprinkler system must be electrically supervised
- 7 exceptions

1. 1- & 2-family dwellings
2. Limited area sprinkler systems
3. NFPA 13R sprinkler systems with a common supply for both domestic and sprinkler water with no shutoff
4. Jockey pump control valves
5. Control valves sealed or locked in the open position
6. Valves controlling the fuel supply
7. Trim valves sealed or locked in the open position

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Sprinkler System Alarm Signals §903.4.1

- Alarm signals must be sent to:
  - Supervising station, or
  - Constantly attended location

What does "constantly attended" mean?

Photo courtesy of Property Protection Inc.

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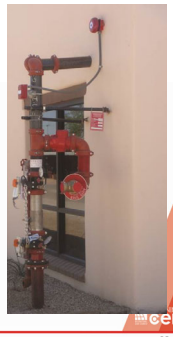
Sprinkler Systems §903.4

- An approved audible device shall be provided for each sprinkler system and located on the exterior of the building
- Floor control valves are on each riser on each floor in high-rise buildings



98

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Fire Department Connection §912

- Street side of building
- 3' access around FDC
- Location approved by FCO
- Approved fit
- Labeled
- Visible from
  OR signs di

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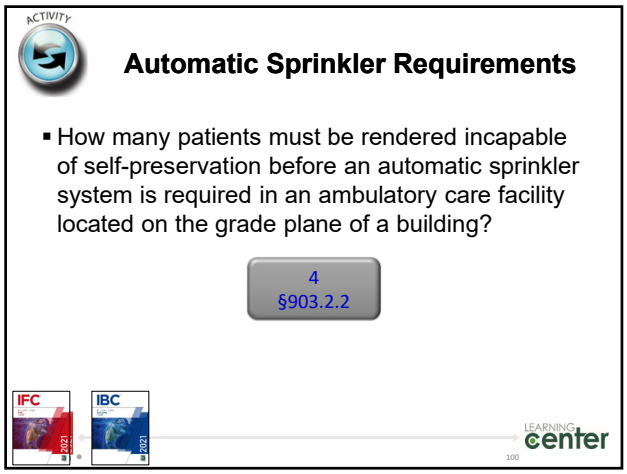

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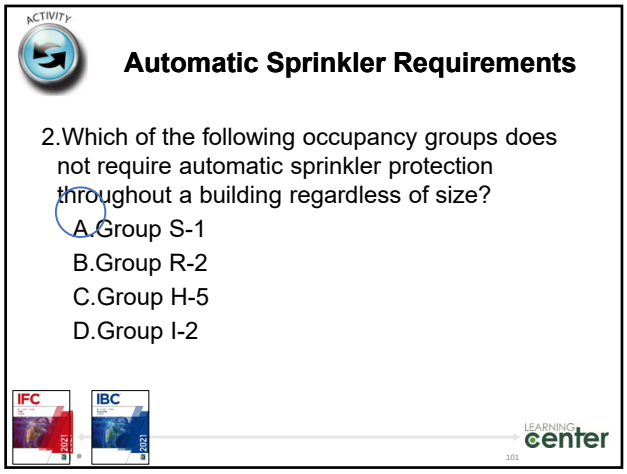

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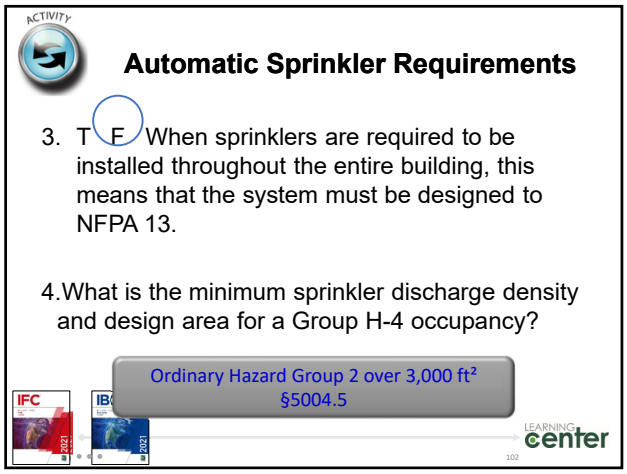


102

Module 4

Automatic Fire Extinguishing Systems

103

Fire-extinguishing Systems §904

- The following suppression types of fire-extinguishing systems are recognized:
  - Dry chemical
  - Wet chemical
  - Carbon Dioxide (CO2)
  - Halon
  - Clean agent
  - Aqueous film forming foam
  - Water mist

104

Flammable Liquid Containment Dike AFFF Flooding System

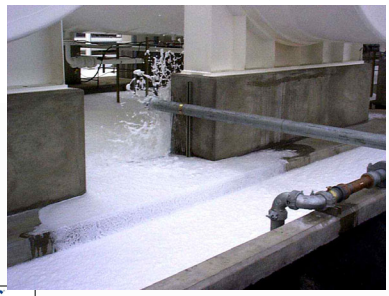


Photo courtesy of International Code Consultants, Inc.

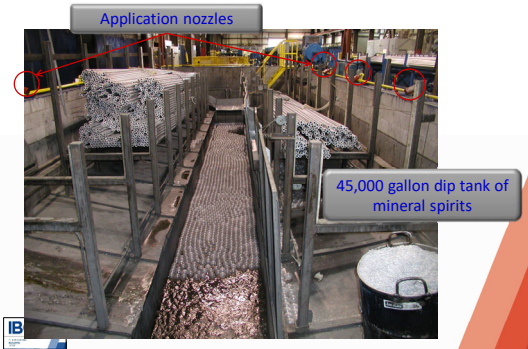
105

Design and Acceptance Testing Considerations for AFES

- Is the selected agent compatible with the hazard being protected?
- Is the system pre-engineered or an engineered design?
- Is the system a local application or total flooding design?
- If applicable, what is the integrity of the enclosure as it relates to air movement and infiltration?
- Is the amount of agent adequate to protect the largest hazard?

106

CO2 Automatic Fire-extinguishing System



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Fire-extinguishing Systems §904.2

2021 IFC §904.2 §904.2.1 Page 9-12

904.2 Where permitted. Automatic fire-extinguishing systems installed as an alternative to the required automatic sprinkler systems of Section 903 shall be approved by the fire code official.

904.2.1 Restriction on using automatic sprinkler system exceptions or reductions. Automatic fire-extinguishing systems shall not be considered alternatives for the purposes of exceptions or reductions allowed for automatic sprinkler systems or by other requirements of this code.

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Installation Requirements for Automatic Fire-extinguishing Systems

- Systems must be designed to automatically activate
- For agents which pose a health hazard, alarm signals shall warn occupants when the system is in the process of beginning to discharge
- For buildings also equipped with a fire alarm system, the AFES must be monitored by the fire alarm system
- Where the AFES system requires notification devices, they must be audible and visual

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Inspection and Testing of Automatic Fire-extinguishing Systems

- Prior to an acceptance test, the following elements to be inspected:
  - Confirm the design is consistent with the hazard being protected
  - Placement and location of detection devices, discharge nozzles, alarms and manual means of activation
  - Signs and operating instructions for the system

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Dry-chemical Fire-extinguishing Systems

- Dry-chemical AFES can be engineered or pre-engineered fire suppression systems designed to protect a specific hazard or can used for total flooding protection applications

- Flammable and combustible liquids
- Flammable gases
- Combustible solids, such as plastics and ordinary combustibles

6-month inspection and testing of:
- Detection and releasing devices
- Alarms (where required)
- Verification that a sufficient volume of agent is available for the protected hazard

111

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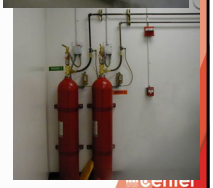
Carbon Dioxide (CO2) Fire-extinguishing Systems

- CO_2 systems can be designed for local application, total flooding or hand hoselines using NFPA 12
- Systems can be engineered or pre-engineered
- Inspected and tested every 6 months
- High-pressure cylinders must be weighed every 6 months to ensure a sufficient amount of agent is available
- Hoses and auxiliary equipment must be inspected annually



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Halon Fire-extinguishing Systems

- Manufacturing of halons has been prohibited in the U.S. since 1994
  - Halons are chlorinated or fluorinated hydrocarbons
  - Excellent extinguishing agents
  - Ozone-depleting chemicals

Montreal Protocol

- New systems using existing stockpiles of halon are permitted
- Inspected annually including cylinders, hoses and releasing components
  - Hoses require a test every 5 years

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Clean Agent Fire-extinguishing System

- A Clean Agent is defined as an

  "Electrically nonconducting, volatile or gaseous fire-extinguishant agent that does not leave a residue upon evaporation."
- Clean agents are available in two formulations:
  - Halocarbons – formulated from organic compounds and flourine, chlorine, bromine or iodine
  - Inert gas – formulated from nitrogen, argon, helium or neon. CO2 may be used as a secondary agent
- All of the agents are liquefied compressed gases

114

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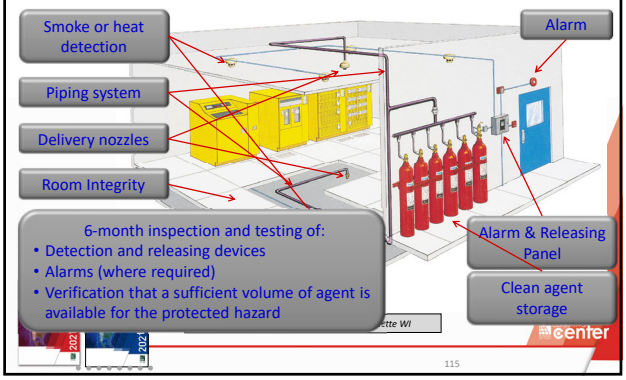
Typical Design for a Clean Agent System Protecting a Computer Room



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Water Mist Fire Protection Systems §904.11

- Systems designed in accordance with NFPA 750
- The systems are either pre-engineered or engine- driver
- Wate a limite secor

NFPA 750 §3.3.19: A water spray for which the *Dv0.99*, for the flow-weighted cumulative volumetric distribution of water droplets, is less than 1,000 microns at the minimum design operating pressure of the water mist nozzle.

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Water Mist Fire Protection Systems

- 5-outlet water mist fire-extinguishing system designed to protect engine test cells

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Water Mist Fire Protection Systems

- Water mist test on a hydrocarbon pool fire

Photograph courtesy of Securiplex LLC

118

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Commercial Cooking Systems §904.12

- Commercial cooking systems shall be protected using:
  - Wet chemical listed to UL 300; or
  - Dry chemical listed to UL 300; or
  - Automatic sprinkler system listed for this application
- These systems must be installed in accordance with their listing and the manufacturer's installation instructions

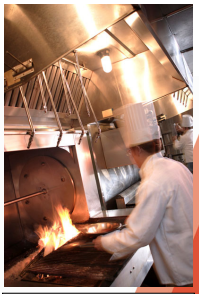

Photo courtesy of Ansul Incorporated

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Commercial Cooking Appliances

REFER TO CODE BOOK

2021 IFC §202 Page 2-6

- Commercial cooking appliances defined:

Appliances used in a commercial food service establishment for heating or cooking food and which produce grease vapors, steam, fumes, smoke or odors that are required to be removed through a local exhaust ventilation system. Such appliances include deep fat fryers, upright broilers, griddles, broilers, steam-jacketed kettles, hot-top ranges, under-fired broilers (charbroilers), ovens, barbecues, rotisseries, and similar appliances. For the purpose of this definition, a food service establishment shall include any building or a portion thereof used for the preparation and serving of food.

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Wet-Chemical Fire-extinguishing Systems

- These systems are installed in accordance with NFPA 17A, *Wet Chemical Extinguishing Systems*
- These systems must be listed to UL 300, *Fire Testing of Fire Extinguishing Systems for Protection of Restaurant Cooking Areas*

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Wet-Chemical Fire-extinguishing Systems

- Wet-chemical fire-extinguishing system protecting a Type I single island cooking hood

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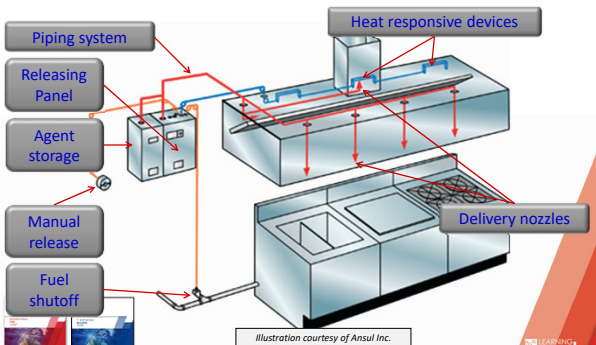
Wet-Chemical Fire Extinguishing System



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Inspection of Commercial Hoods

Table 607.3.3.1
Commercial Cooking System Inspection Frequency

Type Of Cooking Operation	Frequency of Inspection
High-volume cooking operations such as 24-hour cooking, charbroiling or wok cooking	3 months
Low-volume cooking operations such as places of religious worship, seasonal businesses and senior centers	12 months
Cooking operations utilizing solid-fuel burning cooking appliances	1 month
All other cooking operations	6 months

Photo courtesy of Flue Steam, Inc.

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Portable Fire Extinguishers for Commercial Cooking Operations

- §906.4.2 requires portable fire extinguishers for commercial cooking systems
  - Listed Type K extinguisher
  - Travel distance ≤30'
  - Solid fuel appliances
    - One 2.5 gallon, or two 1.5 gallon
  - Deep fat fryers
    - One 1.5 gallon for 4 fryers, ≤80 lbs each
    - See manufacturer's instructions for fryers >6 ft²

Photo courtesy of Amerex Inc.

125

ACTIVITY

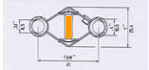
Fire-extinguishing Systems

- Can a dry-chemical fire-extinguishing system be used to increase the allowable height of a building?

NO
§904.2.1

- How often must frangible bulb fusible links in a Type I hood be replaced?

After activation
§904.12.5.3, Exception



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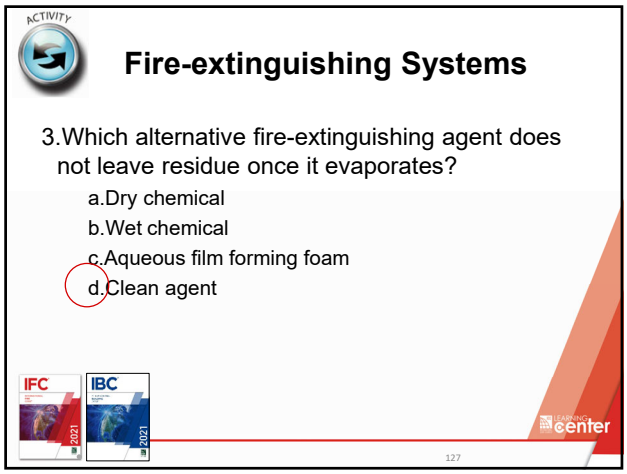

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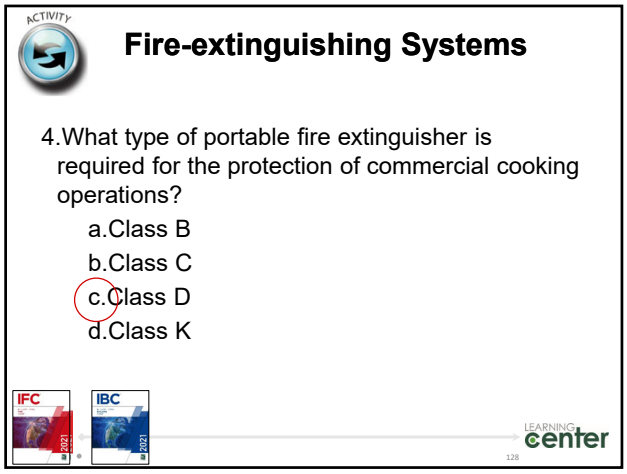

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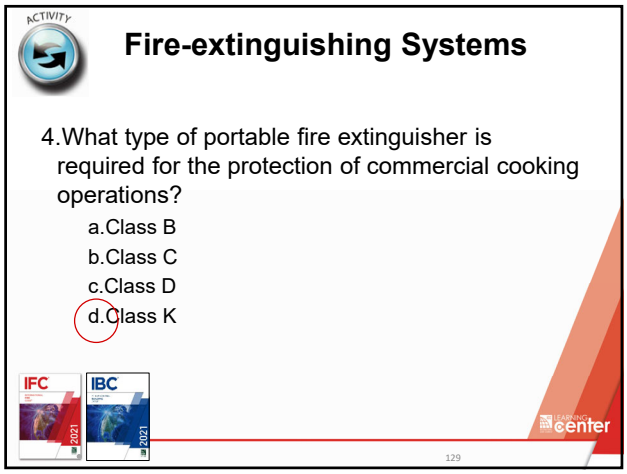

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Standpipe Systems §905.3.1

- Standpipes required in:
  - ≥ 4 above or below grade plane.
  - Buildings with a floor level >30' above LLFDVA
  - Buildings with a floor level >30' below HLFDVA
  - Group A with OL >1,000
  - Covered & open malls
  - Stages >1,000 ft²
  - Underground buildings
  - Marinas and boatyards

IFC 2021 IBC 2021 center

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Standpipe Systems §202

- Standpipes are classified as follows:
  - Class I: designed for FD use only
  - Class II: designed for use by building occupants
  - Class III: designed for use by FD or building occupants

2½" hose connections

1½" hose connections with hose and nozzle

Combination of 2½" connections PLUS 1½" hose connections with hose and nozzle

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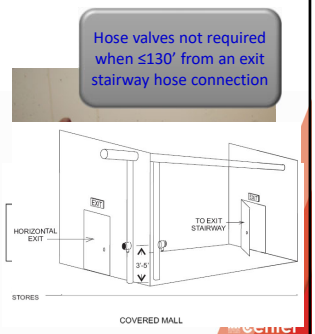
Location of Class I Hose Valves §905.4

- In stair shafts, hose valves are required at main floor landings unless otherwise approved by the FCO
- On each side of a horizontal exit
- Adjacent to each public entrance to the mall and adjacent to each entrance from an exit passageway or exit corridor



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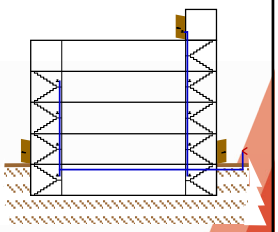
Interconnection of Standpipes §905.4.2, §905.6.2

- Where ≥2 Class I or III standpipes are in the same building or area they must be interconnected
- NFPA 14 requires interconnection of standpipes at the top of the building when the water supply or tank is at the top



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Location of Class II Hose Connections §905.5

- Where Class II standpipe system is required throughout building, hose and valves must be accessible and distributed so all portions of the building are ≤100' hose with 30' hose stream
- Hose stations required in Group A-1 & A-2 occupancies with OL >1,000
  - Each side of stage
  - At rear of auditorium
  - Each side of balconies
  - Each tier of dressing rooms

135

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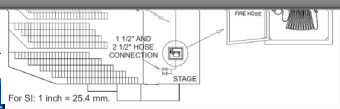
Class III Standpipe at Stages

- Class III wet standpipe required at stages >1,000 ft²
- In sprinklered buildings, hose and nozzle is not required

Stage is a space in a building utilized for entertainment or presentations, and includes overhead hanging curtains, drops, scenery or stage effects other than lighting and sound.



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Module 6

Fire Alarm and Detection Systems

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Purpose of a Fire Alarm and Detection System

A fire alarm and detection system can be designed to perform several functions:

- Providing notification of an emergency
- Monitoring and notification of supervisory and trouble signals
- Alerting the occupants
- Summoning aid
- Controlling fire safety functions

Photo courtesy of Siemens Building Systems Inc.

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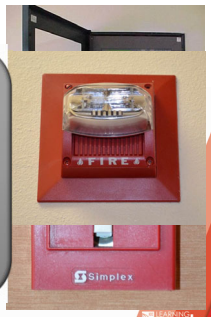
Fundamental Components of a Fire Alarm and Detection System

- Fire Alarm Control Unit

Receives inputs from automatic and manual fire alarm devices and may be capable of supplying power to detection devices and transponders or off-premises transmitters. The control unit may be capable of providing a transfer of power to the notification appliances and transfer of condition to relays or devices.



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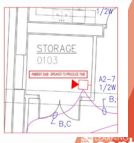
Fire Alarm Systems Requirements §907.2

- Must comply with NFPA 72, *National Fire Alarm Code*
- All components must be listed and approved
- Design audibility level must be shown on plans
- Where fire detection is required, smoke detection is 1st choice
- Where heat detection is required, fire sprinklers can substitute for heat detectors



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Group A §907.2.1

- Manual fire alarm system required where OL ≥300

Group A-1, A-2, A-3 and A-4 will all require a fire sprinkler system when OL ≥300

alarm boxes can be eli
on

When a required fire alarm system is installed in a building, ALL fire-extinguishing systems shall be monitored by FACU §904.3.5

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Group A §907.2.1.1

- Emergency voice/alarm communication system is required in Group A with OL ≥1,000
- This system must be connected to a source of emergency power

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Group B §907.2.2

- Manual fire alarm required where:
  - OL ≥500
  - ≥100 persons are located above or below LED
- In sprinklered buildings, manual fire alarm boxes can be eliminated except for one in an approved location

143

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Group B Ambulatory Care Facility §907.2.2.1

- Manual fire alarm system required throughout the fire area containing an ACF
  - In sprinklered buildings, manual fire alarm boxes can be eliminated except for one in an approved location
- Smoke detection system required in ACF and all public areas including corridors and lobbies
  - Smoke detection can be eliminated in sprinklered buildings

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Group E §907.2.3

- Manual fire alarm system required where OL ≥50
- Emergency voice/alarm communication system required where OL >100
- Manual fire alarm boxes are not required where:
  - Interior corridors are protected by smoke detectors
  - Smoke or heat detection is provided in auditoriums, cafeterias and gyms
- Manual fire alarm boxes are not required where:
  - Building is sprinklered and EVAC will activate upon waterflow

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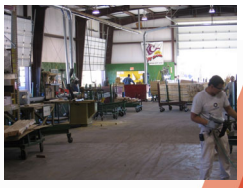
Group F §907.2.4

- Manual fire alarm required where:
  - ≥2 stories in height
  - OL ≥500 above or below the lowest LED
- In sprinklered buildings, manual fire alarm boxes can be eliminated except for one in an approved location



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Group H §907.2.5

- Manual fire alarm required in:
  - Group H-5
  - Group H-2 or H-3 that manufacture organic coatings
- Smoke detection system required where storing
  - Highly toxic gases
  - Organic peroxides
  - Oxidizers

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Group I
§907.2.6

- Manual fire alarm system required in all Group I
  - Manual fire alarm boxes are permitted to be located at constantly attended locations, as long as travel distances are maintained
- Smoke detection system shall be installed in corridors and waiting areas open to corridors Group I-1
  - Smoke detection not required in sprinklered Group I-1 Condition 1

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Group I-2 Condition 1
§907.2.6.2

- In addition to manual system, smoke detection is required in corridors and areas open to corridors
  - Corridor detection not required where sleeping units have smoke detectors that notify at nursing station
  - Corridor detection not required where sleeping unit doors are equipped with smoke-detector- activated door-closing device

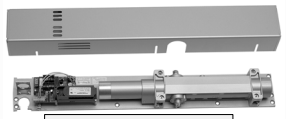

Photo courtesy of ASSA ABLOY Door Security Solutions

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Group I-3
§907.2.6.3.3

- In addition to manual system, smoke detection system is required in housing areas, sleeping units, day rooms and other common spaces accessible to residents
  - Sleeping unit detectors not required in Group I-3 Use Condition 2 or 3
  - Sleeping unit detectors not required in where ≤4 residents and the building is sprinklered

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Group M
§907.2.7

- Manual fire alarm required where:
  - OL ≥500
  - ≥100 persons are located above or below LED
- Not required in covered or open malls
- In sprinklered buildings, manual fire alarm boxes can be eliminated except for one in an approved location
- Notification signal can go to normally attended location if emergency voice/alarm communication system is provided

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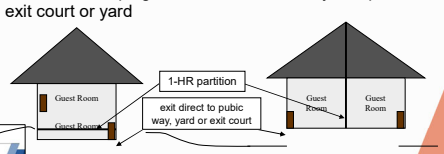
Group R-1
§907.2.8.1

- Manual fire alarm system required
- Manual fire alarm system is ***NOT*** required where:
  - Building is ≤2 stories in height
  - Sleeping units, attics & crawl spaces have a minimum 1-HR separation
  - Each individual sleeping unit has an exit directly to a public way, exit court or yard



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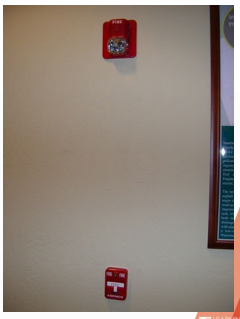
Group R-1
§907.2.8.1, Exc 2

- Manual fire alarm boxes are not required where:
  - Building is sprinklered with NFPA 13 or 13R
  - Notification appliances activate upon sprinkler flow
  - 1 manual fire alarm box is installed at an approved location



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Group R-1
§907.2.8.2

- Smoke detection required in interior corridors serving sleeping rooms
  - Detection system is not required where the sleeping units have means of egress door opening directly to an exterior exit access

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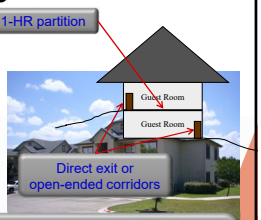
Group R-2
§907.2.9

- Manual fire alarm system required where:
  - Any dwelling unit is ≥3 stories above lowest LED
  - Any dwelling unit is located >1story below the highest LED
  - Building houses >16 dwelling units or sleeping units



Manual fire alarm system is not required IF 1-HR partition separates all units and each unit has direct exit or exits through open-ended corridors

with NFPA 13 or 13R

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Group R-2 College & Univ. Buildings
§907.2.9.3

- Smoke detection system is required in Group R-2 occupancies operated by a college or university for student or staff housing
  - Common spaces outside of dwelling and sleeping units
  - Laundry rooms, mechanical equipment rooms and storage rooms
  - Interior corridors serving sleeping or dwelling units

Detection system is not required in buildings without interior corridors

Smoke alarms in dwelling units and sleeping units SHALL be interconnected to fire alarm system

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Group R-4 §907.2.10

- Manual fire alarm system is required
- Smoke detection system is required in corri… kitch…

Manual fire alarm system is not required IF building ≤2-stories with 1-HR partitions separating all units and each unit has direct exit

Smoke detection is not required in buildings sprinklered with NFPA 13

Smoke detection is not required if no interior corridors serving sleeping units and unit has exit to exterior

sprinklered with NFPA 13 or 13R

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Special Amusement Buildings

2021 IFC §202 Page 2-34

A special amusement building represents a high fire and life safety challenge based on its definition:

> A building that is temporary, permanent or mobile that contains a device or system that conveys passengers or provides a walkway along, around or over a course in any direction as a form of amusement arranged so that the egress path is not readily apparent due to visual or audio distractions or an intentionally confounded egress path, or is not readily available because of the mode of conveyance through the building or structure.

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Special Amusement Buildings §907.2.11

- Smoke detection system required
  - Activate audible/visual alarms
  - Illuminate the means of egress
  - Shut off sound
  - Shut off visual distractions that confuse occupants
  - Activate approved directional exit marking
  - Activate pre-recorded message on emergency voice/alarm communication system

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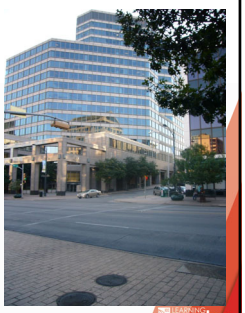
High-rise Buildings §907.2.12

- Smoke detection required in:
  - Air-handling systems
  - Mechanical equipment rooms
  - Elevator machine rooms
  - Elevator lobbies
- Emergency voice/alarm communication system required
- Emergency responder radio coverage
  - Fire department communication systems



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Emergency Voice/Alarm Communication Systems §907.5.2.2

- System to deliver voice instructions on the floor of fire origin and the floor above and below the floor of fire origin
- Speakers are required to be designed as dedicated paging zones:
  - Elevator groups
  - Exit stairways
  - Each floor
  - Areas of refuge

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Fire Alarm System Zones §907.6.4

- Each floor is zoned separately
  - ≤22,500 ft², except for sprinkler systems
  - ≤300' in any direction
- In high-rise buildings each floor will have separate zones for:
  - Smoke detectors
  - Sprinkler water-flow devices
  - Manual fire alarm boxes
  - Other fire detection or suppression systems

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Retroactive Fire Alarm Systems §1103.7

- If the following existing buildings do not have a fire alarm system, one must be installed:
  - Groups E, I-1, I-2, I-3, R-2
  - Group R-1 boarding and rooming houses
  - Group R-1 hotel and motel
  - Group R-4 residential care/assisted living facilities.
- Single- and multiple-station smoke alarms in Groups I-1 and R

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Duct Smoke Detection §907.3.1

- When a fire alarm system is required, all extinguishing and detection systems must be connected to fire alarm system
- IMC §602 requires duct detection when:
  - Return air systems have a capacity >2,000 CFM
  - Common supply and return air systems have a capacity >2,000 CFM
  - Return air risers serving ≥2 stories have a design capacity >15,000 CFM

Photo courtesy of Air Products and Control, Inc.

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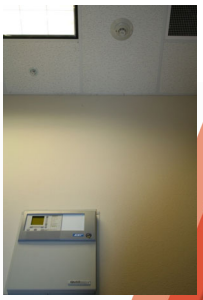
Protection of Fire Alarm Control Unit §907.4.1

- When FACU is located in an area which is not in a continuously occupied area, it must be protected by:
  - A single smoke detector; or
  - A heat detector where ambient conditions are not favorable to smoke detectors
  - §907.4.3.1 states that a fire sprinkler can fulfill the service of a heat detector



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Manual Fire Alarm Boxes §907.4.2

- Manual fire alarm boxes must:
  - Be located ≤5' from each exit
  - Have an exit access travel distance to manual fire alarm box of ≤ 200'
  - Have an activation handle located 42-48" AFF
  - Be **red** in color
  - Be equipped with listed protective covers if ordered by the FCC

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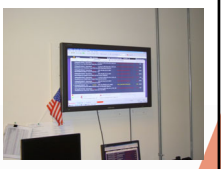
Occupant Notification Systems §907.5

- Notification appliances are required in most occupancies
  - Audible
  - Visual
  - Tactile
  - Any combination thereof
- Notification must occur upon activation of a fire detector, sprinkler flow, a manual fire alarm box or an automatic fire-extinguishing system



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Audible Alarms §907.5.2

- 15 dBA above ambient sound level
- Maximum sound pressure level permitted is 110 dBA
- Minimum required sound pressure level for all appliances and for certain areas of buildings

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Visual Alarms §907.5.2.3.1

- Visua
  - Pu
  - Cc
  - Sl ur
- Empl audib notific desig capacity for future visual alar

Number of Sleeping Units	
6 to 25	
26 to 50	
51 to 75	
76 to 100	
101 to 150	12
151 to 200	14
201 to 300	17
301 to 400	20
401 to 500	22
501 to 1,000	5% of total
1,001 and over	50 plus 3 for each 100 over 1,000

All dwelling units and sleeping units in Group R-2 shall be provided with the capability to support visible alarm notification appliances

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Monitoring §907.6.6

- All required fire alarm systems to be monitored by an approved supervising station
- Supervision is not required for:
  - Smoke alarms or smoke detectors in Group I-3
  - Automatic sprinklers in 1- and 2-family dwellings
  - Smoke alarms

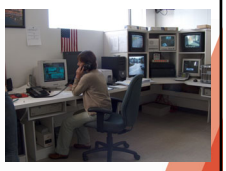

Photo courtesy of Property Protection Inc.

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Inspection, Testing and Maintenance §907.8

- Acceptance testing of fire detection and alarm systems is required at time of installation
- Additional/routine testing in accordance with the schedules in NFPA 72
- Written records of the maintenance, inspection and testing
- Records to be maintained and made available to FCO upon request

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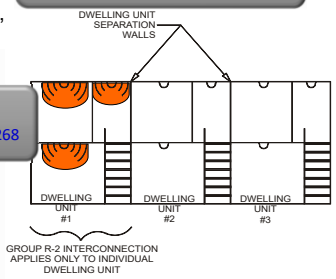
Where Smoke Alarms Are Required §907.2.10

- Smoke alarms are required in:
  - Groups R-1, R-2, R-3, R-4 and I-1
- In new occupancies,
- backup power supply
- Interconnection when ≥1 device

A single- or multiple-station alarm which responds to smoke and is not connected to a system

- Smoke alarms comply with UL 217
- Smoke detectors comply with UL 268



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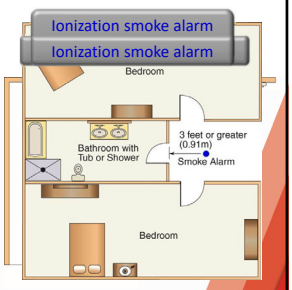
Smoke Alarms near Cooking Appliances and Bathrooms - §907.2.10.3, §907.2.10.4

- Criteria for locating smoke alarms in relation to cooking appliances
- Criteria for locating smoke alarms in relation to bathrooms
- Proper location of smoke alarms can help reduce the number of nuisance alarms



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Emergency Alarm Systems §908

- Emergency alarm systems required for:
  - Group H-5
  - Indoor storage & use areas of highly toxic or toxic gases as required by §6004.2.2.10
  - Ozone gas-generator rooms
  - Repair garages for vehicles fueled with a nonodorized gas
  - Refrigeration systems

Emergency alarms are systems to provide indication and warning of emergency situations involving hazardous materials

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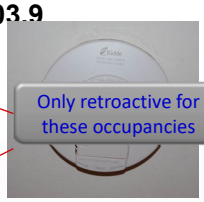
Carbon Monoxide Alarms §915, §1103.9

- CO alarms required in:
  - Groups I-1, I-2, I-4 and R
  - Group E classrooms
- IF:
  - Fuel-burning appliances
  - Force air furnace with fuel-burning appliance
  - Attached private garage
- Could be [illegible] system



Only retroactive for these occupancies

Public garages are regulated under IBC §406 and provided with ventilation

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Fire Alarm and Detection Systems

- What is the component in a fire alarm and detection system that recognizes a change of state or condition?

Alarm-initiating device §902.1

- What IFC chapter contains the retroactive requirements for fire alarm systems?

Chapter 11 Construction Requirements for Existing Buildings §1103.7

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Fire Alarm and Detection Systems

3. Which occupancies/facilities require an emergency alarm/voice communications system?

Cover or open mall >50,000 ft² §914.2.3
Group A with OL >1,000 §907.2.1.2
Group E with OL >100 §907.2.3
Group A, E or M with atrium §907.2.13
High-rise buildings §914.3.5

4. T (F) CO alarms are required in all rooms of Group E occupancies.

Only in classrooms of Group E §915.1.1

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Module 7

Smoke Management

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Smoke Management Systems §909, §910

- Two concepts of handling smoke in the code
  - §909 – Smoke Control Systems
  - §91[illegible] – Smoke and Heat Removal
- These
  - Bot
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  - Smoke Control System's main function is for life safety

These systems are designed to maintain

These systems are designed to remove smoke from buildings in large Group F and S occupancies

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Required Smoke Control Systems

- IBC §402.7.2 – covered malls constructed as an atrium >2 stories in height
- IBC §404.5 – atriums
- IBC §405.5 – underground buildings
- IBC §408.9 – windowless buildings
- IBC §410.2.7.2 – stage >1,000 ft²
- §1029.6.2.1 – smoke-protected assembly seating
- §1023.11 – smokeproof enclosures

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Types of Smoke Control Systems

- 3 methods of smoke control:
  - Smoke barrier construction – can be either active or passive
  - Pressurization method – provides a differential pressure across smoke barriers. It is permitted in spr
  - Ex f large vol y with NF ' ab ke zo

- These systems are engineered for a specific building and specific purpose
- Each system will have distinct components and design
- Systems need to be commissioned and inspected in accordance with the design documents

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Smoke and Heat Removal

- Smoke and heat removal required in:
  - Group F-1 and S-1 >50,000 ft²
  - High-piled storage where required by Table 3206.2
- A smoke and heat removal can be accomplished by either:
  - Sm
  - M

Not required:
- In frozen food warehouses with Class I or II commodities
- Where ESFR sprinklers are installed
- Where CMSA sprinklers with RTI ≤50 are installed

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Smoke and Heat Removal §910

- Selection of smoke & heat removal method

Method of Smoke & Heat Removal	Sprinklered Building	Nonsprinklered Building	1st Story with Stories Above
Smoke/Heat Vents	Option 1	Required	Not allowed
Mechanical Smoke Removal	Option 2	Not allowed	Required

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Smoke/Heat Vents

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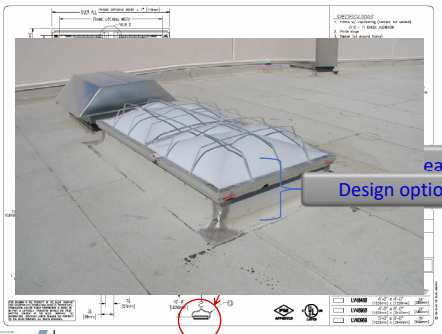
- Al
  - cc
  - sc



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Design option

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Photo courtesy of Bilco Corporation

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Smoke and Heat Removal §910

- Smoke/heat vents
  - Calculation for sprinklered building
    - A_{VR} = V/9000
  - Cal

NOTE: formula is based on volume; no longer based on floor area

- A_{VR} = the aggregate vent area required
- V = the volume of the area to be vented

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Smoke/Heat Vents

- Calculation for sprinklered building
  - 400,000 ft² warehouse
  - Ceiling/roof height = 36’
  - 400,000 x 36 = 14,400,000 ft³
  - 14,400,000 ÷ 9,000 = 1,600 ft² of vent area
  - 4’ x 8’ Smoke/heat vent = 32 ft²
  - 1,600 ÷ 32 = 50 vents

$A_{VR} = V \div 9000$

Photo courtesy of Bilco, Inc.

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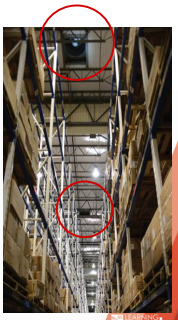
Smoke and Heat Removal §910

- Mechanical smoke removal
  - 2 air changes per hour
  - Based on empty building
  - Makeup air openings ≤6' of floor
  - Automatic shutdown upon sprinkler operation
  - Manual controls in room accessible from the exterior with 1-HR separation



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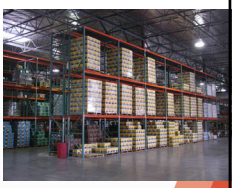
Smoke/Heat Vents

Given:

- Building area: 65,000 ft²
- Storage Height: 21'
- Ceiling Height: 27'
- High-piled Storage: Yes
- Commodity: Class IV
- Area of each smoke and heat vent: 32 ft²
- Building is sprinklered



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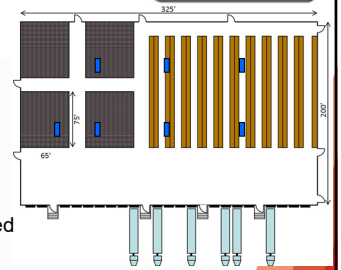
Smoke/Heat Vents

Determine smoke/heat vent requirements

$A_{VR} = V \div 9000$

- Volume = 65,000 X 27
- Volume = 1,755,000 ft³
- $A_{VR} = V \div 9000$
- $A_{VR} = 1{,}755{,}000 \div 9000$
- $A_{VR} = 195$ ft²
- Smoke/heat vent = 32 ft²
- 195 ÷ 32 = 6.09 vents
- Therefore 7 vents required

Is this design acceptable?



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Smoke/Heat Vents §910.3

- Vents listed to UL 793 or FM 4430
- Gravity drop out vents must operate after a 5-minute exposure to temperature of 500°F
- Activation temperature is not specified in the IFC
  - FM specifies that vents should be ≤100°F above the sprinkler operating temperature
- Smoke/heat vents ≥16 ft²
- Located ≥20' from property lines and ≥10' from fire barriers or fire walls

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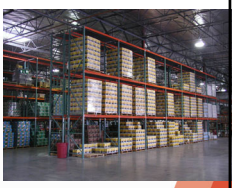
Mechanical Smoke Removal

Given:

- Building area: 65,000 ft²
- Storage Height: 21'
- Ceiling Height: 27'
- High-piled Storage: Yes
- Commodity: Class IV
- Exhaust fans rated at 30,000 CFM
- Building is sprinklered



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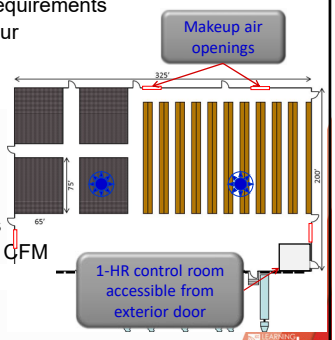
Mechanical Smoke Removal

Determine smoke/heat vent requirements
Ventilation = 2 air changes/hour

- Volume = 65,000 X 27
- Volume = 1,755,000 ft³
- CFH = 2 X 1,755,000
- CFH = 3,510,000 ft³
- CFM = 3,510,000 ÷ 60
- CFM = 58,500
- 58,500 ÷ 30,000 = 1.95 fans
- Makeup air = 8 ft² per 1,000 CFM
  293 ft² required



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Discussion Activity

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Final Reflection

Reflect on the day. What will you take back to the job and apply?

- **What?** What happened and what was observed in the training?
- **So what?** What did you learn? What difference did this training make?
- **Now what?** How will you do things differently back on the job as a result of this training?

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