2018 IFC Commercial Fire Plan Reviews

Based on the 2018 International Fire Code® (IFC®)

Rob Neale - Presenter

1

Welcome

- Instructor Introduction
- Exits
- Breaks and Schedule
- Cell Phones
- Our attendees
  - Fire code official
  - Building code official
  - Design professional

2018 IFC Commercial Plan Reviews 2

2

Description

- This course addresses numerous provisions in the 2018 International Fire Code® (IFC®) that contain requirements applicable to:
  - Construction
  - Design
  - Operations
  - Storage
  - Use and handling that occurs in an occupancy, not specifically regulated by the International Building Code® (IBC®)

2018 IFC Commercial Plan Reviews 3

3

Objectives

- After completing this seminar, participants will be better able to:
  - Employ administrative authorities and responsibilities in the IFC and perform a commercial fire plan review
  - Verify requirements affecting the building use and occupancy classification
  - Determine that fire apparatus access roads, gates, barricades, and building access indicated on the submitted plans comply
  - Determine compliance for fire protection water supply and location and distribution of hydrants

2018 IFC Commercial Plan Reviews 4

4

Objectives (cont'd)

- Apply the requirements for building services and systems as specified in IFC Ch 6; fire protection systems and equipment in IFC Ch 9; means of egress requirements in IFC Ch 10; are met on submitted commercial building plans.
- Identify those conditions where special operations require fire code plan review
- Verify requirements for storage and use of haz mat
- Verify requirements for the flammable and combustible liquids

2018 IFC Commercial Plan Reviews 5

5

Prerequisite Understanding

- Occupancy classifications are based on the use and character of the building
- Many code requirements are based on the occupancy classification
- Different uses can occur within each occupancy classification
  - Group F-1: woodworking, bakery, or aircraft manufacturing
  - Group B: office, ambulatory care facility, or commercial kitchen

2018 IFC Commercial Plan Reviews 6

6

Module 1

Document Review

7

Reading Codes and Standards

- **"Codes"** are documents that are adopted by the legal authority in your jurisdiction,
  - Establish minimum performance requirements to achieve life safety and property protection
  - Are written in "mandatory" language and tell people ***what*** must be done
- **"Standards"** are documents referenced in the codes, and tell people ***how*** to achieve what must be done

2018 IFC Commercial Plan Reviews 8

8

Always Read the Exceptions

- Unusual circumstances can have inadvertent consequences
- Rather than rewrite entire code sections, one or more ***exceptions*** to the rules may be added

IFC 2407.3 Construction of equipment. Electrodes and electrostatic atomizing heads shall be of approved construction, rigidly supported in permanent locations and effectively insulated from ground. Insulators shall be nonporous and noncombustible.

Exception: Portable electrostatic paint-spraying apparatus listed for use in Class I, Division 1, locations.

9

Always Read the Footnotes

- Many tables and graphs include footnotes
  - Requirements found in the footnotes may not exist anywhere else in the code
  - Footnotes can provide limitations, modifications or exceptions to the requirements in tables or graphs

	Light (Low) Hazard Occupancy	Ordinary (Moderate) Hazard Occupancy	Extra (High) Hazard Occupancy
Minimum rated single extinguisher	2-A[c]	2-A	4-A[a]
Maximum floor area per unit of A	3,000 square feet	1,500 square feet	1,000 square feet
Maximum floor area for extinguisher[b]	11,250 square feet	11,250 square feet	11,250 square feet
Maximum distance of travel to extinguisher	75 feet	75 feet	75 feet

a. Two 2½ gallon water-type extinguishers shall be deemed the equivalent of one 4-A rated extinguisher.
b. Annex E.3.3 of NFPA 10 provides more details concerning application of the maximum floor area criteria.
c. Two water-type extinguishers each with a 1-A rating shall be deemed the equivalent of one 2-A rated extinguisher for Light (Low) Hazard Occupancies.

10

Check for "and/or" Details

- Several requirements or conditions, divided with commas and the last item preceded with "and"
  - All of the items or conditions apply
    - For example, "The requirements shall include A, B, C and D," – then all 4 items are required
- Several requirements or conditions, divided with commas and ending with "or"
  - Any of the conditions apply
    - For example, "The requirements shall include A, B, C or D," then any of the 4 items are permissible

11

Understand that the 'Specific' Takes Precedence

- General requirements: "mechanical ventilation is required to prevent the accumulation of flammable vapors"
- Specific requirements: "provide ventilation at the rate of 1.5 cfm/ft² for basement or pit areas"

12

Plan Review Authorities & Responsibilities §104.2

- IFC gives the FCO authority to:
  - Review construction documents and issue permits
  - Enforce the codes and abate hazardous conditions
    - Perform inspections
    - Conduct investigations
    - Issue permits to regulate hazardous operations

13

Permits §105

- A permit issued by the FCO authorizes the permit holder:
  - To conduct a hazardous operation that is regulated by the fire code
  - Install or modify fire protection systems and equipment regulated by the IFC
- FCO can specify the information to be included on a fire code permit application

14

Construction Permits §105.7

- Allows the applicant to install or modify systems and equipment for which a permit is required
- 18 different construction permit types
- §105.7.1 through §105.7.18 set forth work that require construction permits

15

Permit Applications §105.2

- FCO can specify the information to be included on a fire code permit application
- Information should be complete, concise and relevant:
  - Location where the work will be performed
  - Name and contact information of the person performing the work
  - A description of the work that is being done

16

Conditions of a Construction Permit §105.3

- A construction permit is a contract between the jurisdiction and the applicant that:
  - Allows applicant to operate, perform, conduct or direct a hazardous operation, process or occupancy
  - Remains active as long as work proceeds
    - Is automatically invalid if
      - Project is not started within 180 days of issuance
      - Work is suspended or abandoned for a 180-day period after the permit has been issued

17

Conditions of a Construction Permit §105.3

- A construction permit is approval to proceed with the work.
  - Not to violate, cancel or set aside any provisions of the code
  - Even with errors or oversights in the permit approval process, code compliance is the responsibility of the permit applicant, not the FCO

18

Permit Revocation §105.5

- The FCO may revoke a permit if the:
  - Permit is used for a location or establishment other than that for which it was issued
  - Permit is used for a condition or activity other than that for which it was issued
  - Conditions and limitations established in the permit have been violated
  - Application or construction documents submitted for the permit contain false statements or misrepresentations as to the material facts

19

Permit Revocation (cont'd) §105.5

- The FCO may revoke a permit if the:
  - Permit is used by a different person or firm that the name for which it was issued
  - Permit holder failed, refused or neglected to comply with order or notices duly served in accordance with the code within the time period specified
  - Permit was issued in error or in violation of an ordinance, regulation or code

20

Construction Documents §105.4

- Permit applicants submit ≥2 sets of construction documents for review and approval
  - FCO keeps one set of documents
  - One set to be kept on site where the work is occurring
  - A 3rd set can be requested and returned to the permit applicant
- Construction documents are to be prepared by a registered design professional - such as a fire protection engineer - when required by state laws that are in effect in the jurisdiction

21

Construction Documents §105.4

- Drawings must be:
  - Prepared to a scale
  - Submitted on a suitable material, including paper or electronic media
  - Of sufficient clarity to indicate the location, nature and extent of the work proposed
  - Show in detail that it will conform to the provisions of the fire code

22

Construction Documents §105.4.4

- FCO should be assured that documents they review are approved "*with the intent that such construction documents comply in all respects with the code.*

"Review and approval by the fire code official shall not relieve the applicant of the responsibility for compliance with the code."

23

Plan Review Process Code Analysis

- Contains information that the designer used in completing the building design that is critical to the accurate review of the plans such as:
  - Codes of record and other applicable requirements & regulations
  - Name of local jurisdiction
  - Zoning information
  - Occupancy classifications
  - Occupant loads (including calculations)
  - Construction type

24

Plan Review Process (cont'd)
Code Analysis

- Building area, including area per floor, with calculations for any modifications
- Building height in stories with calculations for any modifications
- Building height in feet with calculations for any modifications
- Declaration of "separated" or "non-separated" uses
- Installation of a fire alarm
- Installation of automatic extinguishing systems

25

Technical Assistance
§104.7.2

- Plan reviewer may need technical assistance to assure compliance
  - Jurisdiction is authorized to require a "technical report" from a qualified expert
    - Costs are covered by the permit applicant
    - Jurisdiction approves the expert's suitability
    - Qualified person – engineer, specialist, laboratory or fire safety consultant

26

Modifications to Code Requirements
§104.8

- "Practical difficulties" can make strict fire code compliance impractical
  - FCO grants modifications for such individual cases, provided they comply with the purpose and intent of the code
- An approved modification is applicable to that project ONLY and is not a "precedent" that applies to all other projects

27

Alternate Materials and Methods
§104.9

- FCO can approve alternative materials or methods of construction where the:
  - Proposed design is satisfactory and complies with the intent of the provisions of the code
  - Material, method or work offered is at least the equivalent of that prescribed in the code in quality, strength, effectiveness, fire resistance, durability and safety

28

Module 2

Occupancy and Use Review

29

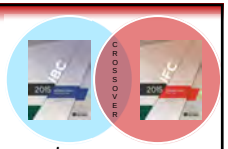
Occupancy Classifications

- The fundamental provisions for use and occupancy are outlined in IBC Ch 3 and 4
- There are occasions where there is a "crossover" in the application of the IBC and IFC

2018 IFC Commercial Plan Reviews 30

30

Occupancy Classifications



- Some situations where IFC requirements may affect the occupancy classification given to the building:
  - The maximum allowable quantity per control area of hazardous materials (MAQ)
  - The aggregate size of spray booths in an occupancy
  - The existence of combustible dusts or combustible fibers

2018 IFC Commercial Plan Reviews 31

31

Maximum Allowable Quantity per Control Area

- Use and occupancy provisions in the IBC are:
  - Based in part on the amount of hazardous materials that may be stored, used, handled, or dispensed in a building
  - Quantities are limited in Groups A, B, E, F, I, M, R, S and U
  - When the quantities are exceeded, the occupancy classification is Group H-1, H-2, H-3, H-4 or H-5

2018 IFC Commercial Plan Reviews 32

32

FOR EXAMPLE

MAQ for Indoor Storage of Flammable or Combustible Liquids

Occupancy Classification	MAQ Per Control Area Reference
Occupancies other than Group M wholesale and retail sales	Table 5003.1.1(1)
Limitations for quantities stored for demonstration, maintenance and operation of equipment	§5704.3.4.2
Group M occupancy wholesale and retail sales uses	Table 5704.3.4.1
Limitations for quantities used for demonstration, maintenance and operation of equipment	§5705.3.5.2
Storage of hazardous production material flammable and combustible liquids in Group H-5 occupancies	Ch 27

IFC 2018 IFC Commercial Plan Reviews 33

33

Reducing the Level of Hazard

- Quantities can be increased when protection schemes are used such as:
  - Flammable liquid storage cabinets
  - Exhausted enclosures
  - Control areas
  - Fire sprinkler system
  - Safety cans

Flammable liquid storage cabinet

IFC 2018 IFC Commercial Plan Reviews 34

34

Control Areas

- Control areas provide an alternative method for the handling of hazardous materials
  - Eliminates classifying the occupancy as Group H
  - Area must be separated from the remainder of the building by 1- or 2-HR fire barriers
  - Number of control areas in a building is limited by their floor level in the building

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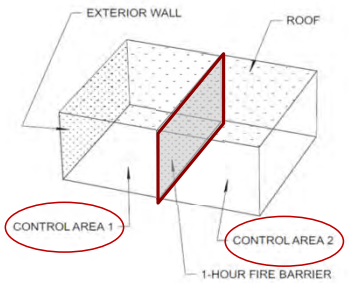
35

Control Area: Defined



- A space "within a building where quantities of haz mat not exceeding the maximum allowable quantities per control area are stored, dispensed, used or handled."

IFC 2018 IFC Commercial Plan Reviews 36

36

REFER TO CODE BOOK

Table 5704.3.4.1

IFC Table 5704.3.4.1
Maximum Allowable Quantity Per Control Area of Flammable and Combustible Liquids in Wholesale and Retail Sales Occupancies

Type of Liquid	Maximum Allowable Quantity Per Control Area (gallons)		
	Sprinklered[b] in accordance with footnote densities and arrangements	Sprinklered in accordance with Tables 5704.3.6.3(4) through 5704.3.6.3(8) and Table 5704.3.7.5.1	Nonsprinklered
Class IA	60	60	30
Class IB, IC, II and IIIA	7,500[c]	15,000[c]	1,600
Class IIIB	Unlimited	Unlimited	13,200

a. Control areas shall be separated from each other by not less than a 1-HR fire barrier.
b. To be considered as sprinklered, a building shall be equipped throughout with an approved automatic sprinkler system with a design providing minimum densities as follows:
   1. For uncartoned commodities on shelves ≤6' in height where the ceiling height does ≤18', quantities are those allowed with a minimum sprinkler design density of Ordinary Hazard Group 2.
   2. For cartoned, palletized or racked commodities where storage is ≤4'-6" in height and where the ceiling height does ≤18', quantities are those allowed with a minimum sprinkler design density of 0.21 gallon per minute per square foot over the most remote 1,500-square-foot area.
c. Where wholesale and retail sales or storage areas >50,000 ft² in area, the maximum allowable quantities are allowed to be increased by 2% for each 1,000 ft² of area in excess of 50,000 ft², up to not more than 100% of the table amounts. A control area separation is not required. The cumulative amounts, including amounts attained by having an additional control area, shall not exceed 30,000 gallons.

37

Nonsprinklered Buildings

- Mercantile occupancy – Table 5704.3.4.1

TYPE OF LIQUID	MAXIMUM ALLOWABLE QUANTITY PER CONTROL AREA (gallons)		
	Sprinklered[b] in accordance with footnote densities and arrangements	Sprinklered in accordance with Tables 5704.3.6.3(4) through 5704.3.6.3(8) and Table 5704.3.7.5.1	Nonsprinklered
Class IA	60	60	30
Class IB, IC, II and IIIA	7,500[c]	15,000[c]	1,600
Class IIIB	Unlimited	Unlimited	13,200

- Other occupancies – Table 5003.1.1(1)

Material	Class	Group When The Maximum Allowable Quantity Is Exceeded	Storage[b]			Use-closed Systems[b]			Use-open Systems[b]	
			Solid pounds (cubic feet)	Liquid gallons (pounds)	Gas (cubic feet at NTP)	Solid pounds (cubic feet)	Liquid gallons (pounds)	Gas (cubic feet at NTP)	Solid pounds (cubic feet)	Liquid gallons (pounds)
Flammable liquid[c]	IA IB and IC	H-2 or H-3	NA	30[d,e] 120[d,e]	NA	NA	30[d] 120[d]	NA	NA	10[d] 30[d]
Flammable Liquid, combination (1A, 1B, 1C)	NA	H-2 or H-3	NA	120[d,e,h]	NA	NA	120[d,h]	NA	NA	30[d,h]

38

Sprinklered Building

TYPE OF LIQUID	MAXIMUM ALLOWABLE QUANTITY PER CONTROL AREA (gallons)		
	Sprinklered[b] in accordance with footnote densities and arrangements	Sprinklered in accordance with Tables 5704.3.6.3(4) through 5704.3.6.3(8) and Table 5704.3.7.5.1	Nonsprinklered
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39

CASE STUDY

Case Study 1
Flammable Liquid MAQ

- A small neighborhood office building has a sprinkler system that was designed as a Light Hazard
- The office building was issued a C of O for Group B
- The office tenant moves out, and a small paint store moves into the space and the new tenant knows that a new C of O is required for the mercantile use
- The new tenant completes a building department permit application and discloses that the store will carry 1,700 gallons of Class IB flammable paints, thinners and related solvents
- The products will not be removed from the shipping cartons and displayed on shelves <6' high

40

Case Study 1
Flammable Liquid MAQ

- As is routine in this jurisdiction, the permit application is routed to the FCO for review and comment
- What is the occupancy classification for the new tenant?

41

Case Study 1
Flammable Liquid MAQ

TABLE 5704.3.4.1
MAXIMUM ALLOWABLE QUANTITY PER CONTROL AREA OF
FLAMMABLE AND COMBUSTIBLE LIQUIDS IN WHOLESALE AND RETAIL SALES OCCUPANCIES[a]

TYPE OF LIQUID	MAXIMUM ALLOWABLE QUANTITY PER CONTROL AREA (gallons)		
	Sprinklered[b] in accordance with footnote densities and arrangements	Sprinklered in accordance with Tables 5704.3.6.3(4) through 5704.3.6.3(8) and Table 5704.3.7.5.1	Nonsprinklered
Class IA	60	60	30
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42

Case Study 1
Flammable Liquid MAQ

- What is the occupancy classification of for the new tenant?

Group H-3

- The sprinkler system design does not meet the minimum requirements described in Table 5704.3.4.1 Footnote b
- Therefore, this building is considered "nonsprinklered" for the purposes of MAQ in Table 5704.3.4.1

Other option: 2 control areas with maximum of 1,600 gallons each

43

Application of Flammable Finishes

- Spray operations can occur in:

Spray Room
- Constructed room
- Required in Group A, E, I & R
- 1-HR separation
- Fire sprinkler system
- Mechanical ventilation
- Size limited to IBC Table 506.2

Spray Booth
- Appliance
- Allowed in all other occupancies
- Noncombustible construction & ≥3' clear space
- Fire-extinguishing system
- Mechanical ventilation
- ≤1500 ft²

Spraying Space
- Designated area
- Limited to 9 ft²/job
- Ventilation required
- Control of ignition sources

44

Spray Room §2404.3.1, IBC §416

- IBC §307.1.1, Exception 1 states that a spray room will not be classified as an H occupancy provided it complies with the IFC
  - Ventilation
  - Spray operation interlocks
  - Fire extinguishing system
  - Control of ignition sources
  - Lighting
  - Electrical
  - Separation to remainder of building

45

Spray Booth §2404.3.2

- A mechanically ventilated appliance of varying dimensions and construction provided to enclose or accommodate a spraying operation and to confine and limit the escape of spray vapor and residue and to exhaust it safely
  - Open face booth, or
  - Enclosed booth

46

Spray Booth Area Limits

- The aggregate area of spray booths in a building shall not exceed the lesser of:
  - 10% of the area of the floor where it is located, ***OR***
  - The tabular area allowed for a Group H-2 without area increases
- Each individual spray booth shall not exceed the lesser of:
  - The aggregate size limit, ***OR***
  - 1,500 ft²

Exception: where only 1 spray booth, and it is ≤500 ft²

47

FOR EXAMPLE

Spray Booth Area Limits

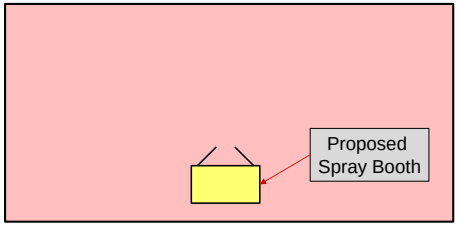
PDQ FABRICATOR

- PDQ Fabricator, is an industrial occupancy that fabricates and assembles assorted metal products
  - IBC Ch 3, would show that PDQ should be classified as a Group F-2
- The owner/operator wants to enhance the operation by spray finishing metal products before they are shipped out
- Would adding a single, small spray booth in this occupancy make a difference to the occupancy classification?

48

Spray Booth Area Limits

- PDQ Fabricator occupies a building that is:
  - Type IIB construction
  - 46,000 ft²



49

Spray Booth Area Limits

- **Aggregate Spray Booth Area**
  - Determine 10% of floor area:
    - 10% x 46,000 ft² = 4,600 ft²
  - Determine tabular area for Group H-2 (IBC Table 506.2)
    - 7,000 ft²
  - Aggregate area = 4,600 ft²

Table 506.2 [a,b]
Allowable Area Factor (A_t = NS, S1, S13R, or SM, … Feet

Occupancy Classification	Type of Construction										
	See Footnotes	Type I		Type II		Type III		Type IV	Type V	
		A	B	A	B	A	B	HT	A	B
H-2	NS									
	S1	21,000	16,5…							…,000
	SM									

Maximum spray booth size = 1,500 ft²

50

Spray Booth Area

- When is the occupancy no longer a Group F-2?
- When does it become a Group H?
  - It doesn't become Group H, but spray booths are limited
  - If spray booth size is exceeded, then spray "booths" are not allowed, spray rooms must be constructed

51

What is "Combustible Dust"? §202

- Finely divided solid material which is 420 microns or less in diameter and which, when dispersed in air in the proper proportions, could be ignited by a flame, spark or other source of ignition
- Combustible dust will pass through a U.S. No. 40 standard sieve

52

What is "Combustible Fiber"? §202

- Readily ignitable and free-burning materials in a fibrous or shredded form, such as cocoa fiber, cloth, cotton, excelsior, hay, hemp, henequen, istle, jute, kapok, oakum, rags, sisal, Spanish moss, straw, tow, wastepaper, certain synthetic fibers or other like materials
- Does not include densely packed baled cotton

53

Combustible Dusts and Fibers Table 5003.1.1(1), Footnote q

- Any combustible material (and some materials normally considered noncombustible) can burn rapidly when in a finely divided form
- When such a dust or fiber is suspended in air in the right concentration, it can become explosive
- Facilities that manufacture, generate, or use combustible dust or combustible fibers are required to provide a technical report

54

Identifying Common Dust Explosion Hazards

- Often, the appearance of combustible dust-producing operations may not be evident until a business if operational
- The technical report is to be developed by a qualified person and should include:
  - Identification of the hazard
  - Assessment of the risk
  - Recommendations for protection or mitigation strategies

55

REFER TO CODE BOOK

Table 2204.1

Table 2204.1 Explosion Protection Standards

Standard	Subject
NFPA 61	Standard for the Prevention of Fires and Dust Explosions in Agricultural and Food Processing Facilities
NFPA 69	Standard on Explosion Prevention Systems
NFPA 70	National Electrical Code
NFPA 85	Boiler and Combustion System Hazards Code
NFPA 120	Standard for Fire Prevention and Control in Coal Mines
NFPA 484	Standard for Combustible Metals
NFPA 654	Manufacturing, Processing and Handling of Combustible Particulate Solids
NFPA 655	Standard for the Prevention of Sulfur Fires and Explosions
NFPA 664	Standard for the Prevention of Fires and Explosions in Wood Processing and Woodworking Facilities

56

Module 3

Building Site and Access Review

57

What are Fire Apparatus Access Roads?

- An approved driving surface that provides fire apparatus access from a fire station to and around a facility, building or portions of them
  - The term includes fire lanes, public and private streets, parking lots, lanes, driveways and access roadways
- Need not be intended for other vehicular traffic

2018 IFC Commercial Plan Reviews 58

58

Fire Apparatus Specs

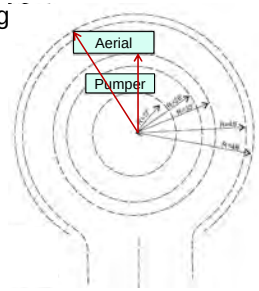
- **Gross Vehicle Weight –** GVW includes the total weight of the apparatus, fuel, water, equipment and personnel
  - Apparatus manufacturer can supply the factory weight
  - Certified truck scale will provide an accurate aftermarket weight
- **Axle weight –** the GVW is distributed between the front axle and the rear axle(s)
  - The weight distributed on the front axle is typically less than the rear

2018 IFC Commercial Plan Reviews 59

59

Turning Radius

- **Outside –** ½ the diameter of the smallest circle within which a turning vehicle can complete a U-turn, measured from the center of the circle to the side of apparatus furthest from the center of the circle
- **Inside –** ½ the diameter of the smallest circle around which a turning vehicle can complete a U-turn, measured from the center of the circle to the side of apparatus closest to the center of the circle

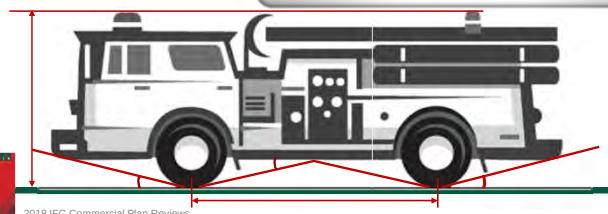


2018 IFC Commercial Plan Reviews 60

60

Fire Apparatus Specs

- **Angle of Departure** — angle between the ground and a line
- **Angle of Approach** — angle between the ground and a line
- **Breakover Angle** — maximum angle a vehicle can drive over a ridge or bump without striking or
- **Wheelbase**
- **Vehicle Height** — Measurement from the road surface to the tallest object on the apparatus: light bar, aerial platform, tiller cab, deck gun, etc



2018 IFC Commercial Plan Reviews 61

61

Fire Apparatus Specs

- **Grade Capacity** — ability to travel a particular grade at a specific speed

2018 IFC Commercial Plan Reviews 62

62

Fire Apparatus Access Roads – Requirements During Construction

- Installed and made serviceable prior to and during time of construction
  - Provided to ≤100' of temporary or permanent FDCs
  - Adequate condition to provide emergency access while a building or facility is under construction
  - Maintained until the permanent fire apparatus access roads are provided

2018 IFC Commercial Plan Reviews 63

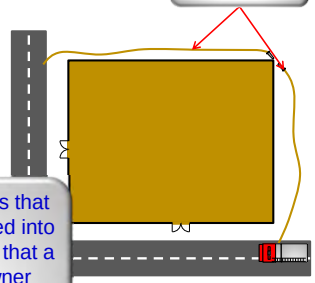
63

Fire Apparatus Access Roads §503.1.1

- Fire apparatus access roads are required for any facility, building or portion of a building constructed or moved into the jurisdiction
  - Located ≤15 of the facilit exterior wal of the buildi by an approved route

"Moved into" means that the *building* is moved into the jurisdiction; ***not*** that a new tenant or owner moved into the building

150' attack hose lines



2018 IFC Commercial Plan Reviews 64

64

Distance Between Road And Structure §503.1.1, Exceptions

- The FCO may permit longer distances between the roads and structures when:
  - Building is the building is equipped throughout with an NFPA 13, 13R or 13D fire sprinkler system
  - Road y, or simil protection are provided, or
  - The site does not include more than two single family dwellings
- FCO can approve the modification or elimination of access roads for solar PV facilities

§3206.6 does not allow this exception based on sprinklers for high-piled storage facilities

65

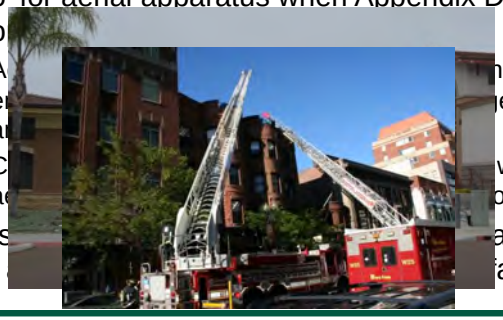
Fire Apparatus Access Roads §503.1.2

- More than one access road may be required if there is potential for impairment of single road by
  - Vehicle congestion
  - Conditions or terrain
  - Other factors that could limit access

66

Fire Apparatus Access Road Specs

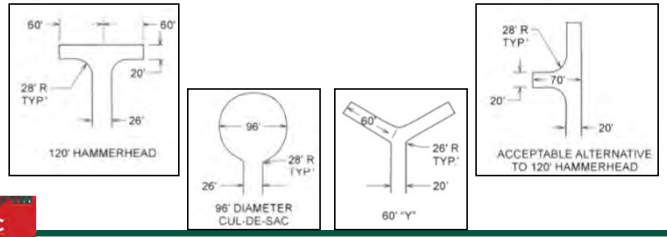
- Width ≥20'
- ≥26' for aerial apparatus when Appendix D is ado
  - A n ≥1 e e ≥15' a
  - C with the a ock
- Mus aviest fire ace



67

Dead Ends – Turnarounds

- Access roads in >150' in length require approved turn around for fire apparatus
- Size and shape of the turnaround is contingent on local needs and conditions



68

Bridges and Elevated Surfaces §503.2.6

- Where used to provide access to a building, bridges and elevated surfaces must be engineered in accordance with the American Association of State Highway and Transportation Officials standard HB-17 "Specification for Highway Bridges"

Where elevated surfaces designed for emergency vehicle use are located adjacent to surfaces not designed for vehicle use, an approved barrier or sign shall be provided when required by the FCO

2018 IFC Commercial Plan Reviews 69

69

Grade

- FCO can establish the maximum permissible grade for fire apparatus access roads
  - When Appendix D is adopted, §D103.2 specifies a maximum grade of 10% unless the fire chief approves of a steeper grade

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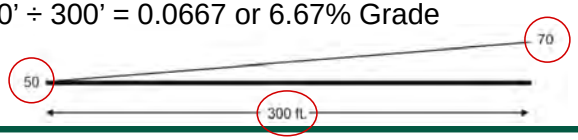
70

FOR EXAMPLE

Grade in Percent

- Grade = Rise/Run
- Determine Rise
  - Ending elevation of 70' – Starting elevation of 50' = Rise of 20'
- Determine Run
  - Measured linear distance along the driving surface = 300'
- 20' ÷ 300' = 0.0667 or 6.67% Grade



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71

Marking and Identification §503.3

- Designated fire apparatus access roads – especially fire lanes – should be clearly identified to prohibit obstructions including parked cars
- When Appendix D is adopted, signs shall have a minimum dimension of 12" wide by 18" high and have red letters on a white reflective background

2018 IFC Commercial Plan Reviews 72

72

Security Gates §503.6

- If security gates are provided across a fire apparatus access road, they must be approved by the fire chief to assure approval for issues like:
  - Clear opening width
  - Means for emergency operation
    - Manual override
    - Manual operation
    - Key box with switch or key

73

Security Gates §503.6

- Gate components shall be maintained in an operative condition at all times and replaced or repaired when defective
- Electric gate operators listed to UL 325
- Automatic gates must comply with ASTM F2200

74

Additional Security Gate Requirements – Appendix D, §D103.5

- Security gates across fire apparatus access roads must be ≥20' wide
  - For divided roadways, ≥12' wide
- Gates shall be of the swinging or sliding type
- Construction of gates shall be of materials that allow manual operation by one person

75

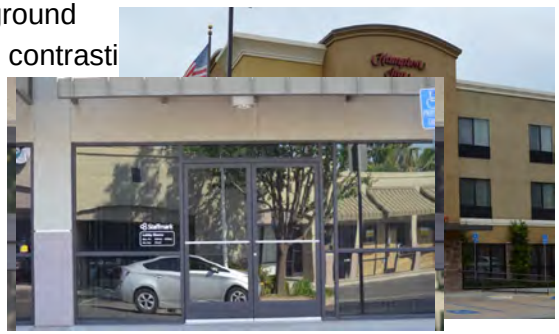
Premises Identification §504.3

- Address must legible and visible from the street fronting the property
- Characters must be ≥4" high with ½" stroke
- Where required by FCO, address identification shall be provided in additional locations
  - Multiple buildings on a site
  - Buildings located far from street access

76

Premises Identification §504.3

- Address characters must have contrasting background
- Is this contrasti



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77

Fire Department Building Access §504.1

- FCO can require an access walkway leading from fire apparatus access roads to exterior openings
  - Exterior doors or windows that are required for either occupant egress or firefighter access
- ≥1 stairway to the roof in new buildings with ≥4 stories, unless they have a roof slope is >4:12
  - Stairway must have a sign at the street level and each floor indicating that it is continuous to the roof

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78

Fire Department Building Access §506

- FCO can require key boxes in approved locations
  - Where access is restricted because of secured openings, ***or***
  - Immediate access is necessary for life-saving or fire-fighting purposes
  - Listed to UL 1037
- Locks on gates or other barricades must be approved where they obstruct access

2018 IFC Commercial Plan Reviews 79

79

Module 4

Water Supply Review

80

Fire Flow §507.1

- An approved water supply capable of supplying the required fire flow for fire protection shall be provided to premises upon which facilities, buildings or portions of buildings are hereafter constructed or moved into or within the jurisdiction

81

Fire Flow - Defined

- Appendix B, §B102.1 defines fire flow
  - Flow rate of a water supply, measured at 20 PSI residual pressure, that is available for manual fire-fighting
  - Flow rate is the volume of water measured in gallons per minute

82

Fire Flow

- Plan reviewer's objective is to effectively provide enough water at the right location for the FFs to extinguish the fire
- Factors to consider:
  - Building construction type
  - Building Size
  - Percentage of involvement
  - Automatic fire-extinguishing systems
  - Fire load inside the building
  - Fire load outside the building

83

Appendix B Fire-Flow Requirements for Buildings

- There is no single "correct" method for establishing fire flow
- When adopted, Appendix B can be used to establish fire flow requirements
  - Tables B105.1(1) and B105.2 specify how to use Table B105.1(2)
  - Table B105.1(2) establishes base fire flow requirements based upon construction type and total floor area of the building

84

Appendix B
Modifications to Calculated Fire-Flow

- Fire-flow can be reduced for isolated buildings or a group of buildings in rural areas or small communities where the development of full fire-flow requirements is impractical
- Fire-flow can be increased up to 100% where conditions indicate an unusual susceptibility to group fires or conflagrations
- Areas without water supply systems:
  - NFPA 1142, Standard on Water Supplies for Suburban and Rural Firefighting
  - International Wildland-Urban Interface Code

85

Fire-Flow Requirements for Buildings §B105

Table B105.1(1)
Required Fire-flow for 1- and 2-family Dwellings, Group R-3 and R-4 Buildings and Townhouses

FIRE-FLOW CALCLUATION AREA (square feet)	AUTOMATIC SPRINKLER SYSTEM (Design Standard)	MINIMUM FIRE-FLOW (gallons per minute)	FLOW DURATION (hours)
0 - 3,600	No automatic sprinkler system	1,000	1
3,601 - greater	No automatic sprinkler system	Value in Table B105.1(2)	Duration in Table B105.1(2) at the required fire-flow rate
0 - 3,600	§903.3.1.3 of the IFC or §P2904 of the IRC	500	½
3,601 - greater	§903.3.1.3 of the IFC or §P2904 of the IRC	½ value in Table B105.1(2)	1

86

Fire-Flow Requirements for Buildings §B105

Table B105.2
Required Fire-flow for Buildings Other Than 1- and 2-family Dwellings, Group R-3 and R-4 Buildings and Townhouses

AUTOMATIC SPRINKLER SYSTEM (Design Standard)	MINIMUM FIRE-FLOW (gallons per minute)	FLOW DURATION (hours)
No automatic sprinkler system	Value in Table B105.1(2)	Duration in Table B105.1(2)
Section 903.3.1.1	25% of the value in Table B105.1(2)[a]	Duration in Table B105.1(2) at reduced flow rate
Section 903.3.1.2	25% of the value in Table B105.1(2)[b]	Duration in Table B105.1(2) at reduced flow rate

a. Reduced fire-flow shall be not less than 1,000 gpm.

b. Reduced fire-flow shall be not less than 1,500 gpm.

87

Fire-Flow Requirements for Buildings §B105

Table B105.1(2)
Reference Table for Tables B105.1(1) and B105.2

Fire-flow Calculation Area (square feet)					Fire-flow (gallons per minute)[b]	Flow Duration (hours)
Type IA and IB[a]	Type IIA and IIIA[a]	Type IV and V-A[a]	Type IIB and IIIB[a]	Type V-B[a]		
0-22,700	0-12,700	0-8,200	0-5,900	0-3,600	1,500	2
22,701-30,[illegible]	[illegible]	[illegible]	5,901-7,900	3,601-4,800	1,750	
30,201-38,[illegible]	[illegible]	[illegible]	7,901-9,800	4,801-6,200	2,000	
38,701-48,[illegible]	[illegible]	[illegible]	9,801-12,600	6,201-7,700	2,250	
48,301-59,[illegible]	[illegible]	[illegible]	12,601-15,400	7,701-9,400	2,500	
59,001-70,[illegible]	[illegible]	[illegible]	15,401-18,400	9,401-11,300	2,750	
70,901-83,[illegible]	[illegible]	[illegible]	18,401-21,800	11,301-13,400	3,000	3
83,701-97,[illegible]	[illegible]	[illegible]	21,801-25,900	13,401-15,600	3,250	
97,701-1[illegible]	[illegible]	[illegible]	25,901-29,300	15,601-18,000	3,500	
112,701-[illegible]	[illegible]	[illegible]	29,301-33,500	18,001-20,600	3,750	
128,701-[illegible]	[illegible]	[illegible]	33,501-37,900	20,601-23,300	4,000	4
145,901-164,2[illegible]	[illegible]	[illegible]	37,901-42,700	23,301-26,300	4,250	
164,201-183,4[illegible]	[illegible]	[illegible]	42,701-47,700	26,301-29,300	4,500	
183,401-203,7[illegible]	[illegible]	[illegible]	47,701-53,000	29,301-32,600	4,750	
203,701-225,2[illegible]	[illegible]	[illegible]	53,001-58,600	32,601-36,000	5,000	
225,201-247,7[illegible]	[illegible]	[illegible]	58,601-65,400	36,001-39,600	5,250	
247,701-271,200	139,401-152,600	89,201-97,700	65,401-70,600	39,601-43,400	5,500	
271,201-295,900	152,601-166,500	97,701-106,500	70,601-77,000	43,401-47,400	5,750	
295,901-Greater	166,501-Greater	106,501-115,800	77,001-83,700	47,401-51,500	6,000	
—	—	115,801-125,500	83,701-90,600	51,501-55,700	6,250	

For example:
Type IIB building
82,000 ft²
Sprinklered

Sprinklered per NFPA 13

25% = 1500 GPM

Duration = 2 hours

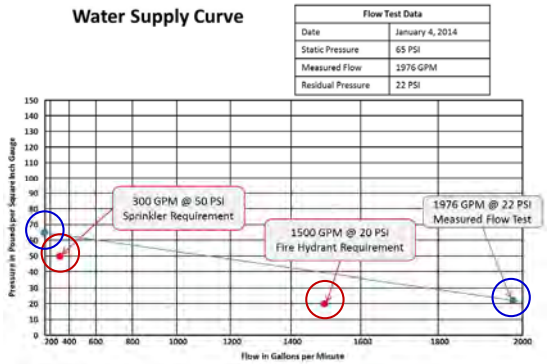
88

Fire-Flow Requirements for Buildings §B105.3

- Example: Required water supply for sprinklered buildings shall meet:
  - Sprinkler demand with hose — 300 GPM @ 50 PSI
  - Required fire-flow — 1,500 GPM @ 20 PSI
- Water system must be adequate for both flows, but not at the same time

89

Fire-Flow Requirements for Buildings §B105



90

FOR EXAMPLE

Fire-flow Example 1

- What is the required fire-flow in gallons per minute for a one-story, sprinklered Group M of Type IIIB construction with a floor area of 19,200 ft²
- Table B105.2

AUTOMATIC SPRINKLER SYSTEM	MINIMUM FIRE-FLOW			FLOW DURATION		
Fire-flow Calculation Area (square feet)					Fire-flow (gallons per minute) [b]	Flow Duration (hours)
Type IA and IB [a]	Type IIA and IIIA [a]	Type IV and V-A [a]	Type IIB and IIIB [a]	Type V-B [a]		
0-22,700	0-12,700	0-8,200	0-5,900	0-3,600	1,500	2
22,701-30,200	12,701-17,000	8,201-10,900	5,901-7,900	3,601-4,800	1,750	
30,201-38,700	17,001-21,800	10,901-12,900	7,901-9,800	4,801-6,200	2,000	
38,701-48,300	21,801-24,200	12,901-17,400	9,801-12,600	6,201-7,700	2,250	
48,301-59,000	24,201-33,200	17,401-21,300	12,601-15,400	7,701-9,400	2,500	
59,001-70,900	33,201-39,700	21,301-25,500	15,401-18,400	9,401-11,300	2,750	
70,901-83,700	39,701-47,100	25,501-30,100	18,401-21,800	11,301-13,400	3,000	3
83,701-97,700	47,101-54,900	30,101-35,200	21,801-25,900	13,401-15,600	3,250	
97,701-112,700	54,901-63,400	35,201-40,600	25,901-29,300	15,601-18,000	3,500	

91

Fire Hydrant Locations §507.5.1

- Where a portion of the facility or building >400' from a hydrant on a fire apparatus access road, as measured by an approved route around the exterior of the facility or building, on-site fire hydrants and mains shall be provided where required by the FCO
  - Exception for Group R-3 and U
  - Buildings sprinklered with NFPA 13 or 13R can be 600'

92

Fire Hydrant Locations
Appendix C

Table C102.1
Required Number and Spacing of Fire Hydrants

Fire-flow Requirement (gpm)	Minimum Number of Hydrants	Average Spacing Between Hydrants[a,b,c,f,g] (feet)	Maximum Distance from any Point on Street or Road Frontage to a Hydrant[d,f,g]
1,750 or less	1	500	250
2,000-2,250	2	450	225
2,500	3	450	225
3,000	3	400	225
3,500-4,000	4	350	210
4,500-5,000	5	300	180
5,500	6	300	180
6,000	6	250	150
6,500-7,000	7	250	150
7,500 or more	8 or more[e]	200	120

a. Reduce by 100' feet for dead-end streets
b. Where streets are provided with median dividers that cannot be crossed by fire fighters pulling hose lines, or where arterial streets are provided with ≥4 traffic lanes and have a traffic count of >30,000 vehicles per day, hydrant spacing shall average 500' on each side of the street and be arranged on an alternating basis
c. Where new water mains are extended along streets where hydrants are not needed for protection of structures or similar fire problems, fire hydrants shall be provided at spacing ≥1,000' to provide for transportation hazards
d. Reduce by 50' for dead-end streets
e. 1 hydrant for each 1,000 gallons per minute or fraction thereof
f. 50%percent spacing increase shall be permitted where the building is sprinklered with NFPA 13
g. 25% spacing increase shall be permitted where the building is sprinklered NFPA 13, 13R or IRC

93

93

FOR EXAMPLE

Table C105.1

- Given a required fire flow of 4,500 gpm, what is the minimum number of hydrants, the average spacing between hydrants, and the maximum distance from any point on a street or road frontage to a hydrant?

Fire-flow Requirement (gpm)	Minimum Number of Hydrants	Average Spacing Between Hydrants[a,b,c,f,g] (feet)	Maximum Distance from any Point on Street or Road Frontage to a Hydrant[d,f,g]
1,750 or less	1	500	250
2,000-2,250	2	450	225
2,500	3	450	225
3,000	3	400	225
3,500-4,000	4	350	210
4,500-5,000	5	300	180
5,500	6	300	180
6,000	6	250	150
6,500-7,000	7	250	150
7,500 or more	8 or more[e]	200	120

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94

Hydrant Access

- Plan examiners should ensure that fire hydrants are accessible
  - ≥3' cle d the circum wise approv

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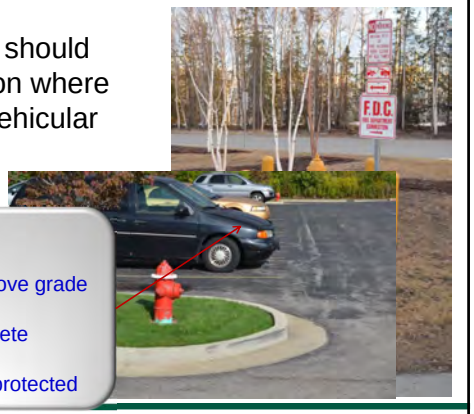
95

Hydrant Access

- Plan examiners should require protection where susceptible to vehicular damage
  - Guard posts



- ≥4" diameter
- Schedule 40
- 3' below & 3' above grade
- Set in concrete
- Filled with concrete
- ≤4' apart
- ≥3' from object protected

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96

97

Building Services and Systems Ch 6

- Requirements for building services and systems:
  - Fuel-fired appliances – §603
  - Emergency and standby power systems – §604
  - Electrical equipment, wiring and hazards – §605
  - Mechanical refrigeration – §606
  - Elevator recall and maintenance – §607
  - Stationary storage battery systems – §608
  - Commercial kitchen hoods – §609

98

Outdoor Fuel Oil Storage Tanks Location

- Tanks <275 gallons – minimum of 5' from adjacent building
- Tanks ≥275 and ≤660 gallons – minimum of 10' from adjacent building
- Tanks >660 gallons – comply with Chapter 57 and NFPA 30

99

Indoor Fuel Oil Storage Tanks

- The aggregate capacity of all tanks is limited to 660 gallons
  - Can be increased to 3,000 gallons ***IF***:
    - Fuel oil quantity is stored in protected aboveground tanks
    - Tanks are located in a room protected by an NFPA 13 sprinkler system
- Indoor storage of more than 3,000 gallons must meet the requirements of IFC Ch 57 and the IBC

100

Incinerators §603.8

- Commercial, industrial and residential-type incinerators must be constructed in accordance with IBC, IFGC and IMC
  - Incinerators must be equipped with an approved spark arrestor

101

Emergency and Standby Power §604

- IFC and IBC require emergency and standby power where an interruption to the normal power supply might adversely effect:
  - Life safety
  - Safety of emergency responders
  - Safety of certain industrial processes that are sensitive to electrical power interruption

102

Emergency and Standby Power §604

- Distinctions between certain key terms are essential for the fire plan examiner to understand and apply:
  - Differences between “emergency” and “standby” power
  - Differences between “legally required” systems and “optional” systems

103

Emergency and Standby Power §604

- Secondary power
  - Generic term that refers to a “second source” of power
  - Could be emergency power or standby power
- Emergency power
  - C
  - F
- Sta
  - Operates automatically within 60 seconds
  - Provides power for at least 120 minutes

Legally required systems are those systems mandated by the building or fire codes or other rules and regulations

104

Emergency Power Systems

- Adequate capacity and rating for all loads to be operated at the same time
- Methods of supplying emergency power source:
  - Battery systems
  - Fuel-fired generator sets
  - A separate power service wired into the building
  - Uninterruptible Power Supplies (UPS)
  - Fuel cells

105

Emergency Power vs Standby Power

Emergency Power	Standby Power
Emergency alarm systems	Elevator and platform lifts
Emergency voice/alarm communication systems	Emergency responder radio coverage systems
Exit signs	Hazardous materials when required in §5004.7 or §5001.5
Essential electrical systems in Group I-2 occupancies	Organic peroxides where required by §6204.1.11
Power operated doors in Group I-3 occupancies	High-rise buildings, depending on application
Highly toxic or toxic gas where required by §6004.2.2.8 or §6004.3.4.2	Horizontal sliding doors
High-rise buildings, depending on application	Hydrogen fuel gas rooms
Means of egress illumination	Permanent membrane structures where required by IBC §3102.8.2
Pyrophoric materials	Temporary air-supported or air-inflated structures where required by §3103.10.4
Semiconductor fabrication facilities	Smoke control systems
Underground buildings, depending on application	Underground buildings, depending on application

106

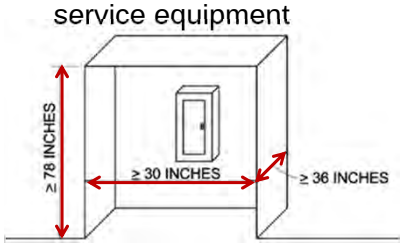
Standby Power Systems

- Legally required standby power source shall be permitted to supply both legally required standby and optional standby system loads under either of the following conditions:
  - Where the power source has adequate capacity to handle all connected loads
  - Where automatic selective load pickup and load shedding is provided that will ensure adequate power to the legally required standby circuits

107

Electrical Equipment – Working Space §605.3

- Working space of ≥30” wide, ≥36” deep and ≥78” high must be provided in front of electrical service equipment



Where the electrical service is wider than 30”, the clear space must be at least equal to the service width

108

Electrical Room §605.3.1

- Doors into electrical control panel rooms are marked with a plainly visible and legible sign stating ELECTRICAL ROOM or similar approved wording
- Disconnects must be labeled

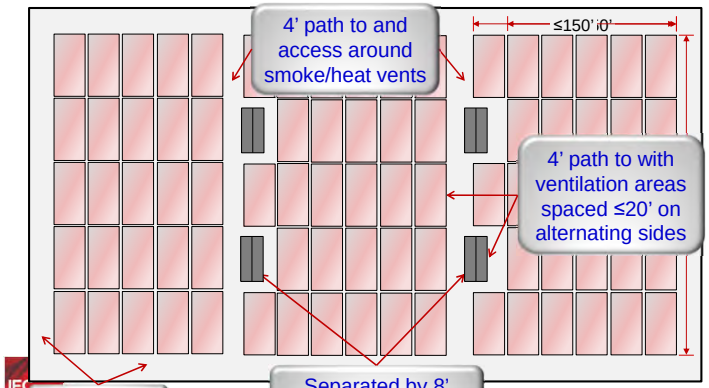
109

Solar PV Power Systems §605.11

- Solar PV power systems on building roofs can affect fire-fighting operations
- Size of PV array:
  - Maximum 22,500 ft²
  - Maximum dimension of 150'
- Clear space around panel array to provide fire fighter walkways:
  - 3' wide for residential buildings
  - 6' wide for commercial buildings

110

Solar PV Power Systems §605.11.1.3



111

Mechanical Refrigeration

- Refrigeration systems vaporize and liquefy fluids during the refrigerating cycle
  - Fluids can be toxic, flammable, corrosive or have a combinati
  - Refrigerants are classified in IMC

Propane – classified as A3

Toxicity Classification	Relative Toxicity
A	Lower toxicity refrigerants for which toxicity has not been identified at concentrations ≤400 ppm
B	Higher toxicity refrigerants for which there is evidence of toxicity at concentrations <400 ppm

Flammability Classification	Relative Flammability
1	Refrigerant will not propagate a flame under normal conditions in open air
2	Refrigerant may propagate a flame under certain conditions in open air
3	Refrigerant is highly flammable

Ammonia – classified as B2

112

IMC Table 1103.1 Refrigerant Classification, Amount and OEL

[F] TABLE 1103.1—continued
REFRIGERANT CLASSIFICATION, AMOUNT AND OEL

CHEMICAL REFRIGERANT	FORMULA	CHEMICAL NAME OR BLEND	REFRIGERANT CLASSIFICATION	DEGREES OF HAZARD[a]	[M] AMOUNT OF REFRIGERANT PER OCCUPIED SPACE			
					Pounds per 1,000 cubic feet	ppm	g/m³	OEL[e]
R-500[d]	azeotrope	R-12/152a (73.8/26.2)	A1	2-0-0[b]	7.6	30,000	120	1,000
R-501[d]	azeotrope	R-22/12 (75.0/25.0)	A1	—	13	54,000	210	1,000
R-502[d]	azeotrope	R-22/115 (48.8/51.2)	A1	2-0-0[b]	21	73,000	330	1,000
R-503[d]	azeotrope	R-23/13 (40.1/59.9)	—	2-0-0[b]	—	—	—	1,000
R-504[d]	azeotrope	R-32/115 (48.2/51.8)	—	—	29	140,000	460	1,000
R-507A	azeotrope	R-125/143a (50/50)	A1	2-0-0[b]	32	130,000	520	1,000
R-508A	azeotrope	R-23/116 (39/61)	A1	2-0-0[b]	14	55,000	220	1,000
R-508B	azeotrope	R-23/116 (46/54)	A1	2-0-0[b]	13	52,000	200	1,000
R-509A	azeotrope	R-22/218 (44/56)	A1	2-0-0[b]	24	75,000	390	1,000
R-510A	azeotrope	R-E170/600a (88.0/12.0)	A3	—	0.87	7,200	14	1,000
R-600	$CH_3CH_2CH_2CH_3$	butane	A3	1-4-0	0.1	1,000	2.4	1,000
R-600a	$CH(CH_3)_2\text{-}CH_3$	isobutane (2-methyl propane)	A3	2-4-0	0.6	4,000	9.6	800
R-601a	$(CH_3)_2CHCH_2CH_3$	isopentane	A3	—	0.2	1,000	2.9	600
R-717	NH_3	ammonia	B2	3-3-0[c]	0.014	320	0.22	25
R-718	H_2O	water	A1	0-0-0	—	—	—	—
R-744	CO_2	carbon dioxide	A1	2-0-0[b]	4.5	40,000	72	5,000
R-1150	$CH_2{=}CH_2$	ethene (ethylene)	A3	1-4-2	—	—	—	200
R-1270	$CH_3CH{=}CH_2$	Propene (propylene)	A3	1-4-1	0.1	1,000	1.7	500

For SI: 1 pound = 0.454 kg, 1 cubic foot = 0.0283 m³.
a. Degrees of hazard are for health, fire, and reactivity, respectively, in accordance with NFPA 704.
b. Reduction to 1-0-0 is allowed if analysis satisfactory to the code official shows that the maximum concentration for a rupture or full loss of refrigerant charge would not exceed the IDLH, considering both other risks and quantity and room volume.
c. For installations that are entirely outdoors, use 3-1-0.
d. Class I ozone-depleting substances prohibited for new installations.
e. Occupational Exposure Limit based on the OSHA PEL, ACGIH TLV-TWA, the AIHA WEEL [illegible] time-weighted average (TWA) basis unless noted. [illegible]

113

113

NFPA 704 Warning Sign Ammonia

- NFPA 704 refers to the familiar 4-color diamond-shaped warning signs for health, flammability, reactivity and special information
- Ammonia refrigeration system located outdoors
- Ammonia refrigeration system located indoors

2018 IFC Commercial Plan Reviews 114

114

Refrigeration Machinery Rooms

- Required to have a refrigerant detector
  - Audible and visual alarm
  - Located in an area where refrigerant from a leak will concentrate
  - Alarm threshold set at a concentration value less than the Threshold Limit Value-Time Weight Average (TLV-TWA)

2018 IFC Commercial Plan Reviews 115

115

Machinery Room Controls for Flammable Refrigerants

- Where flammable refrigerants are used, remote control of the mechanical equipment is required
  - Located immediately outside the machinery room and adjacent to its principal entrance
  - Switch for “off-only” control of electrically energized equipment and appliances
  - Switch for “on-only control” of the machinery room ventilation fans
- Mechanical refrigeration equipment will shut down when:
  - 25% of LFL is detected
  - TLV-TWA threshold is detected

2018 IFC Commercial Plan Reviews 116

116

Emergency Pressure Control System §606.10

- Each high- and intermediate-pressure zone in a refrigeration system shall be provided with a single automatic valve providing a crossover connection to a lower pressure zone
  - Automatic crossover valves must be arranged to automatically relieve excess system pressure to a lower pressure zone when the pressure rises to 90% of the set point for emergency pressure-relief devices
- FCO may require automatic crossover valves capable of manual operation
- Operation of a crossover valve shall shut down the refrigeration system

IFC 2018 IFC Commercial Plan Reviews 117

117

Elevator Recall §607

- Phase I recall and Phase II emergency in-car operation in all new elevators
- American Society of Mechanical Engineers A17.1, Safety Code for Elevators and Escalators
  - Standard emergency warning signs posted adjacent to each elevator call station on all floors

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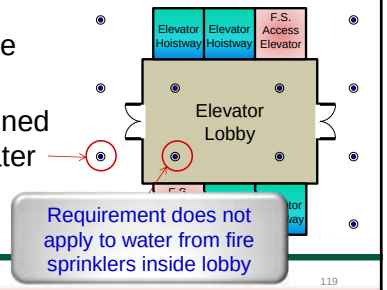
118

Fire Service Access Elevator IBC §403.6.1 & §3007

- ≥2 fire service access elevators are required in high-rise buildings with an occupied floor >120' above LLFDVA
- Elevator shunt trip is prohibited in fire service access elevators
- Building must be designed to prevent sprinkler water from entering elevator hoistway



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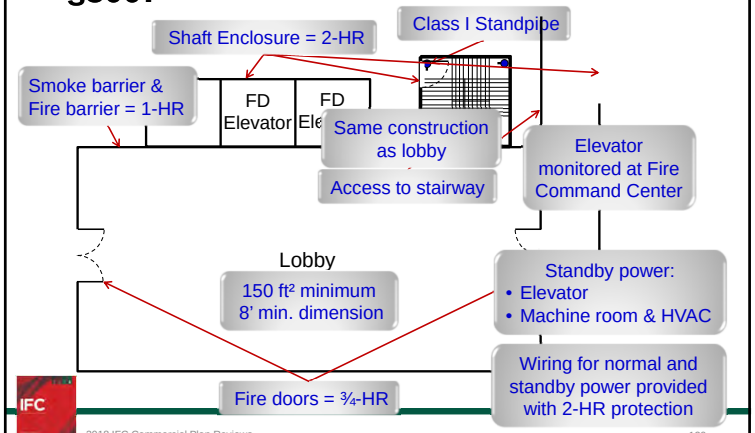
119

Fire Service Access Elevators §3007



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120

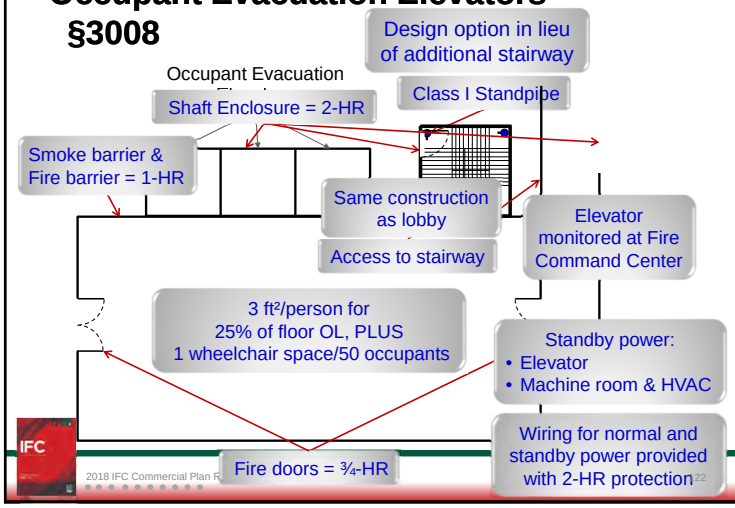
Occupant Evacuation Elevators §3008

- Elevators in high-rise buildings are permitted to be used for occupant self-evacuation
- The occupant evacuation elevator:
  - Can not reduce the means-of-egress requirements established in Ch 10
  - May be used as an alternative to the additional exit stairway mandated for high-rise buildings >420' in height

2018 IFC Commercial Plan Reviews 121

121

Occupant Evacuation Elevators §3008



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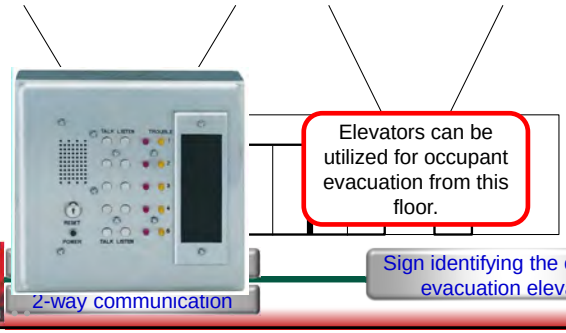
Occupant Evacuation Elevators §3008



123

Stationary Storage Battery Systems §608

Battery Type	Code Threshold
Flooded Lead Acid Batteries	>50 gallons
Nickel-Cadmium Batteries (Ni-Cd)	>50 gallons
Valve Regulated Lead-Acid Cells (VRLA)	>50 gallons
Lithium-Ion Cells (Li-ion)	>1,000 lbs
Lithium Metal Cells	>1,000 lbs

2018 IFC Commercial Plan Reviews 124

124

Table 608.1 – Battery Requirements

Requirement	Nonrecombinant Batteries		Recombinant Batteries		Other Batteries
	Vented (Flooded) Lead Acid Batteries	Vented (Flooded) Nickel-cadmium (Ni-cd) Batteries	Valve Regulated Lead-acid (VRLA) Cells	Lithium-ion Cells	Lithium Metal Cells
Safety Caps	Venting Caps (608.2.1)	Venting Caps (608.2.1)	Self-resealing Flame-arresting Caps (608.2.2)	No Caps	No Caps
Thermal Runaway Management	Not required	Not required	Required (608.3)	Not required	Required (608.3)
Spill Control	Required (608.5)	Required (608.5)	Not Required	Not required	Not required
Neutralization	Required (608.5.1)	Required (608.5.1)	Required (608.5.2)	Not required	Not required
Ventilation	Required (608.6.1; 608.6.2)	Required (608.6.1; 608.6.2)	Required (608.6.1; 608.6.2)	Not required	Not required
Signage	Required (608.7)	Required (608.7)	Required (608.7)	Required (608.7)	Required (608.7)
Seismic Protection	Required (608.8)	Required (608.8)	Required (608.8)	Required (608.8)	Required (608.8)
Smoke Detection	Required (608.9)	Required (608.9)	Required (608.9)	Required (608.9)	Required (608.9)

125

Enclosures of Stationary Battery Systems

- Stationary battery system rooms must comply with the IBC
- Battery storage areas are specifically exempt from the requirements for Group H ***if***
  - Battery systems are installed with safety caps
  - Room is ventilated according to the IMC
- Stationary battery systems shall either be located in a separate room, or they can be co-located in the same room with the equipment they support

126

Ventilation §608.6

- Rooms containing stationary battery storage systems must be ventilated in accordance with the IMC and the following:
  - Designed to limit the maximum concentration of hydrogen to ≤1% of the total volume of the room; ***or***
  - Provide continuous ventilation at a rate of not less than 1 cfm/ft² of floor area of the room

127

Spill Control and Neutralization §608.5

- Areas containing the following batteries require to provide spill control
  - Lead-acid
  - Nickel-cadmium
- Areas containing the following batteries require to provide an approved method for neutralization of an electrolyte spill
  - Lead-acid
  - Nickel-cadmium
  - VRLA

128

Warning Signs §608.7

- Due to the inherent fire and toxicity hazards associated with stationary battery storage systems, warning signs are required
- Doors into electrical equipment rooms or buildings containing stationary battery systems shall be provided with approved signs
  - The room contains energized battery systems
  - The room contains energized electrical circuits
  - The battery electrolyte solutions, where present, are corrosive liquids

129

Module 6

Fire Protection Systems and Equipment Review

130

Fire Protection Systems

- Fire protection systems are required:
  - To improve life safety
  - Offer fire protection
  - Protect special hazards
  - As an alternative to some other code requirement
    - Using automatic sprinklers to eliminate the need for 1-HR fire-resistance-rated corridors
    - Increasing allowable area

131

Non-separated Mixed Use Buildings and Fire Alarms

- Non-separated mixed use buildings have >1 occupancy and the occupancies are not separated so the building complies with the requirements for both occupancies
- ***IF*** one of these occupancies requires a fire protection system, the system is required to be installed throughout the building in accordance with IBC §508.3.1

132

Fire Protection Systems

- Fire sprinklers systems
- Standpipe systems
- Fire alarm systems
- Smoke co
- Fire-extinc systems
- Commerci extinguish

133

IFC Sprinkler Increases

- IFC and IBC offer numerous exceptions and modifications where buildings are protected by a fire sprinkler system

Code Section	Modification	NFPA 13	NFPA 13R	NFPA 13D
IFC §503.1.1	The travel distance on fire department access roadways to be increased	Yes	Yes	Yes
IFC §507.5.1	The hydrant spacing can be increased to 600'	Yes	Yes	No
IFC §807.3	Increase in amount of curtains, drapes and fabric hangings in Group A	Yes	No	No
IFC Tables 5003.1.1(1) & (2)	100% increase in MAQ for certain haz mat	Yes	Yes	No
IFC Table 5003.11.1	100 percent increase in MAQ for certain hazardous materials in Group M & S	Yes	Yes	No

134

IFC Sprinkler Reductions

Code Section	Modification	NFPA 13	NFPA 13R	NFPA 13D
IFC Table 803.3	Interior finish	Yes	Yes	No
IFC §906.1	Portable fire extinguishers in Group A, B & E	Yes	Yes	No
IFC §907.2	Number of manual fire alarm boxes	Yes	No	No
IFC §907.2.2.1	Smoke detection in corridors of ambulatory care facilities	Yes	No	No
IFC §907.2.2.6	Smoke detection in corridors in Group I-1, Condition 1	Yes	No	No
IFC §907.2.9.1	Manual fire alarm system in Group R-2	Yes	Yes	No
IFC §905.3.1	Class III standpipe	Yes	Yes	No
IFC Table 3260.2	Elimination of smoke and heat removal with certain types of sprinkler systems	Yes	No	No
IFC §5003.8.3.4	Reduction in fire-resistance rating for floor of control areas in Type IIA, IIIA or VA construction	Yes	No	No
IFC §B105.1(1)	Reduction in fire flow for 1- and 2-family dwellings and townhouses	Yes	Yes	Yes
IFC §B105.2	Reduction in fire flow for commercial buildings	Yes	Yes	No

135

IFC Sprinkler Modifications

Code Section	Modification	NFPA 13	NFPA 13R	NFPA 13D
IFC §304.2.4	Dumpsters of 1 cubic yard or more allowed inside the building	Yes	Yes	Yes
IFC §806.1	Natural cut trees allowed in buildings	Yes	Yes	Yes
IFC Table 1105.3	Protection of incidental uses in existing Group I-2 occupancies	Yes	No	No

136

IBC Sprinkler Increases

Code Section	Modification	NFPA 13	NFPA 13R	NFPA 13D
IBC §410.6.3.2	Exit access travel distance increase for technical production areas	Yes	No	No
IBC §412.4.6.1	Increase in the amount of fuel in aircraft within an aircraft hangar	Yes	No	No
IBC Table 504.3	Building height in feet	Yes	Yes	No
IBC Table 504.4	Building height in stories	Yes	Yes	No
IBC §505.2.1	Area of mezzanines	Yes	No	No
IBC Table 506.2	Building area	Yes	No	No
IBC §507.4 & §507.5	Unlimited building area for certain occupancies	Yes	No	No
IBC Table 1006.2.1	Increased common path of travel distance in a means of egress	Yes	Yes	No
IBC Table 1017.2	Increased exit access travel distance	Yes	Yes	No
IBC §1020.4	Length of dead-end exits	Yes	No	No
IBC §1406.3	Length of balconies	Yes	Yes	Yes
IBC §2607.5	Area of light-transmitting plastic wall panels	Yes	No	No

2018 IFC Commercial Plan Reviews 137

137

IBC Sprinkler Reductions

Code Section	Modification	NFPA 13	NFPA 13R	NFPA 13D
IBC §403.2.1	Reduction in fire resistance in Type I high-rise buildings	Yes	No	No
IBC §403.4.8.2	Reduction in protection of fuel line for generators	Yes	Yes	No
IBC §404.2	Atriums furnishings	Yes	No	No
IBC §404.6	Glazing in atriums	Yes	No	No
IBC §505.2.3 Exception 5	Openness of mezzanines to the floor below where not in Group H or I	Yes	No	No
IBC Table 508.4	Separation of occupancies	Yes	No	No
IBC Table 705.8	Exterior wall openings	Yes	No	No
IBC §705.8.2	Elimination of opening protectives in exterior walls	Yes	No	No
IBC §705.8.2	Opening protection in exterior walls	Yes	No	No
IBC §706.5	Horizontal continuity of fire walls	Yes	Yes	No
IBC §706.8	Area of openings in fire walls	Yes	No	No
IBC §708.3	Fire-resistance rating of fire partitions separating dwelling and sleeping units in Type IIB, IIIB and VB construction	Yes	No	No

2018 IFC Commercial Plan Reviews 138

138

IBC Sprinkler Modifications

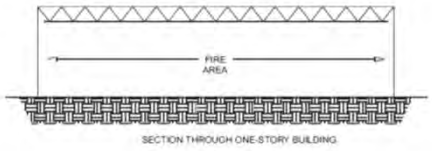
Code Section	Modification	NFPA 13	NFPA 13R	NFPA 13D
IBC §1010.1.9.4	One leaf of a pair of doors is allowed to have surface-mounted bolts in Groups B, F or S	Yes	No	No
IBC §410.3.5	Protection of proscenium openings on stages	Yes	No	No
IBC Table 509	Protection of certain incidental uses	Yes	No	No

2018 IFC Commercial Plan Reviews 139

139

Fire Area §202

- Fire area is the "aggregate floor area enclosed and bounded by fire walls, fire barriers, exterior walls or fire-resistance rated horizontal assemblies of a building."
  - Every building consists of at least 1 fire area



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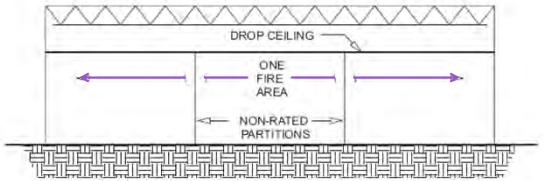
140

Fire Area

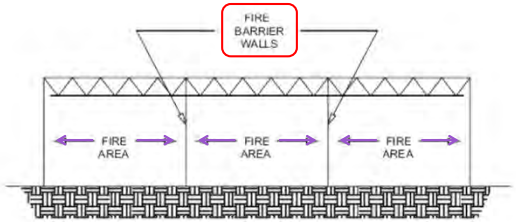
- The fire area of a typical single-story building shown here that has an unrated horizontal assembly or a partition is also classified as having one fire area



141

Fire Area

- The fire areas of a building with interior walls constructed as fire barriers that are fire-resistance-rated according to IBC Table 508.3.3 are defined by the exterior walls and the fire barrier assemblies



SECTION THRU 1 STORY BUILDING

142

Fire Areas §901.4.3

- Fire barriers constructed to divide buildings divided into fire areas to avoid installing a fire sprinkler system shall have a fire-resistance rating of not less than shown in IBC §707.3.10
- IBC 707.3.10 - The fire barrier or horizontal assembly, or both, separating a single occupancy into different fire areas
  - A fire-resistance rating of not less than that indicated in Table 707.3.10

143

REFER TO CODE BOOK

IBC Table 707.3.10

IBC Table 707.3.10
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

144

Fire Area

- Fire areas are also defined as the two adjacent areas separated by a fire wall that establishes two separate buildings

145

Application Matrix of the Automatic Fire Sprinkler Standards

System Feature	Sprinkler Design Standard		
	NFPA 13	NFPA 13R	NFPA 13D or IRC §P2904
Code Section	§903.3.1.1	§903.3.1.2	§903.3.1.3
Design Intent	Life safety and property protection	Life safety	Life safety
Extent of protection	Throughout the building	Occupied spaces	Occupied spaces
Scope	All occupancies	Group R uses up to 4 stories or 60' in height	1- and 2-family dwellings and townhomes
Sprinkler Design	Pipe schedule; Control mode – discharge density/design area; Control mode – specific application; Suppression mode	4 sprinklers per compartment	2 sprinklers per compartment
Sprinkler Types	All approved types	Residential only	Residential only
Water Supply Duration	30 to 120 minutes depending on design	30 minutes	7 or 10 minutes depending on building size

146

Fire Sprinkler Requirements Based on Occupancy

Occupancy	Sprinklers Installed Where?	Sprinklers Required When?
A-1	Throughout the story where the Group A-1 is located and all stories from the Group A-1 to, and including, the LED	1. Fire area >12,000 ft² 2. Fire area has OL ≥300 3. Fire area is located on a floor other than a LED 4. Fire area contains a multi-theater complex
A-2	Throughout the story where the Group A-2 is located and all stories from the Group A-2 to, and including, the LED	1. Fire area >5,000 ft² 2. Fire area has OL ≥100 3. Fire area is located on a floor other than a LED
	Throughout all stories from the top floor to, and including, the LED	When located on rooftop with OL >100
A-3	Throughout the story where the Group A-3 is located and all stories from the Group A-3 to, and including, the LED	1. Fire area >12,000 ft² 2. Fire area has OL ≥300 3. Fire area is located on a floor other than a LED
	Throughout all stories from the top floor to, and including, the LED	When located on rooftop with OL >300
A-4	Throughout the story where the Group A-4 is located and all stories from the Group A-4 to, and including, the LED	1. Fire area >12,000 ft² 2. Fire area has OL ≥300 3. Fire area is located on a floor other than a LED
A-5	Only in accessory areas when required	Concession stands, retail areas, press boxes and other accessory use areas >1,000 ft²

147

Fire Sprinkler Requirements Based on Occupancy

Occupancy	Sprinklers Installed Where?	Sprinklers Required When?
B Ambulatory Care Facility	Throughout the story where the Group B Ambulatory Care Facility is located and all stories from the Ambulatory Care Facility to, and including, the nearest LED	1. ≥4 care recipients incapable of self-preservation 2. ≥1 care recipients incapable of self-preservation located on a level other than the LED
E	Throughout the fire area	1. Fire area >12,000 ft² 2. Portions below the lowest LED serving that portion of the building unless every classroom throughout the building has ≥1 exterior exit door at ground level
F-1	Throughout the building	1. Fire area >12,000 ft² 2. Fire area >3 stories above grade plane 3. Aggregate fire areas on all floors, including mezzanines, >24,000 ft² 4. Used for the manufacture of upholstered furniture or mattresses >2,500 ft²
F-1 Woodworking	Throughout the fire area	Woodworking operation >2,500 ft² that generates finely divided combustible waste or uses finely divided combustible materials
F-2	NA	NA

148

Fire Sprinkler Requirements Based on Occupancy

Occupancy	Sprinklers Installed Where?	Sprinklers Required When?
H-1 H-2 H-3 H-4 H-5	Throughout the occupancy	All
I-1 I-2 I-3	Throughout the building	All
I-4	Throughout the building	All, except for Group I-4 day care facilities at the LED, where every room where care is provided has ≤1 exterior exit door
M	Throughout the building	1. Fire area >12,000 ft² 2. Fire area >3 stories above grade plane 3. Aggregate fire areas on all floors, including mezzanines, >24,000 ft² 4. Used for the display and sale of upholstered furniture or mattresses >5,000 ft²

149

Fire Sprinkler Requirements Based on Occupancy

Occupancy	Sprinklers Installed Where?	Sprinklers Required When?
R-1 R-2 R-3 R-4	Throughout the building	All
S-1	Throughout the building	1. Fire area >12,000 ft² 2. Fire area >3 stories above grade plane 3. Aggregate fire areas on all floors, including mezzanines, >24,000 ft² 4. Fire area used for the storage of commercial motor vehicles >5,000 ft² 5. Used for the storage of upholstered furniture or mattresses >2,500 ft² 6. Storage of tires where volume of tires >20,000 ft³

150

Fire Sprinkler Requirements Based on Occupancy

Occupancy	Sprinklers Installed Where?	Sprinklers Required When?
S-1 Repair Garage	Throughout the building	1. Buildings with ≥2 stories above grade plane, including basements, and fire area containing a repair garage >10,000 ft² 2. Buildings with 1 story above grade plane and fire area containing a repair garage >12,000 ft² 3. Repair garages servicing vehicles in basements 4. Fire area used for the repair of commercial motor vehicles and the fire area >5,000 ft²
S-2 Enclosed Parking Garage	Throughout the parking garage	1. Fire area >12,000 ft² 2. Enclosed parking garge is located beneath another occupancy, except for Group R-3
S-2 Parking Garage	Throughout the building	Fire area used for the storage or parking commercial motor vehicles and the fire area >5,000 ft²
U	NA	NA

151

Alternative Fire-extinguishing Systems §904

- An alternative fire-extinguishing system uses a solid (dry), compressed gas (gaseous), or aqueous (wet) chemical as the fire suppression agent
- If an alternative suppression system is installed rather than fire sprinklers in a room or area, the building is ***NOT*** considered sprinklered throughout and therefore cannot take advantage of sprinkler benefits such as increased travel distance, height/area increases, etc.

152

Alternative Fire-extinguishing Systems §904

- IFC recognizes the following systems:
  - Wet chemical
  - Dry chemical
  - Foam
  - Carbon Dioxide (CO2)
  - Halon
  - Clean agents
  - Water mist
  - Commercial cooking
  - Domestic cooking

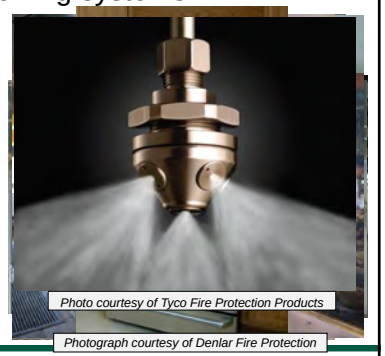


Photo courtesy of Tyco Fire Protection Products

Photograph courtesy of Denlar Fire Protection

153

Design Considerations for AFES

- Is the selected agent compatible with the hazard being protected?
- Is the system:
  - Pre-engineered or an engineered design?
  - 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?

154

AFES Installation Requirements §904.3

- Electrical wiring must be in compliance with NFPA 70
- AFES must be:
  - Capable of automatic actuation
  - Capable of manual operation
- AFES must be interlocked with fuel sources, ventilation systems or any component necessary for the proper operation of the system and to contain the agent in the space where it will extinguish a fire

155

AFES Installation Requirements §904.3

- Alarms and warning signs are required to indicate pending agent discharge
  - Visual and audible alarms are needed to give occupants time to escape before the agent is released from its container
- If the building has a fire alarm system, the automatic fire extinguishing system must be integrated with it and monitored in accordance with NFPA 72

156

Commercial Cooking Systems §904.11

- The IMC describes two categories of commercial kitchen exhaust systems:
  - Type I hoods:
    - Required where commercial cooking appliances produce grease or smoke such as griddles, fryers, broilers, ovens, ranges and wok ranges
  - Type II hoods:
    - Required where cooking or dishwashing appliances produce heat, steam or products of combustion such as steamers, kettles, pasta cookers and dishwashing machines

157

Commercial Cooking Systems

- The hood and duct system installations are required to comply with detailed installation specifications found in IMC §506, §507, §508 and §509
- Type 1 hood requires an automatic fire-extinguishing system

158

Commercial Cooking Systems

- The fire-extinguishing system must be one recognized for protecting the hazard
  - Pre-engineered wet-chemical systems are required to be tested in accordance with UL 300 “Fire Testing of Fire Extinguishing Systems for Protection of Restaurant Cooking Areas”
- Factory built commercial cooking recirculating systems listed to UL 710B, “Recirculating Systems” are not required to have a fire-extinguishing system

159

Means of Manual Operation

- Except for automatic sprinkler systems, the automatic fire-extinguishing system installed for commercial cooking operations must have a means of manual operation
- Remote manual release located in the egress path from the cooking area
- Operation of the shall shut-down to the cooking equ

Located 42” to 48” above the floor

Located between 10’ and 20’ from the

Shut-down devices must have only manual reset capability

Photographs courtesy of Ansul Inc.

160

Standpipe Systems §905

- Standpipe systems:
  - Installed in tall buildings or specific occupancies to provide a means to get manual hose streams quickly without having to extend many feet of hose
  - Requirements for standpipes based on practical requirements of typical fire-fighting operations
  - NFPA 14, "Installation of Standpipe and Hose Systems" prescribes the installation requirements
  - Standpipe systems are not required for Group R-3

IFC 2018 IFC Commercial Plan Reviews 161

161

Standpipe Systems

- Standpipe systems are categorized into 3 ***classes***

Class	Intended Users	Performance Criteria
I	Fire services or persons qualified in handling hose streams	500 gpm at 100 psi at topmost 2½" outlet, 250 gpm for each additional outlet
II	Building occupants	100 gpm at 65 psi at topmost 1½" outlet
III	Fire service and building occupants	500 gpm at 100 psi at topmost 2½" outlet Combines both 2½" and 1½ outlets

IFC 2018 IFC Commercial Plan Reviews 162

162

Standpipe Systems

- Standpipe systems are categorized into 5 ***types***

Type	Description
Wet-automatic	Always has water in the system to provide immediate volume and pressure at the hose outlet connection. Typical standpipe placed in locations that are ≥40°F all year long.
Wet-manual	Contains water in the pipe with a minimal water supply. Does not have a water supply capable of delivering the system demand. Manual wet standpipe systems require water from FD apparatus to be pumped into the FDC to supply the pressure and volume.
Dry-automatic	Normally filled with pressurized air. Arranged through the use of approved devices to admit water to the system automatically by opening a hose valve. A typical dry standpipe system has an automatic water supply and a dry-pipe valve. Typical in areas where the temperature <40°F.
Dry-semiautomatic	Admits water into the system piping upon activation of an approved remote control device located at each hose connection. This remote control device will open the main supply valve, such as a deluge valve. This system is used in areas where temperatures <40°F.
Dry-manual	Does not have a permanent water supply connected to it. Manual dry standpipe systems require water from FD apparatus to be pumped into the system through the FDC to supply the system demand. Manual dry standpipe systems are permitted only for use in structures or facilities that are subject to freezing temperatures or where an approved water supply is not available.

163

163

Standpipe Systems §905.3

- Standpipes required in:
  - Buildings with a floor level >30' above LLFDVA
  - Buildings with a floor level >30' below HLFDVA
  - Group A with
  - Covered & o
  - Stages >1,00
  - Underground
  - Marinas and

Buildings with a standpipe ***and*** a rooftop helistop or heliport shall have a Class I or III standpipe system extended to reach within 150' of all portions of the helistop or heliport

- Each requirement will specify the "class" and "type" of standpipe

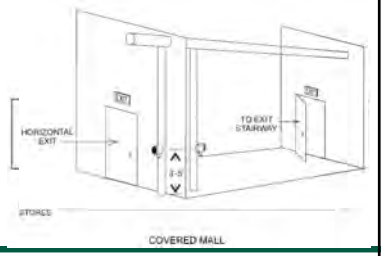
IFC 2018 IFC Commercial Plan Reviews 164

164

Location of Class I Hose Valves §905.4

- In stair shafts, hose valves are required at intermediate 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

Hose valves not required when ≤130' from an exit stairway hose connection



165

Fire Alarm and Detection Systems §907

- By promptly notifying the occupants of the building and the fire department of an emergency, fire alarm and detection systems
  - Limit casualties and property losses
  - Increase the time available for evacuation
  - Reduce the fire department response time relative to the fire's onset

166

Required Fire Alarm Systems

Occupancy	Type of Fire Alarm System	Threshold
Assembly (A-1, A-2, A-3, A-4, A-5)	≥Manual	• All with OL ≥300 OR ≥100 above/below LED
Business (B)	≤Manual	• Total OL is ≥500 • OL ≥100 above or below the level of exit discharge
	Manual and Automatic	• Ambulatory care facility
Educational (E)	Manual	• >50 occupants (see exceptions)
	Emergency voice / alarm communication	• >100 occupants
Factory (F-1, F-2)	Manual	• ≥2-stories with OL ≥500 above or below the level of exit discharge
High Hazard (H-1, H-2, H-3, H-4, H-5)	Manual	• H-5 occupancies • Occupancies used for manufacture of organic coatings
	Automatic	• Areas containing highly toxic gases, organic peroxides or oxidizers

167

Required Fire Alarm Systems

Occupancy	Type of Fire Alarm System	Threshold
Institutional (I-1, I-2, I-3, I-4)	Manual	• All Group I (Exceptions for I-1 and I-2)
	Automatic	• Corridors in Group I-1 and Group I-2 Condition 1 and 2 • Resident sleeping areas in Group I-3
Mercantile (M)	Manual	• Total OL ≥500 • OL ≥100 above or below the level of exit discharge
Residential (R-1)	Manual	• All unsprinklered buildings except those ≤2 stories with guestrooms having exit directly to exterior
	Automatic	• All except buildings without interior corridors and guestrooms having exit directly to exterior

168

Required Fire Alarm Systems

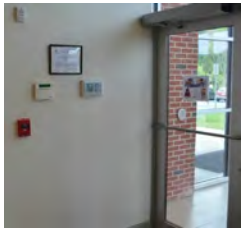
Occupancy	Type of Fire Alarm System	Threshold
Residential (R-2)	Manual	• Unsprinklered with 3 stories • 1 story below level of exit discharge • ≥16 dwelling units or sleeping units without exits directly to exterior
	Automatic	• College or university buildings except where each sleeping or dwelling unit has direct access to an exit and there are no interior corridors
~~Residential (R-4)~~	~~Manual~~	~~• All unsprinklered buildings except those ≤2 stories with guestrooms having exit directly to exterior~~
	~~Automatic~~	~~• Corridors serving sleeping units if sleeping units do not have direct exit~~ Deleted in 2018 IFC

IFC 2018 IFC Commercial Plan Reviews 169

169

Manual Fire Alarm Boxes §907.4.2

- In ***nonsprinklered*** buildings
  - Required ≤5' of every exit from every floor
  - Additional manual fire alarm boxes where travel distance >200'
- In ***sprinklered*** buildings
  - Required ≤5' of every exit from every floor



In some occupancies, all but 1 manual fire alarm box can be deleted when sprinklered

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170

Manual Fire Alarm Boxes §907.4.2.2

- Manual fire alarm boxes must be between 42" and 48" between the floor level and the activating handle or lever of the box

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171

Visible Alarms §905.2.3.2

- Visible alarm notification appliances must be provided in public and common areas
- Ampacity of the notification appliance circuit must be designed with a minimum 20% spare capacity in all employee work areas to be able to add appliances if needed in the future to accommodate ambient noise levels

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172

Visible Alarm Notification Appliances §907.6.2.3

- Group I-1 and R-1 occupancies require visible alarm notification appliances to be located in sleeping rooms
  - Must be activated by both the in-room smoke alarm and the building fire alarm system
- Dwelling units in Group R-2 occupancies required to have a fire alarm system must support visible alarm notification appliances in accordance with ICC A117.1 "Accessible and Usable Buildings and Facilities"

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173

Initiating Devices §907.6.3

- New fire alarms must ID the specific initiating device
- Exceptions
  - 1-story buildings <22,500 ft²
  - Systems ≤10 initiating devices consisting of manual fire alarm boxes and waterflow
  - Initiating devices which do not support individual ID
  - Fire alarm systems or devices installed to replace existing components where this function is not provided

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174

High-rise Buildings IBC §403.4.7

- High-rise buildings must be equipped with natural or mechanical ventilation for smoke removal by one of the following methods:
  - Manually operable windows or panels

• Around perimeter of each floor ≤50' intervals

Return and exhaust air moved directly to the outside without recirculation to other portions of the building

IFC 2018 IFC Commercial Plan Reviews 175

175

Smoke and Heat Removal §910.3.3

- Smoke/heat vents
  - Calculation for ***sprinklered*** building
    - $A_{VR} = V \div 9000$
  - C

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

• A_{VR} = th
• A_{FA} = th

NOTE: formula for sprinklered buildings is based on volume; not based on floor area

removal

IFC 2018 IFC Commercial Plan Reviews 176

176

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

177

Fire Pump Components §913

- Installation must comply with NFPA 20 "Installation of Stationary Pumps for Fire Protection"
- 3 main components of the fire pump assembly
  - Pump
  - Driver
  - Controller
- Must be protected from service interruption through damage caused by explosion, fire, flood, earthquake, rodents, insects, windstorm, freezing, vandalism and other adverse conditions

178

Fire Pump Rooms §913

- Fire pump room is ***NOT*** required, but fire pump must be:
  - Separated from building by 50', ***OR***
  - Located in pump room separated from rest of building
- Pump roo[illegible] >40ºF to prevent fre[illegible]
- Adequate access must be provided for maintenance of equipment
  - This distance would be 30" in front of electrical panels
  - Distances specified by the manufacturer
- Doors and passageways must be large enough to allow largest piece of equipment to be removed and replaced

Separation in high-rise = 2-HR
In other than high-rise = 1-HR

179

Fire Command Center

- Provides an area of fire department operation where building equipment and safety features can be monitored and controlled
  - Required in:
    - High-rise buildings
    - Covered mall buildings with a smoke control system
    - Buildings with smoke-protected assembly seating

180

Fire Command Center §508

- Separated from the remainder of the building by not less than a 1-HR fire-resistive rated construction
- Must be ≥200 ft² in area with a minimum dimension of 10’

181

Fire Command Center Features §508.1.6

- Emergency voice/alarm communication system control unit
- Fire department communications system
- Fire detection and alarm system annunciator
- Fire alarm annunciator unit visually indicating the location of the elevators and whether they are operational
- Status indicators and controls for air distribution systems
- The fire-fighter’s control panel for any smoke control systems installed in the building
- Controls for unlocking stairway doors

182

Fire Command Center Features §508.1.6

- Sprinkler valve and water-flow display panels
- Emergency and standby power status indicators
- Telephone for FD
- Fire pump status indicators
- Schematic building plans
- Building Information Card
- Work table
- Generator manual start and transfer features
- PA system, where a PA system is required by the code
- Elevator recall switch

183

Emergency Responder Radio Coverage §510

- All buildings must be capable of meeting the in-building radio performance criteria
- Applicable to all new construction
- Many handheld radio systems are ineffective in buildings constructed today
  - Buildings are larger
  - More steel and concrete
  - Steel racks used often

184

Responsibility for Signal Quality

- The IFC requirement cannot be used to require the radio system infrastructure be modified to provide an adequate signal at the street level
  - The radio signal outside the building is the responsibility of the jurisdiction, not the building owner
  - Reception and transmission of radio signals inside and throughout the building is the responsibility of the owner

185

Emergency Responder Radio Coverage §510

- Installation parameters for the design of emergency responder radio coverage system
- The radio signal received in the building must be -95 dBm in at least 95% of the building
- Test must be conducted after construction and prior to final inspection
- Designer should either include a system into the building plans, ***OR*** provide a note that emergency responder radio coverage will be tested and complied with

186

Module 8

Special Uses and Hazards Review

187

Dry Cleaning Ch 21

- Dry cleaning solvents, dry cleaning plants and dry cleaning systems are classified based on the solvents used

Solvent Class	Flash Point Range for Liquids	Dry Cleaning Plant & System Classification
I	Below 100°F (38°C)	Type I
II	At or above 100°F (38°C) and below 140°F (60°C)	Type II
IIIA	At or above 140°F (60°C) and below 200°F (93°C)	Type III-A
IIIB	At or above 200°F (93°C)	Type III-B
IV	Classified as nonflammable	Type IV
IV	Facilities where dry cleaning is conducted by the public using Class IV solvents	Type V

188

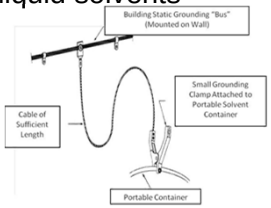
Occupancy Classification, Design and Construction of Dry Cleaning

- IBC §307.1 exempts the following dry cleaning plants from Group H:
  - Type III-A or III-B dry cleaning plants using solvents in closed systems employing listed equipment and separated from other areas of the building by 1-HR fire-resistance-rated construction
  - Type III-B dry cleaning plants
- Group H dry cleaning plants must comply with IFC, IMC, IPC and NFPA 32

189

Bonding and Grounding §2104.2.4

- Solvent containers and processing equipment must be bonded and grounded to prevent buildup of static charges, a common source of ignition for vapors emitted by flammable and combustible liquid solvents



190

Fire Protection

- Type II
  - Fire sprinkler system
  - Automatic fire-extinguishing system or steam injection in Type II dry cleaning units, washer-extractors, and drying tumblers
- Type III-A with >330 gallons
  - Fire sprinkler system, ***or***
  - Safety devices integral to dry cleaning machines
- Type III-B
  - Fire sprinkler system with >3,300 gallons

191

Mechanical Ventilation

- Type II dry cleaning rooms and drying rooms require a system designed to exhaust ≥1 cfm/ft^2
  - System operates automatically when cleaning equipment is in operation; has manual controls at an approved location
- Type IV and V dry cleaning systems shall be provided with an automatically activated exhaust ventilation system providing ≥100 fpm air velocity through the loading door when the door is opened

192

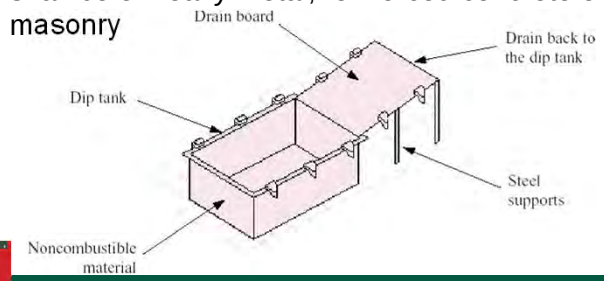
Dipping Operations §2405

- Dip-tank and flow-coating operations conducted in buildings used for Group A, I or R shall be:
  - Located in a room designed for that purpose
  - Equipped with a fire sprinkler system
  - Separated vertically and horizontally from other areas in compliance with the IBC
- Dipping operations may occur in all other occupancies as long as they comply with the requirements of §2405

193

Dip Tank Construction §2405.3

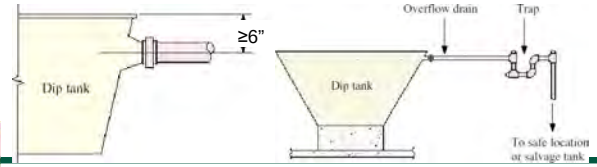
- Dip tanks, including drain boards, must be made of noncombustible material and their supports shall be of heavy metal, reinforced concrete or masonry



194

Dip Tank Safety Features

- Dip tanks with a capacity >150 gallons or >10 ft² in liquid surface area must have a trapped overflow pipe ≥6" below the top of the tank leading to an approved location outside the building
- Dip tanks with a capacity >500 gallons must have bottom drain capable of automatically or manually drain the tank in cae of fire



195

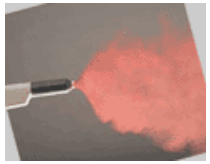
Dip Tank Fire Protection

- Automatic dip-tank cover, ***OR*** fire-extinguishing system must be provided for:
  - Dip tanks <150 gallons or <10 ft² in liquid surface area
  - Dip tanks containing a liquid with a flash point below 110°F used in such manner that the liquid temperature could equal to or greater than its flash point, ***AND*** a capacity >10 gallons ***AND*** a liquid surface area of >4 ft²

196

Powder Coating §2406

- A process where a thermosetting plastic powder is applied as a coating
  - Powder has a positive electrical charge
  - Metal object being coated is given a negative charge
  - Opposite charges attract and the coating adheres to the metal object
- Application methods
  - Fluidized bed
  - Electrostatic fluidized bed
  - Powder spray guns
  - Electrostatic powder spray guns



197

Powder Coating

- Powder coating operations must be conducted in noncombustible enclosed and ventilated powder coating rooms, enclosed and ventilated powder coating facilities, or ventilated spray booths complying
- Listed spray-booth assemblies that are constructed of other materials are allowed
- Areas used for powder coating operations must be protected by an automatic fire-extinguishing system

198

Industrial Ovens Ch 30

- Industrial ovens and furnaces include a broad range high-heat producing appliances used to manufacture, treat or cure a variety of products
- NFPA 86, Standards for Ovens and Furnaces, includes a generic list of these devices

199

Limits on Locations §3003

- Industrial ovens and furnaces shall be located so as not to pose an ignition hazard to flammable vapors or mists or combustible dusts
- Ovens roofs and floors must be insulated and ventilated to prevent temperatures at nearby combustible ceilings and floors ≤160°F

200

Fire Protection for Industrial Ovens §3006

- Class A and B ovens that contain, or are utilized for the processing of, combustible materials shall be protected by an automatic fire-extinguishing system
- Fixed fire-extinguishing systems shall be provided for Class C or D ovens to protect against such hazards as overheating, spillage of molten salts or metals, quench tanks, ignition of hydraulic oil and escape of fuel

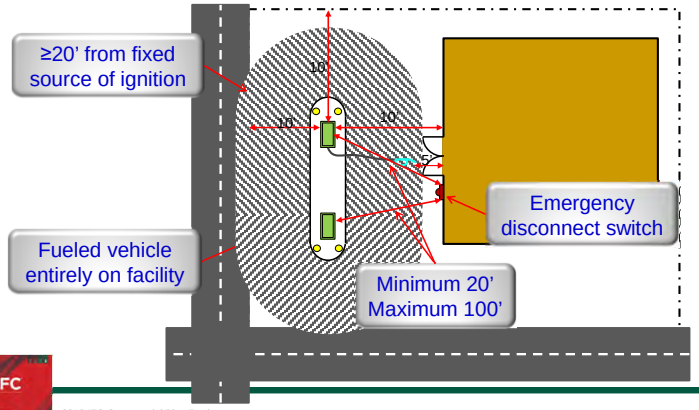
201

Motor Fuel Dispensing Facilities and Repair Garages

- Ch 23 contains requirements for storage and dispensing of:
  - Class I, II and III fuels
  - Compressed and cryogenic methane (CNG or LNG)
  - Compressed and cryogenic hydrogen
  - Liquefied petroleum gases

202

Dispensing Locations for All Liquid Fuels §2303



203

Attended Facilities §2304.2

- Attended facilities must have ≥1 qualified attendant on duty while the facility is open for business
  - Dispensing devices must be in clear view of the attendant at all times
  - Obstructions may not be built or placed between the dispensing area and the attendant
  - Communication with persons in the dispensing area must be possible at all times
  - Approved method of communicating with FD shall be provided for the attendant

204

Unattended Facilities §2304.3

- Unattended facilities are allowed ***IF*** approved by FCO
  - As a condition of approval, the owner or operator shall provide, and be accountable for, daily site visits, regular equipment inspection and maintenance
- Emergency disconnect switch shall be provided
- Telephone not requiring a coin to operate or other approved, clearly identified means to notify FD shall be provided on the site in a location approved by the FCO

205

Above-ground Tanks

Table 2306.2.3
Minimum Separation Requirements for Above-ground Tanks

Class of Liquid and Tank Type	Individual Tank Capacity (gallons)	Minimum Distance from Nearest Important Building on Same Property (feet)	Minimum Distance from Nearest Fuel Dispenser (feet)	Minimum Distance from Lot Line that is or Can Be Built Upon, Including the Opposite Side of a Public Way (feet)	Minimum Distance from Nearest Side of any Public Way (feet)	Minimum Distance Between Tanks (feet)
Class I PAST	≤6,000	5	25 [a]	15	5	3
	>6,000	15	25 [a]	25	15	3
Class II and III PAST	Same as Class I	Same as Class I	Same as Class I [c]	Same as Class I	Same as Class I	Same as Class I
Tanks in vaults	0 – 20,000	0 [b]	0	0 [b]	0	Separate compartment required for each tank
Other tanks	All	50	50	100	50	3

a. At fleet vehicle motor fuel-dispensing facilities, no minimum separation distance is required.
b. Underground vaults shall be located such that they will not be subject to loading from nearby adjacent structures, or they shall be designed to accommodate applied loads from existing or future structures that can be built nearby.
c. For Class IIIB liquids in protected above-ground tanks, no minimum separation distance is required.

206

Above-ground Fuel Storage §2306.2

- Protected above-ground storage tank
  - Allowed for Class I, II or III fuels
- Above-g anks
  - Allowe
- Other ta
  - Allowe
  - Allowe or IIIA, by FC

207

Dispensers, Piping & Equipment

- Protected from physical damage
- Dispensers & nozzles listed for product
- Dispenser hose ≤18’
- Breakaway devices
- Automatic closing nozzles
- Class I cannot be dispensed by gravity

208

Alcohol-blended Fuels §2306.8

- Dispensers shall be listed
- UL 87A
  - *Outline of Investigation for Power-Operated Dispensing Devices for Gasoline and Gasoline/Ethanol Blends with Nominal Ethanol Concentrations up to 85%*
- Dispensers for alcohol-blended fuels shall be marked

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209

Location of LP-gas Dispensing

- The point of transfer for LP-gas dispensing operations must be 25' or more from:
  - Buildings having combustible exterior wall surfaces
  - Buildings having noncombustible exterior wall surfaces that are not part of a 1-HR fire-resistance-rated assembly
  - Buildings having combustible overhangs
  - Lot lines of property which could be built on
  - Public streets
  - Sidewalks
  - Railroads

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210

LP-Gas Container Locations

Table 6104.3
Location of LP-gas Containers

LP-Gas Container Capacity (water gallons)	Minimum Separation Between LP-gas Containers and Buildings, Public Ways or Lot Lines of Adjoining Property that Can Be Built Upon		Minimum Separation Between LP-gas Containers[b,c] (feet)
	Mounded or Underground LP-gas Containers[a] (feet)	Above-ground LP-gas Containers[b] (feet)	
Less than 125[c,d]	10	5[e]	None
125 to 250	10	10	None
251 to 500	10	10	3
501 to 2,000	10	25[e,f]	3
2,001 to 30,000	50	50	5
30,001 to 70,000	50	75	(0.25 of sum of diameters of adjacent LP-gas containers)
70,001 to 90,000	50	100	
90,001 to 120,000	50	125	

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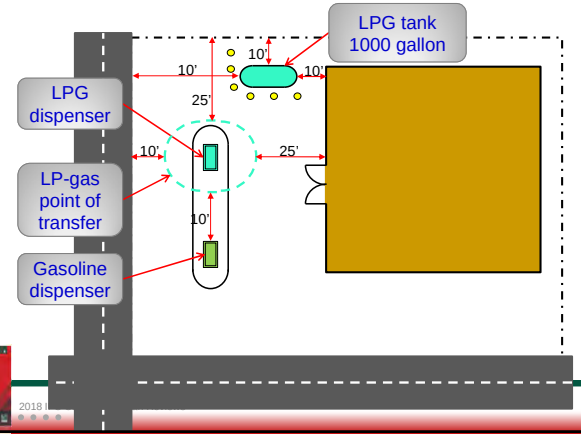
211

Liquefied Petroleum Gas Dispensing Operations



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212

Hydrogen Motor Fuel-Dispensing §2309

- Hydrogen is a flammable, colorless, odorless, compressed gas
- Packaged in cylinders at high pressure or generated on-site
- It poses an immediate fire and explosive hazard when concentrations ≥4%
- It is much lighter than air – vapor density = 0.07
- Burns with an invisible flame, until it is contaminated with other particulates

213

Gaseous Hydrogen Installations

- Cylinders, containers, tanks, pressure relief devices, vaporizers, pressure regulators and piping used for gaseous hydrogen systems shall be designed and constructed in accordance with Ch 53 & 58
- For liquefied hydrogen systems – constructed in accordance with Ch 55 & 58
- Components must be listed and labeled for use with hydrogen

214

Repair Garages §2311.1

- Repair garages shall comply with §2311 and the IBC for Group S-1
  - Unless they exceed the MAQ for materials presenting a physical hazard
- Where a repair garage also includes a motor fuel-dispensing facility, the fuel-dispensing operation shall comply with the requirements of Ch 23 for motor fuel-dispensing facilities

215

Repair Garages §2311.2

- Garage floor drains, where provided, shall drain to approved oil separators or traps discharging to a sewer in accordance with the IPC
- Tanks storing Class IIIB combustible liquids can be located above grade or below grade, provided adequate drainage or containment is provided

216

Ventilation of Basements or Pits §2311.4.3

- Where Class I liquids or LP-gas are stored or used within a building having a basement or pit wherein flammable vapors could accumulate, the basement or pit shall be provided with mechanical ventilation
  - ≥1.5 cfm/ft² to prevent the accumulation of flammable vapors

2018 IFC Commercial Plan Reviews 217

217

Special Ventilation Considerations §2311.7

- Mechanical ventilation system is required in repair garages for the conversion or repair of vehicles that use lighter-than-air fuels such as:
  - CNG
  - LNG
  - Hydrogen

Not required in repair garages where work is not performed on the fuel system ***and*** is limited to exchange of parts and maintenance requiring no open flame or welding

For hydrogen-fueled vehicles, ventilation is not required in repair garages where work is not performed on the fuel system ***and*** is limited to exchange of parts and maintenance requiring no open flame or welding ***and*** the entire hydrogen fuel system contains <200 ft³ of hydrogen

2018 IFC Commercial Plan Reviews 218

218

Special Ventilation Considerations §2311.7

- Ventilation shall be:
  - Continuous mechanical ventilation system, ***OR***
  - Mechanical ventilation activated by a gas detection system
    - Gas detection system threshold of 25% LFL
- Activation of gas detection system shall:
  - Initiate a distinct audible and visual alarm
  - Deactivate all heating systems in the repair garage
  - Activate the mechanical ventilation system, where the system is interlocked

2018 IFC Commercial Plan Reviews 219

219

High-piled Combustible Storage Ch 32

- Storage height >12'
  - Storage height >6' for high hazard commodities
- The plans shall include the following:
  - Commodity class
  - Storage arrangement
  - Aisle widths
  - Flue spaces
  - Fire protection features
  - Additional information as required by FCO

2018 IFC Commercial Plan Reviews 220

220

Commodity Classification §3203

Class	Description
I	Essentially noncombustible products on wooden pallets, in ordinary corrugated cartons with or without single-thickness dividers, or in ordinary paper wrappings with or without pallets. Class I commodities are allowed to contain a limited amount of Group A plastics.
II	Class I products stored in slatted wooden crates, solid wooden boxes, multiple- thickness pape[illegible] pallets. Class II com[illegible]
III	Wo[illegible] ithout pallets. Pro[illegible] metal bicycles with plastic handles, pedals, seats and tires. The amount of Group A plastics is limited.
IV	Class I, II or III products containing Group A plastics in ordinary corrugated cartons and Class I, II and III products, with Group A plastic packaging, with or without pallets. Group B plastics and free-flowing Group A plastics are also included in this class.
High Hazard	High-hazard products presenting special fire hazards beyond those of Class I, II, III or IV. Group A plastics not otherwise classified are included in this class.

- "Commodity" is more than just the item stored
- It includes a "combination of products, packing materials and containers"

221

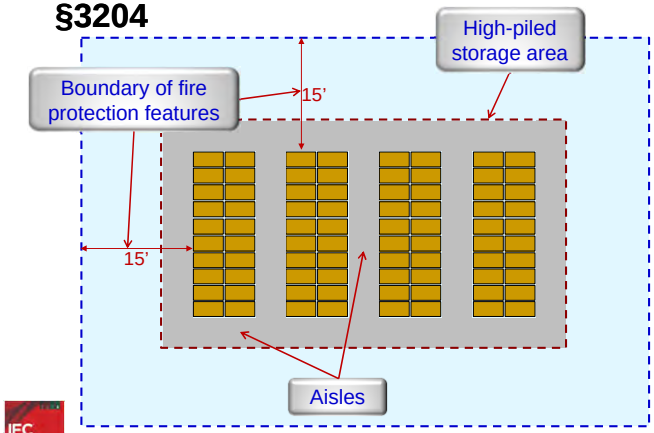
Commodity Classification §3203

- Plastic commodities present an additional hazard
- Classified based on heat release rate

Group	Characteristics
A	Plastic materials having a heat of combustion that is much higher than that of ordinary combustibles, and a burning rate higher than that of Group B plastics.
B	Plastic materials having a heat of combustion and a burning rate higher than that of ordinary combustibles, but not as high as those of Group A plastics.
C	Plastic materials having a heat of combustion and a burning rate similar to those of ordinary combustibles.

222

High-piled Storage Area §3204



223

Fire Protection Requirements

Table 3206.2 – General Fire Protection and Life Safety Requirements

Commodity class	Size of high-piled storage area[a] (square feet) (see §3206.2 and §3206.4)	All storage areas (See §3206, 3207 and 3208)[b]				Solid-piled storage, shelf storage and palletized storage (see §3207.3)		
		Automatic fire-extinguishing system (see §3206.4)	Fire detection system (see §3206.5)	Building access (see §3206.6)	Smoke and heat removal (see §3206.7)	Maximum pile dimension[c] (feet)	Maximum permissible storage height[d] (feet)	Maximum pile volume (cubic feet)
I-IV	0–500	Not Required[a]	Not Required	Not Required[e]	Not Required	Not Required	Not Required	Not Required
	(Option 1)							100,000
								400,000
								400,000
	2,501–12,000 Nonpublic accessible (Option 2)	Not Required[a]	Yes	Yes	Yes[i]	100	30[f]	200,000
	12,001–20,000	Yes	Not Required	Yes	Yes[i]	100	40	400,000
	20,001–500,000	Yes	Not Required	Yes	Yes[i]	100	40	400,000
	>500,000[g]	Yes	Not Required	Yes	Yes[i]	100	40	400,000

g. Special fire protection provisions, including but not limited to, fire protection of exposed steel columns; increased sprinkler density; additional in-rack sprinklers, without associated reductions in ceiling sprinkler density; or additional FD hose connections, shall be provided when required by the FCO.

224

Fire Protection Requirements

Table 3206.2 – General Fire Protection and Life Safety Requirements

Commodity class	Size of high-piled storage area[a] (square feet) (see §3206.2 and §3206.4)	All storage areas (See §3206, 3207 and 3208)[b]				Solid-piled storage, shelf storage and palletized storage (see §3207.3)		
		Automatic fire-extinguishing system (see §3206.4)	Fire detection system (see §3206.5)	Building access (see §3206.6)	Smoke and heat removal (see §3206.7)	Maximum pile dimension[c] (feet)	Maximum permissible storage height[d] (feet)	Maximum pile volume (cubic feet)
High-hazard	0-5[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	501-[illegible] Pe[illegible] acce[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	501-[illegible] Nor[illegible] acce[illegible] (Opt[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	501-[illegible] Nor[illegible] acce[illegible] (Option 2)	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	2,501–300,000	Yes	Not Required	Yes	Yes[j]	50	30	75,000
	300,001–500,000[g,h]	Yes	Not Required	Yes	Yes[j]	50	30	75,000

g. Special fire protection provisions, including but not limited to, fire protection of exposed steel columns; increased sprinkler density; additional in-rack sprinklers, without associated reductions in ceiling sprinkler density; or additional FD hose connections, shall be provided when required by the FCO.

h. High-piled storage areas shall not exceed 500,000 ft². A 2-HR fire wall shall be used to divide high-piled storage >500,000 ft² in area.

225

226

General Haz Mat Provisions Ch 50

- Applies to all haz mat, including those materials regulated elsewhere in this code
- When specific requirements are provided in other chapters, those specific requirements shall apply
  - Example, the control and protection requirements for compressed gases are found both in Ch 50 and 53
  - Where Ch 53 has specific requirements, those specific requirements take precedence over general provisions in Ch 50

227

Physical Hazards

- Explosives and blasting agents
- Combustible liquids
- Flammable solids, liquids or gases
- Organic peroxide solids or liquids
- Oxidizer solids or liquids
- Oxidizer gases
- Pyrophoric solids, liquids or gases
- Unstable (reactive) solids, liquids or gases
- Water-reactive materials solids and liquids
- Cryogenic fluids

228

Health Hazards

- These material categories are classified as health hazards:
  - Highly toxic solids, liquids or gases
  - Toxic solids, liquids or gases
  - Corrosive solids, liquids or gases
- A material with a primary classification as a health hazard can also pose a physical hazard

229

Hazardous Materials Maximum Allowable Quantities

Excerpt from

Table 5003.1.1(1) Maximum Allowable Quantity per Control Area of Hazardous Materials Posing a Physical Hazard [a,j,m,n,p]

Material	Class	Group when the MAQ is Exceeded	Storage[b]			Use-Closed System[b]			Use-Open Systems[b]	
			Solid Lbs. (cubic feet)	Liquid Gallons (pounds)	Gas Cubic Feet at NTP	Solid Lbs. (cubic feet)	Liquid Gallons (pounds)	Gas Cubic Feet at NTP	Solid Lbs. (cubic feet)	Liquid Gallons (pounds)
Combustible liquid[c,i]	II	H-2 or H-3	N/A	120[d,e]	N/A	N/A	120[d]	N/A	N/A	30[d]
Oxidizer	2	H-3	250[d,e]	(250)[d,e]	N/A	250[d]	(250)[d]	N/A	50[d]	(50)[d]

230

Hazardous Materials Maximum Allowable Quantities

- ***Read*** the Footnotes

Table 5003.1.1(1) Maximum Allowable Quantity per Control Area of Hazardous Materials Posing a Physical Hazard [a,j,m,n,p]

Material	Class	Group when the MAQ is Exceeded	Storage[b]			Use-Closed System[b]			Use-Open Systems[b]	
			Solid Lbs. (cubic feet)	Liquid Gallons (pounds)	Gas Cubic Feet at NTP	Solid Lbs. (cubic feet)	Liquid Gallons (pounds)	Gas Cubic Feet at NTP	Solid Lbs. (cubic feet)	Liquid Gallons (pounds)
Combustible liquid[c,i]	II	H-2 or H-3	N/A	120[d,e]	N/A	N/A	120[d]	N/A	N/A	30[d]
Oxidizer	2	H-3	250[d,e]	(250)[d,e]	N/A	250[d]	(250)[d]	N/A	50[d]	(50)[d]

231

Footnotes to Table 5003.1.1(1)

- b – a UL 1313 quantity shall not ex UL 30 torage
- d – increase 100% for sprinklers

cabinets, gas rooms, day
closures, safety cans
can be used together
is so designed
FPA 13)

232

Footnotes to Table 5003.1.1(1)

- l – fireworks 1.4G based on 25% of gross weight
-
-
-
-

§104.7.2 Technical assistance. To determine the acceptability of technologies, processes, products, facilities, materials and uses attending the design, operation or use of a building or premises…the FCO is authorized to require the owner or agent to provide, without charge to the jurisdiction, a technical opinion and report. The…report shall be prepared by a qualified engineer, specialist, laboratory or fire safety specialty organization acceptable to the FCO and shall analyze the fire safety properties of the design, operation or use…to recommend necessary changes. The FCO is authorized to require design submittals to be prepared by, and bear the stamp of, a registered design professional.

233

REFER TO CODE BOOK

Table 5003.11.1

Table 5003.11.1
Maximum Allowable Quantity Per Indoor and Outdoor Control Area in Group M And S Occupancies – Nonflammable Solids, Nonflammable and Noncombustible Liquids [d,e,f]

Condition		Maximum Allowable Quantity per Control Area	
Material [a]	Class	Solids pounds	Liquids gallons
A. Health Hazard Materials—Nonflammable and Noncombustible Solids and Liquids			
1. Corrosives [b,c]	Not Applicable	9,750	975
1. Highly Toxics	Not Applicable	20 [b,c]	2 [b,c]
1. Toxics [b,c]	Not Applicable	1,000	100
A. Physical Hazard Materials—Nonflammable and Noncombustible Solids and Liquids			
1. Oxidizers [b,c]	4	Not Allowed	Not Allowed
	3	1,150 [g]	115
	2	2,250 [h]	225
	1	18,000 [i,j]	1,800 [i,j]
1. Unstable (Reactives) [b,c]	4	Not Allowed	Not Allowed
	3	550	55
	2	1,150	115
	1	Not Limited	Not Limited
1. Water Reactives	3 [b,c]	550	55
	2 [b,c]	1,150	115
	1	Not Limited	Not Limited

234

Additional Requirements in Groups M and S §5003.11.3

- Specific requirements for storage and display of hazardous materials in Group M and S
  - Display heights limited to 6'
  - Storage heights limited to 8'
  - Maximum of 20 gallon/ft²
  - Maximum of 200 lbs/ft²
  - Container volumes are limited to 100 lbs for solids or 10 gallons for liquids
  - 4' wide aisles on 3 sides of the storage or display area

235

REFER TO CODE BOOK

Table 5003.8.3.2

Control Areas Table 5003.8.3.2

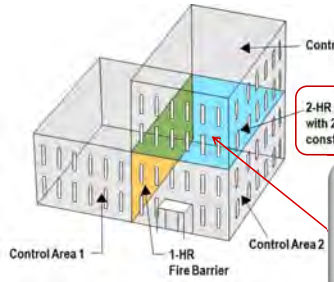
- Number of control areas based on floor level
- Modified MAQ as the floor level moves away from grade
- Fire-resistance-rating based on floor level

Floor Level		Percentage of the Maximum Allowable Quantity Per Control Area[a]	Number of Control Areas Per Floor	Fire-Resistance Rating for Fire Barriers in Hours[b]
Above grade plane	Higher than 9	5	1	2
	7-9	5	2	2
	6	12.5	2	2
	5	12.5	2	2
	4	12.5	2	2
	3	50	2	1
	2	75	3	1
	1	100	4	1
Below grade plane	1	75	3	1
	2	50	2	1
	Lower than 2	Not Allowed	Not Allowed	Not Allowed

236

Control Area Construction

- Control areas are separated by fire barriers, horizontal assemblies, or both



Can be reduced to 1-HR for buildings of Type IIA, IIIA and VA construction provided that the building is equipped with a fire sprinkler system and ≤3 stories

237

Gas Rooms for Toxic & Highly Toxic Gases §5003.8.4

- A gas room provided for highly toxic and toxic materials, shall be protected with a fire sprinkler system
  - Separated from the remainder of the building in accordance with the IBC based on occupancy classification
  - Gas room occupancy classification could be H-4, or a combination of H-2/H-4 or H-3/H-4
  - Ventilation system designed to operate at a negative pressure in relation to the surrounding area
  - Ventilation system installed in accordance with IMC

238

Exhausted Enclosures §5003.8.5.1

- Exhausted enclosures are commonly called "fume hoods" or "lab hoods"
  - Exhausted enclosure shall be [illegible] construction where it is [illegible]
    - Increase the MAQ per [illegible]
    - Comply with the provisions [illegible] toxic materials
  - Ventilation system for fume ho[illegible] at a negative pressure in relation to [illegible] area
    - For highly toxic and toxic ga[illegible] elocity at the face of access ports [illegible]

239

Gas Cabinets §5003.8.6.1

- Gas cabinet shall be a minimum of No.12 gage steel construction
- All access ports or doors into the gas cabinet must have self-closing doors or windows
- Ventilation system must be designed to operate at a negative p[illegible]ing area
- The gas c[illegible] xhaust system, a[illegible]ns of exhaust fo[illegible]
- The ventilation system shall be installed in accordance with IMC

Gas cabinets for toxic or highly toxic gases shall be protected by an approved automatic fire-extinguishing system

240

Case Study 1
Maximum Allowable Quantity

- A new factory is moving into an existing building. The existing building is a 22,000 ft² Group F-1with a sprinkler system. The building is separated into 4 compartments by 1-HR fire-resistance-rated construction with 1-HR doors. The company plans to use one compartment for offices, one for raw product, one for processing and one for finished product.
  - Liquid Organic Peroxide Class III
  - 2 gallon containers
  - Maximum in storage at any time of 40 gallons
  - Open top blending vat utilizes 4 gallons of the Organic Peroxide Class III at any one time
  - Finished product is considered non-hazardous

2018 IFC Commercial Plan Reviews 241

241

Case Study 1
Maximum Allowable Quantity

1. What is the MAQ in the storage room?

   250 pounds = 25 gallons

2. What is the MAQ in the mixing area?

   50 pounds = 5 gallons

3. What is the occupancy classification?

   Mixing area: F-1
   Storage room: H-3

Office	Finished Product
Raw Product Storage	Mixing Area

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242

Case Study 1
Maximum Allowable Quantity

4. The local Economic Development corporation has assured this new company coming to town that this building is just right for their operation. Is there a way to make this building work without an occupancy reclassification to a Group H occupancy?

   Storage in Haz Mat Storage Cabinets
   Storage Room MAQ becomes 50 gallons
   So still F-1

Office	Finished Product
Raw Product Storage	Mixing Area

2018 IFC Commercial Plan Reviews 243

243

Case Study 2
Retail MAQ

- The Agua Fresh Pool Supply Center is moving into a sprinklered retail strip center. The main product they carry is swimming pool chemicals in powder form and tablet form. The chemicals are classified as Oxidizer Class 3. The pool chemicals are sold in 10 pound and 30 pound tubs.

			Aqua Fresh Pool Supply Center	

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244

CASE STUDY

Case Study 2
Retail MAQ

1. What is the MAQ for this retail occupancy? — 2,250 pounds Table 5003.11
2. Can the 10-pound tubs be displayed on shelving? — YES §5003.11.3.3
3. What is the maximum storage height on the display floor for the 30-pound tubs? — 6' §5003.11.3.2

			Aqua Fresh Pool Supply Center	

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245

Spill Control
§5004.2.1

- Spill control required for liquids in storage or use
  IF
  - Individual vessel capacity >55 gallons, ***OR***
  - Aggregate capacity >1,000 gallons
- Contain largest single vessel

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2018 IFC Commercial Plan Reviews Workbook Page 74 246

246

Secondary Containment
§5004.2.2

- Secondary containment required when:
  - Specified by IFC Table 5004.2.2, ***AND***
  - Quantities exceed MAQ, ***AND***
  - For liquids:
    - Individual container >55 gallons
    - Aggregate >1,000 gallons
  - For solids:
    - Individual package >550 pounds
    - Aggregate >10,000 pounds

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2018 IFC Commercial Plan Reviews Workbook Page 75 247

247

Secondary Containment for Liquids
Table 5004.2.2 – *excerpts*

Material		Indoor Storage		Outdoor Storage	
		Solids	Liquids	Solids	Liquids
1. Physical-hazard materials					
Combustible liquids	Class II	Not Applicable	See Chapter 57	Not Applicable	See Chapter 57
Flammable solids		Not Required	Not Applicable	Not Required	Not Applicable
Organic peroxides	Unclassified Detonable Class I Class II Class III Class IV	Required	Required	Not Required	Not Required
	Class V	Not Required	Not Required	Not Required	Not Required
Oxidizers	Class 4 Class 3 Class 2	Required	Required	Required	Required
	Class 1	Not Required	Not Required	Not Required	Not Required
Pyrophorics		Not Required	Required	Not Required	Required
Unstable (reactives)	Class 4 Class 3 Class 2	Required	Required	Required	Required
	Class 1	Not Required	Not Required	Not Required	Not Required
Water reactives	Class 3 Class 2	Required	Required	Required	Required
	Class 1	Not Required	Not Required	Not Required	Not Required
2. Health-hazard materials					
Corrosives		Not Required	Required	Not Required	Required
Highly toxics Toxics		Required	Required	Required	Required

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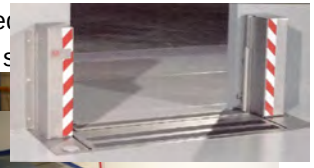
248

Secondary Containment §5004.2.2.1

- Methods of secondary containment
  - Liquid-tight sloped or recessed
  - Liquid-tight floors with raised s
  - Sumps and collection s
  - Drainage systems
  - 



249

Secondary Containment Design – *Indoor* §5004.2.2.3

- Sized to contain:
  - Volume of the largest container
  - The sprinkler design discharge density
  - The area of the Group H occupancy or the design area of the automatic sprinkler system, whichever is smaller
  - 20 minutes of sprinkler flow

250

Secondary Containment Design – *Outdoor* §5004.2.2.4

- Sized to contain:
  - Volume of the largest container
  - Rainfall from 24-hours of a 25-year storm
- Approved monitoring method required where subject to the intrusion of water
- Method provided to drain containment

Enforce the codes and abate hazardous conditions

251

Flammable and Combustible Liquids §5701.2

- Does ***NOT*** apply to:
  - Flammable liquids in motor fuel-dispensing facilities, repair garages, airports and marinas
  - Medicines, foodstuffs, cosmetics, and commercial, institutional and industrial products in the same concentration and packaging containing ≤50% by volume of water-miscible liquids and with the remainder of the solution not being flammable, and alcoholic beverages in retail or wholesale sales or storage uses when packaged in individual containers ≤1.3 gallons

252

Open Systems §202

- The use of a solid or liquid hazardous material involving a vessel or system that is continuously open to the atmosphere during normal operations and where vapors are liberated, or the product is exposed to the atmosphere during normal operations
  - Examples: include dispensing from or into open beakers or containers, dip tank and plating tank operations

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253

Closed Systems §202

- The use of a solid or liquid hazardous material involving a closed vessel or system that remains closed during normal operations where vapors emitted by the product are not liberated outside of the vessel or system and the product is not exposed to the atmosphere during normal operations; and all uses of compressed gases.
  - Examples: include product conveyed through a piping system into a closed vessel, system or piece of equipment

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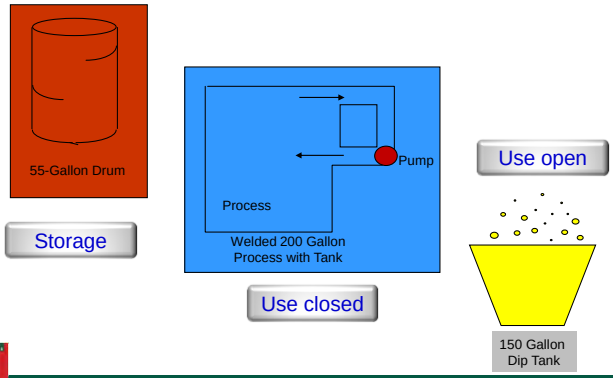
254

Storage, Use-closed, Use-open?



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255

Electrical Requirements for Flammable and Combustible Liquid

- Electrical wiring and equipment shall be installed and maintained in accordance with §605 and NFPA 70
- Areas where flammable liquids are stored, handled, dispensed or mixed must be classified in accordance with Table 5703.1.1
- A classified area need not extend beyond an u

The extent of the classified area is allowed to be reduced, or eliminated, where sufficient technical justification is provided to the FCO that a concentration >25% percent of the LFL in the area cannot be generated

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256

Electrical Requirements for Flammable and Combustible Liquid

- Areas where Class II or III liquids are heated above their flash points will be classified Class I
- The FCO is authorized to determine the extent of the Class I electrical equipment and wiring location when a condition is not specifically covered by these requirements or NFPA 70

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257

Group H-2 §202

- Group H-2 occupancies contain
  - Materials that pose a deflagration hazard or a hazard from accelerated burning,
    - Class I, or II or III-A flammable or combustible liquids
- Materials used or stored
  - Normally open containers or systems,
  - Closed containers, or
  - Systems pressurized at more than 15 psig

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258

Group H-3 §202

- Group H-3 occupancies contain:
  - Materials that readily support combustion or that pose a physical hazard
    - Class I, II or IIIA flammable or combustible liquids
- Materials used or stored
  - Normally closed containers, or
  - Systems pressurized at 15 psig or less

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259

Liquid Storage Rooms & Liquid Storage Warehouses

- Both are classified as Group H-3
- Both are u r combustib
- **Liquid st** m the remainde BC
- **Liquid st** lding, not part of a r

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260

REFER TO CODE BOOK

Table 5704.3.6.3(2)

Table 5704.3.6.3(2)
Storage Arrangements for Palletized or Solid-pile Storage in Liquid Storage Rooms and Warehouses

CLASS	STORAGE LEVEL	MAXIMUM STORAGE HEIGHT			MAXIMUM QUANTITY PER PILE (gallons)		MAXIMUM QUANTITY PER ROOM [a] (gallons)	
		Drums	Containers [b] (feet)	Portable tanks [b] (feet)	Containers	Portable tanks	Containers	Portable tanks
IA	Ground floor	1	5	Not Allowed	3,000	Not Allowed	12,000	Not Allowed
	Upper floors	1	5	Not Allowed	2,000	Not Allowed	8,000	Not Allowed
	Basements	0	Not Allowed	Not Allowed	Not Allowed	Not Allowed	Not Allowed	Not Allowed
	Ground floor	1	6.5	7	5,000	20,000	15,000	40,000
							12,000	20,000
							Not Allowed	Not Allowed
							15,000	40,000
							12,000	20,000
							Not Allowed	Not Allowed
							25,000	80,000
							25,000	80,000
	Basements	1	5	7	7,500	20,000	7,500	20,000
III	Ground floor	5	20	14	15,000	60,000	50,000	100,000
	Upper floors	5	20	14	15,000	60,000	50,000	100,000
	Basements	3	10	7	10,000	20,000	25,000	40,000

- When quantity is exceeded, then Liquid Storage Warehouse is required
- Liquid Storage Warehouse is a separate building

- Only applicable to Liquid Storage Rooms
- Does ***NOT*** apply in Liquid Storage Warehouses

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261

Use, Dispensing and Handling §5005

- Spill control
- Secondary containment
- Limit controls

- Temperature
- Pressure
- High level
- Low level

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2018 IFC Commercial Plan Reviews Workbook Page 84 262

262

Liquid Transfer §5005.1.10

- Transferring liquids with a
  or 4 shall be:
  - Safety cans – UL 30
  - Closed piping systems
  - By suction through a top
    tanks
  - By gravity throu
    valve when the
    secondary con
    - Highly toxic

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2018 IFC Commercial Plan Reviews Workbook Page 85 263

263

Indoor Dispensing and *Use-Open* §5005.2.1

- Mechanical ventilation when a NFPA 704 ranking of 3 or 4
- Process
- Explosio
- Spill con
  - Dispen
  - Open-u
- Seconda
  - Individu
    when required by Table 5005.2.1.4

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2018 IFC Commercial Plan Reviews Workbook Page 85 264

264

Indoor Dispensing and *Use-Closed* §5005.2.2

- Mechanical ventilation when systems are routinely opened
- Process limit controls
- Expl
- Spill
  - Di
- Seco
  - In
    wh

and

NOTE: different table for "use" versus "storage"

265

Piping, Tubing, Valves and Fittings §5003.2.2

- Piping, tubing, valves and fittings
- must be designed with adequate
- strength and materials compatible
- with the material contained
- Piping identified in accordance
- with ASME A13.1
- Excess flow control for health or reactivity hazards with a NFPA 704 ranking of "3" or "4" or a NFPA 704 flammability rating of "4"
- Check valves or similar means of backflow prevention if a backflow could cause an unauthorized discharge

266

Final Reflection

- **Purpose:** To reflect on today's seminar and document your key points.
- *What (Happened)?*
  - What was the most important thing you learned today?
- *So What (Does it Mean to You)?*
  - Why is this information important for you to know?
- *Now What (Are You Going to Do)?*
  - How will you use this information at work?

267

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268

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269

269

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270

270