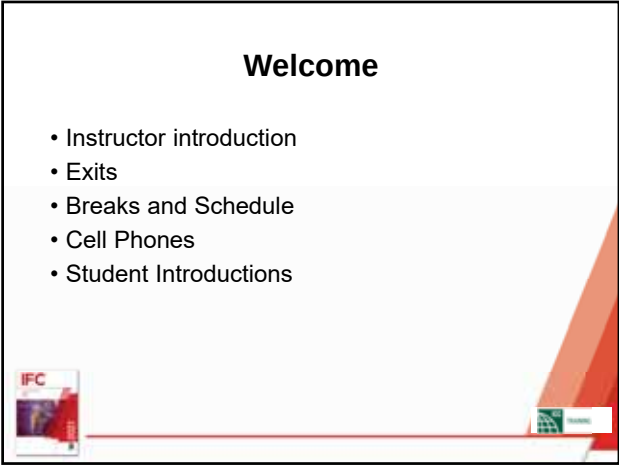
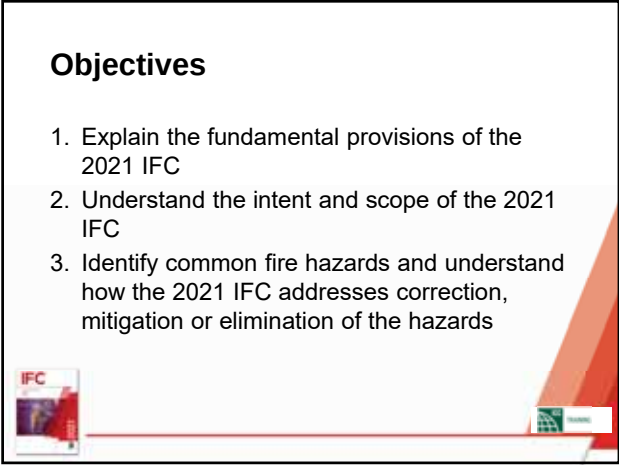




1



3



4

Objectives

- 4. Understand how life safety and fire protection issues are addressed in building design and construction
- 5. Understand how the 2021 IFC applies to maintenance of building design and components to maintain fire and life safety
- 6. Understand how the 2021 IFC addresses hazardous materials



5

Guide to a successful class:

- Slides contain some text and images to help you learn
- Follow along in the course handout
- Ask Questions, ask questions, ASK QUESTIONS!!!!





6

Prerequisite Understanding

- Occupancy classifications are based on the use and character of the building
- Requirements are based on the occupancy classification

A – Assembly

- A-1 fixed seating for entertainment
- A-2 drinking and dining establishments
- A-3 general assembly classification
- A-4 indoor sports facility

- F-1 moderate hazard factory
- F-2 low hazard factory

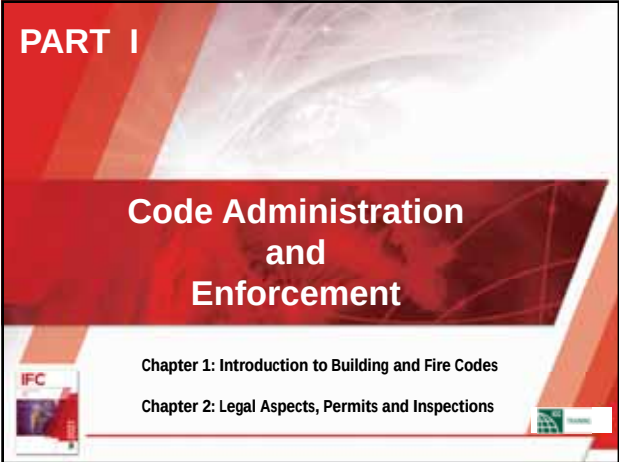
- S-1 high hazard
- S-2 low hazard

- I-1 high hazard
- I-2 low hazard

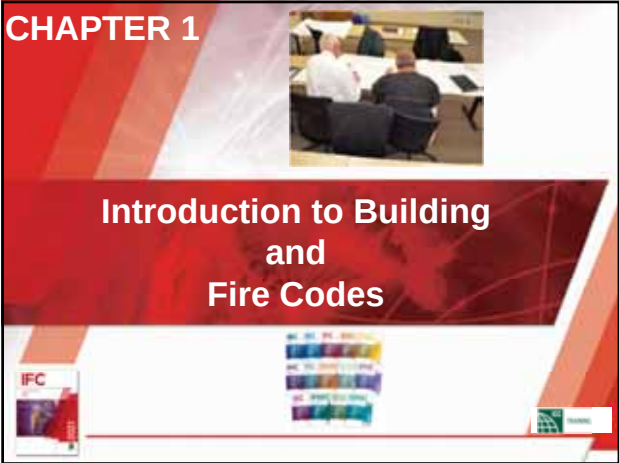
- U-1 high hazard
- U-2 low hazard



7



8



9



10

ICC Code Development Cycle

- New code published every 3 years
- 12 month code change cycles
- Codes divided into 2 groups
 - IBC, IFC, IFGC, IMC, IPC, IPMC, IPSDC, IRC, ISPC, IWUIC
 - Admin, IBC-S, IEBC, IECC, IgCC, IRC-B

• IFC is in Group A

• Code change cycle in 2018, 2021, etc.

Committee Action Hearing

Online Floor Motion Voting

Report of CAH

Public Comments submitted

Public Comments available

Public Comment Hearing

Online Governmental Consensus Vote

New edition published



Code change cycle as of March 1, 2018

11

IBC – International Building Code

- Applies to the construction, alteration, movement, enlargement, replacement, repair, equipment, removal and demolition of every building or structure or any appurtenances connected or attached to such buildings or structures
- Provides safety to life and property from fire and other hazards attributed to the built environment
- Provides safety to firefighters and emergency responders during emergency operations







12

IRC – International Residential Code

- Regulates 1- and 2-family dwellings, and townhouses
- Designed to be a stand-alone code for residential construction
- Combines all of the regulations for the building, energy, mechanical, fuel gas, plumbing and electrical into one document
- IFC is applicable to the exterior elements of IRC regulated buildings
 - Premises identification
 - Fire apparatus access
 - Water supplies







13

**IWUIC –
International Wildland-Urban Interface Code**

- Provides requirements for geographical areas where structures and development meet or intermingle with wildland or vegetative fuels
- Applies to mitigation of the risk to life and property loss from wildland fire
- Requires defensible space to protect the wildland from structure fires, and protect structures from wildland fires



14

**IMC –
International Mechanical Code**

- Applies to the design, installation, maintenance, alteration and inspection of permanent mechanical systems that are installed within buildings
- Covers:
 - Heating
 - Ventilation
 - Air-conditioning systems



15

**IGFC –
International Fuel Gas Code**

- Regulates the design, installation, maintenance, alteration and inspection of appliances that utilize natural gas and liquefied petroleum gas (LPG), gaseous hydrogen systems, and related accessories



16

IPMC – International Property Maintenance Code

- Provides for the maintenance of existing buildings and properties
- Provides minimum requirements for premises, structures, equipment, and facilities
- Addresses lighting, ventilation, space, heating, sanitation, life safety, and safety from fire and other hazards and for safe and sanitary maintenance





2018 IBC Essentials

17

Workbook Page 8



17

IFC – International Fire Code

- Provides a reasonable level of life safety and property protection from the hazards of fire, explosion or dangerous conditions in new and existing buildings and facilities
- Addresses design, construction, installation, testing and maintenance of fire protection systems
- Contains regulations for the safety of firefighters and emergency responders during emergency operations





2018 IBC Essentials

18

Workbook Page 9



18

Navigating the IFC

- 7 major parts to the IFC

Part	Title	Chapters
I	Administrative	1 – 2

IFC Chapter	Subject	IBC Chapter
7	Fire & Smoke Protection Features	7
8	Interior Finish, Decorative Materials & Furnishings	8
9	Fire Protection & Life Safety Systems	9
10	Means of Egress	10
33	Fire Safety During Construction & Demolition	33



2018 IBC Essentials

19

Workbook Page 10



19

Applicability §102.1

- IFC
- S
- th
- Existing structures,
 - facilities and conditions not legally in existence at the time the code is adopted
 - facilities and conditions when required by Chapter 11
- Existing structures, facilities and conditions which, in the opinion of the FCO, constitute a distinct hazard to life or property

*If the appendices are adopted:
Appendix K (ambulatory care facilities)
Appendix M (sprinklers in high-rise)*

after



20

Applicability §102.2

- IFC administrative, operational and maintenance requirements apply to:
 - New conditions and operations arising after the adoption of this code
 - Existing conditions and operations





21

Retroactive Application of Construction Requirements

- §102.1 Item 3 refers to Ch 11
- Ch 11 contains retroactive construction requirements for existing buildings
- Ch 11 establishes minimum safety requirements for existing buildings
 - Protection of open vertical shafts
 - Installation of a fire alarm system in buildings which represent a high life safety risk
 - Provide minimum egress door widths

- Ch 11 requirements are less restrictive than new construction requirements
- Ch 11 is designed to mitigate specific life hazards in existing buildings



22

Change of Use or Occupancy

§102.3

- The C of O can be used to verify the building's occupancy or use has not changed
- IFC generally prohibits a change of occupancy or use unless the change is done in conformance with the IBC
 - Some changes are allowed when:
 - It does not change the overall use or character of a building
 - It reduces the hazard





23

Historic Buildings

§102.6

- Historic buildings generally must be maintained in their original condition
- Historic buildings may lack fire safety features normally required for new buildings having the same occupancy classification
- Unless the building is a distinct hazard, the IFC requires that historic structures be provided with fire protection and life safety features based on an approved fire protection plan





24

Codes and Standards

§102.7

- “Codes” are documents that are adopted
 - Requirements in the code supersede the requirements in the referenced standard
 - It does not matter which is more ‘restrictive’
 - It is based on the hierarchy of the codes
- “Standards” are documents referenced in the codes
 - Tell people how to achieve what must be done
 - Referenced standards are in Ch 80









25

CHAPTER 2



Legal Aspects,
Permits and
Inspections



26

Appendices
§101.2.1

- Developed the same as main body of the code
- Some are designed to be adopted
- Some are designed to be adopted

- Appendix A Board of Appeals
- Appendix E Hazardous Materials
- Appendix F Hazard Ranking
- Appendix G Cryogenic Conversions
- Appendix I Non-compliant Fire Protection Systems
- Appendix J Building Information Signs
- Appendix K Ambulatory Care Facilities
- Appendix L Fire Fighter Air Replenishment Systems
- Appendix M Sprinklers in Existing High-rise
- Appendix N Indoor Trade Shows and Exhibitions



27

Authority §104

- Local jurisdiction creates the Department of Fire Prevention
- A Fire Code Official (FCO) is appointed to manage the fire prevention office
- Reviews plans, issues permits, inspects work to comply with code and plans
- Interprets code requirements
- Develops policies and procedures to clarify local application of the code

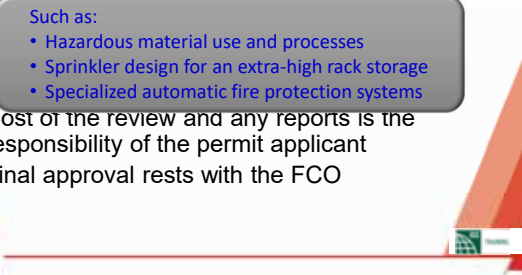


28

Technical Assistance

§104.8.2

- The code allows the FCO to obtain technical assistance when a plan or project involves a design or system that is complicated or unusual
- **Such as:**
 - Hazardous material use and processes
 - Sprinkler design for an extra-high rack storage
 - Specialized automatic fire protection systems
- Cost of the review and any reports is the responsibility of the permit applicant
- Final approval rests with the FCO

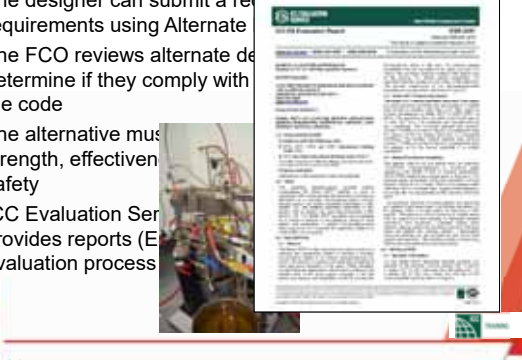


29

Alternate Materials and Methods

§104.10

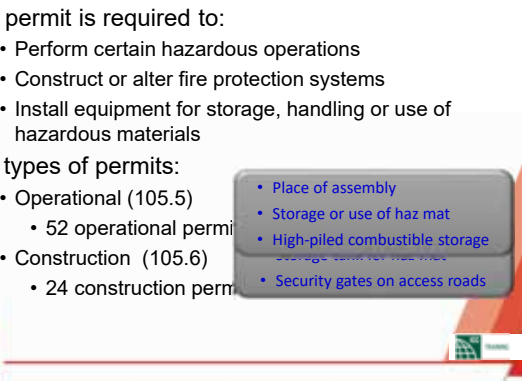
- The designer can submit a request for alternate materials and methods
- The FCO reviews alternate materials and methods to determine if they comply with the code
- The alternative must meet the same level of strength, effectiveness and safety
- ICC Evaluation Service provides reports (ETL) for the evaluation process



30

Permits §105

- A permit is required to:
 - Perform certain hazardous operations
 - Construct or alter fire protection systems
 - Install equipment for storage, handling or use of hazardous materials
- 2 types of permits:
 - Operational (105.5)
 - 52 operational permits
 - Construction (105.6)
 - 24 construction permits



31

Permits

§105

- It is very common for a particular facility or regulated use to require both a construction permit and an operational permit



- Installation of explosives magazine
- Storage, use and handling of explosives



- Installation of aboveground storage tanks
- Dispensing of flammable and combustible liquids



32

Permit Application

§105.2.4

- The FCO reviews the plans for compliance with the code and other jurisdictional requirements
- FCO can perform inspections of buildings, processes or systems
- This inspection may establish any operational constraints or limits

If the plans are found in compliance, a permit can be issued for the work

If the plans have discrepancies, a plan review report (compliance list) is provided to the applicant





33

Construction Documents §106

- Drawings
- Specifications
- Prepared by a registered design professional where required by the statutes of the state or jurisdiction
 - FCO can waive this requirement
 - when the work does not require
 - a registered design professional
- Manufacturer's installation instructions





34

Inspections §108

- Inspectors check the installation to confirm conformance with the approved design documents
- Inspectors evaluate fire protection systems to confirm installation according to design standards
- An inspection may be required for licensing of day care and health care occupancies
- An inspection is required before an operational permit can be issued



35

Right of Entry

- Permission to perform the inspection must be obtained from the property owner, tenant or an individual with authority over the business, building or site
- A person inspecting a building must carry identification and a copy of the 4th Amendment to the U.S. Constitution
- U.S. Supreme Court decision in *Illinois v. Lafayette* (1983) established that a business may request a copy of the legal basis for an inspection – IFC §106 and §104.3
- Once consent is granted, the inspection can proceed



36

Testing and Operation §109.2

- Fire protection and life safety systems are inspected, tested and approved at initial installation
- Owner is responsible to maintain the operational readiness of the system
 - Many systems require annual inspection or testing
 - Owner must maintain records
- Records must be available for review by FCO



37

Unsafe Buildings §114

- The FCO has the authority to require corrections to bring a building or system into compliance when a serious fire or life safety threat is found
- This authority extends to systems or items regulated by the IFC
- If the violation constitutes an imminent danger, the FCO is authorized to require the partial or complete evacuation of the building and prohibit re-entry



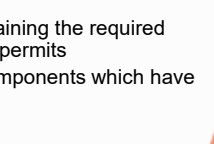
Photo courtesy of New Orleans Fire Department, LA



38

Stop Work Order §113

- The FCO is authorized to issue a Stop Work Order
- In the IFC, Stop Work Orders can be issued for:
 - Work performed without obtaining the required Operational or Construction permits
 - Work that has concealed components which have not yet been inspected
 - Work regulated by the IFC
- Stop Work Orders are an immediate order to stop





39

Board of Appeals §109

- The FCO is responsible for interpretation of the IFC
- A property or business owner has the right to legally challenge those interpretations
- The Board of Appeals evaluates the information against the IFC and makes a decision regarding the appeal
- The appeal is based on the Board of Appeals interpreting the code or has wrongly applied a code section
- The Board of Appeals cannot waive code requirements

Appendix A contains guidelines on establishing a Board of Appeals



40



Part I – Code Administration & Enforcement

1. T **F** The design and use of a building or property can never stray from the requirements found in the IFC.

False

The design and operation must meet the *intent* of the code; alternate methods approved by the fire code official are allowed.

2. T **F** All of the I-Codes work separately and independently of each other.

False

The I-Codes work as a set of codes, each applying to a specific portion of the facility.



41



Part I – Code Administration & Enforcement

3. After a building receives a Certificate of Occupancy, how often does the IFC require fire inspections to be conducted?

As often as deemed necessary

IFC §108.2

4. When the FCO arrives to conduct an inspection, the building owner refuses to allow the inspection. Does the FCO have the authority to demand the inspection? What options are there?

- Owner has the right to refuse the inspection
- FCO cannot demand inspection
- FCO can obtain an inspection warrant (administrative warrant)

IFC §104.3



42

PART II

General Safety Requirements

Chapter 3: General Precautions Against Fire

Chapter 4: Emergency Planning and Preparedness



43

CHAPTER 3



General Precautions
Against Fire



44

Combustible Waste Materials
§304

- Orderly storage
- Located away from ignition sources
- Separation from means of egress
- Separation from concealed spaces
- Dumpsters located $\geq 5'$ from combustible construction, wall openings and combustible roof eaves

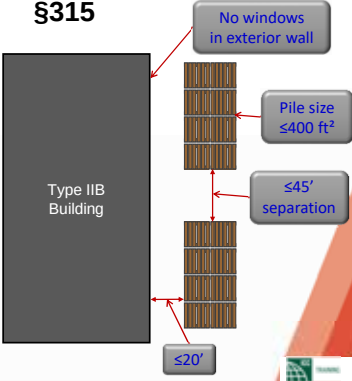




45

Outdoor Pallet Storage
§315

- Wood pallets
 - Table 315.7.6(1)
- Plastic pallets
 - Table 315.7.6(2)
- Listed plastic pallets should be considered under the table for wood pallets





46

Open Flames §308

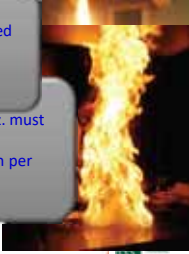
- Separation of uses and activities involving potential sources of open flames from combustible materials

- Pour 1 ounce at a time
- In the immediate vicinity of the table being served
- Not transported or carried while burning
- Wet towel immediately available

IFC §308.1.8

- Liquid- or solid-fueled lighting devices of >8 oz. must self-extinguish if tipped over
- Devices must not leak at a rate >0.25 teaspoon per minute if tipped over

IFC §308.3.1





47

Vacant Premises §311

- Safeguarding vacant buildings
 - Openings into the structure are unauthorized entry
 - Hazardous materials removed
 - Fire protection systems should be in service

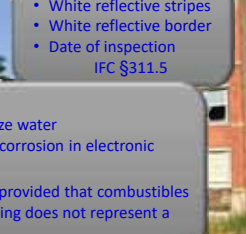
- 24" x 24"
- Red background
- White reflective stripes
- White reflective border
- Date of inspection

IFC §311.5

This can be difficult in:

1. Cold weather environments can freeze water
2. Hot, humid environments can cause corrosion in electronic components

FCO can permit systems to be disabled, provided that combustibles and haz mat are removed, and the building does not represent a hazard – IFC §311.2





48

Indoor Display of Vehicles §314

- ≤5 gallons or ¼ tank of fuel
- Fuel tank fill opening closed and sealed
- No fueling or defueling inside building
- Batteries disconnected?
 - Depends on vehicle and built-in safety features





49

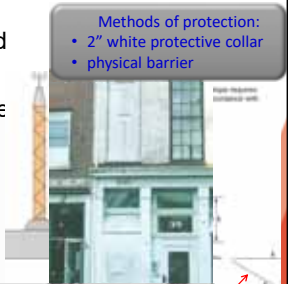
Hazards to Fire Fighters §316

- Trap doors must be closed
- Shaftway markings
- Obstructions <7' above the surface of a roof:
 - Must not create an obstruction, or
 - Must be protected or identified to emergency responders

Methods of protection:

- 2" white protective collar
- physical barrier

The provision applies to roofs with a slope of ≤30°



50

Rooftop Gardens and Landscaped Roofs §317

- Landscaped portion of the roof is limited in size
 - Maximum area of 15,625 ft²
 - Maximum dimension of 125'
- Additional landscaped areas
 - Separated by 6'
 - Roof rating of separation must be Class A

- When a standpipe is already provided in the building, it must be available to all landscaped areas
- Landscape maintenance plan required



51

Mobile Food Preparation Vehicles §319

- Permit required
- Cooking oil storage
 - Metallic tanks or listed nonmetallic
- Fire-extinguishing system if grease-laden vapors are produced
- Fuel gas storage



52

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17

CHAPTER 4



Emergency Planning and Preparedness



53

Public Assemblies and Events

§403

- Public assemblies and events can occur inside buildings or outdoors
- Public assemblies in other than Group A or E, the FCO can require a public safety plan
 - Fire apparatus access
 - Emergency medical response
 - Law enforcement
- Fire watch
- Crowd Managers
 - Crowd managers required when:
 - OL >500 inside a building
 - OL >1,000 for place of religious worship
 - OL >1,000 for outdoor event



54

Fire Safety and Evacuation Plans

§404

- Fire Safety & Evacuation Plans are required in:
 - Group A except for place of religious worship with OL of <2,000
 - Group B ambulatory care facility
 - Group B, F and M with an OL ≥500 or an OL >100 above or below the level of exit discharge
 - Group F – if required in pallet manufacturing or recycling facility
 - Group E, H, I, R-1, R-2 college & university buildings, and R-4
 - Covered malls and open malls >50,000 ft²
 - Underground buildings
 - Group A, E or M with an atrium
 - High-rise buildings of any occupancy
 - Buildings using occupant evacuation elevators
 - High-piled storage >500,000 Class I – IV, >300,000 high-hazard



55



Table 405.3
Page 4-9

Table 405.2 – Fire and Evacuation Drill Frequency and Participation

GROUP OR OCCUPANCY	FREQUENCY	PARTICIPATION
Group A	Quarterly	Staff
Group B ^a	Annually	All occupants
Group B (ACF)	Quarterly on Each Shift	Staff
Group B ^a (clinic, outpatient)	Annually	Staff
Group E	Monthly ^a	All occupants
Group F	Annually	Employees
Group I-1	Semiannually on each shift	All occupants
Group I-2	Quarterly on each shift	Staff
Group I-3	Quarterly on each shift ^a	Staff
Group I-4	Monthly on each shift	All occupants
Group R-1	Quarterly on each shift	Employees
Group R-2 ^b	Four annually	All occupants
Group R-4	Semiannually on each shift	All occupants

a. Emergency evacuation drills are required in Group B buildings having an occupant load ≥500 persons or >100 persons above or below the lowest level of exit discharge.
b. Emergency evacuation drills in Group R-2 college and university buildings shall be in accordance with §403.9.2.1. Other Group R-2 occupancies shall be in accordance with §403.9.2.2.

56



Part II General Safety Requirements

1. ☒ True ☐ False Open flame devices are prohibited in sleeping units of Group R-2 dormitories.

True
IFC §308.4.1

2. The fuel tanks in vehicles on display in a mall are limited to gallons, or capacity of the tank.

IFC §314.4

57



Part II General Safety Requirements

3. A Fire Safety and Evacuation Plan is required in a Group F occupancy when the total occupant load in the building is or more, or when there are or more above or below the level of exit discharge.

IFC §403.5

4. In the above Group F occupancy, evacuation drills are required , and all must participate in the drill.

IFC Table 405.3

58

PART III



Site and Building Services

IFC

Chapter 5: Fire Service Features
Chapter 6: Building Systems
Chapter 7: Interior Finish and Decorative Materials

59

CHAPTER 5



Fire Service Features

IFC

60

Fire Apparatus Access Roads

§503

- A fire apparatus access road is the road from the fire station to a facility, building or location
- Access road requirements are typically applied to private property
- Public roads are typically constructed to specifications developed by Public Works or Transportation Engineering department

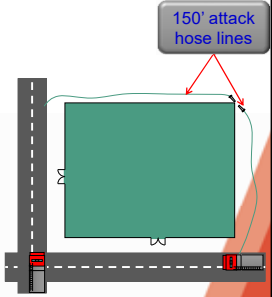
IFC

61

Fire Apparatus Access Roads

§503.1

- Fire apparatus access roads are required for any facility, building or portion of a building constructed or moved into the jurisdiction
 - Located ≤150' of all portions of the facility and the exterior walls of the 1st story of the building as measured by an approved route



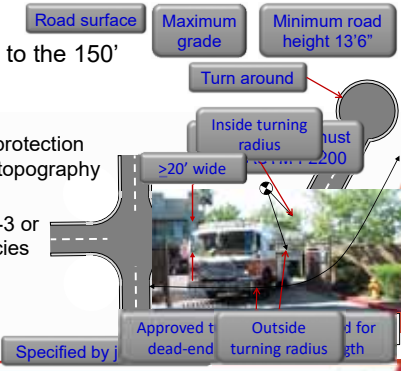
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62

Fire Apparatus Access Roads

§503

- Modifications to the 150' distance
 - Sprinklers
 - Alternative protection because of topography limitations
 - ≤2 Group R-3 or U occupancies



IFC

63

Fire Apparatus Access Roads

§503

- Design and construction
 - Appendix D

Many of the specific dimensions can be included in Appendix D.... if it is adopted

Requirement	Chapter 5	Appendix D
Minimum road width	20'	20'; 26' for aerial apparatus access
Maximum grade	As required by FCO	10%
Minimum turning radius	As required by FCO	As required by FCO
Turnaround design	Must be approved	Specific design criteria
Angle of approach/departure	As required by FCO	As required by FCO
Road surface	All weather	Asphalt, concrete or other approved surface
Road design	Support load of fire apparatus	Designed for vehicles with a weight of 75,000 pounds
Aerial apparatus access	Not specified	Buildings >30' in height
Fire lane signs	Must be approved	Minimum size, reflective background, specific design
Multiple access into subdivisions	When required by FCO	>30 units unless sprinklered

IFC

64

Access to Buildings §504

- Required exterior doors or openings must be maintained accessible for use by FD
 - Identification of riser rooms, electrical and mechanical rooms
- Key box – approved by the FCO
 - Location of the key box
 - Number of keys
 - Manufacturer of the key box
- Stairway to roof
 - Required when ≥4 stories
 - Stairway must be identified





65

Hazards to Firefighters §504, §316

- Doors to shaftways must be marked
 - Interior doors
 - Exterior doors
- Security devices which could harm or injure FF are prohibited
- Trapdoors or scuttles must be closed when not in use





66

Fire Protection Water Supplies §507

- As part of construction, facilities or buildings require a fire water supply capable of delivering the required fire flow for manual fire-fighting operations
- Determining required water supply
 - Appendix B
 - IWUIC
 - NFPA 1142
 - Iowa State University
 - National Fire Academy



67

Water Supply

- Relationship of fire sprinkler requirements and fire-flow requirements are addressed in Appendix B
 - Both must be met
 - Do not combine
 - Water supply must be able to provide both, but not simultaneously

Water Supply Curve

Flow (GPM)	Pressure (PSI)	Flow (GPM)	Pressure (PSI)
1425	34	1743	20

68

Water Source §507

- Tank, reservoir, pressurized water system
- Hydrant (or tank connection) within 400' of the 1st floor exterior walls of the building
 - Sprinklered buildings ≤600'
 - Group R-3 and U ≤600'
 - Add hydrants

69

Water Source

- System must be tested and maintained
- NFPA 25
 - Annual flow test and maintenance of private fire hydrants
 - Flow test private fire protection water mains every 5 years
- Minimum 3' clearance around hydrants
- Protection of hydrants required where subject to vehicle impact

70

Emergency Responder Radio Coverage §510

- Emergency responder radio coverage provisions are concerned with the reliability of portable radios used inside buildings
- Requires that all buildings have approved radio coverage in 95% of the building
 - Digital audio quality is evaluated
 - DAQ 3.0 (Delivered Audio Quality)
- If radio signals are not adequate, owner must install equipment to enhance signal



71

Emergency Responder Radio Coverage §510

- IFC provides performance criteria for complying with radio coverage requirements
 - Does not specify solution, but allows use of any appropriate technology
- Secondary power required
- Testing and maintenance requirements
- Must meet FCC compliance



72

Emergency Responder Radio Coverage §510

Delivered Audio Quality (DAQ)

DAQ 1: Transmission is unusable. Speech is present but unreadable.

DAQ 2: Speech is understandable with considerable effort. Frequent repetition is needed due to noise or distortion.

DAQ 3: Speech is understandable with slight effort. Occasional repetition is needed due to noise or distortion.

DAQ 3.5: Speech is understandable with slight effort. Occasional repetition is needed due to noise or distortion.

DAQ 4: Speech is easily understood. There is occasional noise or distortion.

DAQ 4.5: Speech is easily understood. There is infrequent noise or distortion.

DAQ 5: Speech is easily understood.



IFC Essentials
Workbook - Page 77

73

CHAPTER 6



Building Systems



74

Fuel-Fired Appliances
§605

- Apparatus or device using fuel gas or fuel oil
- Equipment must be installed in accordance with manufacturer's instructions
- Modifications must be in accordance with manufacturer's requirements
- Access is required so equipment can be maintained

Waste oil is used as the fuel in these burners



Photo courtesy of
Clean Burn Energy Systems
Leola, PA



75

Fuel Oil Inside Buildings
§605.4.2

- Aggregate fuel oil storage ≤660 gallons is allowed inside building in
 - Tanks allowed by Ch 57, or
 - Tanks integral to fuel burning equipment

≤660 gallons

Tank listed to:

- UL 80, or
- UL 142, or
- UL 2085

>660 and ≤1,320 gallons

Tank listed to:

- UL 142, or
- UL 2085

AND building is sprinklered with NFPA 13 system

>1,320 and ≤3,000 gallons

Tank listed to:

- UL 2085

AND room is sprinklered with NFPA 13 system





76

Fuel-fired Appliances *Inside* Buildings

§605.5

- Portable unvented fuel-fired appliances inside buildings
 - Prohibited in Groups A, E, I and R
 - Listed and approved heaters allowed in 1- and 2-family dwellings
 - Cannot be located inside sleeping rooms, bathrooms or closets



77

Portable Gas-Fired Heaters *Outside* Buildings

- Portable outdoor heaters allowed in outdoor locations
- Listed to ANSI Z83.26 Standard for Gas-Fired Outdoor Infrared Patio Heaters
 - Requires CGA 790 gas valve



5' separation to:

- Exits, or exit discharge
- Building wall
- Combustible decorations

Photo courtesy of Infrared Dynamics, Yorba Linda, CA

78

Mechanical Refrigeration

§608

- IFC regulates refrigeration systems with
 - Toxic refrigerants
 - Ammonia
 - Flammable refrigerants
 - New – Class 2L
 - “Lower flammability”
 - Still treated as flammable

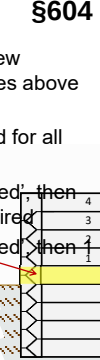


79

Elevators

§604

- Elevator required in new buildings with ≥4 stories above or below the LED
- Phase I and II required for all new elevators
- If elevators are 'required', then standby power is required
- If elevators are 'required', then standby power is required





80

Commercial Kitchen Hoods

§607

- Commercial cooking appliances require a local exhaust ventilation system to remove heat, vapors, steam, smoke and odors
- Type I hoods are designed to also remove of grease-laden vapors and smoke
- Extinguishing system is required when Type I hood is required





81

Commercial Hood Maintenance

Table 606.3.3.1

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

System is cleaned when inspection finds excess grease







82

Commercial Kitchen Cooking Oil Storage §607

- Storage of cooking oil in



Nonmetallic tanks ≤200 gallons

Nonmetallic tanks can be listed without emergency vent

Courtesy of Restaurant Technologies, Inc., Mendota Heights, MN



Courtesy of Darling International Inc., Irving, TX

83

Emergency/Stand by Power Systems §1203

Emergency Power System	Standby Power System
Emergency alarms	Elevators and platform lifts
Emergency voice/alarm communication systems	Emergency responder radio coverage
Exit signs	High-rise buildings – depending on electric load function
Gas detection systems	Horizontal sliding doors
Essential systems in Group I-2	Hydrogen fuel gas rooms
Power operated locks and doors in Group I-2	Membrane structures—inflation systems in permanent membrane structures
Highly toxic and toxic materials	
High-rise buildings – depending on electric load function	
Laboratory suites	
Means of egress illumination	
Semiconductor fabrication facilities	
Underground buildings – depending on electric load function	

Emergency power

- Serious life safety hazard, or critical systems
- Transfer within 10 seconds

Standby power

- Possible life safety hazard, or interruption of firefighting
- Transfer within 60 seconds

84

Emergency/Standby Power Systems §1203

- Power source
 - Batteries
 - Generator
- Automatic transfer switch
- Maintenance
 - Operate trans
 - Run generator
 - Use generator
- Protection of emergency and standby power



Courtesy of Pentair Thermal Management, Houston, TX



Protected by 1-HR assembly

UL 2196 listed cable

85

29

CHAPTER 7



Interior Finish and Decorative Material



89

Interior Wall/Ceiling Finish and Trim
Table 803.3

Flame spread requirements are based on:

- Occupancy
- Sprinklers
- Location in the building

For example

Group	Sprinklered ¹			Nonsprinklered		
	Interior exit stairways and interior exit ramps and exit passageways ^{4,5}	Corridors and enclosure for exit access stairways and exit access ramps	Rooms and enclosed spaces ¹	Interior exit stairways and interior exit ramps and exit passageways ^{4,5}	Corridors and enclosure for exit access stairways and exit access ramps	Rooms and enclosed spaces ¹
A-1, A-2	B	B	C	A	A ^d	R ⁶
A-3 ¹ , A-4, A-5	B	B	C	A	A ^d	C
B, E, M, R-1, R-4	B	C ^m	C	A	B ^m	C
F	C	C	C	B	C	C
H	B	B	C ^g	A	A	B
I-1	B	C	C	A	B	B
I-2	B	B	B ^{h,j}	A	A	B
I-3	A	A ^l	C	A	A	B
I-4	B	B	B ^{h,j}	A	A	B
R-2	C	C	C	B	B	C
R-3	C	C	C	C	C	C
S	C	C	C	B	B	C
U	No restrictions			No restrictions		



90

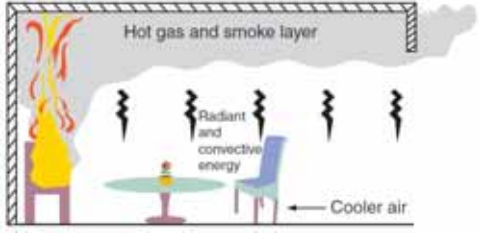
Interior finishes and furnishings

Location	Date	Number of fatalities	Number of injuries
Rhythm Night Club, Natchez, MS	April 23, 1940	209	Unknown
Cocoanut Grove Night Club, Boston, MA	November 28, 1942	492	Unknown
Beverly Hills Supper Club, Southgate, KY	May 28, 1977	165	> 200
Station Nightclub, Warwick, RI	February 20, 2003	100	> 200



91

Dangers of Flashover



92



4 Phases of Growth and Decay

1. incipient
2. pre-flashover
3. flashover
4. post-flashover

- Flashover occurs at approximately 1,100°F and is driven primarily by radiant energy within the fire's hot gas and smoke layer.



93

Testing

- ASTM E84, Standard Test Method for Surface Burning Characteristics of Building Materials
 - The test results are reported as a material's flame spread index (FSI) and smoke-developed index (SDI).

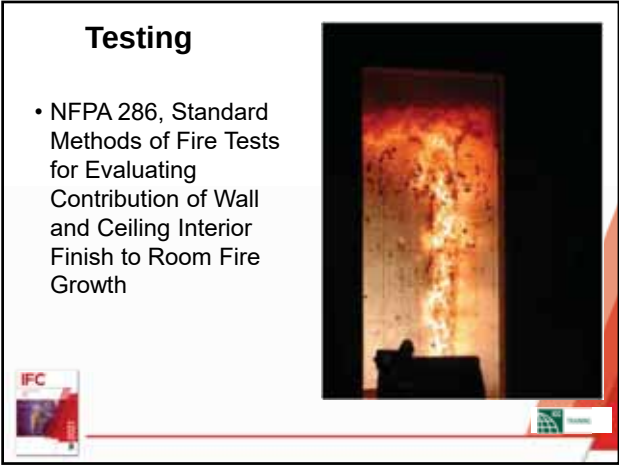
Material class	Flame spread index	Smoke-developed index
Class A	0-25	0-450
Class B	26-75	0-450
Class C	76-900	0-450



94



95



96

TABLE 803.3
INTERIOR WALL AND CEILING FINISH REQUIREMENTS BY OCCUPANCY*

Group	Interior wall (stairways and interior wall openings and wall penetrations)	Interior wall (stairways and interior wall openings and wall penetrations)	Interior wall (stairways and interior wall openings and wall penetrations)	Interior wall (stairways and interior wall openings and wall penetrations)	Interior wall (stairways and interior wall openings and wall penetrations)	Interior wall (stairways and interior wall openings and wall penetrations)	Interior wall (stairways and interior wall openings and wall penetrations)
A-1, A-2	1	1	1	1	1	1	1
A-3, A-4, A-5	1	1	1	1	1	1	1
B-1, B-2, B-3	1	1	1	1	1	1	1
B-4, B-5, B-6	1	1	1	1	1	1	1
C-1, C-2, C-3	1	1	1	1	1	1	1
C-4, C-5, C-6	1	1	1	1	1	1	1
D-1, D-2, D-3	1	1	1	1	1	1	1
D-4, D-5, D-6	1	1	1	1	1	1	1
E-1, E-2, E-3	1	1	1	1	1	1	1
F-1, F-2, F-3	1	1	1	1	1	1	1
G-1, G-2, G-3	1	1	1	1	1	1	1
H-1, H-2, H-3	1	1	1	1	1	1	1
I-1, I-2, I-3	1	1	1	1	1	1	1
J-1, J-2, J-3	1	1	1	1	1	1	1
K-1, K-2, K-3	1	1	1	1	1	1	1
L-1, L-2, L-3	1	1	1	1	1	1	1
M-1, M-2, M-3	1	1	1	1	1	1	1
N-1, N-2, N-3	1	1	1	1	1	1	1
O-1, O-2, O-3	1	1	1	1	1	1	1
P-1, P-2, P-3	1	1	1	1	1	1	1
Q-1, Q-2, Q-3	1	1	1	1	1	1	1
R-1, R-2, R-3	1	1	1	1	1	1	1
S-1, S-2, S-3	1	1	1	1	1	1	1
T-1, T-2, T-3	1	1	1	1	1	1	1
U-1, U-2, U-3	1	1	1	1	1	1	1
V-1, V-2, V-3	1	1	1	1	1	1	1
W-1, W-2, W-3	1	1	1	1	1	1	1
X-1, X-2, X-3	1	1	1	1	1	1	1
Y-1, Y-2, Y-3	1	1	1	1	1	1	1
Z-1, Z-2, Z-3	1	1	1	1	1	1	1

a. Class C interior finish materials shall be allowed for wallcovering or paneling of not more than 1,000 square feet of applied surface area in the grade lobby where applied directly to a noncombustible base or over furring to be applied to a noncombustible base and fastened as required by Section 803.3.1.1 of the International Building Code.

b. In exit enclosures of buildings less than three stories in height of other than Group I-3, Class B interior finish for nonsprinklered buildings and Class C for sprinklered buildings shall be permitted.

c. Requirements for rooms and enclosed spaces shall be based upon spaces enclosed by partitions. Where a fire-resistance rating is required for structural elements, the enclosing partitions shall extend from the floor to the ceiling. Partitions that do not comply with this shall be considered as enclosing spaces and the rooms or spaces on both sides shall be considered as one. In determining the applicable requirements for rooms and enclosed spaces, the specific occupancy thereof shall be the governing factor regardless of the group classification of the building or structure.

d. Lobby areas in Group A-1, A-2 and A-3 occupancies shall not be less than Class B materials.

e. Class C interior finish materials shall be allowed in Group A occupancies with an occupant load of 300 persons or less.

f. In places of religious worship, used for ornamental purposes, incense, painting or charcoal burning shall be allowed.

g. Class B material is required where the building exceeds two stories.

h. Class C interior finish materials shall be allowed in administrative spaces.

i. Class C interior finish materials shall be allowed in rooms with a capacity of four persons or less.

j. Class B materials shall be allowed in wallcovering extending not more than 48 inches above the finished floor in corridors.

k. Finish materials as provided for in other sections of this code.

l. Applies when the vertical walls, partitions, corridors, or rooms and spaces are protected by an approved automatic sprinkler system installed in accordance with Section 903.3.1.1 or 903.3.1.2.

m. Corridors in ambulatory care facilities shall have a Class B or better interior finish material.

97



In Summary

- Interior wall and ceiling finish requirements were developed so that selected materials contribute little fuel to a fire.
- The requirements in the IFC are based on the FSI and SDI of a material.
- As an alternative to the ASTM E84 test, the IFC allows the use of a roomcorner test, which offers a realistic assessment of a material's fire behavior.



98

Foam Plastics



- The foam plastic trim used to create the columns and cornice around the window cannot exceed 10 percent of the wall area.



99

Limits to Combustibles based on Occupancy

Occupancy	Maximum surface area covered	
	Sprinklered	Nonsprinklered
Group A	75% ^a	10%
Groups B, M	10% ^b	10% ^b
Groups I-1, I-2, I-4	10%	10%
Group I-3	NA	NA
Group R-2 dormitories	50%	10%
Groups E, R-1	50% ^c	10%
All others	10%	Not limited

NA = not allowed
a. Percentage only allowed in auditoriums of Group A.
b. The amount of ceiling area covered is not limited if the material meets the fire test criteria for NFPA 289 or 701.
c. Percentage only allowed in dormitories of Group R-2. [\[Ref. 807.2, 807.3\]](#)



100



Part III

Site and Building Services

1. How often must the exhaust system over a gas-fired commercial cooking appliance be inspected in a restaurant open 7 days/week for lunch and dinner only?

At least every 6 months
IFC Table 609.3.3.1

2. In a stairway of a Group B high-rise, the new wall and ceiling finishes must have a flame spread rating of **Class B** or better.

IFC Table 803.3

101



Module III

Site and Building Services

3. Fire apparatus access roads must be provided to within **150** of all exterior portions of the building.

IFC §503.1.1, some exceptions

4. Fire hydrants, or fire-fighting water supply, must be available within **400'** of all exterior portions of a non-sprinklered building or facility.

IFC §507.5.1
600' if sprinklered

102

PART IV



Fire/Life Safety Systems And Features

Chapter 8: Requirements for All Fire Protection Systems
Chapter 9: Automatic Sprinkler Systems
Chapter 10: Fire Alarm and Detection Systems
Chapter 11: Means of Egress

103

CHAPTER 8



Requirements for All Fire Protection Systems



104

When are Fire Protection Systems Required?

- Fire protection systems thresholds based on:
 - Occupancy of the building

For example – all Group H
 - Size of fire area

For example – Group F-1 >12,000 ft²
 - Occupant load

For example – Group A-3 ≥300
 - Height of the building

For example – high-rise
 - Area of the building

For example – allowable area increase
 - Quantity of hazardous materials stored or used

For example – MAQ increase
 - Use or processes

For example – high-piled storage



105

Additional Fire Protection §901.4.4

- Where process or hazards are especially challenging to emergency responders or to FD resources, the FCO can require additional fire protection safeguards
 - Fire protection systems
 - Detection systems
 - Flow control
 - Automatic shut-down



106

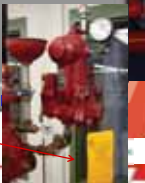
Fire Protection System Impairment §901.7

- FD and FCO must be informed when impairment occurs
- Impairment procedures:
 - Identify the extent and duration of impairment
 - Inspect areas that will be impaired and identify any processes to be discontinued
 - Notify the FD, FCO, fire alarm system monitoring station, and required notifications within the organization
 - Assemble the necessary tools and materials
 - Implement the impairment tag program
 - Ensure system is back in operation
 - Notify FD, FCO and all affected parties
- Impairment tag

Fire Watch could be:

- FD personnel
- Owner or designated employee
- Hired 3rd party company
- Option must be approved by FCO





107

Fire Protection System Monitoring §903.4, §907.6.6

- Sprinkler system monitoring
 - Main control valves
 - Floor
 - Water
 - Trouble
- Fire alarm
 - Alarm activation
 - Trouble
- Cancellation
 - Supervision

Except:

- Sprinkler systems with <20 sprinklers
- 1- and 2-family dwellings
- NFPA 13R installations with combined domestic and sprinkler piping

Except:

- 1- and 2-family dwellings
- Smoke alarms in Groups I-3 and R



108

CHAPTER 9



Automatic Sprinkler Systems





109

Automatic Fire Sprinkler Systems

- Most reliable fire protection system
- Many modifications can occur in the building based on the installation of a fire sprinkler system
 - IFC
 - IBC
- System must be properly installed and maintained

IFC:

- Increased haz mat quantities
- Reduction in fire flow
- Increased distance to access road
- Relaxed interior finish flame spread rating

IBC:

- Increased height and area
- Increased exit access travel distance
- Reduced fire-resistance-rating of fire barriers
- Unlimited building size for certain occupancies



Workbook Page 106

110

Level of Exit Discharge and Fire Area

- Level of exit discharge
- Fire area
 - Fire-resistance-rated construction between areas
 - IBC Table 508.4
 - IBC Table 707.3.10
- For example
 - If the floor assemblies are fire rated, each floor becomes a fire area

The separate floor area created by a fire barrier

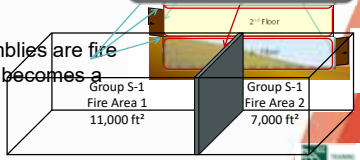
The story at the point at which an exit terminates and an exit discharge begins

Minimum 3-HR fire barrier in accordance with IBC Table 707.3.10

2nd floor

Group S-1 Fire Area 1 11,000 ft²

Group S-1 Fire Area 2 7,000 ft²



111

111

Design and Installation Standards

Design Consideration	Sprinkler Standard		
	NFPA 13	NFPA 13R	IRC Section P2904 or NFPA 13D
Extent of Protection	Throughout the entire building (Section 903.3.1.1)	Occupied spaces (Section 903.3.1.2)	Occupied spaces (Section 903.3.1.3)
Design Intent	Life Safety and Property Protection	Life Safety	Life Safety
Applicability	All occupancies	Group R ≤4 stories	1- and 2-family dwellings and townhomes ≤3 stories
Design Methods	Pipe schedule Control mode – density/design area Control mode – specific application Suppression modes	4 sprinklers in the hydraulic remote compartment	IRC §P2904 – Prescriptive design; NFPA 13D – 2 sprinklers in the hydraulic remote compartment using
Sprinklers	All listed and approved sprinklers	Listed residential sprinklers	Listed residential sprinklers
Minimum Water Supply Duration	30 to 120 minutes depending on the hazard and design	30 minutes	IRC Section P2904 – 7 to 10 minutes depending on dwelling size and stories; NFPA 13D – 10 Minutes

- Control mode sprinkler design
- Suppression mode sprinkler design

Intended to control the fire and stop the fire spread

Intended to suppress and extinguish the fire



112

Automatic Sprinkler Systems

- NFPA 13 recognizes 4 types of sprinkler systems:
 - Wet-pipe sprinkler system
 - Dry-pipe sprinkler system
 - Pre-action sprinkler system

These systems are designed for use inside buildings with temperatures $\leq 40^{\circ}\text{F}$

Water does not enter system until activation of detection device and sprinkler



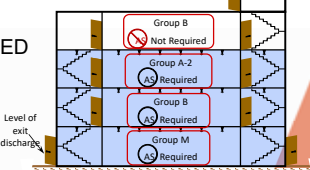
Graphic courtesy of Viking Corp.

113

Occupancies Requiring Automatic Fire Sprinkler Protection

- Groups A-1, A-3 and A-4
 - Fire area $>12,000\text{ ft}^2$
 - $\text{OL} \geq 300$
 - Floor other than the LED
 - Multi-theater
- Group A-2
 - Fire area $>5,000\text{ ft}^2$
 - $\text{OL} \geq 100$
 - Floor other than the LED

3rd floor does not require sprinklers provided it is a separate fire area



Group A requires the entire floor to be sprinklered and all floors between that floor and the LED

114

Additional requirements for Group A §903.2.1.6

- Assembly on rooftop – install sprinklers to LED



Automatic sprinkler systems required on all floors between occupied roof and level of exit discharge if roof has:

- A-2 with occupant load exceeding 100
- Occupant load exceeds 300 for other assembly uses

115

Additional requirements for Group A §903.2.1.7

- Multiple Group A fire areas
 - With 2-HR separation each Group A is considered separately and creates separate fire area

2-HR fire barriers

2-HR fire barriers

Multiple Group A occupancies share egress system so aggregate OL is considered

If aggregate OL >300, then sprinkler system is required

116

Occupancies Requiring Automatic Fire Sprinkler Protection

- Group B
 - Ambulatory health care facilities
- OL ≥30 on a floor ≥55' above LLFDVA

Group B ACFs require the entire floor to be sprinklered and all floors below that floor

When sprinklers are required because of the height of the building, the entire building must be sprinklered

117

Occupancies Requiring Automatic Fire Sprinkler Protection

- Group E
 - Fire area >12,000 ft²
 - All portions below LED
 - Sprinklers not required in areas below LED where each classroom has at least one exterior exit door at ground level

118

Occupancies Requiring Automatic Fire Sprinkler Protection

- Groups F-1, M and S-1
 - Fire area >12,000 ft²
 - Aggregate fire area >24,000 ft²
 - Above the 3rd story
- Special hazards
 - Woodworking >2,500 ft²
 - Manufacture or storage of upholstered furniture or mattresses >2,500 ft²
 - Retail sale of upholstered furniture or mattresses >5,000 ft²
 - High-piled storage
 - Distilled Spirits / F-1



Group F, M and S require the entire building to be sprinklered

119

Occupancies Requiring Automatic Fire Sprinkler Protection

- Group H
 - All subgroups
- Group I, R
 - All subgroups
 - Some exceptions for Group I-4



Group H requires the occupancy to be sprinklered

Group I and R require the entire building to be sprinklered

120

“Sprinklers Installed Throughout”

- Often the code states “...equipped the building with an automatic sprinkler system...”
- What does “throughout the building” mean?
- Exempt locations in §903.3.1.1.1

1. Rooms where sleeping accommodations are provided	1. Attic spaces without fuel-fired appliances
2. Rooms where sleeping accommodations are provided	2. Small bathrooms
3. Garages	3. Closets
4. Roofs	4. Garages

Bottom line...the building is considered fully sprinklered when the sprinkler system is installed in accordance with the standard as modified by the code

121

Fire Department Connection §912

- FDC required for most sprinkler and standpipe systems
- Must be identified and labeled
- Signs required if not labeled

- Cannot obstruct access to the building
- Located on exterior wall



122

CHAPTER 10



Fire Alarm and Detection Systems

123

Design & Installation Standards

- Design, construction and maintenance requirements in NFPA 72
- Notification methods
 - Audible
 - Visible
 - Text
- Supervisory signals



Distinctive signal that cannot be used for any other purpose

Such as:

- Closing of a main water supply control valve
- Low air pressure on a dry-pipe system
- Any condition that takes a fire protection system off-line

124

Fire Safety Functions §907.3

- Close fire and smoke dampers
- Release fire doors
- Shutdown HVAC
- Recall elevators
- Activate extinguishing systems







125

Fire Alarm Components

- Fundamental components:
 - Fire alarm control unit
 - Primary and secondary electrical power supply
 - Initiating devices
 - Occupant notification devices
 - Emergency Voice/Alarm Communication System
 - Required in high-rise and Group A-1 with OL ≥1,000
 - Recorded messages upon activation
 - Live messages from FD







126

Occupancies Requiring Fire Alarm and Detection Systems

- Group A
 - OL ≥300
 - If OL ≥1,000 must have emergency alarm/voice communication system
- Groups B and M
 - OL ≥500
 - OL ≥100 on a floor other than level of exit discharge
 - Group B ambulatory care facility







127

Occupancies Requiring Fire Alarm and Detection Systems

- Group E
 - OL >50
 - If OL >100 must have emergency alarm/voice communication system
- Group I
 - All subgroups
 - Private mode signals
 - Corridor smoke detectors
 - Groups I-1 and I-2

Manual when:

- Smoke
- Fire
- gym
- Mar
- point

- Not required in I-1 when building has fire sprinklers
- Not required in I-2 when sleeping rooms have smoke alarms





128

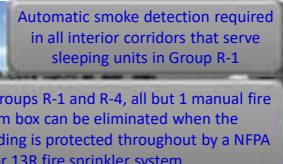
Occupancies Requiring Fire Alarm and Detection Systems

- Group R
 - Groups R-1 and R-4 require a manual fire alarm system
 - Group R-2 requires a manual fire alarm system when:
 - >16 dwelling units
 - Smoke detection in common areas when the Group R-2 is part of a college or university

Automatic smoke detection required in all interior corridors that serve sleeping units in Group R-1

In Groups R-1 and R-4, all but 1 manual fire alarm box can be eliminated when the building is protected throughout by a NFPA 13 or 13R fire sprinkler system

In Group R-2, all manual fire alarm boxes can be eliminated when the building is protected throughout by a NFPA 13 or 13R fire sprinkler system





129

Carbon Monoxide Alarms §915

- CO alarms required in Group I and R if:
 - The building contains a fuel-burning appliance
 - The building has an attached garage
- Single station CO alarms must be listed to UL 2034
- CO detectors must be listed to UL 2075





130

Gas Detection Systems

§916

- This section does not require gas detection
 - Other sections require gas detection
 - This section provides criteria
- Thresholds
 - 25% LEL
 - 50% IDLH





131

CHAPTER 11



Means of Egress (MOE)



132

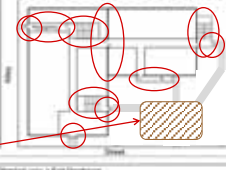
Means of Egress

- 3 means of egress components
 - Exit

That portion of a MoE system between the exit access and the exit.

The portion of a MoE system that leads from any occupied portion of a building or structure to an exit.

- exterior exit ramps
- interior exit ramps
- exit passageways
- exterior exit stairways
- exterior exit ramps
- horizontal exits





133

Means of Egress Minimum Features

- Exit components require minimum width
- Total width of doors, corridors, stairways and ramps must equal or exceed the width of the exit
- The distance from the exit access travel distance must be increased based on OL
- Any change in level, such as stairs, ramps, or elevators, must be accessible
- Illumination of exit access travel paths must be provided
- Exit signs required when ≥2 exits are required
- When ≥2 exits are required, emergency power is required for exit signs and egress path illumination

134

Means of Egress Minimum Features

- Generally, all means of egress must be accessible for persons with disabilities
- MoE system must be designed to be accessible
- Egress components must be accessible
- Unless otherwise specified, egress components such as elevators, escalators, and ramps must be accessible

135

Occupant Load §1004

- The potential number of people in a building is determined by calculating the design occupant load
- Gross floor area is the entire floor area within the exterior walls, exclusive of vent shafts and courts
- Net floor area is the normally occupied area within the exterior walls
 - Excludes unoccupied accessory uses including corridors, stairways, toilets, mechanical rooms and closets

136

Egress Width §1005

- Calculation of minimum egress width
 - 0.3"/person for stairways
 - 0.2"/person for level areas or ramps
- Obstructions to egress width

When the building is equipped with a fire sprinkler system **AND** an emergency voice/alarm communication system the egress widths are reduced to:

- 0.2"/person for stairways
- 0.15"/person for other areas



IFC

Workbook Page 140

IFC

137

Egress Width §1005

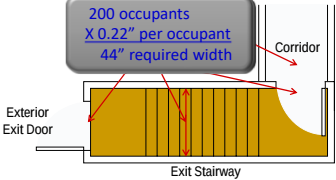
- **Given:** A portion of the egress system serves 200 occupants in an unsprinklered Group B building.
- **Determine:** The minimum required width of each egress component.

Stair width = 60"

Door width = 40"

Corridor width = 44"

200 occupants
X 0.22" per occupant
44" required width



IFC

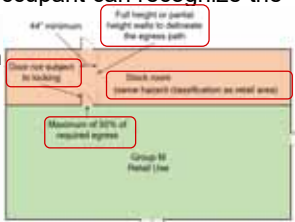
IFC

138

Exit Access §1016

- Egress through an adjacent area or room is allowed provided the exit path is direct and obvious so that the occupant can recognize the exit path
- Cannot pass through closets, storage rooms or kitchens

Exception for Group M



IFC

IFC

139

Exit Access Travel Distance

Table 1017.2

- Exit access travel distance is measured to:
 - An exit passageway
 - A horizontal exit
 - The door of a vertical exit enclosure
 - An exterior exit ramp or stairway
 - An exterior exit door

Occupancy	Without sprinkler system (feet)	With sprinkler system (feet)
A, E, F-1, M, R, S-1	200	250 ^{b,e}
I-1	Not Permitted	250 ^c
B	200	300 ^c
F-2, S-2, U	300	400 ^c
H-1	Not Permitted	75 ^d
H-2	Not Permitted	100 ^d
H-3	Not Permitted	150 ^d
H-4	Not Permitted	175 ^d
H-5	Not Permitted	200 ^c
I-2, I-3	Not Permitted	200 ^c
I-4	150	200 ^c

140

Exit and Exit Access Doorway Arrangement

- When 2 exits are required, they shall be separated at least $\frac{1}{2}$ of the diagonal of the room or building served

When sprinklered, the separation distance is $\frac{1}{3}$ the maximum diagonal

Overall diagonal

$\geq \frac{1}{2}$ max diagonal

141

Exit Signs and Means of Egress Illumination

- Illumination of the exit and exit access is required, except:
 - Group U
 - Aisles in Group A
 - Dwelling and sleeping units in Groups I, R-1, R-2 & R-3
- When ≥ 2 exits or exit access doors are required, emergency power is required for egress path illumination
 - 90 minute duration

142

Exit Signs §1013

- Required at all exits, including doors, windows, and other openings leading directly outside.
- Group U sleeping units, R-1, R-2 or R-3



Internally or externally illuminated

All doors into corridors must have visible exit sign within 100'

Signs located at changes in direction

Indicate direction to exit

Signs spaced in accordance with their listing

143

Maintenance of MoE §1032

- Cannot obstruct, block or disable MoE components
- Maintained to prevent



IFC

144

Egress Calculation Loretta's Honky Tonk

ACTIVITY

- Given: Existing building with
- Group A-2
- Fire sprinkler system
- Determine OL
 - Fixed seats = 90
 - Dance floor = 60
 - Bar service area = 1
 - Exit aisles = 34
 - Total OL = 185

- 1. Exit width is not adequate $185 \times 0.2 = 37"$
- 2. 2nd exit is required $OL \geq 50$
- 3. Panic hardware is required $OL \geq 50$
- 4. Main door could have key-lock ☒ YES $185 \times 0.15 = 28"$
- 5. Exit signs are required
- 6. Egress illumination required

145



Part IV – Fire/Life Safety Systems and Features

1. What standard is referenced by the IFC for the design and installation of a CO2 fire extinguishing system?

NFPA 12 Carbon Dioxide Extinguishing Systems
IFC §904.8

2. An existing tenant space on the 3rd floor of a building is being renovated into a restaurant with full bar. Are fire sprinklers required?

YES – IFC §903.2.1.2, Item 3
Group A-2 occupancy on a floor other than the LED requires sprinklers on that floor and all floors to the LED



146



Part IV – Fire/Life Safety Systems and Features

3. The restaurant dining area will be 6,000 ft². Is a fire alarm system required?

Yes
OL = 450; manual fire alarm system required
IFC §907.2.1

4. Is an automatic fire extinguishing system required to protect the cooking appliances?

Yes...unless they are just serving steamed hot dogs
IFC §904.2.2



147

Part V

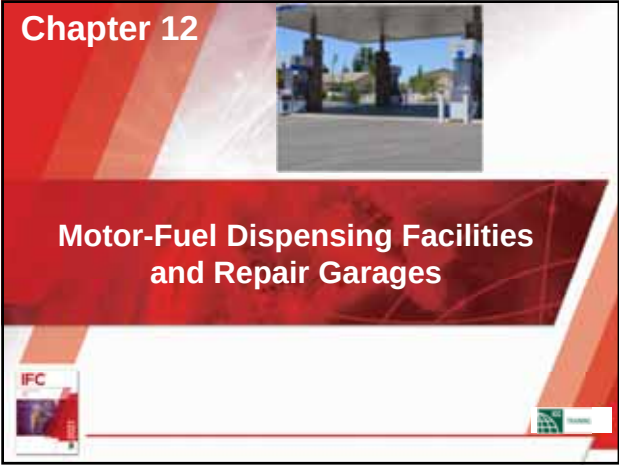


Special Processes and Building Uses

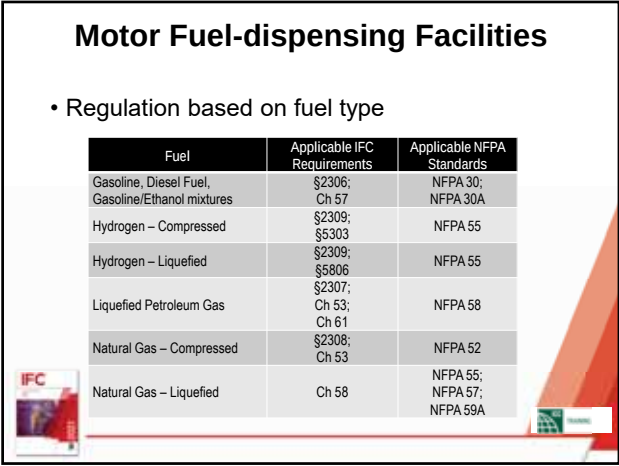
Chapter 12: Motor Fuel-Dispensing Facilities and Repair Garages
Chapter 13: Flammable Finishes
Chapter 14: High-Piled Combustible Storage
Chapter 15: Other Special Uses and Processes



148



149



150



151

Dispensing Operations and Devices Arrangement

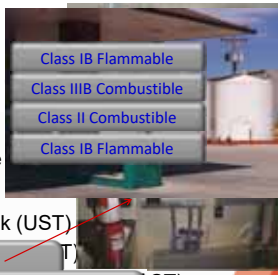
- Minimum separation to property lines, buildings, openings in building and fixed ignition sources
- Vehicle receiving fuel and the dispensing equipment must be on same property
- Clearly identified
- Liquid-tight and vapor-tight for tanks
 - Minimum 2A:20B:C
 - No further than 75'



152

Flammable and Combustible Liquid Motor Fuel-dispensing

- Fuels
 - Gasoline
 - Biodiesel
 - #2 diesel fuel
 - Alcohol-blended gasoline
- Storage tanks
 - Underground storage tank (UST)
 - Class I, II and III liquids
 - Class II and III liquids
 - Maximum 12,000 gallons each
 - Maximum 15,000 gallons per vault and
 - Maximum 45,000 gallons aggregate



153

Flammable and Combustible Liquid Dispensing Operations

- All openings must be through the top of the tank
- Fuel is pumped **to** the dispenser
- Listed com
- Emergency
- Emergency
- Fuel delivery
 - Automatic closing
 - Bonding connection to fill neck on vehicle
 - Designed to remain engaged to fill connection



154

Flammable and Combustible Liquid Alcohol-blended Fuel

- E10 = 10% ethanol and 90% unleaded gasoline
- E85 = 85% ethanol and 15% unleaded gasoline

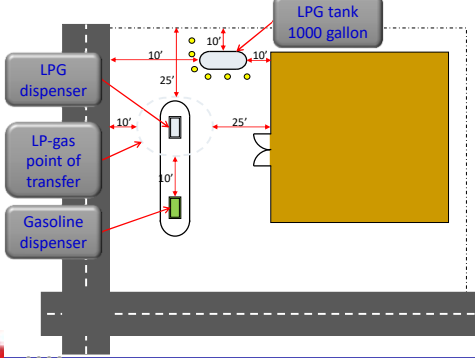
Fuel	Lower flammable limit (percent volume in air)	Upper flammable limit (percent volume in air)
Unleaded gasoline	1.4%	7.6%
E85 alcohol-blended fuel	1.4%	19.0%

- Components must be listed
 - Ethanol potentially increases corrosion
 - This can create a concern when an existing motor fuel-dispensing facility changes from gasoline to E85



155

Liquefied Petroleum Gas Dispensing Operations



The diagram illustrates the required clearances for an LPG dispensing station. A 1000-gallon LPG tank is shown with a 25-foot clearance from the building. The LPG dispenser is located 10 feet from the tank. The LP-gas point of transfer is 10 feet from the dispenser and 25 feet from the building. A gasoline dispenser is also shown, with a 10-foot clearance from the point of transfer.



156

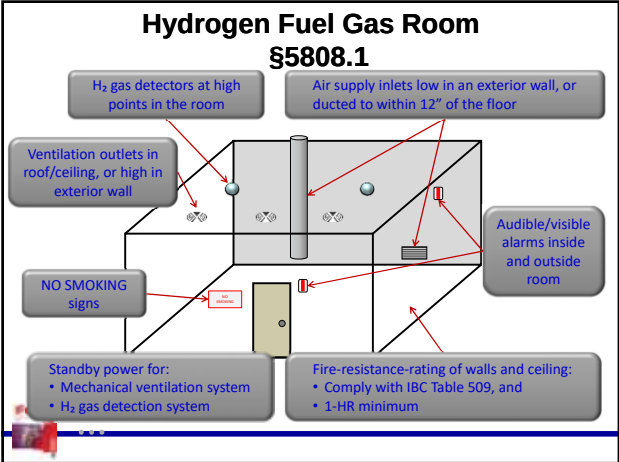
Liquefied Petroleum Gas Dispensing Operations

- Excess flow control valve at tank
- At dispenser, either
 - 2nd excess flow control valve, or
 - Differential backpressure valve
- Pressure relief valve
- Listed Required where liquid LP-gas can be trapped

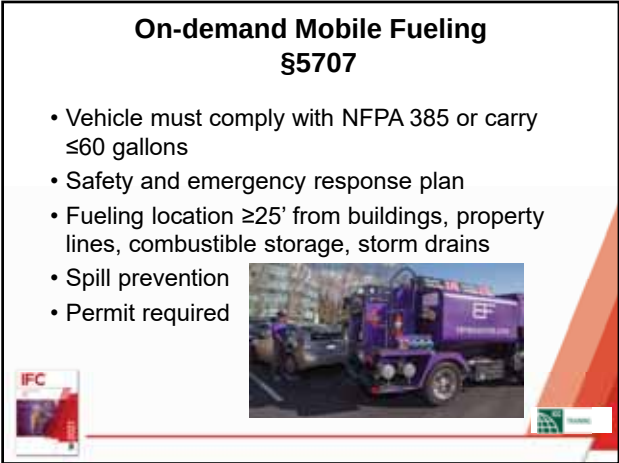
Liquid LP-gas cannot flow unless positive connection is made



157



158



159



160

Flammable Finishes

Ch 24

- Application of “**finishes** that are **flammable**”
 - Spray applied liquids
 - Dip tanks
 - Powder coating
 - Fiber glass
- Hazards
 - Atomized liquid particles
 - Combustible dusts
 - Vapor release in open top tanks





161

Types of Flammable Finishing Processes

- Spray finishing uses flammable or combustible liquids pressurized and dispersed via a spray nozzle
- Powder coating of plastic powders on
- Fiber glass



Suspension of the powder in air represents the greatest hazard





162

Spray Booth and Spray Room Construction

- §2404.3.1 – spray room
 - Permanent construction
 - Fire-resistance rated construction
- §2404.3.3 – spray booth
 - Considered an “appliance”
 - Noncombustible construction



Required for spray finishing operations in Group A, E, I and R occupancies

Allowed in all other occupancies

Spray Booths and Spray Rooms:

- Constructed of approved materials
- Mechanical ventilation system
- Illuminated using approved luminaires
- Required interlocks
- Control of ignition sources
- Fire extinguishing system



163

Limited Spraying Spaces

§2404.9

- FCO can approve limited spraying spaces
 - Area is designated for spraying operations
 - Aggregate surface area sprayed ≤9 ft²
 - Spraying operations cannot be continuous
 - Mechanical ventilation providing 6 air changes per hour is required
 - Electrical wiring within 10' of the floor and 20' horizontally of the limited spraying space shall be designed for Class I, Division 2





164

Mechanical Ventilation

§2404.7

- Mechanical ventilation system safely removes flammable vapors or combustible dusts and exhausts them to a safe location
- Designed to maintain the atmosphere
 - <25% of the lower flammable limit for liquids
 - <50% of the minimum explosive concentration for combustible dusts



Ventilation point of termination:

- 30' from property lines
- 10' from openings into buildings
- 6' above exterior walls and roofs
- 30' from combustible walls
- 10' above adjoining grade



165

Illumination

§2404.6.2

- Portable electric lamps are prohibited
 - Portable lamps can be used for cleaning or repair operations and only when approved for hazardous atmospheres
- Fixed luminaires
 - External to spray area
 - Located outside of the classified area
 - Ordinary electrical





166

Interlocks

§2404.7.1

- Ventilation system is interlocked with the spraying apparatus
- Solenoid in air supply line connected to ventilation system motor
- Differential pressure switch
 - Measures pressure on each side of exhaust filters





167

Fire Protection

§2404.4

- Automatic fire extinguishing system required in spray booths and spray rooms
 - Fire sprinkler system
 - Dry chemical extinguishing system
 - Can be used even when the rest of the building is protected with a fire sprinkler system





168

Chapter 14



High-Piled Combustible Storage



169

High-piled Combustible Storage

- Storage of combustible materials in closely packed piles or combustible materials on pallets, in racks or on shelves where the top of storage is >12' in height
- Where required by the FCO, high-piled combustible storage also includes certain high-hazard commodities, such as rubber tires, Group A plastics, flammable liquids, idle pallets and similar commodities, where the top of storage is >6' in height



170

Commodity Classification §3203

- Commodity classification based on heat release rate of products
- Includes products, packing materials and containers
- 5 classifications
 - Class I
 - Class II
 - Class III
 - Class IV
 - High-hazard



Lowest fire hazard

products in the finished products in cardboard boxes or multi-wall containers, except those of Class I, II or III products with Group A plastics: rubber tires; foam plastic mattresses

Highest fire hazard

171

Plastics §3203.7

- Classifications:
 - Group A
 - Group B
 - Group C
- Geometry:
 - Expanded
 - Unexpanded
 - Free-flowing



Highest fire hazard

Lowest fire hazard

Plastics are grouped based on heat release rate

Highest fire hazard

Lowest fire hazard

172

Table 3206.2
General Fire Protection and Life Safety
Requirements

Commodity Class	Size of High-Piled Storage Area ^a	All Storage Areas ^b				Solid-Piled Storage, Shelf Storage and Palletized Storage		
		Automatic Fire Extinguishing System	Fire Detection System	FD Access Doors	Smoke and Heat Removal	Maximum Pile Dimension ^c	Maximum Pile Height ^d	Maximum Pile Volume
High-hazard	0 – 500							NR
	501 – 2,500							100,000
	2,501 – 500,000							200,000
	>500,000	Yes ^h	NR	Yes	Yes ^h	120	40	400,000

Footnote c. Piles shall be separated by aisles complying with §3206.9.

Footnote b. For aisles, see §3206.9.

Footnote h. Not required where storage areas are protected by ESFR or CMSA sprinkler systems with RTI ≤50 and listed for control of fire with ≤12 sprinklers.

Footnote e. For storage exceeding 30 feet in height, Option 1 shall be used.

Footnote i. Not required in frozen food warehouses with Class I or II commodities.

For example: 125,000 sq. ft. warehouse with rack storage of Class III commodity

173

Table 3206.2
General Fire Protection and Life Safety
Requirements

Commodity Class	Size of High-Piled Storage Area ^a	All Storage Areas ^b				Solid-Piled Storage, Shelf Storage and Palletized Storage		
		Automatic Fire Extinguishing System	Fire Detection System	FD Access Doors	Smoke and Heat Removal	Maximum Pile Dimension ^c	Maximum Pile Height ^d	Maximum Pile Volume
High-hazard	0 – 500							NR
	501 – 2,500							100,000
	2,501 – 500,000							200,000
	>500,000	Yes	NR	Yes	Yes ^h	60	30	75,000

Footnote f. When required by the FCO, special fire protection provisions shall be provided, 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
- additional fire department hose connections

174

Storage Methods

- Solid-piled storage
- Palletized storage
 - Plastic pallets?



Fire Plastic pallets listed to UL 2335 are considered an equivalent fire hazard to wood pallets

175

Other Considerations

- Table 3208.3 – flue spaces
 - Longitudinal flue
 - Transverse flue
- Automated storage
 - §3209
 - When >500 ft²:
 - Fire detection system, OR
 - Dead-man switch controls

Plan View

Transverse Flue Space

Flues extend from floor to top of storage

Minimum flue widths required

176

Chapter 15

Other Special Uses and Processes

177

Combustible Dust Producing Operations

Ch 22

- Combustible dust is a finely divided solid material which is ≤420 microns (0.0165”) in diameter
- When dispersed in air in the proper proportions, it can be ignited
- Combustible dust will pass through a U.S. number 40 sieve
- Dust Hazard Analysis
 - Housekeeping
 - Dust collection
 - Control of ignition sources

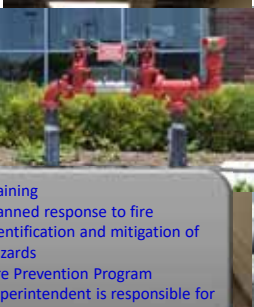
Material	Size (micron)
White granulated sugar	450-600
Sand	50 and greater
Talcum powder	10
Mold spores	10-30
Human hair	40-300
Wheat, corn, or soybean flour	1-100

178

Fire Safety During Construction/Demolition

Ch 33

- Temporary heating
- Precautions against fire
- Storage of combustibles
 - Clearance to combustibles
 - Flammable finishes
- Materials handling
 - Quantities limited
 - Location of storage
 - Separation of incompatible
- Fire protection
 - Standpipe required where in height
 - Standpipe available to floor
 - Systems restored at end of work



- Training
- Planned response to fire
- Identification and mitigation of hazards
- Fire Prevention Program
 - Superintendent is responsible for implementation of plan



179

Welding and Other Hot Work

Ch 35

- Welding
- Cutting
- Torch-applied roofing
- Hot Work Program Permits
 - "Person-in-Charge" is identified
 - Identify combustibles
 - During hot work
 - Review
 - 30 minutes after hot work is completed
 - Review
 - Available for FCO review





180

Higher Education Laboratories

Ch 38

- College or university level
- Group B building
- Laboratory suites – different than control areas
- Allowable quantities – different than MAQ per control area

Floor Level		Percentage of the Maximum Allowable Quantity per Lab Suite ^a	Number of Lab Suites per Floor	Fire-resistance Rating for Fire Barriers in Hours ^b
Above grade plane	21+	Not allowed	Not Permitted	Not Permitted
	16-20	25	1	2 ^c
	11-15	50	1	2 ^c
	7-10	50	2	2 ^c
	4-6	75	4	1
	3	100	4	1
Below grade plane	1-2	100	6	1
	1	75	4	1
	2	50	2	1
	Lower than 2	Not Allowed	Not Allowed	Not Allowed





181

Plant Processing and Extraction Ch 39

- Prohibited in buildings containing Group A, E, I or R occupancies
- Listed extraction equipment or technical report
- Gas detection
 - Extraction room
 - CO₂ enriched atmosphere





182

Distilled Spirits and Wines Ch 40

- Beverages greater than 16 percent alcohol content present some level of combustibility
- Distilling process is classified as a F-1
- Storage is classified as a S-1
- Storage exceeding 16%, is classified as an S-2
- Occupancies protected with Automatic Sprinkler Systems in accordance with Chapter 9.





183



Part V – Special Processes and Building Uses

1. Continuous flammable finish spray operations must be conducted in a spray room in which occupancies?

Group A, E, I and R
When operations exceed a limited spray area
IFC §2404.2
2. What types of storage tanks can be used for the dispensing of gasoline into motor vehicles?

Underground Storage Tank, Protected Above-ground Storage Tank, or Above-ground Tank in a Vault
IFC §2306.2



184



Part V – Special Processes and Building Uses

3. What fire protection requirements apply to 25,000 ft² of 18' high rack storage of polyethylene cups in cardboard boxes?

Fire Sprinklers, Building Access, Smoke Removal
(unless ESFR or CMSA sprinklers)
IFC Table 3206.2

4. What is the purpose of flue spaces in high-piled rack storage?

Allow the heat to rise to activate the sprinkler system;
Allow the sprinkler water to reach down to the fire level



185

Part VI



Hazardous Materials

Chapter 16: General Requirements for Hazardous Materials
Chapter 17: Compressed Gases
Chapter 18: Flammable and Combustible Liquids



186

Chapter 16



General Requirements for Hazardous Materials



187

General Concepts

- Storage, handling, use and dispensing of hazardous materials is regulated in Ch 50 through Ch 67
- General requirements in Ch 50 are used with requirements in Ch 51 – 67 which contain hazard specific requirements
- Some exceptions to Ch 50 address items covered elsewhere in the IFC

For example, mechanical refrigeration systems are already covered in Ch 6



188

Material Classification

- Materials are classified characteristics
 - Materials can possess r
 - All hazards must be add
- Classification resources

Nationally recognized standards

SDS
Safety Data Sheets

IFC Appendix E
Hazard Categories



189

Material Classification

HMEC
Hazardous Materials Expert Assistant

Sulfuric Acid	IFC Class	Common uses
Concentration in water		
98%	Class 2 Corrosive	Manufacturing; cleaning of semiconductor
32–38%	Class 1 Corrosive	Wet-cell automobile batteries
3%	Nonhazardous	Cutting an onion releases an amino acid known as a sulfoxide. When the sulfoxide mixes with the water in a human eye, it forms a weak solution of sulfuric acid.

Physical Hazards

Health Hazards



190

Material Classification

- Physical hazard
 - Explosives 1.1, 1.2, 1.3, 1.4, 1.5, 1.6
 - Combustible liquids II, IIIA, IIIB
 - Flammable liquids IA, IB, IC
 - Flammable solids and gases
 - Organic peroxide I, II, III, IV V, Unclassified Detonable
 - Oxidizers 1, 2, 3, 4
 - Pyrophoric
 - Unstable (reactive) 1, 2, 3, 4
 - Water-reactive 1, 2, 3
 - Cryogenic fluids
- Health hazard
 - Corrosive
 - Highly toxic
 - Toxic

- Many of the materials have subclasses
- Based on the relative hazard

191

Material Classification

- Acrolein is used in the manufacturing of a number of plastics.
 - Flash point of 15°F
 - Boiling point of 127°F
 - Absorption LD50 value of 200 Mg/Kg
 - Ingestion LD50 value of 26 Mg/Kg
- What is its classification?

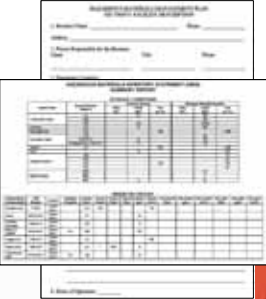
Acrolein is:

- Class I-B flammable liquid
- AND
- Highly toxic liquid

192

Hazardous Materials Reporting §5001.5

- When required by the FCO, owner must provide:
 - Hazardous Materials Management Plan (HMMP)
 - Hazardous Materials Inventory Statement (HMIS)



193

Storage and Use §202

- Storage
- Use
 - Use-closed
 - Use-open

Use of a solid or liquid hazardous material involving a closed vessel or system that remains closed during the process. Material that is placed into action by the process and the product is not exposed to the atmosphere during normal operations; and all uses of compressed gases

Dip Tank Storage Tank Valve Pump

194

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

195

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

196

Footnotes to Table 5003.1.1(1)

- b – aggregate quantity shall not exceed storage
- d – increase 100% for sprinklers
- e – increase 100% for cabinets, day boxes, exhaust hoods, and safety cans
- f – not limited in sprinklered buildings
- g – not permitted in unsprinklered buildings
- k – 220 lbs. or 22 gallons of Oxidizer 3 for maintenance or operation of equipment

Footnotes d and e can be used together if the building complies



Workbook Page 204



197

Footnotes to Table 5003.1.1(1)

- l – fireworks 1.4G based on 25% of gross weight
- m – 1 gallon = 10 lbs.
- n – storage and display in M, storage in S
- p – situations not included

1. Fuel in fuel tanks on vehicles
2. Fuel in fuel tanks on motorized equipment operated in accordance with IFC
3. Gas fuels in piping systems and appliances regulated by IFGC
4. Liquid fuels in piping systems and appliances regulated by IMC
5. Alcohol-based hand rubs in dispensers complying with §5705.5



Workbook Page 205



198

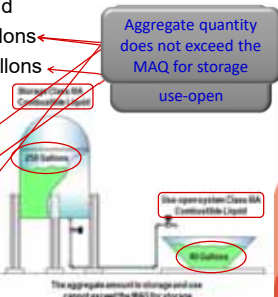
MAQ Footnote b

- Class IIIA combustible liquid
- MAQ for storage = 330 gallons
- MAQ for use-open = 80 gallons

Actual quantities

- Storage = 250 gallons
- Use-open = 80 gallons
- Aggregate = 330 gallons

Aggregate quantity does not exceed the MAQ for storage use-open



Storage Tank 250 Gallons
Use-open area 80 Gallons
The aggregate amount in storage and use cannot exceed the MAQ for storage

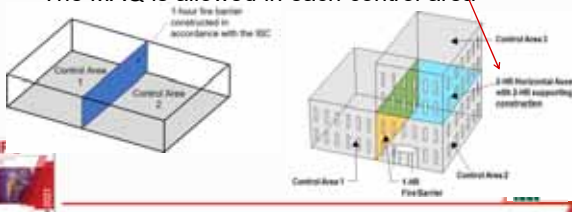


199

Control Areas

- Control area is a space where hazardous materials stored or dispensed does not exceed the MAQ
- The MAQ is allowed in each control area

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 in height



200

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	
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	1
Lower than 2	Not Allowed	Not Allowed	Not Allowed	Not Allowed

201

Application of Control Area Concept

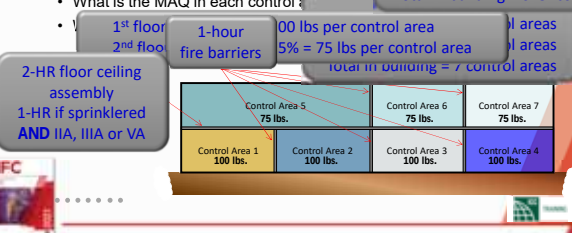
- Manufacturer of specialized optics
- 2 story Group F-1, Type IIA construction, sprinklered
- Storage and use of liquid Class II organic peroxide
- Company asks:
 - What is the maximum number control areas?
 - What is the MAQ in each control area?

1st floor = 400 lbs
2nd floor = 225 lbs
Total in building = 625 lbs

1-hour fire barriers

2-HR floor ceiling assembly
1-HR if sprinklered
AND IIA, IIIA or VA

Control Area 1: 100 lbs.
Control Area 2: 100 lbs.
Control Area 3: 100 lbs.
Control Area 4: 100 lbs.
Control Area 5: 75 lbs.
Control Area 6: 75 lbs.
Control Area 7: 75 lbs.



202

Hazard Identification Signs

- Required on:
 - Buildings
 - Tanks
 - Entrances to facilities
- Ranking of 0 → 4
 - Blue – health hazards
 - Red – flammable hazards
 - Yellow – chemical instability
 - White – special hazards

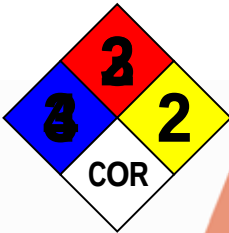


203

Hazard Identification Signs

- NFPA 704 placard
- Appendix F – excerpts

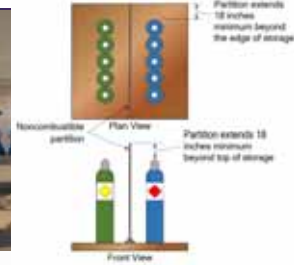
Hazard Category	Designation
Combustible liquid Class II	
Flammable liquid Class IB	
Unstable reactive Class 2	
Toxic gas	
Corrosive liquid	
Highly toxic liquid	



204

Separation of Incompatible Materials §5003.9.8

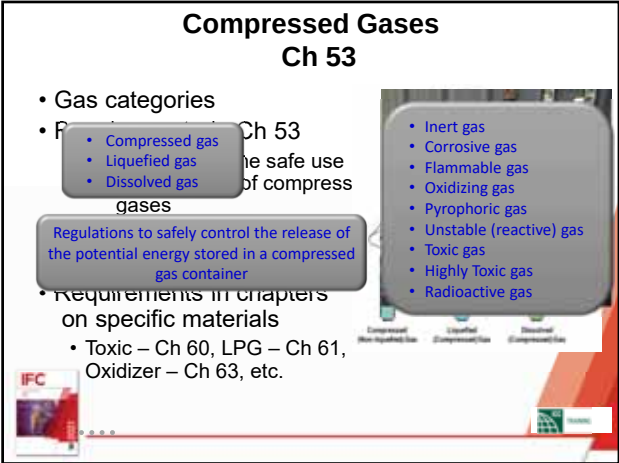
- Separation required when:
 - >5 lbs.
 - >1/2 gallon
 - All compressed gases
- Determine incompatibility
 - SDS
 - HMEX program can assist
- Methods of separation
 - 20'
 - Haz mat storage cabinets
 - Gas storage cabinets
 - Physical barrier



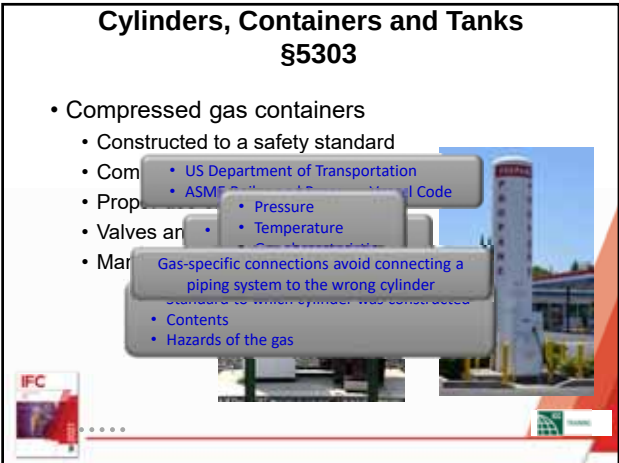
205



206



207



208

Pressure Relief Devices

§5303.3

- Pressure relief device is required to prevent catastrophic failure of gas containers
 - Some exceptions based on hazards of specific gas
 - Internal PRD
 - External PRD
 - Burst disc for PRD
 - Fusible plugs







209

Security

§5303.5

- Compressed gas containers must be:
 - Provided with security when outdoors

Nesting



Storage Rack









210

Exhausted Enclosures and Gas Cabinets

- Appliances designed to capture and exhaust a leak from a gas container or its piping system
 - Gas Cabinet
 - Noncombustible
 - Noncombustible
 - Top, sides and back
 - Mechanical ventilation
 - Maximum 3 cylinders/cabinet







211

LP-gas Cylinder Exchange

§6109.15

- Basic purpose is to remove unsafe LP-gas cylinders from use
- Provide safe exchange of cylinders



Defective cylinders removed from service

Courtesy of National Fire Protection Association

212

CO₂ for Beverage Dispensing

§5307

- Liquid, or refrigerated CO₂ used in beverage dispensing >100 lbs requires permit
- Mechanical ventilation required
 - Operates continuously, or
 - Activated by gas detection
 - Low-level alarm at 5,000 ppm (PEL)
 - High-level alarm at 30,000 ppm (TLV-STEL)



213

Chapter 18



Flammable and Combustible Liquids

214

Flammable and Combustible Liquids

Ch 57

- Ch 57 contains the main regulations for flammable and combustible liquids, but other regulations in:
 - Ch 6 for Fuel-fired Appliances
 - Ch 20 for Aviation Facilities
 - Ch 21 for Dry Cleaning
 - Ch 23 for Motor Fuel-dispensing & Repair Garages
 - Ch 24 for Application of Flammable Finishes
 - Ch 27 for Semiconductor Fabrication Facilities
 - Ch 29 for Manufacture of Organic Coatings
 - Ch 33 for Fire Safety During Construction and Demolition
 - Ch 36 for Marinas
 - Ch 38 for Higher Education Laboratories
 - Ch 39 for Processing and Extraction Facilities



215

Classification of Liquids

- Closed-cup flash point testing provides a repeatable result

Classification	Flash Point Temperature	Boiling Point Temperature	Example Liquids By Class
Class IA	<73°F	<100°F	N-Pentane; Ethyl Ether
Class IB	<73°F	≥100°F	Gasoline; Isopropyl Alcohol
Class IC	≥73 and <100°F	Not Applicable	Methyl Ethyl Ketone
Class II	≥100°F and <140°F	Not Applicable	No. 2 Diesel fuel; Kerosene
Class IIIA	≥140°F and <200°F	Not Applicable	Turpentine; No. 3 Fuel Oil
Class IIIB	≥200°F	Not Applicable	Motor Oil; Cooking Oil; No.6 (bunker) Fuel Oil

Flammable Liquids

Combustible Liquids



216

Containers and Portable Tanks

- “Containers” are a maximum of 60 gallons
- “Portable tanks” are more than 60 gallons and designed for transportation
- Intermediate bulk containers (IBCs) can be constructed of metal, plastic, fiber, or composite material. NFPA 30 limits size to 793 gallons



Manufactured of glass, steel or plastic

Glass is limited in volume based on its contents

Can be constructed of metal, plastic, fiber, or composite material. NFPA 30 limits size to 793 gallons



217

Stationary Tanks

§5704.2

• Stationary tanks are designed for permanent installation

• Stationary tanks can be installed:

Above ground

Below ground

Inside buildings

In vaults

• Tanks can be field-erected or fabricated in a shop



IFC

218

Design and Construction of Storage

• Material of construction must be chemically compatible with the liquid

• Tank must have a normal vent

• Nameplate is attached to the tank that indicates the standard to which it was constructed



IFC

219

Location of Above-ground Tanks for Dispensing – Table 2306.2.3

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)
Protected above-ground tanks	≤6,000	5	25 ^{a,c}	15	5	3
	>6,000	15	25 ^{a,c}	25	15	3
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, a minimum separation distance is not required.

b. Underground tanks 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, a minimum separation distance is not required.

IFC

220

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73

PAST for Fuel Dispensing

- UL 2085 tank
- Requirements in Ch 57 and
- Overfill prevention
- Spill container

Manual drain back into tank

Minimum 5 gallon capacity

- Slows filling operation at 90% capacity
- Stops filling operation at 95% capacity





221

Storage Tank Openings

- Connections are needed for filling and withdrawing liquid
 - Valve on all connections below liquid level
- Normal vent
 - Class I liquids require a pressure-vacuum cap on the normal vent

Minimum 5'

Minimum 12'





222

Emergency Vent

- Emergency vent required on all ASTs

Normal

Emergency vents

Long bolt cover

pressure when internal pressure reaches 2.5 PSI





223



Part VI

Hazardous Materials

1. A factory sprays wood and metal products with lacquer (Class IC flammable liquid). What is the occupancy classification if they use 5 gallons at a time and store 80 gallons maximum?

Group F-1
Does not exceed the MAQ
IFC Table 5003.1.1(1)

2. Does the facility above need to separate the lacquer from incompatible materials?

Yes – incompatible materials over
¼ gal. or 5 lbs. must be separated
IFC 5003.9.8

224



Part VI

Hazardous Materials

3. The 1-story factory wants to create another control area to double their production. What is the minimum fire-resistance-rating between the control areas?

1-HR
IFC Table 5003.8.3.2

4. The factory uses a 3,000 gallon Protected Above-ground Storage Tank for vehicle fueling. What is the required separation to the building?

5 feet
IFC Table 2306.2.3

225

Discussion Activity



226



Final Reflection

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

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



227

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228

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229

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230

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231
