

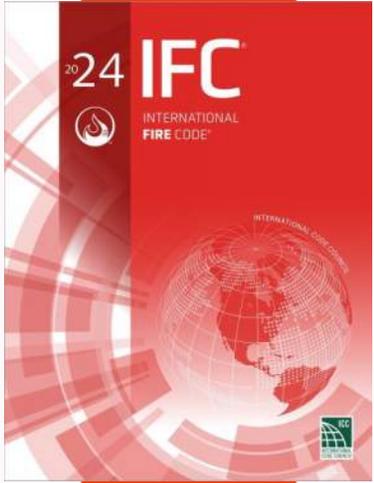


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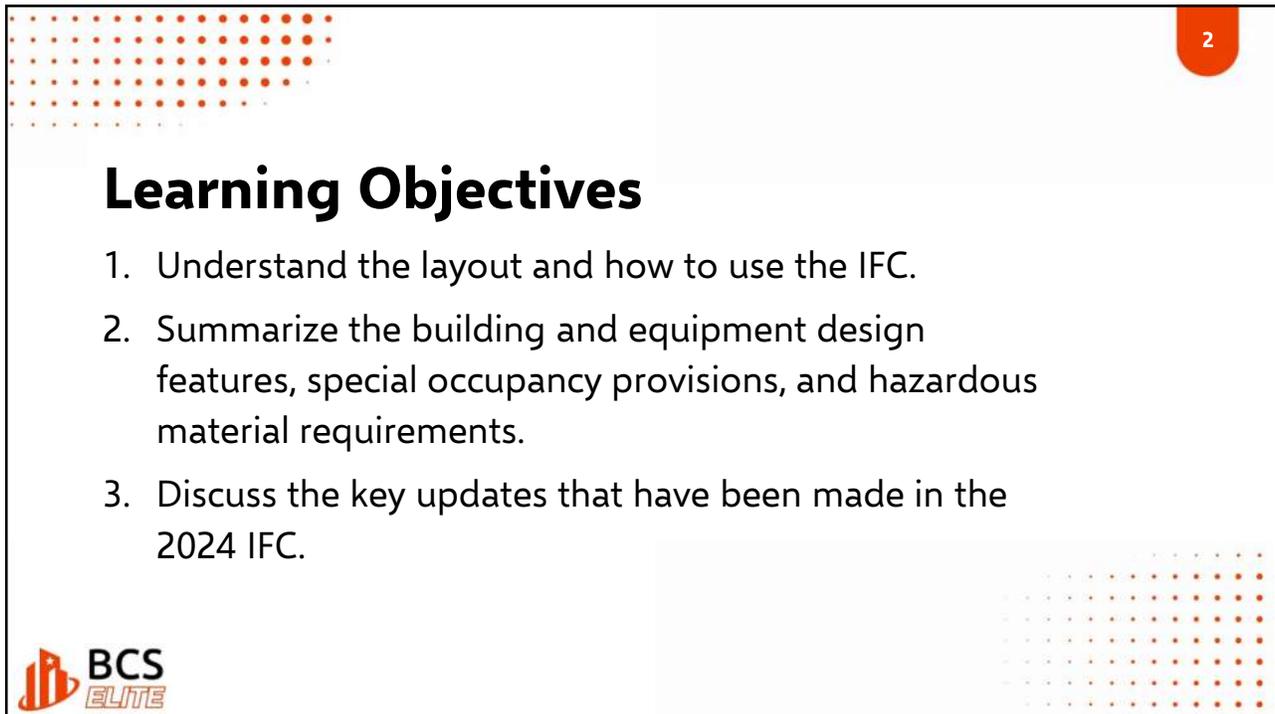
2024 IFC

Overview & Update

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2024 IFC
INTERNATIONAL
FIRE CODE
International Code Council 2024 IFC®



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Learning Objectives

1. Understand the layout and how to use the IFC.
2. Summarize the building and equipment design features, special occupancy provisions, and hazardous material requirements.
3. Discuss the key updates that have been made in the 2024 IFC.



Seminar Format

1. Introduction
2. Administration *(Chapters 1-2)*
3. General Safety *(Chapters 3-4)*
4. Buildings & Equipment *(Chapters 5-19)*
5. Special Occupancies *(Chapters 20-49)*
6. Hazardous Materials *(Chapters 50-69)*
7. Appendices *(Appendices A-O)*



1. Introduction

"The only constant in life is change." – Heraclitus

The code is revised every 3 years, but why?

- New materials and construction methods are introduced.
- Disasters and failures teach us hard lessons.
- Science and engineering uncover new insights.
- Social priorities—like accessibility, sustainability, or resilience—evolve.



The code is a living document

- Similar to a software update...
 - Each new version fixes bugs, improves performance
 - You wouldn't run a hospital, a plane, or even your smartphone on 20-year-old software
 - Why would we build communities that way?



Significant Reformatting



PREFACE

FORMATTING CHANGES TO THE 2024 INTERNATIONAL CODES

The 2024 International Codes® (I-Codes®) have undergone substantial formatting changes as part of the digital transformation strategy of the International Code Council® (ICC®) to improve the user experience. The resulting product better aligns the print and PDF versions of the I-Codes with the ICC's Digital Code content. Additional information can be found at iccsafe.org/design-updates.

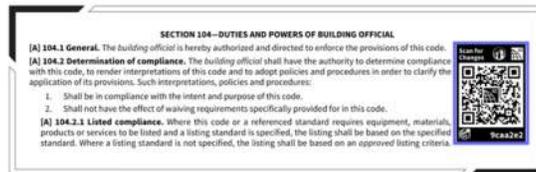
Replacement of Marginal Markings with QR Codes

Through 2021, print editions of the I-Codes identified technical changes from prior code cycles with marginal markings [solid vertical lines for new text, deletion arrows (➤), asterisks for relocations (*)]. The 2024 I-Code print editions replace the marginal markings with QR codes to identify code changes more precisely.

A QR code is placed at the beginning of any section that has undergone technical revision. If there is no QR code, there are no technical changes to that section.

In the following example from the 2024 International Building Code® (IBC®), a QR code indicates there are changes to Section 104 from the 2021 IBC. Note that the change may occur in the main section or in one or more subsections of the main section.

International Code Council, 2024 IBC ©



SECTION 4005—FIRE PROTECTION

4005.1 Palletized storage of distilled spirits in wooden barrels. The palletized storage of distilled spirits in wooden barrels shall be protected by an *approved automatic sprinkler system* installed throughout the building in accordance with Section 903.3.1.1 as modified in this section. The palletized storage of metal containers of distilled spirits shall be protected by an *approved automatic sprinkler system* that complies with Chapter 57.

4005.1.1 Storage height. Palletized storage arrays of barrels stored on end shall be limited to a maximum of seven pallets high.

4005.1.2 Flue spaces. Flue spaces with a minimum width of 6 inches (152 mm) shall be maintained between adjacent pallets.

4005.1.3 Loading aisles. Palletized storage that is provided with a defined loading aisle between pallet storage areas shall be arranged using one of the following:

1. Draft curtains, installed in accordance with Section 4005.1.3.1, shall be provided along the side of palletized storage facing the loading aisle to separate the quick-response sprinklers and standard-response sprinklers.
2. A trench drain shall be provided on each side of the loading aisle, arranged to capture any spilled distilled spirits in the aisle space and remove them from the building to prevent spills from spreading into the barrel storage area.
3. Barrels shall be banded on each pallet to prevent barrels from falling off pallets during transportation and loading into the storage racks.



Scan for Changes
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URL: qr.iccsafe.org/

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Menu Search Digital Codes

2024 International Fire Code (IFC)
Version: Oct 2023 (Historical)

Codes / 2024 I-Codes / 2024 International Fire Code (IFC)

Chapter 40 Storage of Distilled Spirits and Wines

BASIC READ ONLY

Fullscreen Legend

4004.4 Bulk beverage storage areas.

There shall be no storage of combustible materials in the bulk beverage storage areas not related to the beverage storage activities.

SECTION 4005

FIRE PROTECTION INSIGHTS

> INSIGHTS (3)

4005.1 Palletized storage of distilled spirits in wooden barrels.

The palletized storage of distilled spirits in wooden barrels shall be protected by an *approved automatic sprinkler system* installed throughout the building in accordance with Section 903.3.1.1 as modified in this section. The palletized storage of metal containers of distilled spirits shall be protected by an *approved automatic sprinkler system* that complies with Chapter 57.

4005.1.1 Storage height.

Palletized storage arrays of barrels stored on end shall be limited to a maximum of seven pallets high.

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Cannot copy text.

2. Administration



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User Notes

CHAPTER
1

SCOPE AND ADMINISTRATION

User notes:

About this chapter: Chapter 1 establishes the limits of applicability of the code and describes how the code is to be applied and enforced. Chapter 1 is in two parts: Part 1—General Provisions (Sections 101–102) and Part 2—Administrative Provisions (Sections 103–115). Section 102 identifies which buildings and structures come under its purview and references other I-Codes as applicable.

This code is intended to be adopted as a legally enforceable document, and it cannot be effective without adequate provisions for its administration and enforcement. The provisions of Chapter 1 establish the authority and duties of the code official appointed by the authority having jurisdiction and also establish the rights and privileges of the design professional, contractor and property owner.

Code development reminder: Code change proposals to this chapter will be considered by the Administrative Code Development Committee during the 2025 (Group B) Code Development Cycle.

Section 104 was revised for the 2024 edition. For clarity, the relocation marginal markings have not been included. For complete information, see the Relocations table in the Preface of this code.

QR code use: A QR code is placed at the beginning of any section that has undergone technical revision. To see those revisions, scan the QR code with a smart device or enter the 7-digit code beneath the QR code at the end of the following URL: qr.iccsafe.org/ (see Formatting Changes to the 2024 International Codes for more information).

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General Requirements

○ IFC 101.3: Purpose

- “The purpose of this code is to establish the **minimum requirements** for providing a **reasonable level of life safety and property protection** from the hazards of fire, explosion or dangerous conditions in new and existing **buildings, structures and premises**, and to provide a **reasonable** level of **safety to firefighters and emergency responders** during emergency operations.”



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Applicability

○ IFC 102.1: Construction & Design Provisions

- Construction and design provisions apply to...
 1. Structures, facilities and conditions arising after the adoption of this code.
 2. Existing structures, facilities and conditions not legally in existence at the time of adoption of this code.
 3. Existing structures, facilities and conditions where required in Chapter 11.
 4. Existing structures, facilities and conditions that, in the opinion of the fire code official, constitute a distinct hazard to life or property.



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Applicability

○ IFC 102.2: *Admin, Operational & Maintenance*

- The administrative, operational and maintenance provisions apply to...
 1. Conditions and operations arising after the adoption of this code.
 2. Existing conditions and operations.



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Applicability

○ IFC 102.3: *Change of Occupancy*

- "A change of occupancy shall not be made unless the use or occupancy is made to comply with the requirements of this code and the International Existing Building Code."
- **Exception:** Where approved by the fire code official, a change of occupancy shall be permitted without complying with the requirements of this code and the IEBC, provided that the new or proposed use or occupancy is less hazardous.





Duties & Powers of FCO

- **IFC 104.2.1:** *Listed Compliance*
 - Where this code or a referenced standard requires equipment, materials, products or services to be listed and a listing standard is specified, the listing shall be based on the specified standard.
 - Where a listing standard is not specified, the listing shall be based on an approved listing criteria.



Duties & Powers of FCO

- **IFC 104.2.2:** *Technical Assistance*
 - When deemed necessary by the FCO, at no cost to the jurisdiction, by someone qualified, with documented report and testing.
- **IFC 104.2.3:** *Alternative Materials, Design & Methods*
 - Subject to FCO approval, must respond in writing, meet the intent of the code, 6 element equivalency criteria list, testing and detailed reporting required, peer review can be requested.



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Duties & Powers of FCO

○ IFC 104.2.4: *Modifications*

- Where there are practical difficulties in complying with the code the FCO has the authority to grant modifications.
 1. **Individual Cases:** The reason must make the strict letter of the code impractical and the modification must be shown to comply with the intent and purpose of the code. ***Must be recorded.***
 2. **Natural Disasters:** Written policies, procedures and rules can be made which modify this code in preparation for, during and after natural disasters. ***Must be made available to the public and include dates.***



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Duties & Powers of FCO

○ IFC 104.4: *Right of Entry*

- Where the FCO has reasonable cause to believe that there exists a condition that is unsafe, dangerous or hazardous...
- The FCO is authorized to enter the premises at all reasonable times to inspect...
- Where occupied, the FCO shall present credentials...
- If not occupied, the FCO shall make a reasonable attempt to contact the owner.



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Duties & Powers of FCO

- **IFC 104.7:** *Official Records*
 - Official records include: approvals, inspections, fire records, **alternate means & modification approvals, tests and fees**
 - Shall be retained for ≥ 5 years, or...
 - For as long as the building exists





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Permits

- **IFC 105.1.2:** *Types of Permits*
 - Operational Permits (IFC 105.5)
 - Construction Permits (IFC 105.6)
 - **What is the difference between these types of permits?**
 - IFC 105.3.4 allows the FCO to issue “conditional permits” before the entire work is completed. The FCO must notify the applicant in writing of any limitations.
 - **When would you do this?**



Operational Permits

o IFC 105.5: Operational Permits

- FCO **may** issue operational permits
- There are **57 items** listed in IFC 105.5
- Why issue operational permits?
- What problems are there, administratively, with operational permits?



- | | | |
|---|--|---|
| <ul style="list-style-type: none"> • Additive manufacturing • Aerosol products • Amusement areas • Aviation facilities • Carnivals & fairs • Cellulose nitrate film • Combustible dust-producing operations • Combustible fibers • Compressed gases • Covered & open malls • Cryogenic fluids • Cutting & welding • Dry cleaning • Energy storage systems • Exhibits & trade shows • Explosives • Fire hydrants & valves • Flammable & combustible liquids • Floor finishing • Fruit crop ripening | <ul style="list-style-type: none"> • Fumigation & insecticidal fogging • Hazardous materials • HPM facilities • High-piled storage • Hot work operations • Indoor plant cultivation • Industrial ovens • Liquid- or gas-fueled vehicles or equipment in assembly buildings • Lithium batteries (> 15 CF) • LP-gas • Lumberyards & woodworking plants • Magnesium • Misc. combustible storage • Mobile food preparation vehicles • Motor fuel-dispensing facilities • Open burning • Open flames & torches • Open flames & candles • Organic coatings • Outdoor assembly event | <ul style="list-style-type: none"> • Places of assembly • Plant extraction systems • Private fire hydrants • Pyrotechnic special effects • Pyroxylin plastics • Refrigeration equipment • Repair garages • Rooftop heliports • Spaying or dipping • Storage of tires and tire byproducts • Temporary membrane structures • Tire rebuilding plants • Waste handling • Wood products • Temporary heating or cooking in tents or membrane structures • Temporary heating or cooking wildfire risk • Temporary heating for construction sites |
|---|--|---|

Construction Permits

o IFC 105.6: *Construction Permits*

- FCO is authorized to issue construction permits
- There are **25 items** listed in IFC 105.6
- These are not to be confused with building permits which often require review by the FCO as well
- Often these are listed as deferred submittals on the building permit plans



- | | | |
|--|---|---|
| <ul style="list-style-type: none"> • Automatic fire-extinguishing systems • Automatic sprinkler systems • Compressed gases • Cryogenic fluids • Emergency responder communication coverage systems • Energy storage systems • Fire alarm and detection systems • Fire pumps | <ul style="list-style-type: none"> • Flammable and combustible liquids • Gas detection systems • Gates and barricades across fire apparatus access roads • HazMat • High-piled combustible storage • Industrial ovens • LP-gas • Motor vehicle repair • Plant extraction systems | <ul style="list-style-type: none"> • Private fire hydrants • Smoke control and smoke exhaust systems • Solar PV systems • Special event structures • Spraying or dipping • Standpipe systems • Temporary membrane structures & tents • Sprinkler underground supply piping |
|--|---|---|

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Construction Documents

- **IFC 106:** *Construction Documents*
 - Shall be prepared by RDP where required.
 - "...shall be of sufficient clarity to indicate the location, nature and extent of the work proposed and show in detail that it will conform to the provisions of this code..."
 - Fire protection system shop drawings "...shall be approved prior to the start of installation."
 - "...any changes made during construction... shall be resubmitted for approval as an amended set of construction documents."



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Miscellaneous

- **IFC 107:** Temporary Structures, Uses, Equipment
- **IFC 109:** Inspections
- **IFC 110:** Maintenance
- **IFC 113:** Violations
- **IFC 114:** Stop Work Orders
- **IFC 115:** Unsafe Structures or Equipment



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Definitions

CHAPTER
2 DEFINITIONS

User notes:

About this chapter: *Codes, by their very nature, are technical documents. Every word, term and punctuation mark can add to or change the meaning of a technical requirement. It is necessary to maintain a consensus on the specific meaning of each term contained in the code. Chapter 2 performs this function by stating clearly what specific terms mean for the purpose of the code. General definitions are located in Section 202 and occupancy classification definitions are located in Section 203.*

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Definitions



- **Additive Manufacturing**
 - **Industrial**
 - 3D printing that uses combustible powders or metals, an inert gas supply, a dust collection system, or that create a hazardous location area outside the equipment
 - **Non-industrial**
 - 3D printing that does not create a hazardous location outside the equipment and do not utilize inert gas or dust collection system



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Definitions

- **Carbon Monoxide Source**
 - A piece of commonly used equipment or permanently installed appliance, fireplace or process that produces or emits carbon monoxide gas.



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Definitions

- **Emergency Responder Communication Enhancement System (ERCES)**
 - An infrastructure solution installed within a building to enhance the communication capabilities of first responders.
 - Includes solutions such as...
 - Signal boosters
 - Voting receivers
 - Base station
 - Etc.

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Definitions

- **Flammable Gas:** A material which is a gas at $\leq 68^{\circ}\text{F}$ at 14.7 psia subdivided as follows:
 - **Category 1A** – A gas that is either ignitable at 14.7 psia when in a mixture of $\leq 13\%$ by volume with air; or $\geq 12\%$ by volume regardless of the lower limit, unless data shows compliance with Category 1B.
 - **Category 1B** – A gas which meets the flammability criteria for Category 1A, is not pyrophoric or chemically unstable, and meets one of more of the following:
 - A lower flammability limit $> 6\%$ by volume of air; or
 - A fundamental burning velocity of less than 3.9 inches/second.



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Definitions

- **Frequency:**
 - Waveband at which communications broadcasts or transmits
- **Frequency License Holder(s):**
 - Person or entity that is issued a license for the frequencies being used by both ERCES and the emergency services communications system that it enhances
- **Frequency Licensing Authority:**
 - Government authority that issues frequency licenses





Definitions

- **Information Technology Equipment (ITE):**
 - Computers, data storage, servers and network communication equipment.
- **Information Technology Equipment Facilities (ITEF):**
 - Data centers and computer rooms used primarily to house information technology equipment.
- **Data Center:**
 - A room or building used primarily to house ITE and serving a total ITE load greater than 10 kW and 20 W/SF of conditioned floor area.



Definitions

- **Occupiable Roof:** An exterior space on a roof that is designed for human occupancy, other than maintenance and repair, and which is equipped with a means of egress system meeting requirements of this code.
 - Not considered a floor
 - Does not change building height
 - Must meet all egress requirements applicable to occupancy classification, as well as accessibility requirements
 - Elevator required if ≥ 4 stories (3rd floor above LED)



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Occupancy Classification & Use

- **IFC 203:** Previously was included in definitions.
 - Provides duplication of IBC Chapter 3
 1. Assembly
 2. Business
 3. Educational
 4. Factory & Industrial
 5. High Hazard
 6. Institutional
 7. Mercantile
 8. Residential
 9. Storage
 10. Utility & Miscellaneous



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Occupancy Classification & Use

- **Biggest Changes:**
 - **Lithium Batteries:**
 - Testing, research & development → Group B
 - ESS equipment or dedicated use buildings → Group F-1
 - Manufacturing of or vehicles powered by → Group F-1
 - Storage of → Group S-1
 - Repair of vehicles powered by → Group S-1
 - **> 20% alcohol content:**
 - Manufacturing of → Group F-1 (otherwise Group F-2)
 - Storage of → Group S-1 (otherwise Group S-2)



3. General Safety



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General Requirements

○ IFC 301.1: *Scope*

- Applies to the occupancy and maintenance of all structures and premises
- Includes provisions for:
 - Asphalt kettles
 - **Combustible waste materials**
 - Ignition sources
 - Motion picture projection rooms
 - Open burning
 - Open flames
 - Powered industrial trucks
 - Smoking
 - Vacant premises
 - Vehicle impact protection
 - Fueled equipment
 - Indoor displays
 - General storage
 - Hazards to firefighters
 - **Vegetative & landscaped roofs**
 - Laundry carts
 - Additive manufacturing
 - **Lithium battery storage**
 - Artificial combustible vegetation
 - **Powered micromobility devices**





Waste and Linen Containers

- **IFC 304.3.6:** *Groups I-1, I-2, I-3 & AC Facilities*
 - Shall be constructed of noncombustible materials or low heat release materials in accordance with IFC 304.3.2.
 - Metal waste containers ≥ 20 gallons shall be listed per UL 1315 and shall be provided with a noncombustible lid.
 - Portable waste and linen containers > 32 gallons shall be stored in an area classified as a waste and linen collection room and constructed in accordance with IBC Table 509.1.



Waste and Linen Containers

- **IFC 304.3.7:** *Group R-2 dormitories*
 - If ≥ 20 gallons, shall be constructed of noncombustible materials or low heat release.
 - Metal waste containers ≥ 20 gallons shall be listed in accordance with UL 1315 and shall be provided with a noncombustible lid.
 - Containers > 32 gallons shall be stored in an area classified as a waste collection room constructed per IBC Table 509.1.



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Landscaped Roofs

- **IFC 317:** *Vegetative & Landscaped Roofs*
 - IBC covers design and construction
 - IFC covers installation and maintenance
 - Means of keeping roof plants alive and dry foliage to a minimum
 - Removal of dead foliage
 - May require a maintenance plan





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Lithium Batteries Storage

- **IFC 320:** *Lithium-Ion and Lithium Metal Battery Storage*
 - Operational permit required if $\geq 15 \text{ ft}^3$ [see IFC 105.5.29]
 - Fire safety and evacuation plan required [see IFC 404]
 - Requirements for 3 storage configurations:
 - Limited indoor storage in containers
 - Indoor storage room
 - Outdoor storage
 - Reduced requirements for partially charged batteries ($\leq 30\%$)



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Powered Micromobility Devices

- **IFC 322:** *Powered Micromobility Devices*
 - Lithium-ion and lithium metal battery powered micromobility devices shall be operated and maintained per this section.
 - Provisions:
 - Locations, battery chargers and equipment, listing, battery charger areas, fire safety plan
 - Exceptions:
 - Residential occupancy and are for personal use
 - Charging of single device by its owner (Any occupancy)




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Emergency Planning & Preparedness

CHAPTER

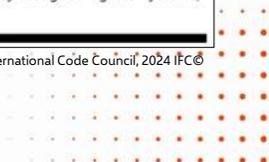
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EMERGENCY PLANNING AND PREPAREDNESS

User notes:

About this chapter: *Chapter 4 addresses the human contribution to life safety in buildings when a fire or other emergency occurs. The requirements for continuous training and scheduled fire, evacuation and lockdown drills can be as important as the required periodic inspections and maintenance of built-in fire protection features. The level of preparation by the occupants also improves the emergency responders' abilities during an emergency. The International Building Code™ focuses on built-in fire protection features, such as automatic sprinkler systems, fire-resistance-rated construction and properly designed egress systems, whereas this chapter fully addresses the human element.*

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Emergency Preparedness

○ IFC 403.2: Group A Occupancies

- An approved fire safety and evacuation plan is required.
- Shall include a detailed seating plan and occupant load limit.
- May require announcements for exits, fire watch and/or crowd managers.

○ IFC 403.3: Group B Occupancies

- An approved fire safety and evacuation plan is required if...
- > 500 occupants or > 100 occupants above or below LED.



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Emergency Preparedness

○ IFC 403.4: Group E Occupancies

- An approved fire safety and evacuation plan is required.
- Emergency evacuation drill required within 10 days of school start.
- Evacuation drills should be conducted at different times of day throughout the year.
- Outdoor assembly areas should be designated and shall be a safe distance away from the building.



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Emergency Preparedness

- **IFC 403.5:** *Group F Occupancies*
 - An approved fire safety and evacuation plan is required if...
 - > 500 occupants, > 100 occupants above or below LED, or pallet manufacturing or recycling facilities.



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Emergency Preparedness

- **IFC 403.6:** *Group H Occupancies*
 - An approved fire safety and evacuation plan is required.
 - Special requirements outlined for Group H-5.
- **IFC 403.7:** *Group I Occupancies*
 - An approved fire safety and evacuation plan is required.
 - Detailed requirements outlined for Group I-1, I-2 and I-3.



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Emergency Preparedness

- **IFC 403.8:** *Group M Occupancies*
 - An approved fire safety and evacuation plan is required if...
 - > 500 occupants or > 100 occupants above or below LED
- **IFC 403.9.1:** *Group R-1 Occupancies*
 - An approved fire safety and evacuation plan is required.
 - Evacuation diagrams must be posted adjacent to egress door in each dwelling or sleeping unit.
 - Emergency duties for staff are outlined.



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Emergency Preparedness

- **IFC 403.9.2:** *Group R-2 Occupancies*
 - Applies to college and university buildings only. (i.e., dormitories)
 - An approved fire safety and evacuation plan is required.
 - Emergency guides and evacuation drills are required.
- **IFC 403.9.3:** *Group R-4 Occupancies*
 - An approved fire safety and evacuation plan is required.
 - Shall include a description of staff actions.
 - Shall include # of care recipients and special locking arrangements.



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Emergency Preparedness

- **IFC 403.10:** *Special Uses*
 - Covered or open mall buildings
 - High-rise buildings
 - Underground buildings
 - Buildings w/ occupant evacuation elevators
 - Buildings w/ high-piled storage
 - **Lithium-ion and lithium metal batteries**



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Emergency Preparedness

- **IFC 403.10.6:** *Lithium-ion & lithium metal batteries*
 - A fire safety & evacuation plan must be provided where R&D, testing, manufacturing, handling and storage occur.
 - Also applies to the repair or servicing areas for EV vehicles.
 - Exceptions: Storage or sale of...
 - New or refurbished batteries installed in equipment
 - New or refurbished lithium-ion rated at ≤ 300 watt-hours
 - New or refurbished lithium metal containing ≤ 25 grams lithium
 - Group R-1, R-2 & R-3 associated with personal use



Fire Safety & Evacuation Plan

- **IFC 404.2: Contents**
 - Fire Evacuation Plans → 10 specific items required
 - Fire Safety Plans → 7 specific items with numerous sub-items required
 - Lockdown Plans → 11 specific items required
- **IFC 404.3: Maintenance**
 - Must be reviewed and updated annually



4. Building & Equipment



Fire Service Features

CHAPTER

5

FIRE SERVICE FEATURES

User notes:
About this chapter:

Chapter 5 provides requirements that apply to all buildings and occupancies and pertain to access roads, access to building openings and roofs, premises identification, key boxes, fire protection water supplies, fire command centers, fire department access to equipment and emergency responder communications enhancement coverage in buildings. Although many safety features are part of the building design, features such as proper fire department access roads and communication coverage are necessary in case of emergency and are important tools for emergency responders for public safety and their own safety.

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Construction Documents

o IFC 501.3: Construction Documents

- Shall be provided for proposed fire apparatus access, location of fire lanes, security gates across fire apparatus access roads, fire hydrant systems (*including hydraulic calculations*).
- A site safety plan may be required per IFC 3303.
- Shall be installed and made serviceable prior to construction.



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Fire Apparatus Access Roads

- **IFC 503: Fire Apparatus Access Roads**
 - Shall be provided for every facility.
 - Shall extend to within **150 feet** of all portions of the facility and all portions of first story exterior walls.
 - FCO can approve increased distances under certain circumstances.
 - FCO can require more than one such access road based on the potential for impairment.



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Fire Apparatus Access Roads

- **IFC 503: Fire Apparatus Access Roads**
 - Unobstructed width = **20 feet**
 - Vertical clearance = **13.5 feet**
 - All-weather surface capable of supporting apparatus
 - Turning radius, grade, and angles of approach/departure per FCO
 - Turn arounds required for dead ends **> 150 feet**
 - Bridges per AASHTO HB-17 and posted live loads



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Fire Apparatus Access Roads

o IFC 503: *Fire Apparatus Access Roads*

- Marking per FCO – should include words “**NO PARKING – FIRE LANE**” – shall be maintained
- Gates or Barricades:
 - Electric operators – UL 325
 - Gates – ASTM F2200
 - Shall have an approved means of emergency operation



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Access to Buildings

o IFC 504: *Access to Building Openings & Roofs*

- An approved access walkway leading from the fire apparatus access roads to exterior openings shall be provided where required by FCO
- New buildings ≥ 4 stories or more (except for $> 4:12$ pitch) shall have a stairway to the roof.



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Fire Protection Water Supplies

○ IFC 507: *Fire Protection Water Supplies*

- Shall be capable of providing the required fire flow.
- Types: Reservoirs, pressure tanks, elevated tanks, water mains or other fixed systems capable of providing the required fire flow.
- Fire flow shall be determined by an approved method. (Appendix B)
- Water supply test shall be provided to FCO prior to final approval of water supply system.



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Fire Protection Water Supplies

○ IFC 507.5: *Fire Hydrant Systems*

- Hydrants shall be provided within **400-feet** of all portions of a facility. *(600-feet for Groups R-3 & U or for sprinklered buildings)*
- Buildings with standpipe systems shall have a hydrant within 100-feet of the FDC.
- Shall not be obstructed, have 3-foot clear space, and require bollard protection if subject to impact.



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Miscellaneous

- **IFC 505:** *Premises Identification*
- **IFC 506:** *Key Boxes*
- **IFC 508:** *Fire Command Center*
- **IFC 509:** *Fire Protection & Utility Equipment Identification & Access*



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ERCES

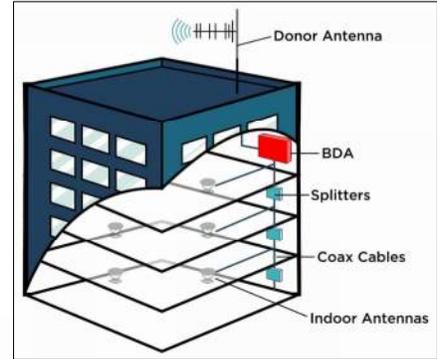
- **IFC 510:** *Emergency Responder Communications Enhancement System (ERCES)*
 - Third name change!
 - Required in all new buildings unless waived by FCO (*Not required in 1-story buildings < 12,000 SF and no basement*)
 - Requires a separate construction permit [**IFC 510.3.1**]
 - Requires an operational permit [**IFC 510.3.2**]



ERCES

o IFC 510: ERCES

- Listed per UL 2524
- Signal: 95% in all areas; **99% in critical areas**
- Into and out of building – DAQ 3.0 minimum
- Design per IFC 510.4.2 and NFPA 1225
- Requires standby power
- FCC compliance



National Training Center, "Emergency Radio Enhancement Systems (ERCES) for Fire Alarm Professionals"



Building Services & Systems

CHAPTER

6

BUILDING SERVICES AND SYSTEMS

User notes:

About this chapter:

Chapter 6 focuses on building systems and services as they relate to potential safety hazards and when and how they should be installed. This chapter brings together all building system- and service-related issues for convenience and provides a more systematic view of buildings. The following building services and systems are addressed: electrical equipment wiring and hazards, elevator operation, maintenance and fire service keys, fuel-fired appliances, commercial cooking equipment and systems, commercial cooking oil storage, mechanical refrigeration, hyperbaric facilities and clothes dryer exhaust systems. Note that building systems focused on energy systems and components are addressed by Chapter 12.

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General

- **IFC Chapter 6:** Applies to installation, operation, *testing* & maintenance of:
 1. Electrical systems, equipment and wiring. (IFC 603)
 2. **Information technology server rooms.**
 3. Elevator systems, emergency operation and recall. (IFC 604)
 4. Fuel-fired appliances, heating systems, chimneys and fuel oil storage. (IFC 605)
 5. Commercial cooking equipment and systems. (IFC 606)
 6. Commercial cooking oil storage. (IFC 607)
 7. Mechanical refrigeration systems. (IFC 608)
 8. Hyperbaric facilities. (IFC 609)
 9. Clothes dryer exhaust systems. (IFC 610)



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Elevators

- **IFC 604.4: Emergency Signs**
 - Where elevators are not a component of an accessible means of egress a sign stating the following shall be provided:
 - **"IN CASE OF FIRE, ELEVATORS ARE OUT OF SERVICE. USE EXIT."**





Mechanical Refrigeration

o **IFC 608.18:** *Group A2L and B2L Refrigerants*

- Shall comply with mechanical code
- Refrigerant detectors shall signal alarm and activate ventilation
- Mechanical ventilation complying with ASHRAE 15

TABLE 608.18.2—GROUP A2L AND B2L DETECTOR ACTIVATION

ACTIVATION LEVEL	MAXIMUM RESPONSE TIME (seconds)	ASHRAE 15 VENTILATION LEVEL	ALARM RESET	ALARM TYPE
Less than or equal to the OEL in Table 1103.1 of the <i>International Mechanical Code</i>	300	1	Automatic	Trouble
Less than or equal to the refrigerant concentration level in Table 1103.1 of the <i>International Mechanical Code</i>	15	2	Manual	Emergency



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Fire & Smoke Protection Features

CHAPTER

7

FIRE AND SMOKE PROTECTION FEATURES

User notes:

About this chapter:

Chapter 7 provides requirements to maintain the fire-resistance ratings of building elements and to limit fire spread. Section 701 addresses the maintenance of and owner's responsibility for construction elements such as fire barriers and smoke barriers. The rest of the chapter deals with various aspects that also must be maintained to achieve overall fire resistance of the main fire- and smoke-resistive features. These include penetrations, joint protection, door and window openings, and duct and air transfer opening protection.

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FRR Construction

○ IFC 701.2: *Fire-Resistance-Rated Construction*

- FR ratings shall be maintained for...
 - Structural members
 - Exterior walls
 - Fire walls, fire barriers & fire partitions
 - Horizontal assemblies
 - Shaft enclosures



○ IFC 701.3: *Smoke Barriers*

- FR ratings & smoke-resistance shall be maintained



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FRR Construction

- IFC 703: *Penetrations*
- IFC 704: *Joints & Voids*
- IFC 704.3 & 705: *Opening Protectives*
- IFC 706: *Duct & Air Transfer Openings*
- IFC 707: *Concealed Spaces*
- IFC 708: *Spray Fire-Resistant & Intumescent Materials*





Rolling Steel Fire Doors

- o **IFC 705.2.7: Periodic Testing**
 - Shall be inspected and tested annually by trained rolling steel fire door technicians in accordance with NFPA 80.
 - Critical to reset the tension properly



Interior Finish, Decorative Materials

CHAPTER
8

INTERIOR FINISH, DECORATIVE MATERIALS AND FURNISHINGS

User notes:

About this chapter: Chapter 8 provides requirements for interior finishes, decorative materials and furnishings in new and existing buildings so that they do not significantly add to or create fire hazards in buildings. The provisions tend to focus on occupancies with specific risk characteristics, such as vulnerability of occupants, density of occupants, lack of familiarity with the building and societal expectations of importance. This chapter is consistent with Chapter 8 of the International Building Code®, which regulates the interior finishes and decorative materials of new buildings.

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Wall & Ceiling Finishes

o **IFC 803:** *Interior Wall & Ceiling Finishes*

- Shall comply with IBC 803
- Classified per NFPA 286, ASTM E84 or UL 723

GROUP	SPRINKLERED ¹			NONSPRINKLERED		
	Interior exit stairways and ramps and exit passageways ^{2,3}	Corridors and enclosure for exit access stairways and ramps	Rooms and enclosed spaces ⁴	Interior exit stairways and ramps and exit passageways ^{2,3}	Corridors and enclosure for exit access stairways and ramps	Rooms and enclosed spaces ⁴
A-1 and A-2	B	B	C	A	A ⁵	B ⁶
A-3, A-4, A-5	B	B	C	A	A ⁵	C
B, E, M, R-1, R-4	B	C ⁷	C	A	B ⁸	C
F	C	C	C	B	C	C
H	B	B	C ⁹	A	A	B
I-1	B	C	C	A	B	B
I-2	B	B	B ¹⁰	A	A	B
I-3	A	A ¹	C	A	A	B
I-4	B	B	B ¹⁰	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		

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Furniture & Mattresses

o **IFC 805:** *Upholstered Furniture & Mattresses*

- Group I-1, Condition 2; Group I-2; Group I-3; Group B; Group R-2 dormitories:
 - Shall be shown to resist ignition by cigarettes
 - Shall have limited rates of heat release
 - Shall bear a label of an approved agency



Fire Protection & Life Safety Systems

CHAPTER

9

FIRE PROTECTION AND LIFE SAFETY SYSTEMS

User notes:

About this chapter:

Chapter 9 prescribes the minimum requirements for active fire protection equipment systems to perform the functions of detecting a fire, alerting the occupants or fire department of a fire emergency, mass notification, gas detection, controlling smoke and controlling or extinguishing the fire. Generally, the requirements are based on the occupancy, the height and the area of the building because these are the factors that most affect firefighting capabilities and the relative hazard of a specific building or portion thereof. This chapter parallels and is substantially duplicated in Chapter 9 of the International Building Code®; however, this chapter also contains periodic testing criteria that are not contained in the International Building Code. In addition, the special fire protection system requirements based on use and occupancy found in Chapter 4 of the International Building Code are duplicated in this chapter as a user convenience.

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General

○ IFC 901: *General*

- FCO can require construction documents and calculations for all fire protection and life safety systems.
- Prior to final inspection, FCO can request in writing a statement from the installing contractor that the system has been installed per the approved plans and tested per the MFR specifications and applicable standard.
- Fire pump and riser room shall have adequate working space, appropriate access, lighting and environment.



General

o IFC 901.6: Inspection, Testing & Maintenance

- Shall be in operative conditions at all times

SYSTEM	STANDARD
Portable fire extinguishers	NFPA 10
Carbon dioxide fire-extinguishing systems	NFPA 12
Halon 1301 fire-extinguishing systems	NFPA 12A
Dry-chemical extinguishing systems	NFPA 17
Wet-chemical extinguishing systems	NFPA 17A
Water-based fire protection systems	NFPA 25
Fire alarm systems	NFPA 72
Fire dampers	NFPA 80
Smoke dampers	NFPA 105
Smoke and heat vents	NFPA 204
Water-mist systems	NFPA 750
Clean-agent extinguishing systems	NFPA 2001
Aerosol fire-extinguishing systems	NFPA 2010

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Fire Sprinklers – IFC 903.2

Use Group	Fire Area (SF)	Occupant Load	Above/Below L.E.D.	Other
A-1	12,000	300	Yes	- Multi-theater complex.
A-2	5,000	100	Yes	
A-3	12,000	300	Yes	
A-4	12,000	300	Yes	
A-5	1,000	---	---	- Enclosed areas under grandstands and bleachers.
A	---	Multiple A w/ combined > 300	---	
B	---	---	---	- > 4 ambulatory care recipients at L.E.D. - > 1 ambulatory care recipients at other levels - Laboratories for testing, research & development of lithium batteries
E	12,000	300	Yes	
F-1	12,000	---	---	- Located > 3 stories above grade - Manufacture of lithium batteries - Manufacture of vehicles, ESS or other equipment with lithium batteries - Woodworking operations > 2,500 SF - Upholstered furniture/mattresses > 2,500 SF - Distilled spirits of any size



Fire Sprinklers – IFC 903.2

Use Group	Fire Area (SF)	Occupant Load	Above/Below L.E.D.	Other
H	---	---	---	- All
I	---	---	---	- All - Exception for Group I-4 where each room has an exterior exit door.
M	12,000	---	---	- Fire area located > 3 stories above grade - High-piled storage areas - Upholstered furniture/mattresses > 5,000 SF - Lithium battery storage where required by the IFC
R	---	---	---	- All
S-1	12,000			- Fire areas > 3 stories from grade - Repair garages > 12,000 SF (6,000 SF commercial) - Bulk tire storage > 20,000 CF (volume) - Storage of commercial vehicles > 5,000 SF - > 500 SF storage of lithium batteries - Distilled spirits - Upholstered furniture/mattresses > 2,500 SF
S-2	12,000			- 12,000 SF (enclosed); 48,000 SF (open) - If located beneath other Use Groups - Open parking garages > 48,000 SF - Commercial vehicles > 5,000 SF - Mechanical-access parking garages



Fire Sprinklers

○ Where else?

- Stories w/out openings (IFC 903.2.11.1)
- Rubbish & linen chutes (IFC 903.2.11.2)
- Buildings > 55-feet (IFC 903.2.11.3)
- Ducts containing HazMat exhaust (IFC 903.2.11.4)
- Commercial cooking operations (IFC 903.2.11.5)



Fire Sprinklers

○ Where else?

TABLE 903.2.11.6—ADDITIONAL REQUIRED FIRE PROTECTION SYSTEMS

SECTION	SUBJECT
320.2	Lithium-ion and lithium metal battery storage
903.2.10.2	Mechanical-access enclosed parking garages
914.2.1	Covered and open mall buildings
914.3.1	High-rise buildings
914.4.1	Atriums
914.5.1	Underground structures
914.6.1	Stages
914.7.1	Special amusement area
914.8.2	Airport traffic control towers
914.8.3, 914.8.6	Aircraft hangars
914.9	Flammable finishes
914.10	Drying rooms
914.11.1	Ambulatory care facilities
1030.6.2.3	Smoke-protected assembly seating

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Fire Sprinklers

○ IFC 903.2.2: Group B

- Ambulatory care facilities when...
 - ≥ 4 care recipients are incapable of self-preservation
 - ≥ 4 care recipients incapable of self-preservation are located above or below the LED
- Laboratories involving R&D or testing of lithium-ion or lithium metal batteries.





Fire Sprinklers

- **IFC 903.2.4:** *Group F-1*
 - Used to manufacture lithium-ion or lithium metal batteries.
 - Used to manufacture vehicles, ESS, or equipment containing lithium-ion or lithium metal batteries where the batteries are installed as part of the manufacturing process.
- **IFC 903.2.7.3:** *Group M*
 - In room or space where lithium-ion or lithium metal battery storage occurs if required by IFC 320 or IFC Chapter 32.



Fire Sprinklers

- **IFC 903.2.9:** *Group S-1*
 - Used to store lithium-ion or lithium metal powered vehicles where fire area > 500 SF
- **IFC 903.2.9.1:** *Repair Garages*
 - Used to store lithium-ion or lithium metal powered vehicles where fire area > 500 SF



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Fire Sprinklers

- **IFC 903.3.1.1.3:** *Automatic Suppression & Lithium*
 - The design shall be based on a series of fire tests conducted or witnessed by an approved testing laboratory.





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NFPA 13R Sprinklers

- **IFC 903.3.1.2:** *NFPA 13R Sprinkler Systems*
- Revised provisions. Now allowed if...
 - **≤ 4 stories**, or...
 - Other than R-2, highest floor level is **≤ 30-feet** above the lowest fire department vehicle access, or... (For R-2, roof assembly is **≤ 45-feet**)
 - Lowest floor level is **≤ 30-feet** below the lowest fire department vehicle access.



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Sprinkler Supervision & Alarms

○ IFC 903.4.3: *Visual Alarms*

- Added “visual sprinkler waterflow alarm” to the previous audible only alarm required at the exterior of buildings.
 - **Exception:** One- and two-family dwellings



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Alternative Systems

○ IFC 904: *Alternative Automatic Fire-Extinguishing Systems*

- Shall be approved by FCO
- Type I hoods require protection
- Prior to final acceptance, the following must be inspected:
 1. Hazard specification for consistency with design hazard.
 2. Type, location and spacing of automatic- and manual-initiating devices.
 3. Size, placement and position of nozzles or discharge orifices.
 4. Location and identification of audible and visible alarm devices.
 5. Identification of devices with proper designations.
 6. Operating instructions.



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Alternative Systems

- **IFC 904.5:** *Wet-Chemical Systems*
- **IFC 904.6:** *Dry-Chemical Systems*
- **IFC 904.7:** *Foam Systems*
- **IFC 904.8:** *Carbon Dioxide Systems*
- **IFC 904.10:** *Clean-Agent Systems*
- **IFC 904.11:** *Water Mist Systems*
- **IFC 904.12:** *Hybrid Systems*
- **IFC 904.13:** *Aerosol Systems*
- **IFC 904.14:** *Commercial Cooking Systems*
- **IFC 904.15:** *Domestic Cooking Facilities*



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Commercial Cooking

- **IFC 904.14.1:** *Manual System Operation*
 - Located 10-20' from kitchen exhaust system
 - **New Exception:** Where not feasible, the fire code official can approve alternative if location is near a means of egress, unobstructed and in view



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Standpipes

o IFC 905.3: Required when...

- ≥ 4 or more stories (above or below)
- Highest/lowest floor level > 30 -feet from grade
- Group A : Nonsprinklered & $> 1,000$ occupants
- Covered & Open Mall Buildings
- Underground Buildings
- Helistops & Heliports
- Marinas & Boatyards
- Roof Gardens & Landscaped Roofs



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Standpipes

o IFC 905.3: Required Installations

- New exemption is R-2 townhouses

o IFC 905.3.4 – Removed → Standpipes at stages

o IFC 905.4: Location of standpipe connections

- Clarifies that required at exterior exit stairways in addition to interior exit stairways



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Fire Extinguishers

o IFC 906.1: Required when...

- Groups A, B, E, F, H, I, M, R-1, R-2, R-4 & S
- Within 30-feet of commercial cooking equip.
- Domestic cooking equip. (I-1, I2- & R-2 dorms)
- Flammable or combustible liquids
- On each floor under construction.
- Special-hazard areas
- Where required by **IFC Table 906.1**



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Fire Extinguishers

o IFC Table 906.3(1)

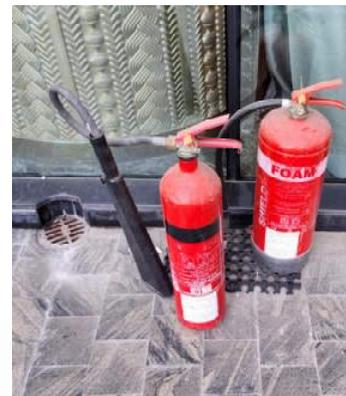
- Light hazards → Type 2-A w/in **75-feet**

o IFC 906.5: Conspicuous Location

- Horizontal projections ≤ 4" (IBC 1003.3.3)

o IFC 906.9: Installation

- ≤ 40 lbs. → Top ≤ 5-feet;
- > 40 lbs. → Top ≤ 3.5-feet
- Min. 4" clearance between bottom and floor



Fire Alarms

o **IFC 907: Types**

- Manual Fire Alarms
- Automatic Smoke Detection
- Automatic Heat Detection
- Single- and Multiple-Station Smoke Alarms
- Audible and Visual Notification Devices
- Emergency Voic/Alarm Communication (EVAC)
- Supervisory Monitoring



Use Group	Occupant Load	Above/Below L.E.D.	Other
A	300	100	- EVAC if > 1,000 occupants
B	500	100	- Contains ambulatory care facility - Laboratories involving research, development or testing of lithium batteries
E	50	---	- EVAC required if > 100 occupants
F	---	500	- And ≥ 2 stories (<i>both must be met to require</i>)
H	---	---	- Where highly toxic gases, organic peroxides & oxidizers exist (see IFC) - Group H-5 occupancies
I	All	All	- Group I-1: Automatic smoke detection in corridors and habitable spaces - Group I-2, Condition 1: Automatic smoke detection in spaces open to corridors - Group I-3: Automatic smoke detection is also required
M	500	100	- Where storage of lithium batteries occurs and required by IFC Chapter 32 - Not required in covered or open mall buildings
R-1	All	All	Not required if... - ≤ 2 stories with units & attics separated - Sprinklered, notification appliances, one manual fire alarm box
R-2	500	100	- Any dwelling/sleeping unit is ≥ 3 stories above LED - Any dwelling/sleeping unit > 1 story below LED - > 16 dwelling/sleeping units - College dormitories
S	All	All	- Public & self storage ≥ 3 stories - Storage of lithium batteries where required by IFC Chapter 32

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Fire Alarms

o IFC 907.2: Other locations...

- Special Amusement Buildings
- High-rise Buildings
- Atriums
- High-piled Storage
- Aerosol Storage
- Lumber mills
- Underground Buildings
- Residential Aircraft Hangars
- Airport Traffic Control Towers
- Energy Storage Systems



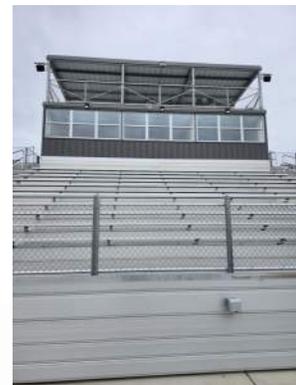
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Fire Alarms – Group A-5

o IFC 907.2.1: *Added exceptions 2 and 3*

- Occupant load is between **300 – 15,000**
- Enclosed spaces are limited (10% area or 1,000 ft²)
- Accessory spaces beneath w/ 1 hr. separation
- All means of egress are open to the outside
(Similar requirements for temporary bleachers)





Fire Alarms

- **IFC 907.2.2.2:** *Laboratories involving R&D or Testing*
 - Fire alarm system activated by air-sampling smoke detection or radiant energy sensing detection installed throughout entire fire area utilized for research and development or testing of lithium-ion or lithium metal batteries.
- **IFC 907.2.4.1:** *MFR of lithium-ion or lithium metal batteries*
 - Similar requirement for Labs.
 - Includes manufacturer of vehicles, ESS or equipment containing lithium-ion or lithium metal batteries.



Fire Alarms

- **IFC 907.2.7.2:** *Group M storage of lithium-ion or lithium metal batteries*
 - Limits to room or space where stored in accordance with IFC 320
- **IFC 907.2.10.2:** *Storage of lithium-ion or lithium metal batteries*
 - Fire area where stored in accordance with IFC 320



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Smoke Alarms

- **IFC 907.2.11.3:** *Installation near cooking appliances*
 - **Simplification:** Smoke alarms shall not be within 10' horizontally of permanent cooking appliances
 - **Exception-** Reduced to 6' if R and I occupancies, where required by code (photoelectric)







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Special Amusement Areas

- **IFC 907.2.12:** *Special Amusement Areas*
 - Detection and alarms per IFC 914.7
 - **IFC 914.7** → *Exceptions:*
 - No walls and roof
 - Puzzle rooms with unlocked means of egress that is readily identifiable
 - **IFC 914.7.2:** Shall have automatic smoke detection and emergency voice/alarm communication system





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Smoke Alarms

- **IFC 907.10.1: Smoke Alarm Replacement**
 - Shall be replaced when...
 - Alarm fails to respond to operability tests
 - > 10 years from MFR date
 - Alarm end-of-life signal is sounded
 - Date of MFR cannot be determined





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Other Systems

- **Emergency Alarm Systems** → Group H (IFC 908)
- **Smoke Control Systems** → Highrise & Atriums (IFC 909)
- **Smoke & Heat Removal** → Groups F-1, S-1 & High-piled (IFC 910)
- **Fire Command Center** → Highrise, Groups F-1 & S-1 (IFC 911)
- **Carbon Monoxide Detection** → Parking, CO source (IFC 915)
- **Gas Detection System** → Group H-5, hydrogen fuel gas rooms, hydrogen & LNG Repair garages (IFC 916)



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<https://www.sandiego.gov/sites/default/files/sdfdrccguide.pdf>

Other Systems

- **Mass Notification System** → Multi-building college or university campus, **Group E > 500 occupants** (IFC 917)
- **ERCES** → As required by AHJ (IFC 510)



SAN DIEGO FIRE-RESCUE
COMMUNITY RISK REDUCTION DIVISION

Emergency Responder Radio Coverage Systems

I. PURPOSE
The purpose of this guideline is to clarify the requirements for emergency responder radio coverage systems (ERCCs) and ensure that the design, installation and testing of these systems meets the requirements of the 2022 California Fire Code (CFC) and the following referenced standards: NFPA 1221 (2019 Edition), NFPA 72 (2022 Edition), NFPA 70 (2020 Edition).

II. MINIMAL REQUIREMENTS

A. New Buildings: All new buildings must meet the minimum performance requirements for in-building, emergency responder communication system coverage. Upon completion of building construction, a radio coverage test shall be conducted per the specific requirements of CFC 510, and if the test fails, an Emergency Responder Radio Coverage System (ERCC) shall be installed.

Considerations should be made to install conduit during building construction to accommodate ERCC's coaxial cables if testing indicates a system is needed to provide acceptable coverage after building construction is completed.

1. All new high-rise buildings must be provided with an Emergency Responder Radio Coverage System (ERCC). A wired phone-jack two-way communication system shall not be permitted to be installed in new high-rise buildings in lieu of the required ERCC.
2. Low-rise buildings meeting ANY of the following conditions:
 - a. Buildings 3 or more stories above grade plane.
 - b. Total building area exceeds 30,000 sq. ft.
 - c. Building contains multiple stories below grade or a basement extending 3.5m (11 ft).
 - d. Buildings determined by the fire code official as requiring evaluation based upon construction features or fire- and life-loss potential.

III. Existing Buildings: Existing buildings must comply with these requirements under the following conditions:

1. Where a previously required two-way wired fire department communication system is removed.



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Explosion Control

- **IFC Table 911.1: Explosion Control Requirements**
 - Two new exceptions:
 - Does not apply to Class 1B Flammable Gases
 - Does not apply to consumer fireworks, 1.4G





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FDC Signage

- **IFC 912.5: Signs**
 - While signs have always been required, it now specifies...
 - Manual systems shall specify if they are “wet” or “dry”
 - If serves more than one building or just a portion of a building it must be noted.
 - Must list the pressure required at the outlets to deliver the system demand
 - Exception: If ≤ 150 psi required



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CO Detection

- **IFC 915: Carbon Monoxide (CO) Detection**
 - **915.1 – General**
 - Now required in all buildings except unoccupied Groups F, S and U
 - **915.1.1 – Where Required**
 - In buildings containing CO source
 - In buildings containing or supplied by CO-producing air furnace.
 - In buildings with attached private garages.
 - In buildings that have CO-producing vehicle used w/in building.



Means of Egress

CHAPTER

10

MEANS OF EGRESS

User note:

About this chapter:

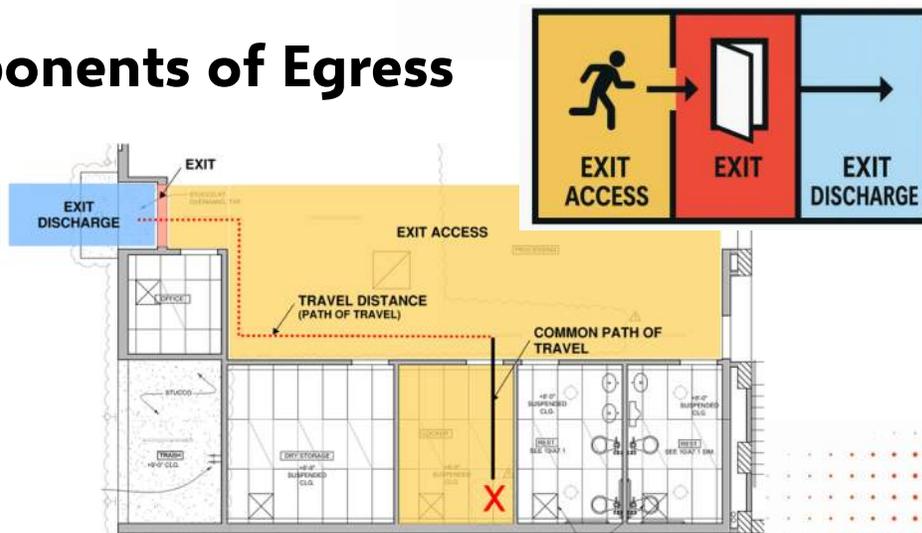
Chapter 10 provides the general criteria for designing the means of egress established as the primary method for protection of people in buildings by allowing timely relocation or evacuation of building occupants. Both prescriptive and performance language is utilized in this chapter to provide for a basic approach in the determination of a safe exiting system for all occupancies. This chapter addresses all portions of the egress system (exit access, exits and exit discharge) and includes design requirements as well as provisions regulating individual components. The requirements detail the size, arrangement, number and protection of means of egress components. Functional and operational characteristics that will permit the safe use of components without special knowledge or effort are specified.

The means of egress protection requirements work in coordination with other sections of the code, such as protection of vertical openings (see Chapter 7), interior finish (see Chapter 8), fire suppression and detection systems (see Chapter 9) and numerous others, all having an impact on life safety. Sections 1003 through 1031 are duplicated text from Chapter 10 of the International Building Code®; however, the International Fire Code® contains an additional Section 1032 on maintenance of the means of egress system in existing buildings. Retroactive minimum means of egress requirements for existing buildings are found in Chapter 11.



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Components of Egress



Key Concepts

- **IFC 1003:** *General Means of Egress*
 - Clear path with adequate ceiling height and headroom
 - Minimal projections or obstructions (continuity)
 - Slip-resistant floor surface with predictable slopes and elevations
 - Limited use of elevators, escalators, moving sidewalks



What Determines Adequate Egress?

- **IFC 1004:** *Occupant Loads*
 - “Rule of thumb” number of people in various spaces
 - Based on functions per **Table 1004.5**

FUNCTION OF SPACE	OCCUPANT LOAD FACTOR*
Accessory storage areas, mechanical equipment room	300 gross
Agricultural building	300 gross
Aircraft hangars	500 gross
Airport terminal	
Baggage claim	20 gross
Baggage handling	300 gross
Concourse	100 gross
Waiting areas	15 gross
Assembly	
Gaming floors (keno, slots, etc.)	11 gross
Exhibit gallery and museum	30 net
Assembly with fixed seats	See Section 1004.6
Assembly without fixed seats	

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Net vs. Gross

- **Table 1004.5-** OLF's are identified **net** or **gross**
 - **Gross** means the calculation includes all space within the perimeter of the walls, including corridors, restrooms, and closets
 - **Net** means the calculation excludes ancillary areas and only includes the usable floor space
 - Occupancies like educational and mercantile (without fixed seats) often use net to better reflect functional capacity



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Fixed Seating

- **IFC 1004.6:**
 - Base occupant load on the number of fixed seats
 - Benches, use 18" per occupant
 - Booths, use 24" per occupant



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Occupant Load Factor

- **IFC Table 1004.5:**
 - Information Technology Equipment Facilities (ITEF)
 - Utilize **300 gross** OLF



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Posting Occupant Loads

- **IFC 1004.9:**
 - Assembly Occupancies (50+ Occupants)
 - Post occupant load in a **conspicuous** place, near the main exit (inside the space)



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Why Egress Sizing Matters



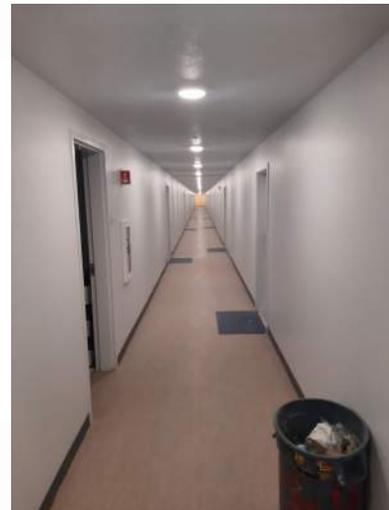
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Egress Sizing

- **IFC 1005:** Key Aspects
 - Capacity Sizing-
 - Based on number of occupants
 - Component Sizing- (minimum widths)
 - Doors, Stairs, Ramps, Corridors



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Stairways

○ IFC 1005.3.1:

- Capacity Sizing-
 - Provide **0.3"** per occupant (see exceptions)
 - Reduction to **0.2"** (sprinklers and EVAC)
- Component Sizing- (minimum widths)
 - **IFC 1011.2**- Minimum width 44"
 - (36" if serving less than 50 occupants)



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Example- No sprinklers

○ Capacity Sizing:

- Stair exiting 220 occupants
 - Provide **0.3"** per occupant = $220 \times 0.3 = 66"$
- Stair exiting 120 occupants
 - Provide **0.3"** per occupant = $120 \times 0.3 = 36"$
 - The 36" width does not meet the minimum width of 44" from **IFC 1011.2**, so **44" width required**



Other Egress Components

o IBC 1005.3.2: Doors, Corridors, Openings

- Capacity Sizing-
 - Provide **0.2"** per occupant (see exceptions)
 - Reduction to **0.15"** (sprinklers and EVAC)
- Component Sizing- (minimum widths)
 - **IBC 1010.1.1- Doors:** Minimum width 32" (clear opening)
 - **IBC 1012.5.1- Ramps:** Minimum width 36" between handrails
 - **IBC 1020.3- Corridors:** Minimum widths per Table 1020.3



Minimum Corridor Width

o IFC Table 1020.3:

OCCUPANCY	MINIMUM WIDTH (inches)
Any facility not listed in this table	44
Access to and utilization of mechanical, plumbing or electrical systems or equipment	24
With an occupant load of less than 50	36
Within a dwelling unit	36
In Group E with a corridor having an occupant load of 100 or more	72
In corridors and areas serving stretcher traffic in ambulatory care facilities	72
Group I-2 in areas where required for bed movement	96

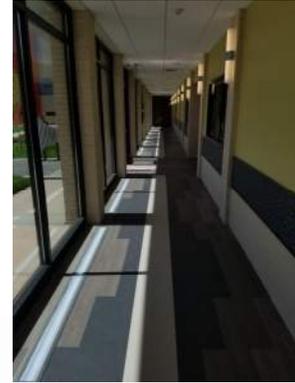
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Example- No sprinklers

o Capacity Sizing:

- Corridor exiting 400 occupants
 - Provide **0.2"** per occupant = $400 \times 0.2 = 80"$
- Corridor exiting 120 occupants
 - Provide **0.2"** per occupant = $120 \times 0.2 = 24"$
 - The 24" width does not meet the minimum width of 44" from **Table 1020.3**, so **44" width required**



Number of Exits

o IFC 1006.2: Egress from Spaces

- Whenever the **occupant load** of a **space** exceeds the limits in Table 1006.2.1 a **minimum of two** exits/exit access are required

TABLE 1006.2.1—SPACES WITH ONE EXIT OR EXIT ACCESS DOORWAY

OCCUPANCY	MAXIMUM OCCUPANT LOAD OF SPACE	MAXIMUM COMMON PATH OF EGRESS TRAVEL DISTANCE (feet)		
		Without Automatic Sprinkler System (feet)		With Automatic Sprinkler System (feet)
		Occupant Load		
		OL ≤ 30	OL > 30	
A', E, M	49	75	75	75'
B	49	100	75	100'
F	49	75	75	100'
H-1, H-2, H-3	3	NP	NP	25'
H-4, H-5	10	NP	NP	75'
I-1, I-2 ^a , I-4	10	NP	NP	75'
I-3	10	NP	NP	100'
R-1	10	NP	NP	75'

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Number of Exits

- o **IBC 1006.2:** Egress from Spaces
 - Whenever the common path of travel of a space exceeds the limits in Table 1006.2.1 a **minimum of two** are also required

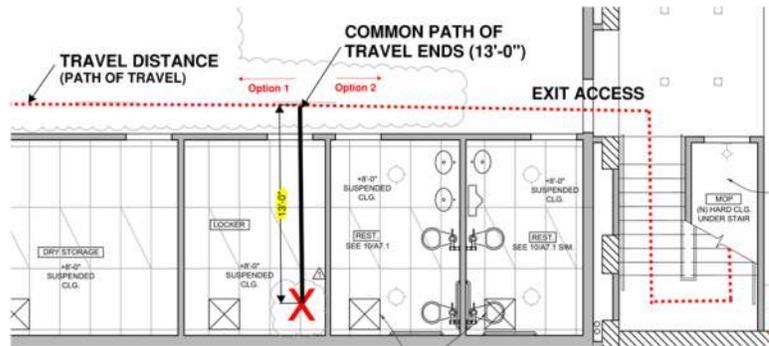
OCCUPANCY	MAXIMUM OCCUPANT LOAD OF SPACE	MAXIMUM COMMON PATH OF EGRESS TRAVEL DISTANCE (feet)		
		Without Automatic Sprinkler System (feet)		With Automatic Sprinkler System (feet)
		Occupant Load		
		OL ≤ 30	OL > 30	
A ¹ , E, M	49	75	75	75 ^a
B	49	100	75	100 ^a
F	49	75	75	100 ^a
H-1, H-2, H-3	3	NP	NP	25 ^b
H-4, H-5	10	NP	NP	75 ^a
I-1, I-2 ^c , I-4	10	NP	NP	75 ^a
I-3	10	NP	NP	100 ^a
R-1	10	NP	NP	75 ^a



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Common Path of Egress Travel

- o **Example:**
 - **Common Path of Travel-** The portion of exit access that occupants must travel before two separate and distinct paths of egress are available.



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Number of Exits Required (Spaces)

o IFC 1006.2.1.1:

1. **Single Exit/Exit Access Allowed:** Occupant Loads < Table 1006.2.1
2. **Two Exits/Exit Accesses Allowed:** Occupant Loads > Table 1006.2.1
3. **Three Exits/Exit Accesses Required:** Occupant Load > 500
4. **Four or More Exits/Exit Accesses Required:** Occupant Load > 1,000



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Occupiable Roofs

o IFC 1006.3: *Egress from stories or occupiable roofs*

- o When occupiable roofs exist, they must have access to the required number of exits in **Table 1006.3.3**
 - Driven by both location (story) and occupant load (# of people)



Number of Exits Required (Stories)

o IFC 1006.3.4: Single Exit

- Stories or occupiable roofs that **do not exceed:**
 - Occupant load
 - Number of dwelling units
 - Travel distances
- Outlined in IFC Tables 1006.3.4.(1) and 1006.3.4(2)

TABLE 1006.3.4(1)
STORIES AND OCCUPIABLE ROOFS WITH ONE EXIT OR ACCESS TO ONE EXIT FOR R-2 OCCUPANCIES

STORY	OCCUPANCY	MAXIMUM NUMBER OF DWELLING UNITS	MAXIMUM EXIT ACCESS TRAVEL DISTANCE
Basement, first, second or third story above grade plane and occupiable roofs over the first or second story above grade plane	R-2A, A*	4 dwelling units	125 feet
Fourth story above grade plane and higher	NP	NA	NA

TABLE 1006.3.4(2)
STORIES AND OCCUPIABLE ROOFS WITH ONE EXIT OR ACCESS TO ONE EXIT FOR OTHER OCCUPANCIES

STORY AND OCCUPIABLE ROOF	OCCUPANCY	MAXIMUM OCCUPANT LOAD PER STORY AND OCCUPIABLE ROOF	MAXIMUM EXIT ACCESS TRAVEL DISTANCE (feet)
First story above or below grade plane and occupiable roofs over the first story above grade plane	A, B ¹ , E, F ¹ , M, U	48	75
	H-2, H-3	3	25
	H-4, H-5, I, R-1, R-2A*	10	75
	9 th *	28	75
Second story above grade plane	B, F, M, 5 th	28	75
Third story above grade plane and higher	NP	NA	NA

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General Rule: A minimum of (2) exits per story (unless compliant with IFC 1006.3.4)

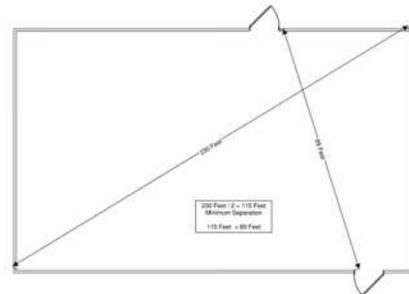


Exit/Exit Access Configuration

o IFC 1007.1.1: Two Exits/Exit

Access/Etc.

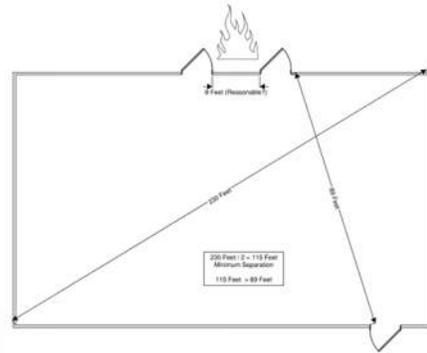
- Take the diagonal dimension of the building/area
- Exits must be space not less than
 - 1/2** this dimension (non-sprinkled)
 - 1/3** this dimension (sprinkled)



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Exit/Exit Access Configuration

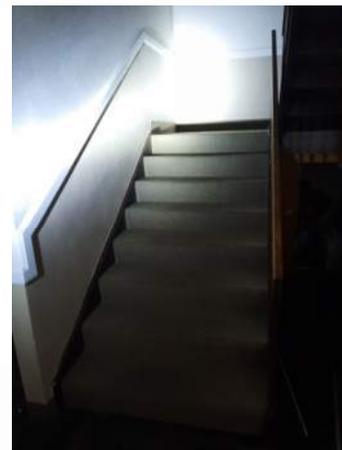
- **IFC 1007.1.1:** Three or more Exits/Exit Access/Etc.
 - Only (2) exits must comply with $\frac{1}{2}$ the diagonal distance
 - Other exits "reasonable distance apart"



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Egress Illumination

- **IFC 1008:** Illumination Required
 - Illumination required when occupied
 - Minimum **1 footcandle**- General
 - Minimum **10 footcandle**- Exit/Exit Access Stairways
 - Provide at exit discharge locations
 - Backup power required 90 min. (**IFC 1008.3**)



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Egress Illumination

- **Not** required in self-storage units 400 ft² or less, with direct exterior access
- **IFC 1008.3-** Consolidated requirements from various sections
 - Cleaner requirements for rooms, buildings and other critical spaces



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Accessible Means of Egress

- **IFC 1009:** Required
 - At least (1) required for all accessible spaces
 - At least (2) required from accessible spaces that require more than one exit
- **IFC 1009.2:** Components
 - Can consist of (9) different elements, including stairs



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Accessible Means of Egress

- **IFC 1009.2.1:** Elevators required
 - In (5) story buildings, or (4) story with an occupiable roof
 - **Exceptions:** Sprinkled buildings with horizontal exits, or with ramps (rather than stairs)
- **IFC 1009.3.3:** Area of refuge
 - If stairs are utilized, incorporate an *area of refuge*
 - Two-way communication also required



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Egress Doors

- **IFC 1010.1.2-** Types
 - Side-hinged swinging
 - Pivoted doors
 - Balanced door (see exceptions)
- **Not allowed:** Sliding, overhead, revolving (see exceptions)



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Direction of Swing

o IFC 1010.1.2.1:

- Swing in the direction of egress travel (push) if serving a **room or area** containing an occupant load of **50** or more

o IFC 1010.2.1:

- Operation cannot require more than one motion in a single linear or rotational direction



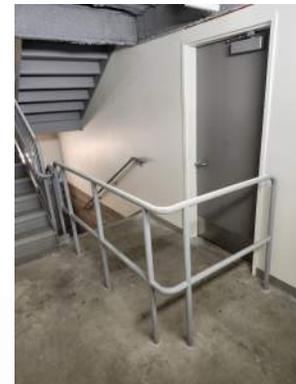
142



Stairway Doors

o IFC 1010.2.6, Exception 3: Expanded

- Access to a floor or tenant from within an exit stair must be openable from both sides, unless **one** of the following apply
 - Capable of being unlocked from the fire command center, or single location at the entrance to the building
 - Must unlock upon activation of a fire alarm in area served
 - Must unlock upon failure of the power supply



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Elevator Lobby Exit Access Doors

- **IFC 1010.2.14:** *Elevator Lobby Exit Access Doors*
 - Elevator lobby doors can be **electronically locked** if meeting a list of **8** specific requirements
 - Exiting does not pass through the lobby
 - Sprinkled, alarmed building with means of automatically unlocking upon alarm, power failure etc.
 - Two-way communication, emergency lighting and listed locking devices (*UL 294 or UL 1034*)



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Panic Hardware

- **IFC 1010.2.8:**
 - If serving an occupant load **> 50** in a Group A or E occupancy
 - Panic hardware required (push bar/crash bar)
 - Also, in all H occupancies

(see exceptions)



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Stairways

- **IFC 1011.5.2:** Riser height / tread depth
 - **Risers:** 7" maximum and 4" minimum
 - **Treads:** 11" minimum
(see exceptions)



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Stairways

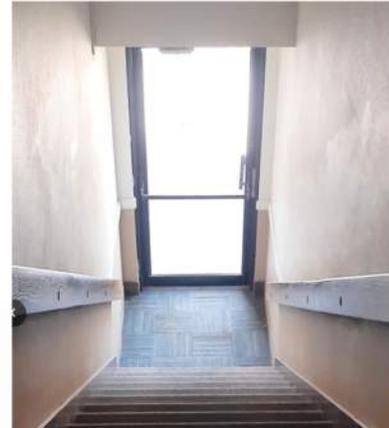
- **IFC 1011.5.4:** Uniformity
 - Within a flight of stairs
 - Largest tread and smallest tread
(**3/8"** max tolerance)
 - Largest riser and smallest riser
(**3/8"** max tolerance)



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Stairways

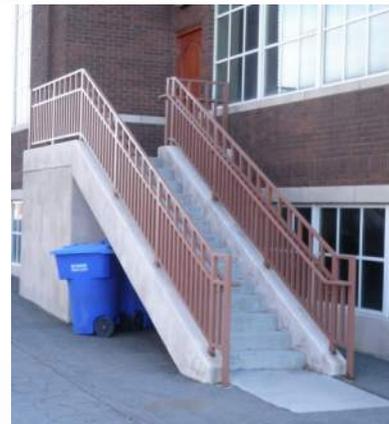
- **IFC 1011.6:** Landings
 - Required at the **top and bottom** of all stairs
 - Depth of **48"** minimum (or width of the stairs)



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Handrails at Stairs

- **IFC 1011.11:**
 - Required on **both sides** of all stairs
 - **IBC 1014:** (Specific Requirements)



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Ramps

- **IFC 1012.2:** Slope
 - Maximum slope of **1:12** (means of egress)
 - Pedestrian ramp **1:8** max
 - Cross slope **1:48** (2%)



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Ramps

- **IFC 1012.6.3:** Length
 - Minimum length of **60"**
 - Exception:
 - Residential units- 36"
 - Not part of accessible route- 48"
 - Change in direction- 60" x 60"



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Handrails at Ramps

o IFC 1012.8:

- Required on both sides of all ramps with a rise > 6"



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Exit Signs

o IFC 1013.1: Where required

- Exit and exit access doors shall be marked by approved exit signs
- Located within a **100'** viewing distance or listed viewing distance (lesser of the two)
- **Key exceptions:**
 - Spaces that require only 1 exit
 - Main exterior exit doors
 - Individual dwelling units
 - Stadiums and arenas

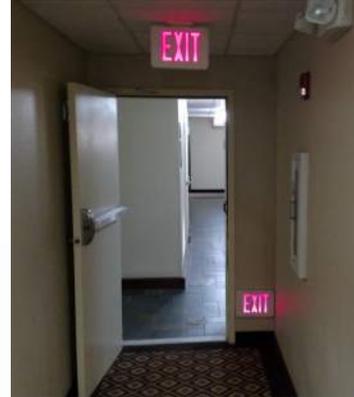


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Low-Level Exit Signs

- **IFC 1013.2:** *Low-Level Exit Signs in Group R-1*
 - **No longer required** in fully sprinkled buildings
 - Sprinkler protection makes the magnitude of fire necessary to justify low-level exit signage



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Handrails

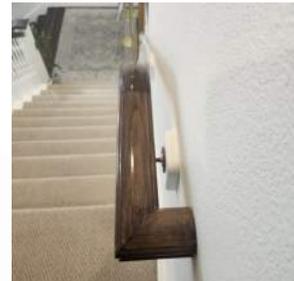
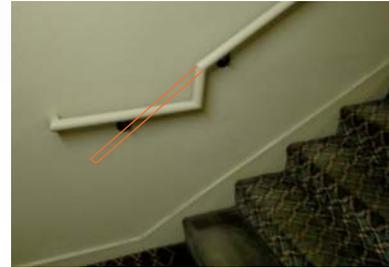
- **IFC 1014:**
 - Mounted 34 – 38" above the line connecting the nosings
 - Must be graspable (IBC 1014.4.1)
 - Must be continuous without interruption



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Handrails

- **IFC 1014.7:** Extensions
 - Extend horizontally 12" at top
 - Extend one tread depth at bottom
- **IFC 1014.8:** Clearance
 - Minimum 1.5" clearance from wall
- **IFC 1014.9:** Projections
 - Maximum 4.5" clearance from wall



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Guards (see exceptions)

- **IFC 1015.2:** Required
 - Where elevation change of >30"
- **IFC 1015.3:** Height
 - Minimum of 42"
- **IFC 1015.4:** Openings
 - Maximum of 4" sphere



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Guards in R-2 and R-3

- **IFC 1015.3:** *Height*
 - New Exception #2
 - Similar to IRC requirements → guards can be **36"** (Rather than 42") tall if:
 - Elevation change of **<25 feet**





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Exit Access

- **IFC 1016.2:** Intervening Spaces (see exceptions)
 - Cannot pass through a room that can be locked
 - Cannot pass through kitchens, storage rooms, closets
 - Cannot require passing through adjacent tenants

(see exceptions)





Exit Access Travel Distance

- o **IFC Table 1017.2:** Limitations
 - Distances are limited, based on occupancy, and whether the building has a sprinkler system

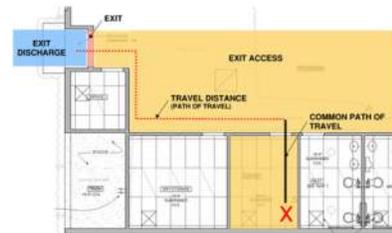
OCCUPANCY	WITHOUT AUTOMATIC SPRINKLER SYSTEM (feet)	WITH AUTOMATIC SPRINKLER SYSTEM (feet)
A, E, F-1, M, R, S-1	200'	250'
I-1	Not Permitted	250'
B	200	300'
F-2, S-2, U	300	400'
H-1	Not Permitted	75'
H-2	Not Permitted	100'
H-3	Not Permitted	150'
H-4	Not Permitted	175'
H-5	Not Permitted	200'
I-2, I-3	Not Permitted	200'
I-4	150	200'

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Exit Access Travel Distance

- o **IFC 1017.3:** Measurement
 - From most remote point of each room
 - Along the natural and unobstructed path
 - To the closest **exit** (*exterior door, exit stair, exit passageway*)



Note: Includes the common path of travel



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Exit Access Stair

- **IFC 1019.3:** Unenclosed
 - Two-story buildings (IBC 713)
 - Sprinkled buildings (Exception 4)
 - Opening in floor twice the area of the stair
 - Protected with draft curtain, closely spaced sprinklers
 - *Limited to 4 story openings*
 - *B & M occupancies- unlimited stories*



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Corridors

- **IFC 1020:** Construction
 - When fire rated- use *fire partitions*
 - Not all corridors are fire rated
 - Corridors = hallways

(see exceptions)



Corridors

- **Fire Ratings:** Dependent upon
 - Presence of fire sprinklers
 - Occupant load served

TABLE 1020.2—CORRIDOR FIRE-RESISTANCE RATING			
OCCUPANCY	OCCUPANT LOAD SERVED BY CORRIDOR	REQUIRED FIRE-RESISTANCE RATING (hours)	
		Without automatic sprinkler system	With automatic sprinkler system
H-1, H-2, H-3	All	Not Permitted	1 ^c
H-4, H-5	Greater than 30	Not Permitted	1 ^c
A, B, E, F, M, S, U	Greater than 30	1	0
R	Greater than 10	Not Permitted	0.5 ^f /1 ^d
I-2 ^e	All	Not Permitted	0
I-1, I-3	All	Not Permitted	1 ^{b,c}
I-4	All	1	0



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Interior Exit Stairways

- **IFC 1023.2:** Construction
 - Build with *fire barriers*
 - **1-hr. minimum-** connecting 3 stories or less
 - **2-hr. minimum-** connecting 4 stories or more
- **IFC 1023.3:** Termination
 - Terminate at an exit discharge or public way
 - Exception: Exit passageways, IFC 1023.2, 1023.2.3.1 & 1024



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Exit Discharge

- **IFC 1028.2:** Exit Discharge
 - To exterior of the building at grade
 - No reenter a building
 - Only 50% can utilize the exceptions
 - **Exception 1:** Discharge inside the building (lobbies, atriums, etc.)
 - **Exception 2:** Discharge through a vestibule

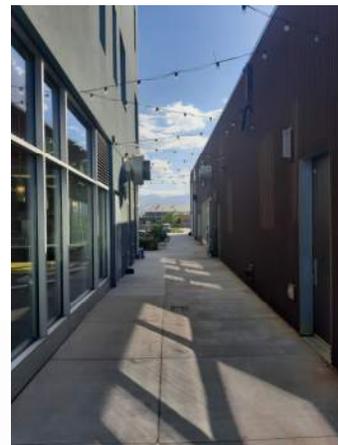


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Egress Courts

- **IFC 1029.3:** *Construction and openings*
 - Where **two or more** paths exist from an egress court
 - **1-hr.** rated walls no longer required
 - **¾-hr.** protection of openings no longer required
 - Minimum width of 10' remains



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Assembly

○ IFC 1030: Assembly

- *“A room or space that contains seats, tables, displays, equipment or other material shall comply with this section.”*
 - Main exit and other exits requirements (1030.2, 1030.3)
 - Foyers and lobbies (1030.4)
 - Aisle requirements (1030.6, 1030.9, 1030.11-14)
 - Special handrail provisions (1030.16)
 - Assembly guard provisions (1030.17)



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Emergency Escape & Rescue

○ IFC 1031.2: Where required

- **Group R-2**- Stories with only (1) exit
- **Group R-3** and **R-4** occupancies (see exceptions)

○ IFC 1031.3.1: Minimum size

- Minimum of **5.7 ft²**
- Minimum of **5.0 ft²** (at grade-floor)
- (24" min. height and 20" min. width)



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Fire Escapes

- **IFC 1032.2.2.2: Examination**
 - Shall be inspected every 5 years by a registered design professional
 - Be able to support dead loads plus 100psf live load.
 - Inspection report shall be submitted to FCO.





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Requirements for Existing Buildings

CHAPTER
11

CONSTRUCTION REQUIREMENTS FOR EXISTING BUILDINGS

User notes:

About this chapter: Chapter 11 applies to existing buildings constructed prior to the adoption of the code and is intended to ensure a minimum degree of fire and life safety to persons occupying existing buildings by providing for alterations to such buildings that do not comply with the minimum requirements of the International Building Code®. The provisions address general fire safety features such as requirements for fire alarm systems in some existing buildings and general means of egress, and include a section dedicated to existing Group I-2 occupancies.

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Existing Buildings

o **IFC 1101.2:** *Intent*

- To provide a minimum degree of fire & life safety to persons occupying existing buildings.
- **No work is required to trigger Chapter 11 requirements!**

o **IFC 1101.4:** *Owner Notification*

- When a building is found in noncompliance the FCO shall notify the owner who shall take necessary actions within specified period of time.



TABLE 1103.1—OCCUPANCY AND USE REQUIREMENTS*																								
SECTION	USE				OCCUPANCY CLASSIFICATION																			
	High-rise	Atrium or covered mall	Underground building	Tire storage	A	B	E	F	H-1	H-2	H-3	H-4	H-5	I-1	I-2	I-3	I-4	M	R-1	R-2	R-3	R-4	S	
1103.2	R	R	R	—	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
1103.3	R	—	R	—	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
1103.4.1	R	—	R	—	—	—	—	—	—	—	—	—	—	—	R	R	—	—	—	—	—	—	—	—
1103.4.2	R	—	R	—	R	R	R	R	R	R	R	R	R	R	—	—	R	R	R	R	—	—	—	—
1103.4.3	R	—	R	—	R	R	R	R	R	R	R	R	R	—	—	R	R	R	R	—	—	—	—	—
1103.4.4	—	R	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
1103.4.5	—	—	—	—	R	—	—	—	—	—	—	—	—	—	—	—	R	—	—	—	—	—	—	—
1103.4.6	—	—	—	—	R	—	R	R	R	R	R	R	R	R	R	R	R	—	R	R	R	R	R	R
1103.4.7	—	—	—	—	R	—	R	R	R	R	R	R	R	R	R	R	R	—	R	R	R	R	R	R
1103.4.8	R	—	R	—	R	R	R	R	R	R	R	R	R	R	—	—	R	R	R	R	R	R	R	R
1103.4.9	R	—	—	—	—	—	—	—	—	—	—	—	—	—	R	—	—	—	—	—	—	—	—	—
1103.4.10	—	—	—	—	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
1103.5.1	—	—	—	—	R	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
1103.5.2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	R	—	—	—	—	—	—	—	—	—
1103.5.3	—	—	—	—	—	—	—	—	—	—	—	—	—	—	R ^b	—	—	—	—	—	—	—	—	—
1103.5.5	—	—	—	—	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
1103.6.1	R	—	R	—	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
1103.6.2	R	—	R	—	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
1103.7.1	—	—	—	—	—	R	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
1103.7.2	—	—	—	—	—	—	—	—	—	—	—	—	—	R	—	—	—	—	—	—	—	—	—	—
1103.7.3	—	—	—	—	—	—	—	—	—	—	—	—	—	—	R	—	—	—	—	—	—	—	—	—
1103.7.4	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	R	—	—	—	—	—	—	—	—
1103.7.5	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	R	—	—	—	—	—
1103.7.6	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	R	—	—	—	—
1103.8	—	—	—	—	—	—	—	—	—	—	—	—	—	R	—	—	—	—	R	R	R	R	R	R
1103.9	R	—	—	—	—	—	—	—	—	—	—	—	—	R	R	—	—	R	R	R	R	R	R	R
1103.10	—	—	—	—	—	—	—	—	—	—	—	—	—	R	R	—	—	—	—	—	—	—	—	—
1104	R	R	R	—	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
1105	—	—	—	—	—	—	—	—	—	—	—	—	—	R	—	—	—	—	—	—	—	—	—	—
1106	—	—	—	R	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

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Existing Buildings

○ Passive & Active Fire Protection that may be required:

- ERCES (1103.2)
- Existing elevators (1103.3)
- Vertical openings (1103.4)
- Sprinkler systems (1103.5)
- Standpipes (1103.6)
- Fire alarm systems (1103.7)
- Smoke alarms (1103.8)
- Carbon monoxide detection (1103.9)
- Medical gases (1103.10)



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Existing Buildings

○ Means of Egress items that may be required:

- Elevators/escalators (1104.2)
- Exit sign illumination (1104.3)
- Illumination emergency power (1104.5)
- Guards (1104.6)
- Size of doors (1104.7)
- Door force (1104.8)
- Revolving doors (1104.9)
- Stair dimensions (1104.10-12)
- Handrails (1104.13)
- Ramps (1104.14-15)
- Fire escapes (1104.16)
- Corridors (1104.17-18)
- Exit access travel (1104.19)
- Common path travel (1104.20)
- Aisle width (1104.23)
- Egress path markings (1104.25)



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Existing Buildings

- **IFC 1107: Energy Storage Systems**
 - ESS containing lithium-ion battery technology with capacities > IFC Table 1207.1.3 shall...
 - Provide FCO a failure modes and effects analysis (FMEA) or other hazard mitigation analysis for review and approval (IFC 104.2.2)
 - Must address how early detection and notification of a thermal runaway event will be provided.
 - This does not apply to installations compliant with 2018 IFC or later



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Energy Systems

CHAPTER

12

ENERGY SYSTEMS

User notes:

About this chapter: *Chapter 12 was added to address the current energy systems found in this code, and is provided for the introduction of a wide range of systems to generate and store energy in, on and adjacent to buildings and facilities. The expansion of such energy systems is related to meeting today's energy, environmental and economic challenges. Ensuring appropriate criteria to address the safety of such systems in building and fire codes is an important part of protecting the public at large, building occupants and emergency responders. More specifically, this chapter addresses standby and emergency power, portable generators, photovoltaic systems, fuel cell energy systems and energy storage systems.*



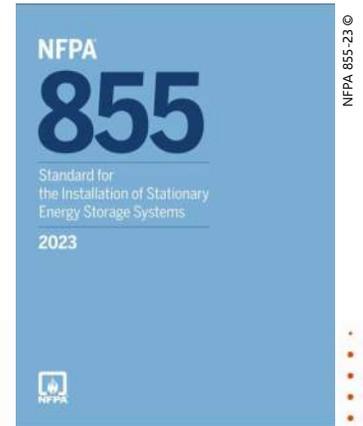
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Energy Systems

o IFC 1201.1: *General*

- Applies to installation, operation, maintenance, repair, retrofitting, testing, commissioning and decommissioning of...
- Systems used for generating or storing energy
- Does not apply to electric utilities
- ESS shall comply with IFC 1207 and NFPA 855



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Energy Systems

o IFC 1203: *Emergency & Standby Power Systems*

- Generators → Listed per UL 2200
- Fuel line protection:
 - 2-HR listed pipe-protection system – UL 1489
 - A 2-FR rated assembly
- Load transfer w/in 10 seconds (Standby – 60 seconds)
- Load duration = 2 hours



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Energy Systems

o IFC 1204: Portable Generators

- MFR after 1/1/21 → Listed & labeled per UL 2201
- Operated and maintained per MFR's instructions.
- Portable generators must be grounded in accordance with NFPA 70. (GFCI protection required)
- Fire extinguisher w/in 50-feet



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Energy Systems

o IFC 1205: Solar PV Power Systems

• Group R-3:

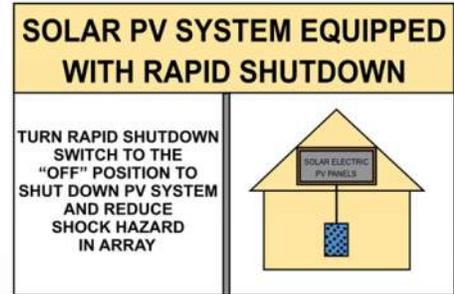
- 36" pathways for each roof plane
- If < 33% roof area → 18" pathway on each side of ridge
- Panels shall not be located on portion of roof below an EERO and pathway is required to the EERO
- Markings shall be provided on BIPV roofs noting hazardous areas to avoid.



Energy Systems

o IFC 1205: Solar PV Power Systems

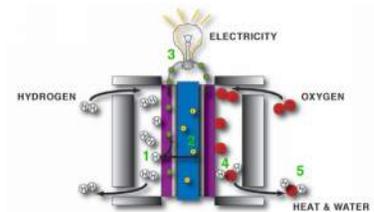
- **Other than Group R-3:**
 - 6-foot-wide perimeter pathways around roof
 - 4-foot-wide interior pathways ≤ 150 feet
 - Buildings with rapid shutdown shall have permanent labels (w/in 3-feet of disconnect)
- **Ground-Mounted Systems:**
 - Vegetation control w/in 10-feet



Energy Systems

o IFC 1206: Stationary Fuel Cell Power Systems

- Listed & labeled per CSA FC1
- Field-fabricated systems shall be approved based upon a technical report sealed by a RDP
- Rooms:
 - Groups B, F, M, S & U → 1-hour separation
 - Groups A, E, I & R → 2-hour separation
- Gas detection required for indoor installations
- Ventilation, exhaust & fire protection per NFPA 853



Energy Systems

o **IFC 1207:** *Electrical Energy Storage Systems (ESS)*

- Applies to both stationary and mobile ESS
- Both construction and operational permits **may** be required
- Clear requirements for preliminary analysis, for system approvals, for testing and for commissioning are provided.



Energy Systems

o **IFC 1207.1.3:** *Scope*

- Revised threshold quantities & references NFPA 855

TECHNOLOGY	ENERGY CAPACITY ^a
Capacitor ESS	3 kWh
Flow batteries ^b	20 kWh
Lead-acid batteries, all types	70 kWh ^c
Lithium-ion batteries	20 kWh
Nickel-cadmium (Ni-Cd), nickel metal hydride (Ni-MH) and nickel zinc (Ni-Zn) batteries	70 kWh
Nonelectrochemical ESS ^d	70 kWh
Other battery technologies	10 kWh
Other electrochemical ESS technologies	3 kWh
Sodium nickel chloride batteries	70 kWh
Zinc manganese dioxide batteries (Zn-MnO ₂)	70 kWh

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Energy Systems

○ **IFC Table 1207.5:** *Maximum Allowable Quantities*

TABLE 1207.5—MAXIMUM ALLOWABLE QUANTITIES OF ELECTROCHEMICAL ESS	
TECHNOLOGY	MAXIMUM ALLOWABLE QUANTITIES ^a
STORAGE BATTERIES	
Flow batteries ^b	600 kWh
Lead-acid, all types	Unlimited
Lithium-ion	600 kWh
Nickel-cadmium (Ni-Cd), nickel-metal hydride (Ni-MH) and nickel zinc (Ni-Zn)	Unlimited
Sodium nickel chloride	600 kWh
Zinc-manganese dioxide (Zn-MnO ₂)	Unlimited
Other battery technologies	200 kWh
CAPACITORS	
All types	20 kWh
OTHER ELECTROCHEMICAL ESS	
All types	20 kWh

BCS
ELITE

For SI: 1 kilowatt hour = 3.6 megajoules.
 a. For electrochemical ESS units rated in amp-hours, kWh shall equal rated voltage times the amp-hour rating divided by 1,000.
 b. Shall include vanadium, zinc-bromine, polysulfide-bromide and other flowing electrolyte-type technologies.

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Energy Systems

○ **IFC 1207.1.5:** *Construction Documents*

- Detailed requirements for what should be provided.
- Plans, FR ratings, ESS quantity & type, MFR information, commissioning plan, and more.
- Notes that a **fire safety & evacuation plan** is required as part of the construction documents. [IFC 404]

BCS
ELITE

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Energy Systems

○ IFC 1207: *Electrical Energy Storage Systems (ESS)*

- A hazard mitigation analysis is required for:
 - ESS technologies not listed
 - > 1 ESS technology is located w/in a single fire area
 - If increasing the MAQs
 - Where required by the FCO



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Energy Systems

○ IFC 1207.1.7: *Large-Scale Fire Test*

- Large-scale fire test (UL 9540A) required for:
 - Systems exceeding MAQs in IFC Table 1207.5
 - Suppression design for units > 50 kWh
 - To reduce the required means of egress separation
 - To be exempt from explosion control
 - To reduce exposure to combustibles
 - To reduce exterior wall separation distances
 - To be exempt from sprinklers in open parking garages








Energy Storage Systems (ESS)

- **IFC 1207.2:** *Commissioning*
- **IFC 1207.3:** *Equipment*
- **IFC 1207.4:** *General Installation Requirements*
- **IFC 1207.5 & 6:** *Electrochemical ESS Protection*
- **IFC 1207.7:** *Indoor Installations*
- **IFC 1207.8:** *Outdoor Installations*
- **IFC 1207.9:** *Special Installations*
- **IFC 1207.10:** *Mobile ESS Equipment & Operations*








Energy Storage Systems (ESS)

- **IFC 1207.5.5:** *Fire Suppression Systems*
 - ESS ≤ 50 kWh – 0.3 gpm/SF over 2,500 SF
 - ESS > 50 kWh – Design based on large-scale fire testing
 - Alternative fire-extinguishing system – based on large-scale fire testing
 - **Exceptions:**
 - Lead-acid & nickel-cadmium under utility control
 - Lead-acid used for UPS comprising < 10% floor area located






Energy Storage Systems (ESS)

o **IFC Table 1207.6:** *Technology Specific Requirements*

TABLE 1207.6—ELECTROCHEMICAL ESS TECHNOLOGY-SPECIFIC REQUIREMENTS

COMPLIANCE REQUIRED ^a		BATTERY TECHNOLOGY							OTHER ESS AND BATTERY TECHNOLOGIES ^b	CAPACITOR ESS ^c
Feature	Section	Lead-acid	Nickel cadmium (Ni-Cd), nickel-metal hydride (Ni-MH) and nickel zinc (Ni-Zn)	Zinc-manganese dioxide (Zn-MnO ₂)	Lithium-ion	Flow	Sodium nickel chloride			
Exhaust ventilation	1207.6.1	Yes	Yes	Yes	No	Yes	No	Yes	Yes	
Explosion control	1207.6.3	Yes ^d	Yes ^d	Yes	Yes	No	Yes	Yes	Yes	
Safety caps	1207.6.4	Yes	Yes	No	No	No	No	Yes	Yes	
Spill control and neutralization	1207.6.2	Yes ^e	Yes ^e	Yes ^f	No	Yes	No	Yes	Yes	
Thermal runaway	1207.6.5	Yes ^d	Yes	Yes ^g	Yes ^g	No	Yes	Yes ^g	Yes	



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Energy Storage Systems (ESS)

o **IFC 1207.11:** *Groups R-3 and R-4*

- Shall comply with IFC 1207.11.1-1207.11.9
- **Exceptions:**
 - Listed and labeled per UL 9540 and marked ***“Fire use in residential dwelling units”*** and installed per NEC.
 - ESS rated < 1 kWh



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Energy Storage Systems (ESS)

- **IFC 1207.11.3:** *Location*
 - Detached garages & accessory structures
 - Attached garages separated from living and sleeping space
 - Outdoors or **exterior side of** exterior walls and > 3-feet from openings
 - Enclosed utility closets, basements and storage or utility spaces separated by 5/8" Type X wallboard.
 - Shall not be installed in sleeping rooms or closets.



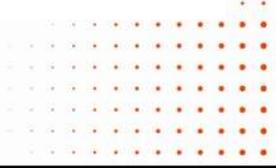


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Energy Storage Systems (ESS)

- **IFC 1207.11.6:** *Fire Detection*
 - Rooms and areas within dwellings units and attached garages where ESS are installed shall be protected with smoke alarms.
 - A listed heat alarm shall be installed where smoke alarms cannot be placed based upon their listing.









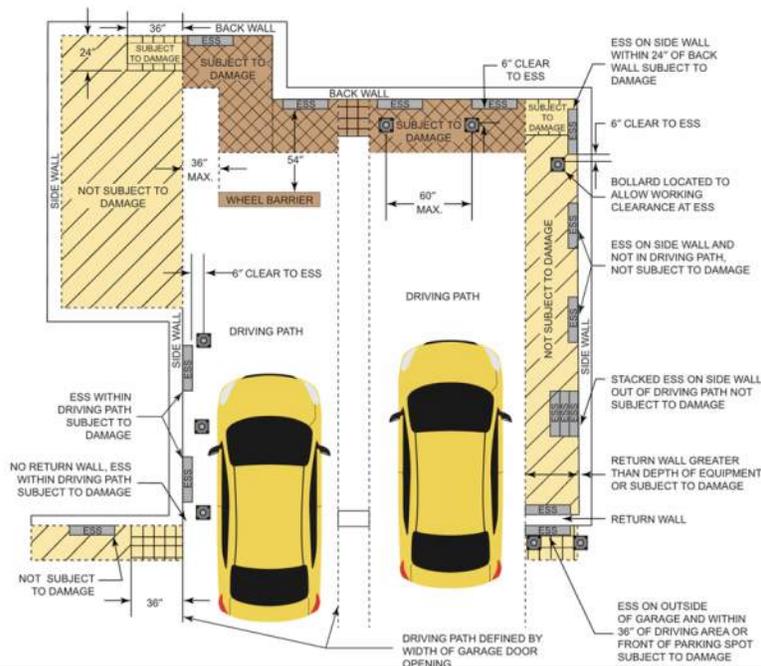
Energy Storage Systems (ESS)

o IFC 1207.11.7.1: Garages

- Driving path = space between garage vehicle opening and interior face of back wall to a height of 48-inches
- Width = garage door opening
- Impact protection required where:
 - Placed on interior face of back wall and w/in 36" of driving path
 - Placed on interior face of side wall w/in 24" of back wall + 36" of driving path



FIGURE 1207.11.7.1 ESS VEHICLE IMPACT PROTECTION

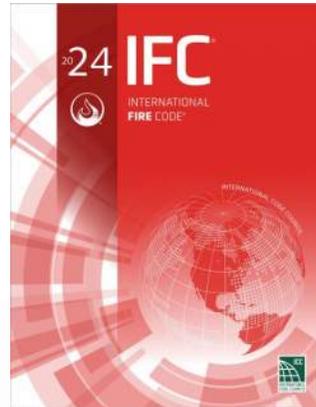


5. Special Occupancies



Special Occupancies & Operations

- Special occupancy and operations provisions are included in Chapters 20-41.



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IFC Special Occupancies

- 20 – Aviation Facilities
- 21 – Dry Cleaning
- 22 – Combustible Dust-Producing Operations
- **23 – Motor Fuel-Dispensing Facilities & Repair Garages***
- 24 – Flammable Finishes
- 25 – Fruit & Crop Ripening
- 26 – Fumigation & Insecticidal Fogging
- 27 – Semiconductor Fabrication Facilities
- 28 – Lumber Yards (etc.)
- 29 – Manufacture of Organic Coatings
- 30 – Industrial Ovens
- 31 – Tents / Special Event
- 32 – High-Piled Combustible Storage
- 33 – During Construction & Demolition
- 34 – Tire Rebuilding & Tire Storage
- 35 – Welding & Other Hot Work
- 36 – Marinas
- 37 – Combustible Fibers
- 38 – Higher Education Laboratories
- 39 – Processing & Extraction Facilities
- 40 – Storage of Distilled Spirits & Wines
- **41 – Temporary Heating & Cooking**



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IFC Special Occupancies

- **Chapter 23: Motor Fuel-Dispensing Facilities**
 - Applies to...
 - Automotive fuel-dispensing & repair facilities
 - Marine fuel-dispensing & repair facilities
 - Fleet vehicle fuel-dispensing & repair facilities
 - Aircraft fuel-dispensing & repair facilities
 - Must also comply with IBC, IMC, IFGC & NFPA 30A



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IFC Special Occupancies

○ Chapter 23: Motor Fuel-Dispensing Facilities

- Heat Producing Appliances (IFC 2301.6)
- If dispensing is located within buildings...
- Appliances must be suitable for location installed, and...
- Comply with NFPA 30A, IFGC & IMC



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IFC Special Occupancies

○ Chapter 23: Motor Fuel-Dispensing Facilities

- Location of Dispensers (IFC 2303.1)
 - Lot lines \geq 10-feet
 - Noncombustible buildings \geq 10-feet
 - All portions of vehicle will be on premises
 - Nozzle, w/ hose fully extended, \geq 5-feet from building openings
 - Fixed sources of ignition \geq 10-feet
 - Fuel dispensing is in view of attendant



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IFC Special Occupancies

○ Chapter 23: Motor Fuel-Dispensing Facilities

- Emergency Disconnect Switches (IFC 2303.2)
 - Exterior: Within 20-100 feet from fuel dispenser.
 - Interior: Shall have read-access and be at an approved location.
 - Distinctly labeled as "Emergency Fuel Shutoff".
 - Placed between 42-48 inches from floor level.



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IFC Special Occupancies

○ Chapter 23: Motor Fuel-Dispensing Facilities

- Qualified Attendant
 - Performed/supervised by qualified attendant at all times.
 - Shall prevent the dispensing of fuel into unapproved containers...
 - Control sources of ignition, ...
 - Give immediate attention to accidental spills or releases
 - Be prepared to use fire extinguishers



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IFC Special Occupancies

○ Chapter 23: Motor Fuel-Dispensing Facilities

- Unattended Self-Service (IFC 2304.3)
 - Allowed if owner/operator...
 - Perform daily site visits, regular equipment inspections & maintenance
 - Approved emergency controls that are manually resettable
 - Dispenser operating instructions are conspicuously posted
 - An emergency procedure sign is posted
 - A telephone is provided to notify the fire department
 - Quantity limits:
 - Manual action required for more than 25 gallons, or...
 - Limited in quantity by a preprogrammed card



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IFC Special Occupancies

○ Chapter 23: Motor Fuel-Dispensing Facilities

- Portable Containers (IFC 2304.4)
 - ≤ 6 gallons, of approved construction and has tight closure
 - Shall not be dispensed into portable or cargo tanks
 - Shall not be filled while located inside trunk or truck bed



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IFC Special Occupancies

○ Chapter 23: Motor Fuel-Dispensing Facilities

- Sources of Ignition (IFC 2305.4)
 - Smoking and open flames shall be prohibited
 - Engines of vehicles being fueled shut off
 - Electrical equipment shall comply with NEC
- Fire Extinguishers (IFC 2305.5)
 - Minimum rating of 2-A:20-B:C
 - Located within 75-feet of pumps, dispensers or storage tank fill openings



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IFC Special Occupancies

○ Chapter 23: Motor Fuel-Dispensing Facilities

- Warning Signs (IFC 2305.6)
 - Conspicuously posted within sight of each dispenser. Must state...
 - No smoking.
 - Shut off motor.
 - Discharge your static electricity before fueling by touching a metal surface away from the nozzle.
 - To prevent static charge, do not reenter your vehicle while gasoline is pumping.
 - If a fire starts, do not remove nozzle—back away immediately.
 - It is unlawful and dangerous to dispense gasoline into unapproved containers.
 - No filling of portable containers in or on a motor vehicle.
 - Place container on ground before filling.



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IFC Special Occupancies

○ Chapter 23: Motor Fuel-Dispensing Facilities

- Tanks & Dispensing Equipment (IFC 2306)
 - Shall comply with IFC Chapter 57 and this Section
 - Items discussed:
 - Security
 - Physical protection
 - Secondary containment
 - Piping, valves, fittings, etc.
 - Listings
 - Emergency relief venting
 - Etc.



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IFC Special Occupancies

○ Chapter 23: Motor Fuel-Dispensing Facilities

- LP-gas Dispensing (IFC 2307)
 - Shall comply with IFC Chapter 61 and this Section
 - Containers, pressure relief devices, pressure regulators & piping shall be approved.
 - Hoses, hose connections, vehicle fuel connections, dispensers, LP-gas pumps and electrical equipment must be listed.
 - Qualified attendants must be present
 - Pumps must be fixed in place
 - Physical protection if within 10-feet of vehicle traffic



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IFC Special Occupancies

○ Chapter 23: Motor Fuel-Dispensing Facilities

- LP-gas Dispensing (IFC 2307)
 - Location:
 - \geq 25-feet from buildings not having a 1-hour fire-rated exterior wall
 - \geq 25-feet from combustible building overhang
 - \geq 25-feet from lot line of property that can be built on
 - \geq 25-feet from centerline of nearest mainline railroad track
 - \geq 10-feet from public streets, highways, thoroughfares, sidewalks & driveways
 - \geq 10-feet from buildings having a 1-hour fire-rated exterior wall.



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IFC Special Occupancies

○ Chapter 23: Motor Fuel-Dispensing Facilities

- Compressed Natural Gas Dispensing (IFC 2308)
 - Shall also comply with IFC Chapter 53
 - Same approval and listing requirements
 - All operations and equipment must be located outdoors and above ground. (Some exceptions)



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IFC Special Occupancies

○ Chapter 23: Motor Fuel-Dispensing Facilities

- Compressed Natural Gas Dispensing (IFC 2308)
 - Location:
 - Not beneath power lines
 - ≥ 10 -feet from nearest building or lot that can be built on, public street, sidewalk or source of ignition
 - ≥ 25 -feet from nearest railway track and ≥ 50 -feet from any track that is powered by an outside electrical source (i.e. third rail or overhead catenary)



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IFC Special Occupancies

○ Chapter 23: Motor Fuel-Dispensing Facilities

- Compressed Natural Gas Dispensing (IFC 2308)
 - Other items:
 - Pressure regulators
 - Valves
 - Emergency shutdown control
 - Closed-transfer systems
 - Atmospheric venting systems
 - Etc.

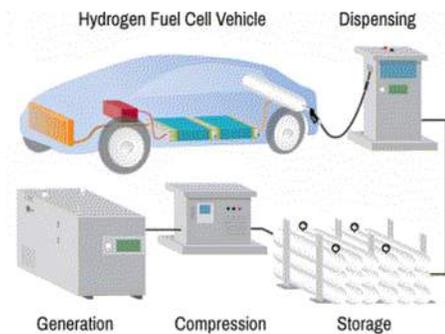


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IFC Special Occupancies

○ Chapter 23: Motor Fuel-Dispensing Facilities

- Hydrogen Dispensing & Generation (IFC 2309)
 - Shall also comply with IFC Chapter 58
 - Same approval and listing requirements
 - All operations and equipment must be located outdoors and above ground.



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IFC Special Occupancies

○ Chapter 23: Motor Fuel-Dispensing Facilities

- Hydrogen Dispensing & Generation (IFC 2309)
 - Location:
 - Outdoors → Per IFC Chapter 58 and **NFPA 2**
 - Indoors → Per IBC, IFGC, IMC, NFPA 2 and...
 - Maintained in accordance with MFR
 - Smoking shall be prohibited
 - Ignition source control
 - Rooms shall be kept free from combustible storage and debris



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IFC Special Occupancies

○ Chapter 23: Motor Fuel-Dispensing Facilities

- Hydrogen Dispensing & Generation (IFC 2309)
 - If hydrogen compression and storage equipment is placed on top of motor-fuel-dispensing canopies...
 - Construction shall comply with IBC 406.7
 - Automatic fire sprinkler system → Extra Hazard Group 2
 - Automatic emergency discharge system upon sprinkler activation
 - Emergency shutdown control upon sprinkler activation
 - Signage noting canopy-top hydrogen storage



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IFC Special Occupancies

○ Chapter 23: Motor Fuel-Dispensing Facilities

- Marine Dispensing (IFC 2310)
 - Construction shall comply with IBC and NFPA 30A
 - Fuel storage shall comply with IFC Chapter 57 & this section
 - Must have an attendant
 - Approved hose with listed nozzle



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IFC Special Occupancies

○ Chapter 23: Motor Fuel-Dispensing Facilities

- Marine Dispensing (IFC 2310)
 - Fire Prevention Regulations:
 - General housekeeping
 - Spills immediately reported to fire department
 - Tight-fitting and self-closing noncombustible rubbish containers
 - Standpipe hose stations shall be provided
 - Portable 20-B:C fire extinguishers shall be provided on each float
 - No smoking or construction, maintenance or repair that involves flames or sparks within 50-feet



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IFC Special Occupancies

○ Chapter 23: Motor Fuel-Dispensing Facilities

- Repair Garages (IFC 2311)
 - Shall also comply with IBC
 - Flammable and combustible liquid storage → IFC Chapter 57
 - Cleaning of parts → in listed parts-cleaning machines
 - Waste oil & motor oil → stored in approved containers
 - Drainage & disposal → approved oil separators or traps
 - Sources of ignition → not within 18-inches of floor
 - Smoking is not allowed except in approved locations



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IFC Special Occupancies

○ Chapter 23: Motor Fuel-Dispensing Facilities

- Repair Garages (IFC 2311)
 - Pits → Constructed per IBC, shall have means of egress, require mechanical ventilation if vapors accumulate
 - Fire extinguishers shall be provided
 - Repair rooms shall be enclosed by \geq 1-hour fire-rated construction with 1-hour opening protectives
 - If spaces are not separately enclosed, noncombustible spray curtains shall be provided to limit the spread of flammable gases
 - Several specific requirements for hydrogen, LNG, non-odorized gases, or lighter than air systems



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IFC Special Occupancies

- Chapter 23 was just an example
- Special occupancy and operation provisions are incorporated throughout Chapters 20-41



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Inflatable Amusement Devices

o IFC 3106: *Inflatable Amusement Devices*

- Exception: Operated on private property where not open to the public.
- Shall be designed, anchored, operated and maintained per MFR instructions and ASTM F2374.
- Shall meet flame propagation criteria of Test Method 2 in NFPA 701. A label shall be permanently affixed.
- Shall have a fire extinguisher in approved location.



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Plant Cultivation

o IFC Chapter 39: *Processing & Extraction Facilities*

- Now includes cultivation and related activities, pre-extraction and post-extraction processes.
- Exception: Greenhouses without CO₂ enrichment
- Lighting must be listed per UL 8800 and installed per MFR and NEC



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Distilled Spirits & Wines

- **IFC Chapter 40:**
 - **IFC 4005.1: Palletized Storage**
 - Wood barrels → sprinklered per IFC 4005.1.4
 - Metal barrels → sprinklered per Chapter 57
 - Maximum 7 pallets high
 - Flue space of 6 inches shall be maintained between pallets
 - Loading aisles conforming to IFC 4005.1.3



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Distilled Spirits & Wines

- **IFC Chapter 40:** continued...
 - **IFC 4005.2: Rack Storage**
 - If > 20% alcohol sprinklers required
 - Flue space of 8 inches for on-side barrels (6" on end)
 - Elevated walkway construction requirements
 - If mixtures up 75% alcohol – special fire protection requirements
 - **IFC 4005.3: Wine (< 20% alcohol)**
 - Shall be protected by automatic sprinkler system







Temporary Heating & Cooking

- **IFC Chapter 41:** *Temporary Heating & Cooking Operations*
 - Mobile and portable equipment and devices used for heating & cooking with open flames
 - Operational permit [IFC 105.5]
 - Listed & labeled equipment installed and maintained per MFR instructions
 - Shall be constantly attended
 - Minimum 4-A fire extinguisher onsite
 - Much more!



Food Trucks

- **IFC 4106:** *Mobile Food Preparation Vehicles*
 - If grease-laden vapors shall comply with 4106 and NFPA 96
 - Operational permit [IFC 105.5]
 - Exhaust hood per IFC 606
 - Exhaust system inspected and cleaned per NFPA 96
 - Fire protection systems maintained per IFC 901.6 – manual system operation shall be provided
 - Annual fuel-gas leakage test – inspection tag required

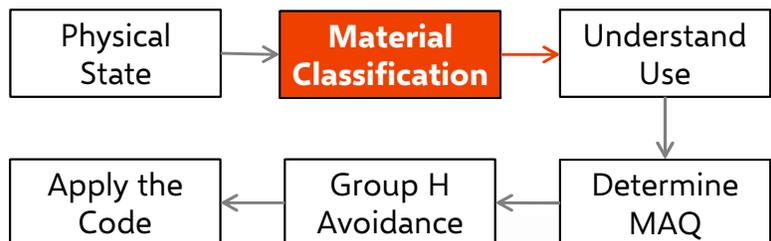


6. Hazardous Materials



Hazardous Materials

o **IFC 5001.1: Exceptions**



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Material Classification

- Haz-Mat classes are divided into two categories...
 - **Physical Hazards**, or...
 - **Health Hazards**
- Both defined in IFC 202



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Material Classification

- **Physical Hazard** (*IFC 202*): A chemical for which there is evidence that it is a...
 - combustible liquid
 - cryogenic fluid
 - Explosive
 - flammable (S, L or G)
 - organic peroxide (S or L)
 - oxidizer (S or L)
 - oxidizing gas
 - pyrophoric (S, L or G)
 - unstable (reactive) material (S, L or G)
 - water-reactive material (solid or liquid).



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Material Classification

- **Health Hazard** (*IFC 202*): A classification of a chemical for which there is statistically significant evidence that acute or chronic health effects are capable of occurring in exposed persons. The term “health hazard” includes chemicals that are ***toxic*** or ***highly toxic***, and ***corrosive***.



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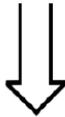
Material Classification

- **Definitions** (*IFC 202*): Each classification of a physical or health hazard is defined in the code.
- **Example:**
 - ***Corrosive***: A chemical that causes visible destruction of, or irreversible alterations in, living tissue by chemical action at the point of contact. ...when tested on the intact skin of albino rabbits... destroys or changes irreversibly the structure of the tissue at the point of contact following an exposure period of 4 hours.



Material Classification

- Many physical hazardous materials are assigned numerical designations (i.e., Class) based upon their hazard potential.
- When classifying HazMat, both the “material” and “class” must be determined.

Arabic Numerals	Highest Hazard	Roman Numeral
4	 Lowest Hazard	I
3		II
2		III
1		IV
0		V

Numbering convention for physical hazardous materials.



Material Classification

- **IFC 5001.5.2:** *Hazardous Material Inventory Statement*
 - Where required by the FCO...
 1. Product name.
 2. Component.
 3. Chemical Abstract Service (CAS) number.
 4. Location where stored or used.
 5. Container size.
 6. Hazard classification.
 7. Amount in storage.
 8. Amount in use-closed systems.
 9. Amount in use-open systems.



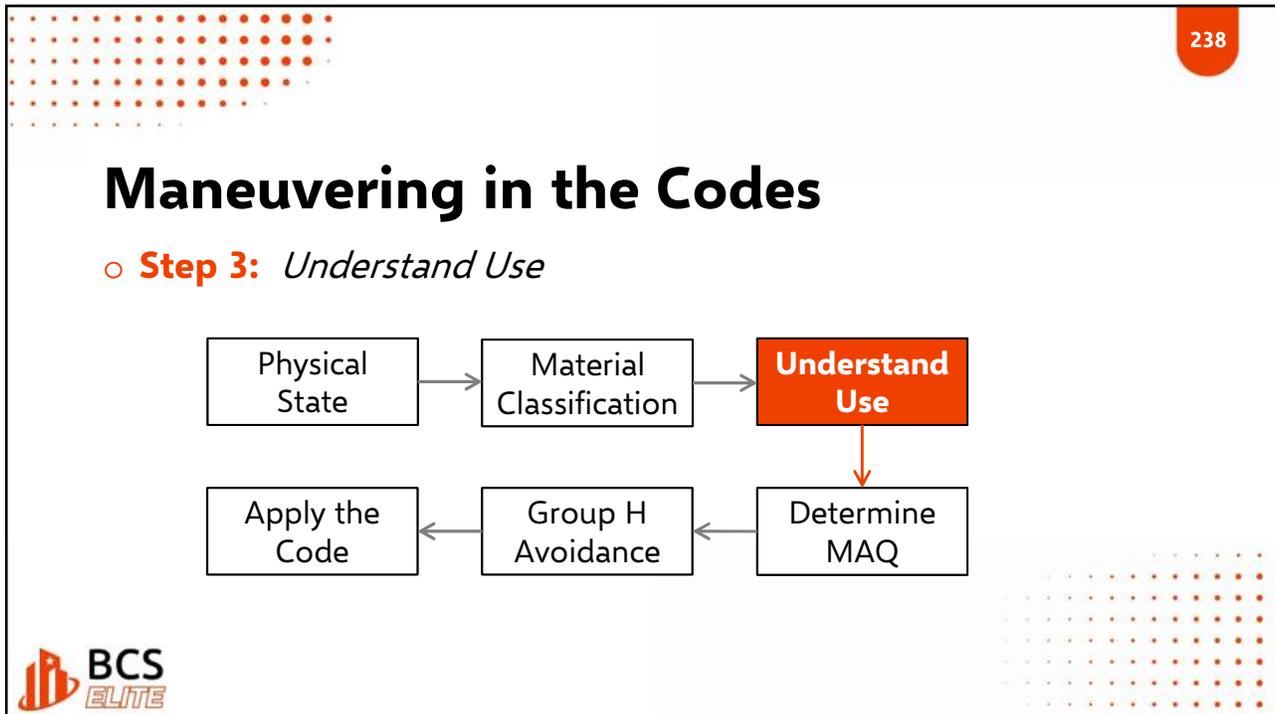
HMIS LIST BY CHEMICAL NAME

Business Name: _____

Common/Trade Name	Conc.	CAS No.	Hazard Class	Quantity				Units
				Stored	Closed	Open	Total	
Control Area: CA-1								
Room : 5115 Research & Hardware Labs								
Acetic acid, ReagentPlus®, ≥99%		64-19-7	CL-II Corr	0.53	0.00	0.26	0.79	Gal.
Acetone		67-64-1	FL-1B Irr	1.00	0.00	0.25	1.25	Gal.
Alcohol : Denon		7863-50-9	Oxy-1 Irr	50.00	0.00	1.00	51.00	Gal.
Dimethyl sulfoxide (DMSO) for Molecular		67-68-5	CL-III Irr	1.79	0.00	0.28	1.98	Gal.
DL-1,4-dithiothreitol		27965-41-6	Sens	0.44	0.00	0.22	0.66	Lit.
Dimethyl Acetate (DMAc) Molecular		84-17-5	FL-1B Irr	2.64	0.00	1.08	3.72	Gal.
for molecular		84-17-5	FL-1B Irr	2.64	0.00	1.08	3.72	Gal.
		544-76-3	CL-III Irr	1.32	0.00	0.28	1.59	Gal.
		544-76-3	CL-III Irr	0.79	0.00	0.31	1.08	Gal.
		544-76-3	CL-III Irr	1.00	0.00	0.25	1.25	Gal.
hydrochloric acid		7647-01-0	Corr	0.26	0.00	0.26	0.52	Gal.
		20999-91-1	Corr	1.50	0.00	0.26	1.76	Gal.
NHCl		7732-18-5	Irr	0.79	0.00	0.31	1.08	Gal.
NaOH		1310-73-4	Corr	0.44	0.00	0.22	0.66	Lit.
NaOH		1310-73-4	Corr	0.79	0.00	0.26	1.05	Gal.
NaOH		144-48-8	Corr	0.26	0.00	0.26	0.52	Gal.
		67-63-0	FL-1B Irr	10.00	0.00	1.00	11.00	Gal.
Isopropyl 70% v/v		67-63-0	FL-1B Irr	10.00	0.00	1.00	11.00	Gal.
Methanol		67-58-1	FL-1B Irr	1.00	0.00	0.25	1.25	Gal.
Methanol AAS-1		67-58-1	FL-1B Irr	1.00	0.00	0.25	1.25	Gal.
n-Heptane		142-82-5	FL-1B Irr	1.00	0.00	0.25	1.25	Gal.
n-Heptane, HPLC grade		142-82-5	FL-1B Irr	1.00	0.00	0.25	1.25	Gal.

Quantity		Units	
Stored	Closed	Open	Total
0.53	0.00	0.26	0.79
		Gal.	

Hazard Class
CL-II Corr
FL-1B Irr
Oxy-1 Irr
CL-III Irr
Sens



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Understand Use

○ Three options...

1. Stored
2. Closed System
3. Open System



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Understand Use

○ Storage: IFC 202

- “The keeping, retention or leaving of hazardous materials in closed containers, tanks, cylinders, or similar vessels; or vessels supplying operations through closed connections to the vessel.”



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Understand Use

- **Closed-System:** IFC 202
 - “The use of a (Haz-Mat) 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...”



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Understand Use

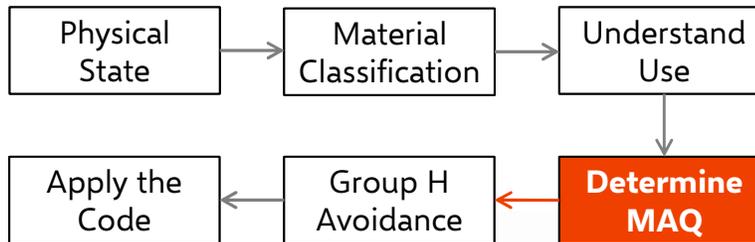
- **Open-System:** IFC 202
 - “The use of a (Haz-Mat) involving a vessel or system that is continuously open to the atmosphere during normal operations and where vapors are liberated, or the product is exposed to the atmosphere during normal operations.”



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Maneuvering in the Codes

○ **Step 4:** *Determine MAQ*



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Maximum Allowable Quantity

- **Does quantity exceed MAQ?**
- Based on MAQs from...
 - **Physical hazards table** → IFC Table 5003.1.1(1)
 - **Health hazards table** → IFC Table 5003.1.1(2)
- Will discuss modifications/exceptions to MAQs later.



Maximum Allowable Quantity

- Does quantity exceed MAQ?
- The tables list MAQs for “control areas”.
- The entire building is considered one control area *unless* applicable “compartmentation” is provided.
- Will discuss modifications/exceptions to MAQs later.



Maximum Allowable Quantity

- Does quantity exceed MAQ?

TABLE 5003.1.1(2)—MAXIMUM ALLOWABLE QUANTITY PER CONTROL AREA OF HAZARDOUS MATERIALS POSING A HEALTH HAZARD^{a, c, h, i, j}

MATERIAL	STORAGE ^b			USE-CLOSED SYSTEMS ^b			USE-OPEN SYSTEMS ^b	
	Solid pounds ^{d, e, f}	Liquid gallons (pounds) ^{d, e, f}	Gas cubic feet at NTP (pounds) ^d	Solid pounds ^d	Liquid gallons (pounds) ^d	Gas cubic feet at NTP (pounds) ^d	Solid pounds ^d	Liquid gallons (pounds) ^d
Corrosives	5,000	500	Gaseous 810 ^g Liquefied (150)	5,000	500	Gaseous 810 ^g Liquefied (150)	1,000	100
Highly toxics	10	(10)	Gaseous 20 ^g Liquefied (4) ^g	10	(10)	Gaseous 20 ^g Liquefied (4) ^g	3	(3)
Toxics	500	(500)	Gaseous 810 ^g Liquefied (150) ^g	500	(500)	Gaseous 810 ^g Liquefied (150) ^g	125	(125)

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Maximum Allowable Quantity

- **Does quantity exceed MAQ?**
- Remember the footnotes!
 - B. Aggregate quantity cannot exceed storage value.
 - D. 100% increase for sprinklered buildings. (NFPA 13)
 - E. 100% increase for approved storage cabinets/enclosures.
 - I. Allowable gallons are simply the value for pounds \div 10.



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Maximum Allowable Quantity

- **Example:**
 - What is the MAQ for a solid Toxic material used in an open system?



Maximum Allowable Quantity

○ What is the MAQ?

TABLE 5003.1.1(2)—MAXIMUM ALLOWABLE QUANTITY PER CONTROL AREA OF HAZARDOUS MATERIALS POSING A HEALTH HAZARD^{a, c, h, i, j}

MATERIAL	STORAGE ^b			USE-CLOSED SYSTEMS ^b			USE-OPEN SYSTEMS ^b	
	Solid pounds ^{d, e, f}	Liquid gallons (pounds) ^{d, e, f}	Gas cubic feet at NTP (pounds) ^d	Solid pounds ^d	Liquid gallons (pounds) ^d	Gas cubic feet at NTP (pounds) ^d	Solid pounds ^d	Liquid gallons (pounds) ^d
Corrosives	5,000	500	Gaseous 810 ^g Liquefied (150)	5,000	500	Gaseous 810 ^g Liquefied (150)	1,000	100
Highly toxics	10	(10)	Gaseous 20 ^g Liquefied (4) ^g	10	(10)	Gaseous 20 ^g Liquefied (4) ^g	3	(3)
Toxics	500	(500)	Gaseous 810 ^g Liquefied (150) ^g	500	(500)	Gaseous 810 ^g Liquefied (150) ^g	125	(125)

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Maximum Allowable Quantity

○ Example:

- What is the MAQ for a solid Toxic material used in an open system? → **125 pounds**
- What if the building is sprinklered?



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Maximum Allowable Quantity

○ Remember the footnotes!

- B. Aggregate quantity cannot exceed storage value.
- D. 100% increase for sprinklered buildings. (NFPA 13)
- E. 100% increase for approved storage cabinets/enclosures.
- F. Some quantities are not limited if sprinklered building.
- G. Only allowed within sprinklered buildings.
- M. Allowable gallons are simply the value for pounds \div 10.



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Maximum Allowable Quantity

○ Example:

- What is the MAQ for a solid Toxic material used in an open system? → **125 pounds**
- What if the building is sprinklered? → **250 pounds**
- What if 800 pounds is stored?



TABLE 5003.1.1(2)—MAXIMUM ALLOWABLE QUANTITY PER CONTROL AREA OF HAZARDOUS MATERIALS POSING A HEALTH HAZARD^{a, c, h, i, j}

MATERIAL	STORAGE ^b			USE-CLOSED SYSTEMS ^b			USE-OPEN SYSTEMS ^b	
	Solid pounds ^{d, e, f}	Liquid gallons (pounds) ^{d, e, f}	Gas cubic feet at NTP (pounds) ^d	Solid pounds ^d	Liquid gallons (pounds) ^d	Gas cubic feet at NTP (pounds) ^d	Solid pounds ^d	Liquid gallons (pounds) ^d
Corrosives	5,000	500	Gaseous 810 ^g Liquefied (150)	5,000	500	Gaseous 810 ^g Liquefied (150)	1,000	100
Highly toxics	10	(10)	Gaseous 20 ^g Liquefied (4) ^g	10	(10)	Gaseous 20 ^g Liquefied (4) ^g	3	(3)
Toxics	500	(500)	Gaseous 810 ^g Liquefied (150) ^g	500	(500)	Gaseous 810 ^g Liquefied (150) ^g	125	(125)

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- Sprinklered? → **Yes**
- 500 lbs. * 2 (Sprinklered) = **1,000 lbs.**
- 1000 lbs. – 800 lbs. (being stored) = **200 lbs. remaining**

Maximum Allowable Quantity

○ **Example:**

- What is the MAQ for a solid Toxic material used in an open system? → **125 pounds**
- What if the building is sprinklered? → **250 pounds**
- What if 800 pounds is stored? → **200 pounds left over**
- If it were liquid, how many gallons could be stored?

TABLE 5003.1.1(2)—MAXIMUM ALLOWABLE QUANTITY PER CONTROL AREA OF HAZARDOUS MATERIALS POSING A HEALTH HAZARD^{a, c, h, i, j}

MATERIAL	STORAGE ^b			USE-CLOSED SYSTEMS ^b			USE-OPEN SYSTEMS ^b	
	Solid pounds ^{d, e, f}	Liquid gallons (pounds) ^{d, e, f}	Gas cubic feet at NTP (pounds) ^d	Solid pounds ^d	Liquid gallons (pounds) ^d	Gas cubic feet at NTP (pounds) ^d	Solid pounds ^d	Liquid gallons (pounds) ^d
Corrosives	5,000	500	Gaseous 810 ^g Liquefied (150)	5,000	500	Gaseous 810 ^g Liquefied (150)	1,000	100
Highly toxics	10	(10)	Gaseous 20 ^g Liquefied (4) ^g	10	(10)	Gaseous 20 ^g Liquefied (4) ^g	3	(3)
Toxics	500	(500)	Gaseous 810 ^g Liquefied (150) ^g	500	(500)	Gaseous 810 ^g Liquefied (150) ^g	125	(125)

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- Sprinklered? → **Yes**
- 500 lbs. * 2 (Sprinklered) = **1,000 lbs.**
- 1000 lbs. ÷ 10 lbs./gallon = **100 gallons**

Maximum Allowable Quantity

○ **Example:**

- What is the MAQ for a solid Toxic material used in an open system? → **125 pounds**
- What if the building is sprinklered? → **250 pounds**
- What if 800 pounds is stored? → **200 pounds**
- If it were liquid, how many gallons could be stored? → **10 gallons**



Maximum Allowable Quantity

TABLE 5003.1.1(1)—MAXIMUM ALLOWABLE QUANTITY PER CONTROL AREA OF HAZARDOUS MATERIALS POSING A PHYSICAL HAZARD^{a, c, i, l, m, o}

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)
Combustible dust	NA	H-2	See Note p	NA	NA	See Note p	NA	NA	See Note p	NA
Combustible fibers ^a	Loose	H-3	(100)	NA	NA	(100)	NA	NA	(20)	NA
	Baled		(1,000)	(1,000)	(200)	NA	NA			
Combustible liquid	II	H-2 or H-3	NA	120 ^{d, e}	NA	NA	120 ^d	NA	NA	30 ^d
	IIIA	H-2 or H-3		330 ^{d, e}			330 ^d			80 ^d
	IIIB	NA		13,200 ^{d, f}			13,200 ^d			3,300 ^d
Cryogenic Flammable	NA	H-2	NA	45 ^d	NA	NA	45 ^d	NA	NA	10 ^d
Cryogenic Inert	NA	NA	NA	NA	NL	NA	NA	NL	NA	NA



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Maximum Allowable Quantity

o **Remember the footnotes!**

- B. Aggregate quantity cannot exceed storage value.
- D. 100% increase for sprinklered buildings. (NFPA 13)
- E. 100% increase for approved storage cabinets/enclosures.
- F. Some quantities are not limited if sprinklered building.
- G. Only allowed within sprinklered buildings.
- M. Allowable gallons are simply the value for pounds ÷ 10.



Maximum Allowable Quantity

○ **Example:**

- What is the MAQ for a Class II combustible liquid that is stored?



Maximum Allowable Quantity

TABLE 5003.1.1(1)—MAXIMUM ALLOWABLE QUANTITY PER CONTROL AREA OF HAZARDOUS MATERIALS POSING A PHYSICAL HAZARD^{a,c,i,l,m,o}

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)
Combustible dust	NA	H-2	See Note p	NA	NA	See Note p	NA	NA	See Note p	NA
Combustible fibers ^o	Loose	H-3	(100)	NA	NA	(100)	NA	NA	(20)	NA
	Baled		(1,000)	NA	NA	(1,000)	NA	NA	(200)	NA
Combustible liquid	II	H-2 or H-3		120 ^{d,e}			120 ^d		NA	30 ^d
	IIIA	H-2 or H-3	NA	330 ^{d,e}	NA	NA	330 ^d	NA	NA	80 ^d
	IIIB	NA		13,200 ^{d,f}			13,200 ^d		NA	3,300 ^d
Cryogenic Flammable	NA	H-2	NA	45 ^d	NA	NA	45 ^d	NA	NA	10 ^d
Cryogenic Inert	NA	NA	NA	NA	NL	NA	NA	NL	NA	NA



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Maximum Allowable Quantity

○ Example:

- What is the MAQ for a Class II combustible liquid that is stored? → **120 gallons**
- What if the building is sprinklered?



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Maximum Allowable Quantity

- Remember the footnotes!
 - B. Aggregate quantity cannot exceed storage value.
 - D. 100% increase for sprinklered buildings. (NFPA 13)
 - E. 100% increase for approved storage cabinets/enclosures.
 - F. Some quantities are not limited if sprinklered building.
 - G. Only allowed within sprinklered buildings.
 - M. Allowable gallons are simply the value for pounds ÷ 10.



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Maximum Allowable Quantity

○ Example:

- What is the MAQ for a Class II combustible liquid that is stored? → **120 gallons**
- What if the building is sprinklered? → **240 gallons**
- What if it is also within an approved cabinet?



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Maximum Allowable Quantity

- Remember the footnotes!
 - B. Aggregate quantity cannot exceed storage value.
 - D. 100% increase for sprinklered buildings. (NFPA 13)
 - E. 100% increase for approved storage cabinets/enclosures.
 - F. Some quantities are not limited if sprinklered building.
 - G. Only allowed within sprinklered buildings.
 - M. Allowable gallons are simply the value for pounds ÷ 10.



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Maximum Allowable Quantity

○ Example:

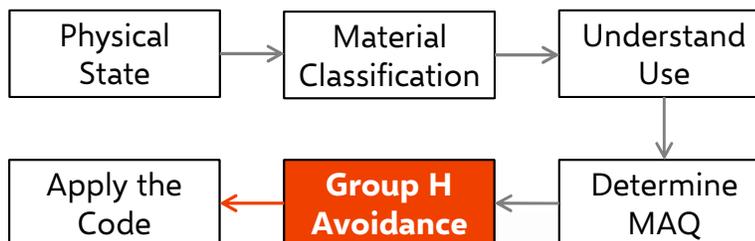
- What is the MAQ for a Class II combustible liquid that is stored? → **120 gallons**
- What if the building is sprinklered? → **240 gallons**
- What if it is also within an approved cabinet? → **480 gallons**



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Maneuvering in the Codes

○ Step 5: *Group H Avoidance*



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Group H Avoidance

- While most buildings contain HazMat...
- The majority do not contain sufficient quantities to be classified as Group H.
- Why would a building owner want to avoid Group H?

Group H

"H" Avoidance

No Hazardous Materials



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Group H Avoidance

- **Four common methods of avoiding Group H...**
 1. Complying with an exception.
 2. Reduce the quantity of HazMat within the building.
 3. Creating control areas or laboratories within the building.
 4. Relocating portions of the HazMat outdoors.



○ **HazMat Exceptions:**

TABLE 5003.1.1(5)—HAZARDOUS MATERIALS EXEMPTIONS*

MATERIAL CLASSIFICATION	OCCUPANCY OR APPLICATION	EXEMPTION
Combustible fiber	Baled cotton	Densely packed baled cotton shall not be classified as combustible fiber, provided that the bales comply with the packing requirements of ISO 8115.
Corrosive	Building materials	The quantity of commonly used building materials that are classified as corrosive materials is not limited.
	Personal and household products	The quantity of personal and household products that are classified as corrosive materials is not limited in retail displays, provided that the products are in original packaging.
	Retail and wholesale sales occupancies	The quantity of medicines, foodstuffs or consumer products, and cosmetics containing not more than 50 percent by volume of water-miscible liquids, with the remainder of the solutions not being flammable, is not limited. To qualify for this allowance, such materials shall be packaged in individual containers not exceeding 1.3 gallons.
Explosives	Groups B, F, M and S	Storage of special industrial explosive devices is not limited.
	Groups M and R-3	Storage of black powder, smokeless propellant, and small arms primers is not limited.

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Group H Avoidance

○ **Reducing Quantity of HazMat:**

- This is the most obvious solution, but...
- **Do you see any pitfalls?**



Group H Avoidance

o IFC 5003.8.3: Control Areas

- Construction: Requires separation by fire barriers or horizontal assemblies.
- **Why have control areas?**

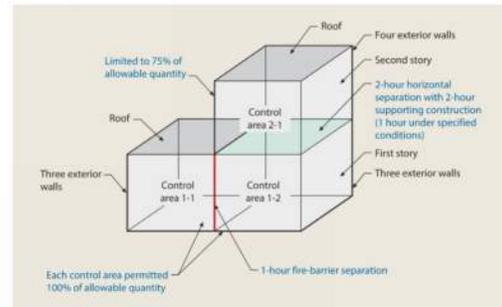


Figure 307-2 Multistory areas.

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Group H Avoidance

o IFC 5003.8.3: Control Areas

- **Table 5003.8.3.2:** Percentage of MAQ, maximum number of control areas, and fire-resistance ratings.
- Floors shall have not less than 2-hour FR rating
 - Exception: 1-hour FR rating allowed for Types IIA, IIIA, IV or VA, and...
 - Fire sprinklers (NFPA 13), and...
 - The buildings is ≤ 3 stories above grade.



TABLE 5003.8.3.2—DESIGN AND NUMBER OF CONTROL AREAS

STORY		PERCENTAGE OF THE MAXIMUM ALLOWABLE QUANTITY PER CONTROL AREA ^a	NUMBER OF CONTROL AREAS PER STORY	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

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Group H Avoidance

- **IFC 5003.8.3: Control Areas**
 - Each portion of a building separated by fire walls shall be considered a separate building for control area purposes.

Group H Avoidance

o **IFC Chapter 38: Higher Education Laboratories**

- **IFC 202:** "Laboratories in Group B occupancies used for educational purposes above the 12th grade..."
- Lab suite construction shall comply with IFC Chapter 38
- The # of suites and quantity of HazMat shall be per Table 3804.1.1



STEM Laboratory at University of Nottingham, England



TABLE 5003.8.3.2—DESIGN AND NUMBER OF CONTROL AREAS				
STORY		PERCENTAGE OF THE MAXIMUM ALLOWABLE QUANTITY PER CONTROL AREA ^a	NUMBER OF CONTROL AREAS PER STORY	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

TABLE 3804.1.1—DESIGN AND NUMBER OF LABORATORY SUITES PER FLOOR				
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 Allowed	Not Allowed
	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
	1-2	100	6	1
Below grade plane	1	75	4	1
	2	50	2	1
	Lower than 2	Not Allowed	Not Allowed	Not Allowed

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Group H Avoidance

○ IFC Chapter 38: *Higher Education Laboratories*

- Separation from non-lab suites:
 - Highest FR rating of...
 - Table 3804.1.1, or...
 - IBC Table 508.4
- Separation from other labs → IFC Table 3804.1.1
- Same floor assembly requirements as for control areas



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Group H Avoidance

○ IFC Chapter 38: *Higher Education Laboratories*

- Means of egress per IFC Chapter 10
- Shall have standby or emergency power
- Shall be ventilated per IMC & Chapter 7 of NFPA 45
- Shall have liquid-tight floor
- Entire building shall be sprinklered (NFPA 13)



Group H Avoidance

o Relocating Outdoors:

- While both the IBC & IFC have MAQ tables for indoor control areas, only the IFC has outdoor control area provisions.
- MAQ per Tables 5003.1.1(3) & (4)
- Footnotes do not allow for increased quantities!



IFC Table 5003.1.1(1) = 1,000 cubic feet

TABLE 5003.1.1(3)—MAXIMUM ALLOWABLE QUANTITY PER CONTROL AREA OF HAZARDOUS MATERIALS POSING A PHYSICAL HAZARD IN AN OUTDOOR CONTROL AREA ^{a, b, c, d}											
MATERIAL	CLASS	STORAGE ^b			USE-CLOSED SYSTEMS ^b			USE-OPEN SYSTEMS ^b			
		Solid pounds (cubic feet)	Liquid gallons (pounds) ^d	Gas cubic feet at NTP	Solid pounds (cubic feet)	Liquid gallons (pounds) ^d	Gas cubic feet at NTP	Solid pounds (cubic feet)	Liquid gallons (pounds) ^d		
Flammable gas	Gaseous	Not Applicable	Not Applicable	3,000	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable		
	1A and 1B (High BV) ^e			195,000						1,500	
	1B (Low BV) ^e			(300)						97,500	Not Applicable
	Liquefied			Not Applicable						(150)	Not Applicable
	1A and 1B (High BV) ^e			(20,000)						(10,000)	Not Applicable
	1B (Low BV) ^e										
Flammable solid	Not Applicable	500	Not Applicable	Not Applicable	250	Not Applicable	Not Applicable	50	Not Applicable		

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IFC Table 5003.1.1(2) = 5,000 pounds

TABLE 5003.1.1(4)—MAXIMUM ALLOWABLE QUANTITY PER CONTROL AREA OF HAZARDOUS MATERIALS POSING A HEALTH HAZARD IN AN OUTDOOR CONTROL AREA^{a, b, c, f}

MATERIAL	STORAGE			USE-CLOSED SYSTEMS			USE-OPEN SYSTEMS	
	Solid pounds	Liquid gallons (pounds)	Gas cubic feet at NTP (pounds)	Solid pounds	Liquid gallons (pounds)	Gas cubic feet at NTP (pounds)	Solid pounds	Liquid gallons (pounds)
Corrosives	20,000	2,000	Gaseous 1,620 Liquefied (300)	10,000	1,000	Gaseous 810 Liquefied (150)	1,000	100
Highly toxics	20	(20)	Gaseous 40 ^d Liquefied (8) ^d	10	(10)	Gaseous 20 ^d Liquefied (4) ^d	3	(3)
Toxics	1,000	(1,000) ^e	Gaseous 1,620 Liquefied (300)	500	50 ^e	Gaseous 810 Liquefied (150)	125	(125) ^e

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Group H Avoidance

○ Relocating Outdoors: IFC 5003.12

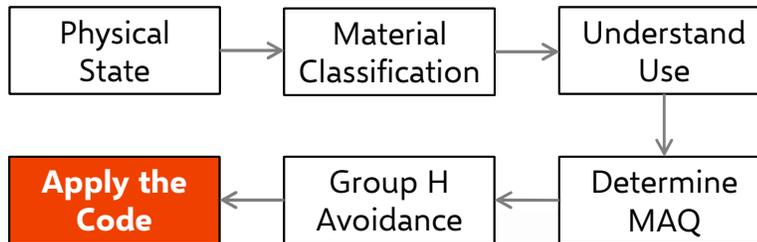
- Kept free from weeds, debris and other combustible materials for 15-foot beyond limits of control area.
- Located not closer than 20-feet from public street, alley, public way or lot line.
- 2 control areas allowed if property > 10,000ft² and they have a 50-foot separation.
- Additional groups of control areas allowed if property > 35,000ft² and groups have a 300-foot separation.



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Hazardous Materials

- **Step 6:** *Apply the Code*



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Hazardous Materials

- **IFC 5004:** *Storage*
- **IFC 5005:** *Use, Dispensing & Handling*
- **Chapters 51-67:** *Specific Hazardous Material Requirements*





Hazardous Materials

- **IFC 5003.8.3.5.4: Flammable Gas**
 - Category 1B having burning velocity ≤ 3.9 in/s...
 - Stored or displayed in outdoor control area of Group M, or...
 - Stored in single control area of Group S...
 - May > MAQ without being Group H when compliant with IFC 5003.11.2





Hazardous Materials

- **IFC Table 5003.11.2: Category 1B Flammable Gas**

TABLE 5003.11.2—MAXIMUM ALLOWABLE QUANTITY OF LOW BURNING VELOCITY CATEGORY 1B FLAMMABLE GAS IN GROUP M AND S OCCUPANCIES PER CONTROL AREA ^a		
CATEGORY 1B (Low BV) ^d	SPRINKLERED IN ACCORDANCE WITH NOTE B	NONSPRINKLERED
Gaseous	39,000 ft ³	195,000 ft ³
Liquified	40,000 lb ^c	20,000 lb

For SI: 1 pound = 0.454 kg, 1 cubic foot = 0.028 m³.

a. Control areas shall be separated from each other by not less than a 1-hour fire barrier.

b. The building shall be equipped throughout with an approved automatic sprinkler system with a minimum sprinkler design density of Ordinary Hazard Group 2 in the area where flammable gases are stored or displayed.

c. Where storage areas exceed 50,000 square feet in area, the maximum allowable quantities area is allowed to be increased by 2 percent for each 1,000 square feet of area in excess of 50,000 square feet, up to not more than 100 percent of the table amounts. Separation of control areas is not required. The aggregate amount shall not exceed 80,000 pounds.

d. "Low BV" Category 1B flammable gas has a burning velocity of 3.9 in/s (10 cm/s) or less.

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Hazardous Materials

o IFC 5003.11.2.1: Fire Protection and Storage Arrangements

- Storage
 - Separate $\geq 20'$ from flammable liquids
 - Separate $\geq 10'$ from flammable liquids if secondary containment provided
 - Edge of secondary containment or diking $\geq 10'$ from Category 1B flammable gas
 - Shelf storage $\geq 6'$ in height
- Fire Protection
 - Rack storage, palletized storage or solid piles $\geq 6'$ in height shall be sprinklered
 - Sprinklers designed for Extra Hazard Group 1
 - Shelf storage shall be on metal shelves
 - Combustible commodities shall not be stored above



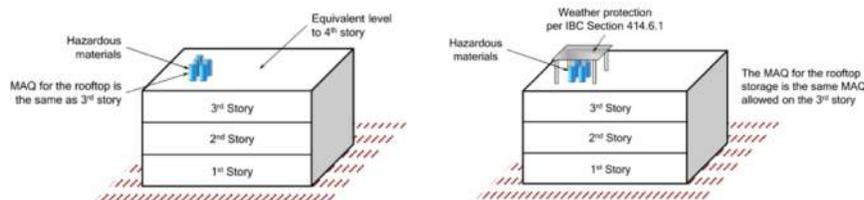
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Hazardous Materials

o IFC 5003.13: Outdoor Rooftop Storage, Use and Handling

- Storage on roofs or on top of canopies
- Rooftop storage quantities shall NOT be included in the MAQ
- Rooftop storage does NOT create another story
- Quantity in rooftop storage shall not exceed the MAQ for story below








Hazardous Materials

- **IFC 5003.13.2:** *Maximum allowable quantity per rooftop or canopy*
 - Shall not > MAQ in IFC Tables 5003.1.1(1) and 5003.1.1(2).
 - LP-gas storage and use shall be in accordance with Chapter 61.
 - Exceptions:
 - Pollution control, exhaust treatment and dust collection equipment when approved.
 - Hydrogen storage at motor fuel-dispensing facilities in accordance with Chapter 23.
 - HazMat in closed piping systems complying with this code.
 - HazMat on top of a normally unoccupied exterior equipment platforms necessary for the operation of mechanical systems or industrial process equipment when approved.
 - HazMat necessary for rooftop swimming pool or hot tub treatment systems, limited to a maximum container size of 50 gallons/500 lbs of toxic or corrosive materials, and 200 pounds/20 gallons of oxidizers.
 - Other situations where rooftop storage or use of hazardous materials is necessary for the operation of equipment serving the building and is approved.








Flammable Gases & Cryogenic Liquids

- **IFC 5809:** *On-Demand Hydrogen Mobile Fueling*
 - Requires permit and FCO approval
 - Specific mobile fueling vehicle requirements
 - Safety & emergency response plan
 - Training records, spill reporting
 - Site plan & mobile fueling areas
 - Separation, emergency access roads, etc.
 - Fire extinguisher & safety cones




7. Appendices

- **Appendix B:** *Fire Flow Requirements*
- **Appendix C:** *Fire Hydrant Locations & Distribution*
- **Appendix D:** *Fire Apparatus Access Roads*
- **Appendix E:** *Hazard Category*



Appendix B

- Considers the total floor area of all floors
 - *Exception:* Type IA & IB → 3 largest successive floors

TABLE B105.1(1)—REQUIRED FIRE FLOW FOR ONE- AND TWO-FAMILY DWELLINGS, GROUP R-3 AND R-4 BUILDINGS AND TOWNHOUSES			
FIRE-FLOW CALCULATION 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 and 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	Section 903.3.1.3 of the <i>International Fire Code</i> or Section P2904 of the <i>International Residential Code</i>	500	1/2
3,601 and greater	Section 903.3.1.3 of the <i>International Fire Code</i> or Section P2904 of the <i>International Residential Code</i>	1/2 value in Table B105.1(2)	1

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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) ^a	FLOW DURATION (hours)
Types IA and IB ^a	Types IIA and IIIA ^a	Types IV and V-A ^a	Types 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	
112,701-128,700	63,401-72,400	40,601-46,400	29,301-33,500	18,001-20,600	3,750	
128,701-145,900	72,401-82,100	46,401-52,500	33,501-37,900	20,601-23,300	4,000	
145,901-164,200	82,101-92,400	52,501-59,100	37,901-42,700	23,301-26,300	4,250	
164,201-183,400	92,401-103,100	59,101-66,000	42,701-47,700	26,301-29,300	4,500	4
183,401-203,700	103,101-114,600	66,001-73,300	47,701-53,000	29,301-32,600	4,750	
203,701-225,200	114,601-126,700	73,301-81,100	53,001-58,600	32,601-36,000	5,000	
225,201-247,700	126,701-139,400	81,101-89,200	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	
—	—	125,501-135,500	90,601-97,900	55,701-60,200	6,500	
—	—	135,501-145,800	97,901-106,800	60,201-64,800	6,750	
—	—	145,801-156,700	106,801-113,200	64,801-69,600	7,000	
—	—	156,701-167,900	113,201-121,300	69,601-74,600	7,250	
—	—	167,901-179,400	121,301-129,600	74,601-79,800	7,500	
—	—	179,401-191,400	129,601-138,300	79,801-85,100	7,750	
—	—	191,401-Greater	138,301-Greater	85,101-Greater	8,000	

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TABLE B105.2—REQUIRED FIRE FLOW FOR BUILDINGS OTHER THAN ONE- AND TWO-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 of the <i>International Fire Code</i>	25% of the value in Table B105.1(2) ^a	Duration in Table B105.1(2) at the reduced flow rate
Section 903.3.1.2 of the <i>International Fire Code</i>	25% of the value in Table B105.1(2) ^b	Duration in Table B105.1(2) at the reduced flow rate
For SI: 1 gallon per minute = 3.785 L/m. a. The reduced fire flow shall be not less than 1,000 gallons per minute. b. The reduced fire flow shall be not less than 1,500 gallons per minute.		

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Appendix C

TABLE C102.1—REQUIRED NUMBER AND SPACING OF FIRE HYDRANTS^h

FIRE-FLOW REQUIREMENT (gpm)	MINIMUM NUMBER OF HYDRANTS	AVERAGE SPACING BETWEEN HYDRANTS ^{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
1,751–2,250	2	450	225
2,251–2,750	3	450	225
2,751–3,250	3	400	225
3,251–4,000	4	350	210
4,001–5,000	5	300	180
5,001–5,500	6	300	180
5,501–6,000	6	250	150
6,001–7,000	7	250	150
7,001 or more	8 or more ^e	200	120

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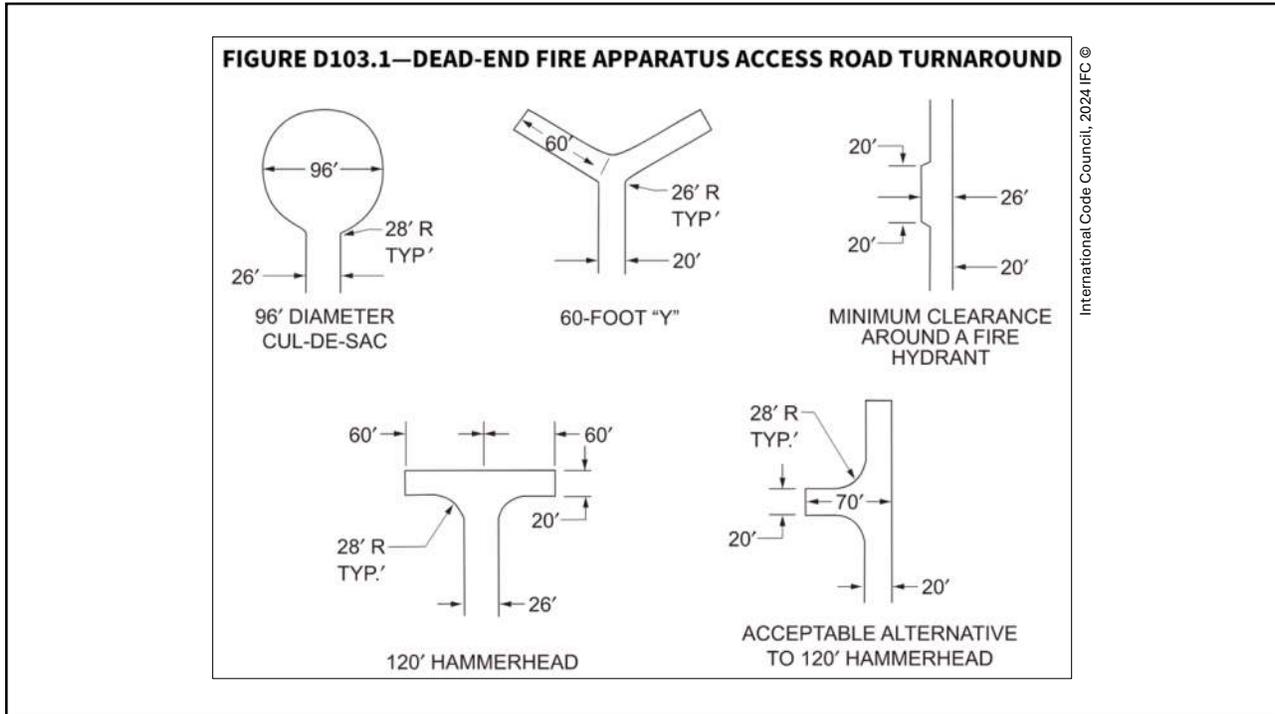


Appendix D

○ Fire Apparatus Access Roads:

- Asphalt, concrete or other approved driving surface capable of supporting 75,000 pounds.
- Min. width at hydrants = 26 feet
- Fire lane sign requirements
- Max. grade = 10%
- Dead ends > 150-feet shall have turn around





Appendix D

○ Fire Apparatus Access Roads:

- Commercial & Industrial Buildings:
 - 3 stories or > 30-feet high → 2 separate access roads
 - > 62,000 SF → 2 separate access roads (124,000 SF if sprinkled)
- Aerial Apparatus:
 - If roof > 30 feet from grade
 - Min. width = 26 feet
 - Within 15-30 feet from exterior of building



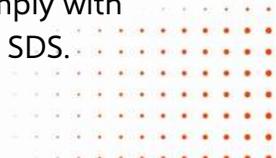
Appendix E

- **Hazard Categories:**
 - E102 → Provides several examples
 - E103 → Questions that help in classifying
 - E104 → **GHS comparisons!**



Appendix E

- **IFC E104: GHS HazMat Definitions**
 - The current HazMat definitions have been developed using criteria found in NFPA codes and standards, model fire prevention codes, NIOSH, DOT (49 CFR) regulations.
 - The chemical industry has changed significantly since these definitions were established.
 - In March 2012, DOL now requires all manufacturers to comply with the GHS and provide this standardized information on the SDS.



Appendix E

o IFC E104: GHS HazMat Definitions

- Have added a new Table comparing the I-code definitions to GHS.

IFC MATERIAL	IFC CLASS	IFC DEFINITION	GHS 2017 (REV 7) CLASSIFICATION (H-CODE AND CATEGORY); HAZARD STATEMENT; DEFINITION
Flammable liquid	IA	Liquids having a flash point below 73°F (23°C) and having a boiling point below 100°F (38°C).	H224, Category 1; Extremely flammable liquid and vapor. Flash point < 23°C and initial boiling point ≤ 35°C
Flammable liquid	IB	Liquids having a flash point below 73°F (23°C) and having a boiling point at or above 100°F (38°C).	H225, Category 2; Highly flammable liquid and vapor. Flash point < 23°C and initial boiling point > 35°C
Flammable liquid	IC	Liquids having a flash point at or above 73°F (23°C) and below 100°F (38°C).	H226, Category 3; Flammable liquid and vapor. Flash point ≥ 23°C and ≤ 60°C

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This SDS is provided for a project and you need to classify the material.

- Section 2 identifies the hazard in accordance with GHS.

SECTION 2: Hazards identification

2.1 Classification of the substance or mixture

GHS Classification in accordance with 29 CFR 1910 (OSHA HCS)

Flammable liquids (Category 1), H224
 Acute toxicity, Oral (Category 4), H302
 Specific target organ toxicity - single exposure (Category 3), Central nervous system, H336

Flammable liquid	IA	Liquids having a flash point below 73°F (23°C) and having a boiling point below 100°F (38°C).	H224, Category 1; Extremely flammable liquid and vapor. Flash point < 23°C and initial boiling point ≤ 35°C
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TABLE E104.2—IFC AND GHS HAZARD DEFINITIONS COMPARISON—continued			
IFC MATERIAL	IFC CLASS	IFC DEFINITION	GHS 2017 (REV 7) CLASSIFICATION (H-CODE AND CATEGORY); HAZARD STATEMENT; DEFINITION
Toxic	—	A chemical falling within any of the following categories: 1. A chemical that has a median lethal dose (LD50) of more than 50 mg per kg, but not more than 500 mg per kg of body weight when administered orally to albino rats weighing between 200 and 300 g each. 2. A chemical that has a median lethal dose (LD50) of more than 200 mg per kg but not more than 1,000 mg per kg of body weight when administered by continuous contact for 24 hr (or less if death occurs within 24 hr) with the bare skin of albino rabbits weighing between 2 and 3 kg each. 3. A chemical that has a median lethal concentration (LC50) in air of more than 200 ppm but not more than 2,000 ppm by volume or less of gas or vapor, or more than 2 mg/l but not more than 20 mg/l of mist, fume or dust, when administered by continuous inhalation for 1 hr (or less if death occurs within 1 hr) to albino rats weighing between 200 and 300 g	Acute toxicity refers to serious adverse health effects (i.e., lethality) occurring after a single or short-term oral, dermal or inhalation exposure to a substance or mixture. Oral H301, Category 3; Toxic if swallowed: LD50 > 50 ≤ 300 mg/kg bodyweight H302, Category 4; Harmful if swallowed: LD50 > 300 ≤ 2,000 mg/kg bodyweight Dermal H311, Category 3; Toxic in contact with skin: LD50 > 200 ≤ 1,000 mg/kg bodyweight Inhalation H330, Category 2; Fatal if inhaled: Gases: LC50 > 100 ppm (4 hr) = 200 ppm (1 hr) ≤ 500 ppm (4 hr) = 1,000 ppm (1 hr) Vapours: LC50 > 0.5 mg/l (4 hr) = 2 mg/l (1 hr) ≤ 2 mg/l (4 hr) = 8 mg/l (1 hr) Dust/mist: LC50 > 0.05 mg/l (4 hr) = 0.2 mg/l (1 hr) ≤ 0.5 mg/l (4 hr) = 2 mg/l (1 hr) H331, Category 3; Toxic if inhaled: Gases: LC50 > 500 ppm (4 hr) = 1,000 ppm (1 hr) ≤ 2,500 ppm (4 hr) = 5,000 ppm (1 hr) Vapours: LC50 > 2 mg/l (4 hr) = 8 mg/l (1 hr) ≤ 10 mg/l (4 hr) = 40 mg/l (1 hr) Dust/mist: LC50 > 0.5 mg/l (4 hr) = 2 mg/l (1 hr) ≤ 1 mg/l (4 hr) = 4 mg/l (1 hr)

IFC Table E104.2:

- H224 – Flammable Liquid, IA
- H302 – Toxic
- H336 – Not listed

More research should be done on H336 → may cause drowsiness or dizziness.

Therefore both a flammable liquid and a toxic substance.

Per IBC Table 307.1(1) the quantity limitation is governed by the flammable liquid → 30 gallons versus 50 gallons w/out sprinklers and cabinets.

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Thank You!

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