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Introduction

- The IFC® and IBC® Hazardous Materials Provisions seminar addresses requirements for buildings utilizing hazardous materials and requiring coordination between the fire and building codes.
Hazardous Materials and the I-Codes
Hazardous Materials and the Codes

- Hazardous materials code requirements are based on both the IFC and the IBC.

- IBC requirements are driven by the Group H occupancy classification assigned to a building.

- IFC requirements are driven by the specific materials stored or used.
Requirements in the IBC

• Indoor storage and use of hazardous materials are regulated in the IBC and the IFC. The IBC requirements address:
  – Occupancy classification.
  – Fire protection.
  – Means of egress.
  – Separation of occupancies.
Requirements in the IBC

- Properly Classified Inventory
- Type of construction.
- Allowable area and height.
- Construction of control areas.
- Structural and environmental loads and designs
Exceptions to Group H Classification

• There are 13 exceptions in IBC Section 307.1 listing conditions that are exempt from a Group H occupancy classification because of:
Exception 1. Flammable Finishes

• Spray painting operations within buildings are exempt from being classified as a Group H occupancy.

• Exception requires that all operations are in accordance with the provisions of IBC Section 416, NFPA 33, NFPA 34 and the IFC.
Exception 2. Flammable Liquids (wholesale/retail)

- Storage of flammable and combustible liquids are regulated by the provisions of NFPA 30 and Chapter 57 of the IFC (IFC Section 5704.3.4.1).
Exception 3. Closed Equipment

- Used exclusively for the operation of machinery or equipment are exempt.

- Not open to the atmosphere.
Exception 3. Closed Systems

• Examples of systems included in this exception are:

  – Oil-burning equipment.
  – Piping for diesel fuel generators.
Exception 4. Dry Cleaning

- Exempt if a closed system is used for all combustible liquid solvents with a flash point at or above 140°F (60°C) and:
  - Separated from other occupancies by 1-hour rated construction.
Exception 6. Liquor Stores

• Exempt from a Group H classification.

• Packaged in individual containers of limited size.
Exception 7. Refrigeration Systems

• Flammable or toxic refrigerants will not change the occupancy classification of the building if the system is installed in accordance with the IMC and the IFC.

• The IMC has specific limitations on refrigerants depending on the occupancy classification of the building.
Exception 9. Stationary Batteries

- Battery storage rooms used as part of an operating system are exempt from a Group H occupancy classification.
- Ventilation must be in compliance with the IFC.
Improper Ventilation
Exception 10. Corrosives (retail)

• Products that technically meet the definition of a corrosive would result in grocery stores and other mercantile occupancies being inappropriately classified as Group H-4.
Exception 10. Corrosives (retail)

- Example exemptions include:
  - Bleaches, detergents and other household cleaning supplies in normal-size containers.
  - The storage or manufacture of commonly used building materials, such as concrete and cement.
• The IFC regulates indoor and outdoor storage and use of hazardous materials. The IFC requirements include:

  – Classification and identification.
  – Construction of process equipment and piping.
  – Containment and drainage systems.
  – Fire Protection, Process Controls
  – Ignition Prevention, Treatment Systems
Exceptions to the IFC Hazardous Materials Provisions

• IFC Section 5001.1 contains 10 exceptions.

• Exceptions apply to the regulations of certain activities or materials regulated by Chapter 50 of the IFC.

• Exceptions do not exempt the hazardous materials from other IFC requirements.
Exceptions to the IFC Hazardous Materials Provisions

The exceptions include:

- Consumer or industrial products containing < 50% water miscible liquids with the remaining solution being nonflammable. The container volume is limited to 1.3 gallons.
- Building materials not regulated by the IFC.
- Mechanical refrigeration systems.
- Stationary storage battery systems.
Exceptions to the IFC Hazardous Materials Provisions

• The exceptions include:
  – The storage of distilled spirits and wines in wooden barrels and casks.
  – Alcohol-based hand rubs in accordance with IFC Section 5705.5.
Module 3: Classifying the Hazardous Materials

1. Classify the hazardous materials
2. Classify the situation of the hazardous materials
3. Determine the MAQ for each hazardous material class
4. Apply the control area requirements for the hazardous materials
5. Does the occupancy contain material specific hazardous materials?
6. Is the storage and use MAQ < the IFC material specific amounts requirements?
7. Does the MAQ exceed IBC & IFC limits?
8. 1) Construct additional control areas;
    2) Construct additional control areas and utilize the IFC requirements for fire-resistive cabinets and automatic sprinkler protection;
    3) Locate the hazardous materials outdoors.
9. Issue Permit
10. Apply IBC requirements for the hazardous material specific H-occupancy requirement
11. Apply IFC hazardous material specific requirements for the regulated hazard(s)
What is a Hazardous Material?

• IFC 5002 defines a hazardous material as:
  – Those chemicals or substances which are physical hazards or health hazards as defined and classified in this chapter, whether the materials are in usable or waste condition.
What is a Hazardous Material?

- Physical state of hazardous materials:
  - Solids
  - Liquids
  - Gases
• IFC Section 5002 defines a physical hazard hazardous material as:

  – A chemical for which there is evidence that it is a combustible liquid, cryogenic fluid, explosive, flammable, organic peroxide (solid or liquid), oxidizer, oxidizing gas, pyrophoric, unstable (reactive) material (solid, liquid or or water-reactive material (solid or liquid).
Physical Hazard Hazardous Materials

• Hazardous materials are assigned numerical designations based upon their hazard potential.

• Numbering convention for physical hazard hazardous materials currently accepted.
• IFC Section 5002 defines a **health hazard** hazardous material as:

  – 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, highly toxic and corrosive.
The classification of materials as either toxic or highly toxic is determined by the:

- Lethal dose to 50% of a group of test animals ($LD_{50}$).
- Lethal concentration to 50% of a group of test animals ($LC_{50}$).
Corrosive materials cause damage to human tissue that results in visible destruction or irreversible alterations based on a single 4-hour exposure.

- The definition in the I-codes is based on the US Department of Transportation classification for corrosive materials.
- Not Corrosive to containers
Evaluation of Health Hazard Mixtures

• Lethal concentration and dose values published in scientific sources and journals are based on pure chemicals or mixtures.

• IFC Section 5001.2.1 requires mixtures to be classified as a whole.
Evaluation of Health Hazard Mixtures

• The amount of material that is either highly toxic or toxic can influence the material’s classification.

• For materials with lethal concentration values, the proper classification criteria are found in ix E, Section E103.1.3.1, which adopts Compressed Gas Association Standard P-20, *Standard for Classification of Toxic Mixtures*. 
Classification Assistance

- IFC Section 105.2 and IBC Section 414.1.3 requires that sufficient information be provided to the code official to issue either construction or operational permits.

- IFC Section 104.7.2 authorizes code officials to obtain technical assistance. The HMEX software is one resource available to assist in classification of hazardous materials.
Classification Assistance

Figure 1: HMEX Classification for Dissolved Acetylene

Table showing properties such as:
- CAS No: 74-86-2
- Concentration: 100%
- State: Gas
- Molecular Weight: 26.04
- Specific Gravity or Density: 1.17
- Vapor Density: 8.90
- Vapor Pressure: 3600.297

Hazard categories:
- Physical Hazards:
  - Explosive Gas
- Health Hazards:
  - Flammable Gas
  - Oxidizer Solid/Liquid
  - Oxidizing Gas
Module 4: Classifying the Situation of Hazardous Material

1. Classify the hazardous materials
   - Determine the MAQ for each hazardous material class
   - Does the occupancy contain material specific hazardous materials?

2. Classify the situation of the hazardous materials
   - Apply the control area requirements for the hazardous materials
   - Is the storage and use MAQ < the IFC material specific amounts requirements?

3. Issue Permit
   - Yes
   - Does the MAQ exceed IBC & IFC limits?
     - Yes
     - Apply IBC requirements for the hazardous material specific H-occupancy requirement
     - Apply IFC hazardous material specific requirements for the regulated hazard(s)
     - No
     - 1) Construct additional control areas; 2) Construct additional control areas and utilize the IFC requirements for fire-resistant cabinets and automatic sprinkler protection; 3) Locate the hazardous materials outdoors.
Situation of the Hazardous Materials

• Before the Maximum Allowable Quantity (MAQ) can be determined, its situation must be evaluated and assigned. The situation of a hazardous material can be either:

  – Storage
  – Use-closed
  – Use-open
Storage and Use Defined

- IFC Section 5002 defines **storage** as:

  - 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.
Storage and Use Defined
Closed-Use System

• A **closed-use system** is defined in IFC Section 202 as:
  – *The use of a solid or liquid hazardous material involving a closed vessel or system that remains closed during normal operations where vapors emitted by the product are not liberated outside of the vessel or system and the product is not exposed to the atmosphere during normal operations; and all uses of compressed gases.*
Closed-Use System
Open Use System

• The IFC defines an open-use system as:

  – The use of a solid or liquid hazardous material involving a vessel or system that is continuously open to the atmosphere during normal operations and where vapors are liberated, or the product is exposed to the atmosphere during normal operations.
Open Use System or Closed Use?
Determining the MAQ for Each Hazardous Material

Classify the hazardous materials → Classify the situation of the hazardous materials

Determine the MAQ for each hazardous material class → Apply the control area requirements for the hazardous materials

Does the occupancy contain material specific hazardous materials?

Is the storage and use MAQ < the IFC material specific amounts requirements?

Yes → Issue Permit

No

1) Construct additional control areas;
2) Construct additional control areas and utilize the IFC requirements for fire-resistant cabinets and automatic sprinkler protection;
3) Locate the hazardous materials outdoors.

Does the MAQ exceed IBC & IFC limits?

Yes

Apply IFC requirements for the hazardous material specific H-occupancy requirement

Apply IFC hazardous material specific requirements for the regulated hazard(s)
Determining the Maximum Allowable Quantity of Hazardous Materials

- IFC Section 5002 defines the MAQ as:
  - The maximum amount of a hazardous material allowed to be stored or used within a control area inside a building or an outdoor control area. The maximum allowable quantity per control area is based on the material state (solid, liquid or gas) and the material storage or use conditions.
Determining the Maximum Allowable Quantity of Hazardous Materials

- The Maximum Allowable Quantity values for indoor storage and use are located in:
  - IBC Table 307.1(1) and IFC Table 5003.1.1.1(1) for physical hazard hazardous materials.
  - IBC Table 307.1(2) and IFC Table 5003.1.1.1(2) for health hazard hazardous materials.
  - Outdoor control area MAQ are located in IFC Tables 5003.1.1.1(3) and (4).
### IFC Table 5003.1.1(1) – Physical Hazard Hazardous Materials

#### TABLE 2703.1.1(1)
**MAXIMUM ALLOWABLE QUANTITY PER CONTROL AREA OF HAZARDOUS MATERIALS POSING A PHYSICAL HAZARD**

<table>
<thead>
<tr>
<th>MATERIAL</th>
<th>CLASS</th>
<th>GROUP WHEN THE MAXIMUM ALLOWABLE QUANTITY IS EXCEEDED</th>
<th>SOLID (cubic feet)</th>
<th>LIQUID (pounds)</th>
<th>GAS (cubic foot) at NTP</th>
<th>SOLID (pounds)</th>
<th>LIQUID (pounds)</th>
<th>GAS (cubic foot) at NTP</th>
<th>SOLID (pounds)</th>
<th>LIQUID (pounds)</th>
<th>GAS (cubic foot) at NTP</th>
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<td>Combustible liquid</td>
<td>II</td>
<td>H-2 or H-3 Not Applicable</td>
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<td>30^e, 80^d, 5,200^e</td>
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<td>30^e, 80^d, 5,200^e</td>
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<td>Combustible liquid</td>
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<td>132,200^c</td>
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<td>30^e, 80^d, 5,200^e</td>
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<td>(20)</td>
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<td>45^d</td>
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<td>Not Applicable</td>
<td>Not Applicable</td>
<td>10^d</td>
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<td>Not Applicable</td>
<td>45^d</td>
<td>Not Applicable</td>
<td>Not Applicable</td>
<td>Not Applicable</td>
<td>Not Applicable</td>
<td>10^d</td>
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<td>Consumer fireworks (Class C)</td>
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<td>1^a</td>
<td>(1)^e</td>
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<td>5^a</td>
<td>(5)^e</td>
<td>5^a</td>
<td>(5)^e</td>
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<td>Not Applicable</td>
<td>Not Applicable</td>
<td>(5)^e</td>
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<td>Division 1.4</td>
<td>H-1</td>
<td>50^a</td>
<td>(50)^e</td>
<td>50^a</td>
<td>(50)^e</td>
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<td>Not Applicable</td>
<td>(50)^e</td>
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<td>Division 1.4G</td>
<td>H-1</td>
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<td>125^a-e</td>
<td>Not Applicable</td>
<td>125^a-e</td>
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<td>125^a-e</td>
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<td>Division 1.5</td>
<td>H-1</td>
<td>1^a</td>
<td>(1)^e</td>
<td>0.25^g</td>
<td>0.25^g</td>
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<td>Not Applicable</td>
<td>0.25^g</td>
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<td>Division 1.6</td>
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<td>Flammable gas</td>
<td>Gaseous</td>
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<td>1,000^e</td>
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<td>Not Applicable</td>
<td>1,000^e</td>
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<td>H-2</td>
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<td>30^g</td>
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<tr>
<td></td>
<td>IB and IC</td>
<td>H-3</td>
<td>120^e</td>
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<td>120^e</td>
<td>Not Applicable</td>
<td>120^e</td>
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<td>Not Applicable</td>
<td>Not Applicable</td>
<td>30^g</td>
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<td>25^d, 80^d, 30^g, 5,200^d</td>
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### IFC Table 5003.1.1(1) – Physical Hazard Hazardous Materials

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<tr>
<th>MATERIAL</th>
<th>CLASS</th>
<th>GROUP WHEN THE MAXIMUM ALLOWABLE QUANTITY IS EXCEEDED</th>
<th>STORAGE&lt;sup&gt;b&lt;/sup&gt;</th>
<th>USE-CLOSED SYSTEMS&lt;sup&gt;b&lt;/sup&gt;</th>
<th>USE-OPEN SYSTEMS&lt;sup&gt;b&lt;/sup&gt;</th>
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<td>Organic peroxide</td>
<td>UD</td>
<td>H-1</td>
<td>1&lt;sup&gt;1&lt;/sup&gt;</td>
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<td>I</td>
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<td>(1)&lt;sup&gt;9&lt;/sup&gt;</td>
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<td></td>
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<td>H-3</td>
<td>50&lt;sup&gt;3&lt;/sup&gt;</td>
<td>10&lt;sup&gt;1&lt;/sup&gt;</td>
<td>(10)&lt;sup&gt;5&lt;/sup&gt;</td>
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<td>III</td>
<td>H-3</td>
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<td>(125)&lt;sup&gt;10&lt;/sup&gt;</td>
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<td></td>
<td>3&lt;sup&gt;a&lt;/sup&gt;</td>
<td>H-2 or H-3</td>
<td>250&lt;sup&gt;4&lt;/sup&gt;</td>
<td>2&lt;sup&gt;4&lt;/sup&gt;</td>
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<td>4&lt;sup&gt;1&lt;/sup&gt;</td>
<td>1&lt;sup&gt;9&lt;/sup&gt;</td>
<td>1&lt;sup&gt;10&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(4)&lt;sup&gt;1&lt;/sup&gt;</td>
<td>(1)</td>
<td>(10)&lt;sup&gt;2&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>50&lt;sup&gt;1&lt;/sup&gt;</td>
<td>10&lt;sup&gt;2&lt;/sup&gt;</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Not Limited</td>
<td>Not Limited</td>
<td>0</td>
</tr>
<tr>
<td>Unstable (reactive)</td>
<td>4</td>
<td>H-1</td>
<td>1&lt;sup&gt;1&lt;/sup&gt;</td>
<td>0.25&lt;sup&gt;2&lt;/sup&gt;</td>
<td>0.25&lt;sup&gt;3&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>H-1 or H-2</td>
<td>50&lt;sup&gt;3&lt;/sup&gt;</td>
<td>1&lt;sup&gt;1&lt;/sup&gt;</td>
<td>(1)&lt;sup&gt;9&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td></td>
<td>(50)&lt;sup&gt;3&lt;/sup&gt;</td>
<td>(10)&lt;sup&gt;5&lt;/sup&gt;</td>
<td>(10)&lt;sup&gt;10&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>H-3</td>
<td>Not Limited</td>
<td>0.25&lt;sup&gt;2&lt;/sup&gt;</td>
<td>0.25&lt;sup&gt;3&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Not Limited</td>
<td>Not Limited</td>
<td>Not Limited</td>
</tr>
<tr>
<td>Water reactive</td>
<td>3</td>
<td>H-2</td>
<td>50&lt;sup&gt;3&lt;/sup&gt;</td>
<td>1&lt;sup&gt;9&lt;/sup&gt;</td>
<td>1&lt;sup&gt;10&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td></td>
<td>50&lt;sup&gt;3&lt;/sup&gt;</td>
<td>(10)&lt;sup&gt;5&lt;/sup&gt;</td>
<td>Not Limited</td>
</tr>
<tr>
<td></td>
<td>1</td>
<td></td>
<td>Not Limited</td>
<td>Not Limited</td>
<td>Not Limited</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Not Limited</td>
<td>Not Limited</td>
<td>Not Limited</td>
</tr>
</tbody>
</table>

For SI: 1 cubic foot = 0.02832 cubic meter; 1 pound = 0.454 kilogram; 1 gallon = 3.785 liters.

<sup>a</sup> Limits of control areas are section 27038.3.

<sup>b</sup> The aggregate quantity in use and storage shall not exceed the quantity listed for storage.

<sup>c</sup> The quantities of flammable beverages, mental, and wholesale sales occupancies shall not be limited provided the liquids are packaged in individual containers not exceeding 1.3 gallons. In retail and wholesale sales occupancies, the quantities of medicines, food stuff, consumer or industrial products, and commodities containing not more than 50 percent by volume of water-soluble liquids with the remainder of the solution not being flammable shall not be limited, provided that such materials are packaged in individual containers not exceeding 1.3 gallons.

(continued)
USE by Height

FLOOR | Max Qty Per Floor
10 | 3
9 | 6
8 | 6
7 | 6
6 | 15
5 | 15
4 | 15
3 | 60
2 | 135
1 | 240

emt Level - 1 | 100%
emt Level - 2 | 100%
TOTAL | IFC 2000 | 696
Permissible MAQ Increases

• For indoor control areas, the IFC and IBC allow the quantity of hazardous materials established in the tables to be increased when isolated and/or protected by an approved sprinkler system.

• Note “e” in IFC Table 5003.1.1(1) and IBC Table 307.1(1).

• Note “d” in IFC Table 5003.1.1(1) and IBC Table 307.1(1).
Permissible MAQ Increases
<table>
<thead>
<tr>
<th>MATERIAL</th>
<th>GROUP WHERE THE MAXIMUM ALLOWABLE QUANTITY IS EXCEEDED</th>
<th>STORAGE&lt;sup&gt;b&lt;/sup&gt;</th>
<th>USE CLOSED BY STEMS&lt;sup&gt;b&lt;/sup&gt;</th>
<th>USE OPEN BY STEMS&lt;sup&gt;b&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>CLASS</td>
<td>Solid pounds (gallons)</td>
<td>Liquid gallons</td>
<td>Gas cubic feet</td>
</tr>
<tr>
<td>Insert Gas</td>
<td>Gaseous</td>
<td>Not Applicable</td>
<td>Not Applicable</td>
<td>Not Limited</td>
</tr>
<tr>
<td></td>
<td>Liquidified</td>
<td>Not Applicable</td>
<td>Not Applicable</td>
<td>Not Limited</td>
</tr>
<tr>
<td></td>
<td>Not Applicable</td>
<td>Not Applicable</td>
<td>Not Applicable</td>
<td>Not Limited</td>
</tr>
<tr>
<td>Cryogenic Insert</td>
<td></td>
<td>Not Applicable</td>
<td>Not Applicable</td>
<td>Not Limited</td>
</tr>
<tr>
<td>Organic Peroxide</td>
<td>UG</td>
<td>H-1</td>
<td>180&lt;sup&gt;b&lt;/sup&gt;</td>
<td>40&lt;sup&gt;c&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td>I</td>
<td>H-2</td>
<td>210&lt;sup&gt;b&lt;/sup&gt;</td>
<td>Not Limited</td>
</tr>
<tr>
<td></td>
<td>II</td>
<td>H-3</td>
<td>Not Limited</td>
<td>Not Limited</td>
</tr>
<tr>
<td></td>
<td>III</td>
<td>H-4</td>
<td>50&lt;sup&gt;a&lt;/sup&gt;</td>
<td>Not Limited</td>
</tr>
<tr>
<td></td>
<td>IV</td>
<td>Not Limited</td>
<td>Not Limited</td>
<td>Not Limited</td>
</tr>
<tr>
<td></td>
<td>V</td>
<td>Not Limited</td>
<td>Not Limited</td>
<td>Not Limited</td>
</tr>
<tr>
<td>Oxidizer</td>
<td>4</td>
<td>H-1</td>
<td>180&lt;sup&gt;b&lt;/sup&gt;</td>
<td>40&lt;sup&gt;c&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td>3&lt;sup&gt;e&lt;/sup&gt;</td>
<td>H-2 or H-3</td>
<td>250&lt;sup&gt;b&lt;/sup&gt;</td>
<td>Not Limited</td>
</tr>
<tr>
<td></td>
<td>2&lt;sup&gt;e&lt;/sup&gt;</td>
<td>H-3</td>
<td>Not Limited</td>
<td>Not Limited</td>
</tr>
<tr>
<td></td>
<td>1&lt;sup&gt;e&lt;/sup&gt;</td>
<td>Not Limited</td>
<td>Not Limited</td>
<td>Not Limited</td>
</tr>
<tr>
<td>Oxidizing Gas</td>
<td>Gaseous</td>
<td>H-3</td>
<td>Not Limited</td>
<td>Not Limited</td>
</tr>
<tr>
<td>Pyrocity</td>
<td>Not Applicable</td>
<td>H-2</td>
<td>50&lt;sup&gt;e&lt;/sup&gt;</td>
<td>Not Limited</td>
</tr>
<tr>
<td>Unstable (reactive)</td>
<td></td>
<td>H-1</td>
<td>180&lt;sup&gt;b&lt;/sup&gt;</td>
<td>40&lt;sup&gt;c&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td>H-1 or H-2</td>
<td>180&lt;sup&gt;b&lt;/sup&gt;</td>
<td>40&lt;sup&gt;c&lt;/sup&gt;</td>
<td>0.25&lt;sup&gt;f&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td>2&lt;sup&gt;e&lt;/sup&gt;</td>
<td>Not Limited</td>
<td>Not Limited</td>
<td>Not Limited</td>
</tr>
<tr>
<td></td>
<td>1&lt;sup&gt;e&lt;/sup&gt;</td>
<td>Not Limited</td>
<td>Not Limited</td>
<td>Not Limited</td>
</tr>
<tr>
<td>Water Reactive</td>
<td>H-2</td>
<td>Not Limited</td>
<td>50&lt;sup&gt;e&lt;/sup&gt;</td>
<td>Not Limited</td>
</tr>
<tr>
<td></td>
<td>H-3</td>
<td>50&lt;sup&gt;e&lt;/sup&gt;</td>
<td>Not Limited</td>
<td>Not Limited</td>
</tr>
</tbody>
</table>

For SI: 1 cubic foot = 0.02832 m³; 1 pound = 0.454 kg; 1 gallon = 3.785 L.

<sup>a</sup> For use of control areas, see Section 2733.3.3.

<sup>b</sup> The aggregate quantity in use and storage shall not exceed the quantity listed for storage.

<sup>c</sup> The quantities of alcoholic beverages in retail establishments or occupancies shall not be limited providing the liquors are packaged in individual containers not exceeding 1.3 gallons. In retail and wholesale sale or occupancy, the quantities of medicines, foods, fats, colors, or industrial products, and cosmetics containing not more than 50 percent by volume of water as an ingredient with the exception of the solutions not being flammable shall not be limited, provided that such materials are packaged in individual containers not exceeding 1.3 gallons.
Additional Requirements in Group M and S Occupancies
Applying the Control Areas Requirements

1. Classify the hazardous materials
2. Classify the situation of the hazardous materials
3. Determine the MAQ for each hazardous material class
4. Does the occupancy contain material specific hazardous materials?
5. Is the storage and use MAQ < the IFC material specific amounts requirements?
   - Yes: Issue Permit
   - No: Apply IBC requirements for the hazardous material specific H-occupancy requirement
   - Yes: Apply IFC hazardous material specific requirements for the regulated hazard(s)

1) Construct additional control areas;
2) Construct additional control areas and utilize the IFC requirements for fire-resistant cabinets and automatic sprinkler protection;
3) Locate the hazardous materials outdoors.
Control Areas

- Amount of hazardous materials stored and used in a control area must be equal to or less than the MAQ.
  - The MAQ can be modified as permitted by the I-Codes.
Control Areas

- The MAQ is based on the physical state, situation and hazard classification of the material. Up to the MAQ for each class of hazardous material is permitted in each control area.

- The location of the control area in relation to the grade plane also influences the MAQ.
Benefits of Control Areas

- Regulate the quantity of hazardous material.
- Two or more provide sufficient protection.
- Offer another means of allowing additional indoor hazardous materials use or storage.
Construction Requirements for Control Areas

- IBC Section 414.2.1 requires control areas to be separated from each other by fire barriers or horizontal assemblies.

- Number of control areas and the MAQ for each floor inside a building is based on the control area location above or below grade plane.
Construction Requirements for Control Areas

• The number of control areas and MAQ limits are set forth in IBC Table 414.2.2 and IFC Table 5003.8.3.2.
### Table 2703.8.2
**Detached Building Required**

A detached building is required when the quantity of material exceeds that listed herein.

<table>
<thead>
<tr>
<th>Material</th>
<th>Class</th>
<th>Solids and Liquids (tons)&lt;sup&gt;a,b&lt;/sup&gt;</th>
<th>Gases (cubic feet)&lt;sup&gt;a,b&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Explosives</td>
<td>Division 1.1</td>
<td>Maximum Allowable Quantity</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Division 1.2</td>
<td>Maximum Allowable Quantity</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Division 1.3</td>
<td>Maximum Allowable Quantity</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Division 1.4</td>
<td>Maximum Allowable Quantity</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Division 1.4&lt;sup&gt;c&lt;/sup&gt;</td>
<td>Maximum Allowable Quantity</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Division 1.5</td>
<td>Maximum Allowable Quantity</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Division 1.6</td>
<td>Maximum Allowable Quantity</td>
<td></td>
</tr>
<tr>
<td>Oxidizers</td>
<td>Class 4</td>
<td>Maximum Allowable Quantity</td>
<td>Maximum Allowable Quantity</td>
</tr>
<tr>
<td>Unstable (reactives) detonable</td>
<td>Class 3 or 4</td>
<td>Maximum Allowable Quantity</td>
<td>Maximum Allowable Quantity</td>
</tr>
<tr>
<td>Oxidizer, liquids and solids</td>
<td>Class 3</td>
<td>1,200</td>
<td>Maximum Allowable Quantity</td>
</tr>
<tr>
<td></td>
<td>Class 2</td>
<td>2,000</td>
<td>Not Applicable</td>
</tr>
<tr>
<td>Organic peroxides</td>
<td>Detonable Class I</td>
<td>Maximum Allowable Quantity</td>
<td>Not Applicable</td>
</tr>
<tr>
<td></td>
<td>Class II</td>
<td>Maximum Allowable Quantity</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Class III</td>
<td>Maximum Allowable Quantity</td>
<td></td>
</tr>
<tr>
<td>Unstable (reactives) nondetonable</td>
<td>Class 3</td>
<td>1</td>
<td>2,000</td>
</tr>
<tr>
<td></td>
<td>Class 2</td>
<td>25</td>
<td>25</td>
</tr>
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<td></td>
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<td></td>
<td>10,000</td>
</tr>
<tr>
<td>Water reactives</td>
<td>Class 3</td>
<td>1</td>
<td>Not Applicable</td>
</tr>
<tr>
<td></td>
<td>Class 2</td>
<td>25</td>
<td></td>
</tr>
<tr>
<td>Pyrophoric gases</td>
<td>Not Applicable</td>
<td>Not Applicable</td>
<td>2,000</td>
</tr>
</tbody>
</table>

For SI: 1 pound = 0.454 kg, 1 cubic foot = 0.02832 m³, 1 ton = 2000 lbs = 907.2 kg.

- **a.** For materials which are detonable, the distance to other buildings or lot lines shall be as specified in the *International Building Code*. For materials classified as explosives, the required separation distances shall be as specified in Chapter 33.
- **b.** “Maximum Allowable Quantity” means the maximum allowable quantity per control area set forth in Table 2703.1.1(1).
- **c.** Limited to Division 1.4 materials and articles, including articles packaged for shipment, that are not regulated as an explosive under Bureau of Alcohol, Tobacco and Firearms regulations, or unpackaged articles used in process operations that do not propagate a detonation or deflagration between articles, providing the net explosive weight of individual articles does not exceed 1 pound.
Application of IBC and IFC Tables

• Construction Requirements for Control Areas:

  – IFC Table 5003.8.3.2 and IBC Table 414.2.2 are used in conjunction with the MAQ values for physical and health hazard materials regulated by IBC Chapter 3 and IFC Chapter 50.
Two Control Areas in a One-Story Building

- Exterior Wall
- Roof
- Control Area 1
- Control Area 2
- 1-Hour Fire Barrier
Applying the MAQ and Control Areas

• Four variables must be considered when determining the indoor MAQ:

1. The physical state of the hazardous material.
2. The situation of the hazardous material.
3. The proper classification of the hazardous material.
4. The location of the control area if the building is more than one story in height.
Occupancy Requirements

Classify the hazardous materials

Classify the situation of the hazardous materials

Determine the MAQ for each hazardous material class

Apply the control area requirements for the hazardous materials

Does the occupancy contain material specific hazardous materials?

Is the storage and use MAQ < the IFC material specific amounts requirements?

No

Yes

Yes

Issue Permit

Does the MAQ exceed IBC & IFC limits?

1) Construct additional control areas; 2) Construct additional control areas and utilize the IFC requirements for fire-resistant cabinets and automatic sprinkler protection; 3) Locate the hazardous materials outdoors.

Apply IBC requirements for the hazardous material specific H-occupancy requirement

Apply IFC hazardous material specific requirements for the regulated hazard(s)
Apply IBC Requirements

Classify the hazardous materials → Classify the situation of the hazardous materials

Determine the MAQ for each hazardous material class → Apply the control area requirements for the hazardous materials

Does the occupancy contain material specific hazardous materials?

1) Construct additional control areas; 2) Construct additional control areas and utilize the IFC requirements for fire-resistant cabinets and automatic sprinkler protection 3) Locate the hazardous materials outdoors.

Is the storage and use MAQ < the IFC material specific amounts requirements?

Yes → Issue Permit

No →

Does the MAQ exceed IBC & IFC limits?

Yes → Apply IBC requirements for the hazardous material specific H-occupancy requirement

No → Apply IFC hazardous material specific requirements for the regulated hazard(s)
Group H Occupancies

• Five classifications established to address the concerns associated with the various high-hazard uses.
  – H-1 – Detonation hazards
  – H-2 – Deflagration hazards
  – H-3 – Conflagration/highly combustible
  – H-4 – Health hazard
  – H-5 – Semiconductor manufacturing and comparable research and development operation.
Group H Occupancies

– The occupancy classifications are based on the stored materials being physical or health hazards (or both – which is very common).

– When quantities of hazardous materials presenting a physical hazard exceed the MAQ, the occupancy containing such materials is classified as a Group H-1, H-2 or H-3.
Group H Occupancies

– When quantities of hazardous materials presenting a health hazard exceed the MAQ, the occupancy containing such materials is classified as Group H-4.

– When the MAQ of either physical or health hazard materials are exceeded and are used for the manufacturing of semiconductors, the building is a Group H-5 occupancy.
Group H-1 Occupancies

- Occupancies with materials that present a detonation hazard:

  1. Explosives, blasting agents, fireworks (other than consumer fireworks) and black powder.
  2. Unclassified detonable organic peroxides.
  3. Class 4 oxidizers.
  4. Detonable UR or PYRO
Group H-2 Occupancy

Occupancies with materials that present a deflagration hazard or a hazard from accelerated burning.

1. Class I, II or IIIA flammable or combustible liquids that are used or stored in normally open containers or systems, or in closed containers or systems pressurized at more than 15 pounds-per-square-inch gauge.

2. Combustible dusts.

4. Flammable gases.

5. Class I organic peroxides.
6. Class 3 oxidizers that are used or stored in normally open containers or systems, or in closed containers or systems pressurized at more than 15 pounds-per-square-inch gauge.

8. Class 3 nondetonable unstable (reactive) materials.

9. Class 3 water-reactive materials.
Group H-3 Occupancy

Occupancies with materials that readily support combustion or present a high physical hazard.

1. Class I, II or III-A flammable or combustible liquids that are used or stored in normally closed containers or systems pressurized at less than 15 pound-per-square-inch gauge.

2. Combustible fibers.
Group H-3 Occupancy

3. Consumer fireworks (1.4G).


5. Flammable solids

6. Class II and III organic peroxides.
7. Class 3 oxidizers that are used or stored in normally closed containers or systems pressurized at less than 15 pound-per square-inch gauge or less.

8. Oxidizing gases
10. Class 2 unstable (reactive) materials.

11. Class 2 water-reactive materials
Group H-4 Occupancy

• Occupancies having materials that are health hazards:

1. Highly toxic materials.
2. Toxic materials.
3. Corrosives
Group H-5 Occupancy

- Semiconductor fabrication facilities and comparable research and development areas in which hazardous production materials (HPM) are used and the aggregate quantity of materials is in excess of those listed in IBC Tables 307.1(1) and 307.1(2) shall be classified as Group H-5. Such facilities and areas shall be designed and constructed in accordance with IBC Section 415.8.
• IBC Section 415 contains requirements for:
  – Minimum fire separation distances.
  – Minimum separation distances for buildings containing explosives.
IBC Section 415

- Special provisions for H-1, H-2, H-3, H-4 and H-5 occupancies.
- Special provisions for buildings or fire areas containing combustible dusts, flammable liquids or liquefied petroleum gases.
IBC Separation Distances

- IBC Section 415.3 sets forth the minimum fire separation distances for Group H occupancies.

Exceptions:
- Liquid use, dispensing and mixing rooms that comply with the IFC and NFPA 30 and are not more than 500 square feet in area
- Liquid storage rooms that comply with the IFC and NFPA 30 and are not more than 1,000 square feet in area
- Spray booths complying with the IFC
IBC Separation Distances

• IBC Section 415.3.1 sets forth the minimum separation distances to lot lines and public ways based on the occupancy classification:

  – Group H-1: Not less than 75 feet and not less than that required by the IFC.
  – Group H-2: Not less than 30 feet for buildings over 1,000 ft.² when not required to be detached storage.
IBC Separation Distances

– Group H-2 or H-3 detached storage: not less than 50 feet
– For all other Group H occupancies see IBC Section 506 and Table 602.
IBC Separation Distances

Separation of occupancies (not less than Table 508.4)

Note: per Section 415.3, 25 percent of perimeter of a Group H-2 or H-3 occupancy must be on an exterior wall.

For SI: 1 foot = 304.8 mm, 1 square foot = 0.093 m².
Detached Building

• IBC Section 415.2 defines a detached building as:

  – A separate single-story building, without a basement or crawl space, used for the storage or use of hazardous materials and located an approved distance from all structures.
IBC Table 508.4 reflects the required degree of fire separation needed for occupancies of Groups H-1, H-2, H-3, H-4 and H-5.

Fire-resistance rating based on anticipated fire hazard severity.
**Table 508.4**

**REQUIRED SEPARATION OF OCCUPANCIES (HOURS)**

<table>
<thead>
<tr>
<th></th>
<th></th>
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<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
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<td>S</td>
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<td>S</td>
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</tr>
<tr>
<td>A^4, E</td>
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<td>2</td>
<td>2</td>
<td>NP</td>
<td>1</td>
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<td>NP</td>
</tr>
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<td>I-1, I-3, I-4</td>
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<td>—</td>
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<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>N</td>
<td>N</td>
<td>2</td>
</tr>
<tr>
<td>H-1</td>
<td>—</td>
<td>—</td>
<td>—</td>
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For SI: 1 square foot = 0.0929 m².

S = Buildings equipped throughout with an automatic sprinkler system installed in accordance with Section 903.3.1.1.

NS = Buildings not equipped throughout with an automatic sprinkler system installed in accordance with Section 903.3.1.1.

N = No separation requirement.

NP = Not permitted.

- a. For Group H-5 occupancies, see Section 903.2.5.2.
- b. The required separation from areas used only for private or pleasure vehicles shall be reduced by 1 hour but to not less than 1 hour.
- c. See Section 406.1.4.
- d. Commercial kitchens need not be separated from the restaurant seating areas that they serve.
- e. Separation is not required between occupancies of the same classification.
- f. For H-5 occupancies, see Section 415.8.2.2.
• Group H-1 occupancies are intended to be in separate detached buildings; mixed-use not permitted.

• A high degree of fire separation is required between Group H occupancies and Institutional Group I and Residential Group R occupancies.
Group H Occupancy Sprinkler System Requirements

- IBC and IFC Section 903.2.5.1 requires all Group H occupancies to be protected throughout by an automatic sprinkler system.
Group H Occupancies in an Unlimited Area Building

- BUILDING AREA
  - GROUP F-1
  - CONSTRUCTION TYPE IIB
  - UNLIMITED AREA BUILDING

- H-2 AREA
  - GROUP H-2
  - ALLOWABLE AREA = 25(7,000)
    \[ \frac{100}{100} = 1,750 \text{ SQ. FT.} \]

For 1 square foot = 0.0929 m²

2-HOUR RATED FIRE BARRIER WALL
Means of Egress — Group H Occupancies

- IBC Chapter 10 has a number of specific requirements for means of egress in Group H occupancies.
  - Stairways in Groups H-1 through H-5 require 0.3 inches/occupant.
  - Revolving, sliding, and horizontal sliding doors in the egress path are prohibited.
Means of Egress — Group H Occupancies

– All means of egress doors require panic hardware.
– Egress through an intervening room or space in a Group H occupancy is permitted if the adjacent spaces are the same or lesser hazard occupancy group.
Means of Egress — Group H Occupancies

- Groups H-1 through H-3 occupancies with an occupant load of 3 or less are permitted one means of egress.
- Groups H-4 and H-5 occupancies with an occupant load of 10 or less are permitted one means of egress.
Special Inspections for Group H Occupancies

- Piping systems and mechanical units containing flammable, combustible or highly toxic materials.
- Anchoring of electrical equipment used for emergency or standby power systems.
- Seismic requirements - US Wide
Applying IFC Requirements

Classify the hazardous materials

- Determine the MAQ for each hazardous material class
- Does the occupancy contain material specific hazardous materials?
  - No
    1) Construct additional control areas;
    2) Construct additional control areas and utilize the IFC requirements for fire-resistant cabinets and automatic sprinkler protection;
    3) Locate the hazardous materials outdoors.
  - Yes
    - Is the storage and use MAQ < the IFC material specific amounts requirements?
      - Yes
        - Issue Permit
      - No
        - Apply the control area requirements for the hazardous materials

- Classify the situation of the hazardous materials
- Apply the control area requirements for the hazardous materials
- Does the MAQ exceed IBC & IFC limits?
  - Yes
    - Apply IFC hazardous material specific requirements for the regulated hazard(s)
  - No
    - Apply IBC requirements for the hazardous material specific H-occupancy requirement
• IFC Section 5001 establishes the general requirements for all hazardous materials.

• IFC Section 5002 contains the definitions used by the IFC for hazardous materials.
IFC Sections 5003 and 5004

• IFC Section 5003 establishes the general storage, use and handling requirements for all hazardous materials.

• IFC Section 5004 specifies the engineering controls required for the safe storage of hazardous materials in excess of the permitted MAQ per control area.
IFC Section 5005

• IFC Section 5005 specifies the engineering controls required for the safe use, dispensing and handling of hazardous materials in excess of the permitted MAQ per control area
Design and Construction of Containers, Cylinders and Tanks

• IFC requires containers, cylinders, and tanks to be constructed in accordance with approved standards when used for the containment of hazardous materials.
Design and Construction of Containers, Cylinders and Tanks

- IFC section 5002 defines:
  - Container.
  - Cylinder.
  - Tank.
Piping, Tubing, Valves and Fittings

• IFC Section 5003.2.2 requires piping, tubing, valves, and fittings to be designed with adequate strength and materials COMPATIBLE with the material contained.
Piping, Tubing, Valves and Fittings

• IFC Section 5003.2.2.1 also requires:
  – Piping identified in accordance with ASME A13.1.
  – A means of excess flow control for health or reactivity hazards with a NFPA 704 ranking of “3” or “4” or a NFPA 704 flammability rating of “4.”
  – Check valves or similar means of backflow prevention if a backflow could cause an unauthorized discharge.
Testing

- IFC Section 5003.2.9 addresses testing of equipment, devices or systems required by the IFC. At a minimum, annual testing is required for:
  - Gas or vapor detection systems required for toxic or highly toxic gases.
  - Temperature, pressure and liquid limit controls.
– Emergency alarm systems (including supervising) circuits.
Testing Exceptions

• IFC Section 5003.2.9 does not require testing if:

  – The test will damage or destroy the device, so long as it is maintained in accordance with manufacturer’s instructions.
  – The devices are equipped with self-diagnostic features.
  – The system activates and performs its function within its approved schedule.
Identification Signs

• IFC Section 5003.5 requires a NFPA 704 placard for stationary containers, aboveground tanks and locations storing hazardous materials in excess of permit quantities.
Gas Cabinets

• IFC Section 5003.8.6 permits a 100 percent MAQ increase when gases are stored in approved gas cabinets.

• IFC Section 5003.8.6.1 sets forth the minimum gas cabinet construction requirements.
Gas cabinet construction requirements include:

- Minimum 12-gage steel construction.
- Self-closing limited-access windows.
- Self-closing doors.
General Safety Requirements

- IFC Section 5003.9 sets forth minimum safety requirements for all hazardous materials including:
  - Personnel training and procedures.
  - FD Liaison.
  - Security.
  - Vehicle impact protection.
Incompatible Hazardous Materials

• IFC Section 5002 defines **incompatible materials** as:

  – *Materials that, when mixed, have the potential to react in a manner which generates heat, fumes, gases or byproducts which are hazardous to life or property.*
Separation of Incompatible Hazardous Materials

• Acceptable methods of separation include:

  – 20 foot spatial separation.
  – A noncombustible barrier that extends 18 inches above and beyond the sides of the stored materials.
  – Storage of liquids or solids in approved cabinets.
  – Storage of gases in gas cabinets or exhausted enclosures.
Approved Methods of Secondary Containment or Drainage

- IFC Section 5004.2.2.1 specifies the approved methods of secondary containment or drainage.
  - Liquid tight sloped, diked or recessed floors.
  - Sumps and collection systems.
  - Drainage systems.
  - Engineered systems.
• IFC 5004.3 contains minimum requirements for mechanical ventilation systems.
  – Minimum exhaust rate of 1 CFM/ft.².
  – Continuous operation.
Mechanical Ventilation

- A manual emergency switch.
- Ducts terminated within 12 inches of the floor or roof, depending on the stored material’s vapor density.
- Air cannot be recirculated.
IFC Section 5005—Use

• IFC Section 5005 contains requirements for use-closed and use-open systems of hazardous materials that exceed the MAQ in one or more control areas.
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