2012 IBC Fire Resistance and Hazardous Uses

Course Description

- This seminar addresses the key issues of the 2012 International Building Code® (IBC®) regarding the need for fire-resistive elements in buildings housing hazardous uses and materials.
- Applicable provisions of the 2012 International Fire Code® (IFC®) are also addressed as they apply to special uses and conditions.

Goal

- Participants will be able to apply the appropriate provisions of the IBC and, as applicable, the IFC as they relate to fire-resistance-rated construction and separations in buildings containing hazardous materials.

Objectives

Upon completion, participants will be better able to:

1. Understand and apply the methodology in addressing control areas containing hazardous materials.
2. Determine the separation requirements as applicable to incidental uses in buildings containing hazardous materials.
3. Identify special fire-resistive requirements as they apply to Group H occupancy buildings.
4. Identify special fire-resistive requirements set forth in the IFC as they apply to a variety of building uses and materials.

Course Overview

- Module I – Regulation of Hazardous Uses
- Module 2 – Control Areas
- Module 3 – Incidental Uses
- Module 4 – Miscellaneous Uses and Facilities
- Module 5 – Group H Occupancies
- Module 6 – IFC Fire-Resistive Requirements for Special Uses and Materials

Module 1

Regulation of Hazardous Uses

Regulation of Hazardous Uses Introduction

- Section 101.3 indicates that IBC is intended to establish minimum standards to provide a reasonable level of health, safety and welfare.
- There is an expectation that this baseline of safety be consistent regardless of the building's use.
- As a result, as the hazard level in a building increases, the requirements in the code become more stringent.

Regulation of Hazardous Uses Introduction

- The requirements fundamentally address two general concerns:
  - Hazards related to the occupants of the building, and
  - Hazards related to the contents of the building.
- Where hazardous materials are present in significant quantities, the primary concern becomes the contents-related hazards.

Regulation of Hazardous Uses Introduction

- Code provisions will vary based upon the:
  - Type of hazardous materials present (explosive, accelerated burning, significant combustible load, etc.)
  - Environment of hazardous materials (use or storage)
  - State of hazardous materials (liquid, solid, or gas)
  - Quantity of hazardous materials
- Fire-resistance-rated elements are often utilized to provide the necessary safeguards to meet the minimum established standard of safety.

Regulation of Hazardous Uses Introduction

- Buildings containing significant quantities of hazardous materials are required to be constructed of fire-resistance-rated construction at lower allowable height and area thresholds than the typical building.
- Areas containing hazardous materials must often be separated from other areas of the building with some degree of fire-resistant separation, typically through the use of fire barriers and/or horizontal assemblies.

Regulation of Hazardous Uses Introduction

- In some cases, the use of fire-resistive separation elements allows for a reduction in the spatial separation that is typically required.
- The IBC, as well as the IFC to some degree, contain a variety of requirements to address the many conditions that are created where hazardous materials are present.

Module 2

Control Areas

2012 IBC Fire Resistance and Hazardous Uses

Control Areas Introduction

- Control areas, by definition, are *spaces within a building where quantities of hazardous materials not exceeding the maximum allowable quantities per control area are stored, dispensed, used or handled*.
- Only when quantities of hazardous materials within a single control area exceed those allowed per control area by Tables 307.1(1) and 307.1(2) is a Group H classification warranted.

Control Areas Introduction

- The concept of control areas recognizes that almost every building has some degree of hazardous material present, but often such material is in such small quantities that the hazard level is not significant.
- By limiting the amount of hazardous material used and/or stored within a fire-resistive compartment, the amount exposed to a fire incident can be strictly regulated.

Control Areas Introduction

- The result of applying the control area concept is that a Group H occupancy classification is no required.
- By creating one or more control areas in a building, with no control containing more than the Maximum Allowable Quantities as set forth in Tables 307.1(1) and 307.1(2), the hazard level is reduced such that classification as a Group H is not necessary to provided a minimum standard of safety.

Control Areas Introduction

- The tables address both physical hazards (Table 307.1(1) and health hazards Table 307.1(2).
- The tables identify the specific hazardous material under consideration, the class of material (if multiple classes), and the state of the material (solid, liquid or gas).
- The maximum amount permitted per control area varies based upon whether the material is in:
  - Use, or
  - Storage

2012 IBC Fire Resistance and Hazardous Uses

[F] TABLE 307.1(1)
MAXIMUM ALLOWABLE QUANTITY PER CONTROL AREA OF HAZARDOUS MATERIALS POSING A PHYSICAL HAZARD[a, i, m, n, p]

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	N/A	H-2	Note q	N/A	N/A	Note q	N/A	N/A	Note q	N/A
Combustible liquid[d, i]	II IIIA IIIB	H-2 or H-3 H-2 or H-3 N/A	N/A	120[d, e] 330[d, e] 13,200[e, f]	N/A	N/A	120[d] 330[d] 13,200[f]	N/A	N/A	30[d] 80[d] 3,300[f]
Combustible fiber	Loose Baled[c]	H-3	(100) (1,000)	N/A	N/A	(100) (1,000)	N/A	N/A	(20) (200)	N/A
Consumer fireworks	1.4G	H-3	125[d, e, i]	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Cryogenics, flammable	N/A	H-2	N/A	45[d]	N/A	N/A	45[d]	N/A	N/A	10[d]
Cryogenics, inert	N/A	N/A	N/A	N/A	NL	N/A	N/A	NL	N/A	N/A
Cryogenics, oxidizing	N/A	H-3	N/A	45[d]	N/A	N/A	45[d]	N/A	N/A	10[d]
Explosives	Division 1.1 Division 1.2 Division 1.3 Division 1.4 Division 1.4G Division 1.5 Division 1.6	H-1 H-1 H-1 or H-2 H-3 H-3 H-1 H-1	1[e, g] 1[e, g] 5[e, g] 50[e, g] 125[d, e, i] 1[e, g] 1[d, e, g]	(1)[e, g] (1)[e, g] (5)[e, g] (50)[e, g] N/A (1)[e, g] N/A	N/A N/A N/A N/A N/A N/A N/A	0.25[g] 0.25[g] 1[g] 50[g] N/A 0.25[g] N/A	(0.25)[g] (0.25)[g] (1)[g] (50)[g] N/A (0.25)[g] N/A	N/A N/A N/A N/A N/A N/A N/A	0.25[g] 0.25[g] 1[g] N/A N/A 0.25[g] N/A	(0.25)[g] (0.25)[g] (1)[g] N/A N/A (0.25)[g] N/A
Flammable gas	Gaseous Liquefied	H-2	N/A	N/A (150)[d, e]	1,000[d, e] N/A	N/A	N/A (150)[d, e]	1,000[d, e] N/A	N/A	N/A
Flammable liquid[d]	1A 1B and 1C	H-2 or H-3	N/A	30[d, e] 120[d, e]	N/A	N/A	30[d] 120[d]	N/A	N/A	10[d] 30[d]
Flammable liquid, combination (1A, 1B, 1C)	N/A	H-2 or H-3	N/A	120[d, e, h]	N/A	N/A	120[d, h]	N/A	N/A	30[d, h]

(continued)

[F] TABLE 307.1(1)—(continued)
MAXIMUM ALLOWABLE QUANTITY PER CONTROL AREA OF HAZARDOUS MATERIALS POSING A PHYSICAL HAZARD[a, i, m, n, p]

MATERIAL	CLASS	GROUP WHEN THE MAXIMUM ALLOWABLE QUANTITY IS EXCEEDED	STORAGE[b]			USE-CLOSED SYSTEMS[b]			USE-OPEN SYSTEMS[b]	
			Solid pounds (cubic feet)	Liquid gallons (pounds)	Gas (cubic feet at NTP)	Solid pounds (cubic feet)	Liquid gallons (pounds)	Gas (cubic feet at NTP)	Solid pounds (cubic feet)	Liquid gallons (pounds)
Flammable solid	N/A	H-3	125[d, e]	N/A	N/A	125[g]	N/A	N/A	25[g]	N/A
Inert gas	Gaseous Liquefied	N/A N/A	N/A N/A	N/A N/A	NL NL	N/A N/A	N/A N/A	NL NL	N/A N/A	N/A N/A
Organic peroxide	UD I II III IV V	H-1 H-2 H-3 H-3 N/A N/A	1[e, g] 5[d, e] 50[d, e] 125[d, e] NL NL	(1)[e, g] (5)[d, e] (50)[d, e] (125)[d, e] NL NL	N/A N/A N/A N/A N/A N/A	0.25[g] 1[g] 50[g] 125[g] NL NL	(0.25)[g] (1)[g] (50)[g] (125)[g] NL NL	N/A N/A N/A N/A N/A N/A	0.25[g] 1[g] 10[g] 25[g] NL NL	(0.25)[g] (1)[g] (10)[g] (25)[g] NL NL
Oxidizer	4 3[k] 2 1	H-1 H-2 or H-3 H-3 N/A	1[e, g] 10[d, e] 250[d, e] 4,000[e, f]	(1)[e, g] (10)[d, e] (250)[d, e] (4,000)[e, f]	N/A N/A N/A N/A	0.25[g] 2[g] 250[g] 4,000[f]	(0.25)[g] (2)[g] (250)[g] (4,000)[f]	N/A N/A N/A N/A	0.25[g] 2[g] 50[g] 1,000[f]	(0.25)[g] (2)[g] (50)[g] (1,000)[f]
Oxidizing gas	Gaseous Liquefied	H-3	N/A N/A	N/A (150)[d, e]	1,500[d, e] N/A	N/A N/A	N/A (150)[d, e]	1,500[d, e] N/A	N/A N/A	N/A N/A
Pyrophoric material	N/A	H-2	4[e, g]	(4)[e, g]	50[e, g]	1[g]	(1)[g]	10[g]	0	0
Unstable (reactive)	4 3 2 1	H-1 H-1 or H-2 H-3 N/A	1[e, g] 5[d, e] 50[d, e] NL	(1)[e, g] (5)[d, e] (50)[d, e] NL	10[g] 50[d, e] 250[d, e] NL	0.25[g] 1[g] 50[g] NL	(0.25)[g] (1)[g] (50)[g] NL	2[e, g] 10[d, e] 250[d, e] NL	0.25[g] 1[g] 10[g] NL	(0.25)[g] (1)[g] (10)[g] NL
Water reactive	3 2 1	H-2 H-3 N/A	5[d, e] 50[d, e] NL	(5)[d, e] (50)[d, e] NL	N/A N/A N/A	5[g] 50[g] NL	(5)[g] (50)[g] NL	N/A N/A N/A	1[g] 10[g] NL	(1)[g] (10)[g] NL

[F] TABLE 307.1(2)
MAXIMUM ALLOWABLE QUANTITY PER CONTROL AREA OF HAZARDOUS MATERIAL POSING A HEALTH HAZARD[a, b, e, i]

MATERIAL	STORAGE[d]			USE-CLOSED SYSTEMS[d]			USE-OPEN SYSTEMS[d]	
	Solid pounds (cubic feet)	Liquid gallons (pounds)[f, i]	Gas (cubic feet at NTP)[c]	Solid pounds[c]	Liquid gallons (pounds)[f]	Gas (cubic feet at NTP)[c]	Solid pounds[c]	Liquid gallons (pounds)[f]
Corrosive	5,000	500	Gaseous 810[f] Liquefied (150)[h]	5,000	500	Gaseous 810[f] Liquefied (150)[h]	1,000	100
Highly toxic	10	(10)[h]	Gaseous 20[g] Liquefied (4)[g, h]	10	(10)[i]	Gaseous 20[g] Liquefied (4)[g, h]	3	(3)[i]
Toxic	500	(500)[h]	Gaseous 810[f] Liquefied (150)[f, h]	500	(500)[i]	Gaseous 810[f] Liquefied (150)[f, h]	125	(125)

For SI: 1 cubic foot = 0.028 m^3, 1 pound = 0.454 kg, 1 gallon = 3.785 L.

a. For use of control areas, see Section 414.2.
b. In retail and wholesale sales occupancies, the quantities of medicines, foodstuffs, consumer or industrial products, and cosmetics, containing not more than 50 percent by volume of water-miscible liquids and with the remainder of the solutions not being flammable, shall not be limited, provided that such materials are packaged in individual containers not exceeding 1.3 gallons.
c. For storage and display quantities in Group M and storage quantities in Group S occupancies complying with Section 414.2.5, see Tables 414.2.5(1) and 414.2.5(2).
d. The aggregate quantity in use and storage shall not exceed the quantity listed for storage.
e. Maximum allowable quantities shall be increased 100 percent in buildings equipped throughout with an *approved automatic sprinkler system* in accordance with Section 903.3.1.1. Where Note f also applies, the increase for both notes shall be applied accumulatively.
f. Maximum allowable quantities shall be increased 100 percent when stored in approved storage cabinets, gas cabinets or exhausted enclosures as specified in the *International Fire Code*. Where Note e also applies, the increase for both notes shall be applied accumulatively.
g. Allowed only when stored in approved exhausted gas cabinets or exhausted enclosures as specified in the *International Fire Code*.
h. Quantities in parenthesis indicate quantity units in parenthesis at the head of each column.
i. For gallons of liquids, divide the amount in pounds by 10 in accordance with Section 5003.1.2 of the *International Fire Code*.

Maximum Allowable Quantities Tables 307.1(1) and 307.1(2)

- Numerous footnotes modify or clarify the application of the tables, including selective:
  - Increases in the maximum allowable quantities per control area based on sprinkler protection and/or safety cans, safety cabinets, exhausted enclosures, etc.
- The footnotes are very important to the proper use of the tables.

Maximum Allowable Quantities Table 307.1(1) footnotes

a. For use of control areas, see Section 414.2.
b. The aggregate quantity in use and storage shall not exceed the quantity listed for storage.
c. The quantities of alcoholic beverages in retail 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, foodstuffs, consumer or industrial products, and cosmetics containing not more than 50 percent by volume of water-miscible liquids with the remainder of the solutions not being flammable, shall not be limited, provided that such materials are packaged in individual containers not exceeding 1.3 gallons.
d. Maximum allowable quantities shall be increased 100 percent in buildings equipped throughout with an automatic sprinkler system in accordance with Section 903.3.1.1. Where Note e also applies, the increase for both notes shall be applied accumulatively.
e. Maximum allowable quantities shall be increased 100 percent when stored in *approved* storage cabinets, day boxes, gas cabinets or exhausted enclosures or in *listed* safety cans in accordance with Section 5003.9.10 of the *International Fire Code*. Where Note d also applies, the increase for both notes shall be applied accumulatively.
f. The permitted quantities shall not be limited in a building equipped throughout with an *automatic sprinkler system* in accordance with Section 903.3.1.1.
g. Permitted only in buildings equipped throughout with an *automatic sprinkler system* in accordance with Section 903.3.1.1.
h. Containing not more than the maximum allowable quantity per *control area* of Class IA, IB or IC flammable liquids.
i. The maximum allowable quantity shall not apply to fuel oil storage complying with Section 603.3.2 of the *International Fire Code*.
j. Quantities in parenthesis indicate quantity units in parenthesis at the head of each column.
k. A maximum quantity of 200 pounds of solid or 20 gallons of liquid Class 3 oxidizers is allowed when such materials are necessary for maintenance purposes, operation or sanitation of equipment. Storage containers and the manner of storage shall be *approved*.
l. Net weight of the pyrotechnic composition of the fireworks. Where the net weight of the pyrotechnic composition of the fireworks is not known, 25 percent of the gross weight of the fireworks, including packaging, shall be used.
m. For gallons of liquids, divide the amount in pounds by 10 in accordance with Section 5003.1.2 of the *International Fire Code*.
n. For storage and display quantities in Group M and storage quantities in Group S occupancies complying with Section 414.2.5, see Tables 414.2.5(1) and 414.2.5(2).
o. Densely packed baled cotton that complies with the packing requirements of ISO 8115 shall not be included in this material class.
p. The following shall not be included in determining the maximum allowable quantities:
   1. Liquid or gaseous fuel in fuel tanks on vehicles.
   2. Liquid or gaseous fuel in fuel tanks on motorized equipment operated in accordance with this code.
   3. Gaseous fuels in piping systems and fixed appliances regulated by the *International Fuel Gas Code*.
   4. Liquid fuels in piping systems and fixed appliances regulated by the *International Mechanical Code*.
q. Where manufactured, generated or used in such a manner that the concentration and conditions create a fire or explosion hazard based on information prepared in accordance with Section 414.1.3.

Maximum Allowable Quantities (MAQs) Exercise #1

- What is the MAQ for:
  - Class IIIA combustible liquids
  - Use condition
  - Nonsprinklered building
- What if the building is fully sprinklered?

Based on a 100% increase per footnote d.

Maximum Allowable Quantities (MAQs) Exercise #1

- What is the MAQ for:
  - Class IIIA combustible liquids
  - Use condition
  - Nonsprinklered building

80 gallons

- What if the building is fully sprinklered?

160 gallons

Based on a 100% increase per footnote d.

Maximum Allowable Quantities (MAQs) Exercise #2

- What is the MAQ for:
  - Combustible baled fibers
  - Storage condition
  - Nonsprinklered building
- What if the building is fully sprinklered?

Maximum Allowable Quantities (MAQs) Exercise #2

- What is the MAQ for:
  - Combustible baled fibers
  - Storage condition
  - Nonsprinklered building

1,000 cubic feet

- What if the building is fully sprinklered?

1,000 cubic feet

No increase permitted for sprinkler building.

Maximum Allowable Quantities (MAQs) Exercise #3

- What is the MAQ for:
  - Class IB flammable liquids
  - Storage and use conditions
  - Storage in approved listed safety cans
  - Fully sprinklered building

Use	Storage	
30 gallons	120 gallons	
60 gallons	240 gallons	**100% sprinkler increase (note d)**
60 gallons	480 gallons	**100% safety can increase (note e)**

Maximum of 480 total gallons permitted with no more than 60 gallons permitted in use. (note b)

Maximum Allowable Quantities (MAQs) Exercise #3

- What is the MAQ for:
  - Class IB flammable liquids
  - Storage and use conditions
  - Storage in approved listed safety cans
  - Fully sprinklered building

Use	Storage

Maximum Allowable Quantities (MAQs) Exercise #4

- What is the MAQ for:
  - Class 4 unstable (reactive) materials
  - Storage condition
  - Nonsprinklered building

Maximum Allowable Quantities (MAQs) Exercise #4

- What is the MAQ for:
  - Class 4 unstable (reactive) materials
  - Storage condition
  - Nonsprinklered building

Not permitted (note g)

Maximum Allowable Quantities (MAQs) Exercise #5

- What is the MAQ for:
  - Class IIIB combustible liquids
  - Use condition
  - Fully sprinklered building

Maximum Allowable Quantities (MAQs) Exercise #5

- What is the MAQ for:
  - Class IIIB combustible liquids
  - Use condition
  - Fully sprinklered building

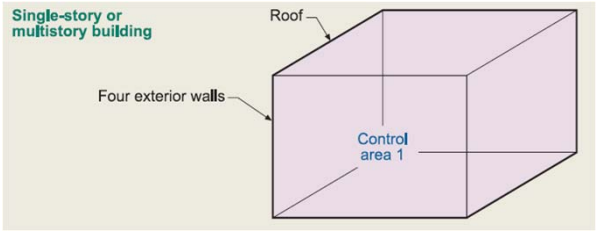
No limit (note f)

Control Areas Section 412.2

- Most buildings have quantities of hazardous materials that can all be located within a single control area without exceeding the limits of Table 307.1(1) or 307.1(2).
- Therefore, the use of fire-resistance-rated separations to create multiple fire areas is typically not necessary as the entire building is considered as a single control area.
- Section 414.2 must be applied where two or more control areas are needed.

2012 IBC Fire Resistance and Hazardous Uses

Control Areas
Section 412.2



Control Areas
Section 412.2

- Where multiple control areas occur within a building, they shall be separated from each other by fire barriers, horizontal assemblies, or both, as established in Section 414.2.
- Fire barriers are regulated under the provisions of Section 707, while horizontal assemblies must comply with Section 711.

Control Areas
Section 412.2

- The minimum required fire-resistance of the control area enclosure varies due to:
  - Fire barrier vs. horizontal assembly
  - Location of control area based on grade plane
  - Type of construction/sprinkler protection/building height

Control Areas
Section 412.2.2

- The required fire-resistance rating for fire barriers is based on Table 414.2.2.

[F] TABLE 414.2.2
DESIGN AND NUMBER OF CONTROL AREAS

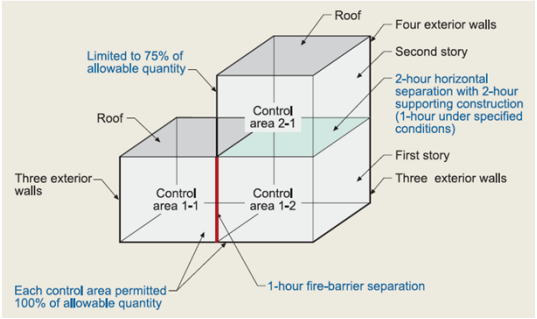
FLOOR LEVEL		PERCENTAGE OF THE MAXIMUM ALLOWABLE QUANTITY PER CONTROL AREA[a]	NUMBER OF CONTROL AREAS PER FLOOR	FIRE-RESISTANCE RATING FOR FIRE BARRIERS IN HOURS[b]
Above grade plane	Higher than 9	5	1	2
	7-9	5	2	2
	6	12.5	2	2
	5	12.5	2	2
	4	12.5	2	2
	3	50	2	1
	2	75	3	1
	1	100	4	1
Below grade plane	1	75	3	1
	2	50	2	1
	Lower than 2	Not Allowed	Not Allowed	Not Allowed

a. Percentages shall be of the maximum allowable quantity per control area shown in Tables 307.1(1) and 307.1(2), with all increases allowed in the notes to those tables.
b. Separation shall include fire barriers and horizontal assemblies as necessary to provide separation from other portions of the building.

Control Areas
Section 412.2.4

- The required fire-resistance rating for the floor assembly of the control area, as well as the construction supporting the floor of the control area, shall be 2 hours.
- A minimum of 1-hour fire-resistance is permitted where the building is:
  - Type IIA, IIIA and VA construction, and
  - Provided with a sprinkler system throughout, and
  - Three or fewer stories above grade plane.

Control Areas
Section 412.2.4



Control Areas
Exercise #1

- Given a 2-story fully sprinklered Type IIB building.
- Determine the maximum allowable MAQ permitted in the building if Table 307.1(1) would permit 120 gallons of MAQ in a control area.
- What is the total MAQ if the entire building is considered a single control area?
- What is the total MAQ if the floor assembly and support elements are of 1-hour construction?

Control Areas
Exercise #1

- Given a 2-story fully sprinklered Type IIB building.
- Determine the maximum allowable MAQ permitted in the building if Table 307.1(1) would permit 120 gallons of MAQ in a control area.
- What is the total MAQ if the entire building is considered a single control area?
  90 gallons (75% of 120 gallons)
- What is the total MAQ if the floor assembly and support elements are of 1-hour construction?
  90 gallons (no increase for 1 hour)

Control Areas
Exercise #1 (continued)

- Given a 2-story fully sprinklered Type IIB building.
- Determine the maximum allowable MAQ permitted in the building if Table 307.1(1) would permit 120 gallons of MAQ in a control area.
- What is the total MAQ if the floor assembly and support elements are of 2-hour construction?
- What is the total MAQ if areas on both stories are further divided with 1-hour fire barriers?

Control Areas
Exercise #1 (continued)

- Given a 2-story fully sprinklered Type IIB building.
- Determine the maximum allowable MAQ permitted in the building if Table 307.1(1) would permit 120 gallons of MAQ in a control area.
- What is the total MAQ if the floor assembly and support elements are of 2-hour construction?

  210 gallons (120 gallons on 1st story and 90 gallons on 2nd story)
- What is the total MAQ if areas on both stories are further divided with 1-hour fire barriers?

  750 gallons [480 gallons on 1st story (4x120) and 270 on 2nd story (3x90)

Control Areas
Exercise #2

- Given a 5-story fully sprinklered Type IB building housing a Group B occupancy with research and development activities. Assume the presence of Class II combustible liquids in storage and in use, with all storage in approved UL-compliant safety cans.
- Determine the maximum allowable MAQ permitted in use and in storage:
  - In each control area
  - On each story

Control Areas
Exercise #2

- Given a 5-story fully sprinklered Type IB building housing a Group B occupancy with research and development activities. Assume the presence of Class II combustible liquids in both storage and in use, with all storage in approved UL-compliant safety cans.
- Determine the maximum allowable MAQ permitted based on Table 307.1(1):

Use	Storage	
30 gallons	120 gallons	
60 gallons	240 gallons	(note d)
60 gallons	480 gallons	(note e)

Control Areas Exercise #2

Story	% of MAQ per Control Area	Max MAQ/CA		# of Control Areas	Max MAQ per story	
		In use	Total w/ storage		In use	Total w/ storage
5th						
4th						
3rd						
2nd						
1st						

Control Areas Exercise #2

Use
60 gallons/CA

Use & Storage
480 gallons/CA

Story	% of MAQ per Control Area	Max MAQ/CA		# of Control Areas	Max MAQ per story	
		In use	Total w/ storage		In use	Total w/ storage
5th	12.5	7.5	60	2	15	120
4th	12.5	7.5	60	2	15	120
3rd	50	30	240	2	60	480
2nd	75	45	360	3	135	1080
1st	100	60	480	4	240	1920

Outdoor Control Areas Introduction

- The use of outdoor control areas is both similar and different in intent to the use of indoor control areas.
- Limits are placed on the quantities of hazardous materials in an outdoor control area, but such quantities are much larger than allowed if located inside the building.
- Because the use of fire-resistive separations is not possible, some degree of spatial separation can be used to increase the permitted quantities outdoors.

Outdoor Control Areas Introduction

- Additionally, spatial separation of outdoor control areas from the exterior walls of a building is required to limit exposure.
- As an alternative, fire-resistance-rated construction can be provided to reduce the distance between the outdoor control area and the building.

Outdoor Control Areas Introduction

- Outdoor control areas are regulated solely by the *International Fire Code,* including Section 5003.12.
- By definition, an outdoor control area is *an outdoor area that contains hazardous materials in amounts not exceeding the maximum allowable quantities of Table 5003.1.1(3) or Table 5003.1.1(4)*.

Outdoor Control Areas IFC Section 5003.12

- Outdoor control areas shall be located not closer than 20 feet from a lot line that can be built upon, public street, public alley or public way.
  - For solid and liquid hazardous materials, the 20-foot separation is not required where a minimum 2-hour wall is constructed
  - The wall shall have no openings and extend at least 30 inches above and to the sides of the storage area.

Outdoor Control Areas IFC Section 5003.12

- The 20-foot clearance for outdoor control areas also does not apply where compressed gas hazardous materials are stored, provided:
  - Minimum 2-hour fire barriers without openings or penetrations are installed to interrupt the line of sight between the storage and the exposure, and
  - The configuration of the fire barrier shall be designed to allow natural ventilation to prevent the accumulation of hazardous gas concentrations.

Module 3

Incidental Uses

2012 IBC Fire Resistance and Hazardous Uses

Incidental Uses Introduction

- Incidental uses, while not considered as high-hazard functions, are considered as a greater hazard than those major spaces that they support.
- They are identified as “ancillary functions associated with a given occupancy that generally pose a greater level of risk to that occupancy.”

Incidental Uses Introduction

- Incidental uses are limited to those rooms or areas that are specifically listed in Table 509.
- The rooms and areas regulated as incidental uses typically have one or more of the following hazard concerns:
  - Moderate to high fire load
  - Ignition sources
  - Concealed spaces
  - Some degree of hazardous materials

Incidental Uses Section 509.2

- Incidental uses are limited to those rooms or areas that are specifically listed in Table 509.
- They are not to be classified individually, as they are to be included in the building occupancies within which they are located.
- As an example, a chemistry classroom in a high school, while identified as an incidental use by Table 509, is classified as a portion of the Group E occupancy.

Incidental Uses

TABLE 509
INCIDENTAL USES

ROOM OR AREA	SEPARATION AND/OR PROTECTION
Furnace room where any piece of equipment is over 400,000 Btu per hour input	1 hour or provide automatic sprinkler system
Rooms with boilers where the largest piece of equipment is over 15 psi and 10 horsepower	1 hour or provide automatic sprinkler system
Refrigerant machinery room	1 hour or provide automatic sprinkler system
Hydrogen cutoff rooms, not classified as Group H	1 hour in Group B, F, M, S and U occupancies; 2 hours in Group A, E, I and R occupancies.
Incinerator rooms	2 hours and automatic sprinkler system
Paint shops, not classified as Group H, located in occupancies other than Group F	2 hours; or 1 hour and provide automatic sprinkler system
Laboratories and vocational shops, not classified as Group H, located in a Group E or I-2 occupancy	1 hour or provide automatic sprinkler system
Laundry rooms over 100 square feet	1 hour or provide automatic sprinkler system
Group I-3 cells equipped with padded surfaces	1 hour
Waste and linen collection rooms located in either Group I-2 occupancies or ambulatory care facilities	1 hour
Waste and linen collection rooms over 100 square feet	1 hour or provide automatic sprinkler system
Stationary storage battery systems having a liquid electrolyte capacity of more than 50 gallons for flooded lead-acid, nickel cadmium or VRLA, or more than 1,000 pounds for lithium-ion and lithium metal polymer used for facility standby power, emergency power or uninterruptable power supplies	1 hour in Group B, F, M, S and U occupancies; 2 hours in Group A, E, I and R occupancies.

For SI: 1 square foot = 0.0929 m^2, 1 pound per square inch (psi) = 6.9 kPa, 1 British thermal unit (Btu) per hour = 0.293 watts, 1 horsepower = 746 watts, 1 gallon = 3.785 L.

Incidental Uses
Section 509.4

- Incidental uses shall be:
  - Separated from the remainder of the building, or
  - Equipped with an automatic sprinkler system, or
  - Both
- Table 509 establishes the degree of separation/protection that is required.

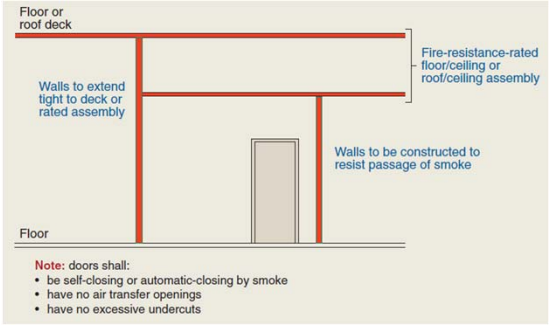
Incidental Uses
Section 509.4

- Where a fire-resistance-rated separation is required by Table 509, the incidental uses shall be separated from the remainder of the building by a fire barrier, horizontal assembly, or both.
  - As an exception to the general rule, construction supporting 1-hour fire barriers and/or horizontal assemblies used for incidental use separations does not require a fire-resistance rating.
  - Allowance limited to Type IIB, IIIB and VB buildings.
  - Does not override other provisions of code requiring fire-resistance.

Incidental Uses
Section 509.4

- Where Table 509 requires a sprinkler system without a fire barriers, the incidental use shall be separated from the remainder of the building by construction capable of resisting the passage of smoke.
  - Doors shall be self-closing or automatic-closing, not have air transfer openings, and not undercut in excess of clearance established by NFPA 80.
  - Walls shall not have air transfer openings unless provided with smoke dampers.

Incidental Uses
Section 509.4



2012 IBC Fire Resistance and Hazardous Uses

Incidental Uses
Table 509

- The following rooms or areas are regulated as incidental uses where 1-hour separations are required unless sprinkler protection is provided:
  - Furnace room where at least one piece of equipment is over 400,000 Btu per hour input
  - Rooms with boilers where the largest piece of equipment is over 15 psi and 10 horsepower
  - Refrigerant machinery room
  - Laboratories and vocational shops, not classified as Group H, in a Group E or I-2 occupancy.

Incidental Uses
Table 509

- The following rooms or areas are also regulated as incidental uses where 1-hour separations are required unless sprinkler protection is provided:
  - Laundry rooms over 100 square feet in floor area
  - Waste and linen collection rooms over 100 square feet in floor area (other than Group I-2 occupancies and ambulatory care facilities)

Incidental Uses
Table 509

- The following rooms or areas are regulated as incidental uses where 1-hour separations are required, as well as sprinkler protection:
  - Group I-3 cells equipped with padded surfaces
  - Waste and linen collection rooms located in Group I-2 occupancies and ambulatory care facilities
  - Hydrogen cutoff rooms, not classified as Group H, located in Group B, F, M, S and U occupancies
  - Rooms containing specified stationary storage battery systems used for facility standby power, emergency power or uninterruptable power supplies located in Group B, F, M, S and U occupancies

Incidental Uses
Table 509

- The following rooms or areas are regulated as incidental uses where 2-hour separations are required, as well as sprinkler protection:
  - Hydrogen cutoff rooms, not classified as Group H, located in Group A, E, I and R occupancies
  - Rooms containing specified stationary storage battery systems used for facility standby power, emergency power or uninterruptable power supplies located in Group A, E, I and R occupancies

Incidental Uses
Table 509

- The following rooms or areas are regulated as incidental uses where both 2-hour separations and sprinkler protection are required:
  - Incinerator rooms

Incidental Uses
Table 509

- The following rooms or areas are regulated as incidental uses where either 2-hour separations are required; or sprinklers and 1-hour separations are required:
  - Paint shops, not classified as Group H, located in all occupancies other than Group F
  - Paint shops are also regulated for fire-resistance in IBC Section 416 and IFC Section 2404

Incidental Uses
Exercise

- Determine if the rooms listed are to be regulated as incidental uses, and if so, the protection requirements that apply:

Room or Area	Floor Area	Sprinkler System	Is space an Incidental Use?	What minimum requirements apply?
Woodworking shop in a high school	900 sf	No		
Paint shop in Group F-1 factory	2200 sf	Yes		
Employee laundry room in a hotel	325 sf	Yes		
Boiler room with 3 boilers rated at 7.5 hp	3200 sf	Yes		

Incidental Uses
Exercise

- Determine if the rooms listed are to be regulated as incidental uses, and if so, the protection requirements that apply:

Room or Area	Floor Area	Sprinkler System	Is space an Incidental Use?	What minimum requirements apply?
Woodworking shop in a high school	900 sf	No	Yes	1-hr fire barrier or sprinkler and smoke resistant-construction
Paint shop in Group F-1 factory	2200 sf	Yes	No	
Employee laundry room in a hotel	325 sf	Yes	Yes	Construction capable resisting passage of smoke
Boiler room with 3 boilers rated at 7.5 hp	3200 sf	Yes	No	

Incidental Uses Exercise (continued)

- Determine if the rooms or spaces listed are to be regulated as incidental uses, and if so, the protection requirements that apply:

Room or Area	Floor Area	Sprinkler System	Is space an Incidental Use?	What minimum requirements apply?
Group H hydrogen cutoff room	1600 sf	Yes		
Paint shop in Group S-1 repair garage	600 sf	Yes		
Guest laundry room in a hotel	120 sf	Yes		
Research lab in a Group B R&D facility	3600 sf	No		

Incidental Uses Exercise (continued)

- Determine if the rooms or spaces listed are to be regulated as incidental uses, and if so, the protection requirements that apply:

Room or Area	Floor Area	Sprinkler System?	Is space an Incidental Use?	What minimum requirements apply?
Group H hydrogen cutoff room	1600 sf	Yes	No	
Paint shop in Group S-1 repair garage	600 sf	Yes	Yes	1-hour fire barrier
Guest laundry room in a hotel	120 sf	Yes	Yes	Construction capable resisting passage of smoke
Research lab in a Group B R&D facility	3600 sf	No	No	

Module 4

Miscellaneous Uses and Facilities

Miscellaneous Uses Introduction

- A number of varied specialized uses are considered as hazardous in nature, but do not rise to the level of a Group H occupancy.
- Such uses include:
  - Aircraft hangars
  - Combustible storage areas
  - Flammable finish activities
  - Organic coating facilities
  - Hydrogen cut-off rooms

Miscellaneous Uses Introduction

- These facilities and uses, all specifically addressed in Chapter 4, are considered hazardous in nature due to the materials that are present, but can be adequately regulated through the appropriate special provisions.
- They are not considered as Group H occupancies unless the quantities of hazardous materials in a control area exceed the maximum allowable quantities established in Section 307.

Miscellaneous Uses Introduction

- The use of fire-resistance-rated construction in each of these cases provides the necessary fire separation between the hazard and other portions of the building.

Aircraft Hangars Section 412

- Exterior walls of aircraft hangars shall be minimum 2-hour fire-resistance-rated where such walls are located less than 30 feet from a lot line or public way.
  - Measurement not made to centerline of public way

Aircraft Hangars Section 412

- As a general rule, heating equipment shall be located in a room separate from the remainder of the building.
- The separation shall be a minimum 2-hour fire barriers, horizontal assemblies or both.
- Entrance to the heating equipment room shall be:
  - From the outside, or
  - By means of a vestibule providing a two-doorway separation.

Combustible Storage Areas Section 413

- Attic, under-floor and concealed spaces used for the storage of combustible materials must be protected on the storage side.
- The minimum required level of protection is 1-hour fire-resistance-rated construction.
  - Openings shall be protected by self-closing assemblies of noncombustible construction or solid wood at least 1 ¾ inches in thickness.
- Fire-resistive construction and opening protectives not required in sprinklered areas or in Groups R-3 and U.

Application of Flammable Finishes Section 416

- Spray rooms shall be separated from other areas of a building by minimum 1-hour fire barriers, horizontal assemblies, or both.
  - Opening protectives shall have minimum ¾-hour fire protection ratings per Table 716.5.
- Paint shops are also regulated under the incidental use provisions of Section 509.

Organic Coatings Section 418

- The manufacturing of organic coatings is strictly regulated, including fire-resistive separation requirements.
- The use of minimum 2-hour fire barrier/horizontal assembly separations is required under the following conditions:
  - Tank storage
  - Nitrocellulose storage
  - Finished products

Organic Coatings Section 418

- Storage for flammable and combustible liquid tanks inside of structures shall be located above grade.
- In addition, such storage areas shall be separated from the processing area by minimum 2-hour fire barriers, horizontal assemblies, or both.

Organic Coatings Section 418

- Nitrocellulose storage shall be located:
  - On a detached pad, or
  - In a separate structure, or
  - In a room enclosed with not less than 2-hour fire barriers, horizontal assemblies, or both.

Organic Coatings Section 418

- Storage rooms for finished products that are flammable or combustible liquids shall be separated from the processing area by not less than 2-hour fire barriers, horizontal assemblies, or both.

Hydrogen Cutoff Rooms Section 421

- Where required by the IFC, hydrogen cutoff rooms shall be separated from other areas of the building by not less than 1-hour fire barriers, horizontal assemblies, or both.
- Where a mixed occupancy condition is created, the provisions of Section 508 will apply.
- In all cases, a hydrogen cutoff room shall be separated from other areas of the building in a manner established by Section 509 for incidental uses.

Module 5

Group H Occupancies

Group H Occupancies Introduction

- Group H occupancies are considered high-hazard due to the contents of the building.
- As a important aspect of providing the degree of fire and life safety needed in such occupancies, fire-resistance-rated construction is used to address a variety of concerns.
- In addition to the type of construction requirements applied to Group H occupancies, special provisions are established in Section 415 to address a variety of concerns.

Group H Occupancies Introduction

- Where the quantity of hazardous materials exceeds the amounts set forth in Section 307, per control area, then a Group H classification is warranted.
- At that point, the IBC, and to some degree the IFC, identify the selective use of fire-resistance to address the hazards anticipated in a Group H condition.

Group H Occupancies Introduction

- Fire-resistance-rated requirements for Group H occupancies include:
  - Type of construction (allowable heights and areas)
  - Mixed occupancy conditions
  - Combustible dust operations
  - Gas rooms (compressed gases)
  - Storage of highly toxics solids and liquids
  - Group H-5 facilities

Group H Occupancies Introduction

- Group H occupancies, most particularly Groups H-1 and H-2, are much more limited than for other building uses.
- The general hierarchy of hazard level, based on allowable building size, is consistent with the order of classification.
- For example, Group H-1 is more limiting than Group H-2, with Group H-2 more limiting than Group H-3, and so on.

2012 IBC Fire Resistance and Hazardous Uses

Group H Occupancies Introduction

- Although buildings of nonfire-resistance-rated construction are permitted to house Group H occupancies, they are significantly limited in most applications.
- In addition, sprinkler increases are not permitted for:
  - Allowable area in Groups H-1, H-2 and H-3
  - Allowable height in Groups H-1, H-2, H-3 and H-5

Group H Occupancies Height and Area Comparisons

- As an example from Table 503, a comparison in building size can be made between a Group F-1 occupancy and several Group H occupancies

	IA	IB	IIA	IIB	IIIA	IIIB	VA	VB
F-1	UL UL	11 UL	4 25k	2 15.5k	3 19k	2 12k	2 14k	1 8.5k
H-1	1 21k	1 16.5k	1 11k	1 7k	1 9.5k	1 7k	1 7.5k	NP NP
H-2	UL 21k	3 16.5k	2 11k	1 7k	2 9.5k	1 7k	1 7.5k	1 3k
H-3	UL UL	6 60k	4 26.5k	2 14k	4 17.5k	2 13k	2 10k	1 5k

Group H Occupancies Height and Area Comparisons

- As illustrated in the table, Group H-1 and H-2 buildings of comparable size to nonrated Group F-1 buildings must be of 1-hour, and in some cases, 2-hour construction.
- The fire-resistive structural requirements, along with the mandated sprinkler protection, is necessary to address the increased hazards found in Group H-1 and H-2 occupancies.

Group H Occupancies Occupancy Separations

- Although Group H-1 occupancies must be located in buildings having no other occupancies, the other Group H occupancies are permitted to be located in mixed-occupancy buildings.
- Where a mixed-occupancy condition exists, the provisions of Section 508.4 must be applied regarding “separated occupancies.”
- The other two methods, accessory occupancies and nonseparated occupancies, are not permitted to be used with Group H occupancies.

2012 IBC Fire Resistance and Hazardous Uses

Group H Separations Sections 508.2 – 508.4

- Under the application of “separated occupancies” it is always necessary to provide fire-resistance-rated separations to isolate the Group H occupancy from all other occupancies in the building.
- Table 508.4 sets forth the minimum required fire separations that are to be provided.

Separated Occupancies

TABLE 508.4
REQUIRED SEPARATION OF OCCUPANCIES (HOURS)

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

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. See Section 420.
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 406.3.4.
d. Separation is not required between occupancies of the same classification.

Group H Occupancy Separations Table 508.4

- The separations shall be accomplished through the use of fire barriers, horizontal assemblies, or both.
- Fire-resistance ratings of 2 hours and 3 hours are typical for the required separations.
- As a reminder, Group H occupancies must always be fire-resistive-separated from other occupancies where located in a mixed-occupancy building.

Group H Exterior Walls Introduction

- For all occupancies other than Group H, the location of exterior walls is not regulated by the IBC.
- However, where such walls are located in close proximity to a lot line (or any other line used to address fire separation distance), a fire-resistance-rated exterior will be required.
- Table 602 establishes the conditions for fire-resistance of exterior walls based on fire separation distance.

2012 IBC Fire Resistance and Hazardous Uses

Group H Exterior Walls Table 602

TABLE 602
FIRE-RESISTANCE RATING REQUIREMENTS FOR EXTERIOR WALLS BASED ON FIRE SEPARATION DISTANCE[a, b]

FIRE SEPARATION DISTANCE = X (feet)	TYPE OF CONSTRUCTION	OCCUPANCY GROUP H[f]	OCCUPANCY GROUP F-1, M, S-1[g]	OCCUPANCY GROUP A, B, E, F-2, I, R, S-2[g], U[h]
X < 5[c]	All	3	2	1
5 ≤ X < 10	IA Others	3 2	2 1	1 1
10 ≤ X < 30	IA, IB IIB, VB Others	2 1 1	1 0 1	1[d] 0 1[d]
X ≥ 30	All	0	0	0

For SI: 1 foot = 304.8 mm.
a. Load-bearing exterior walls shall also comply with the fire-resistance rating requirements of Table 601.
b. For special requirements for Group U occupancies, see Section 406.3.
c. See Section 706.1.1 for party walls.
d. Open parking garages complying with Section 406 shall not be required to have a fire-resistance rating.
e. The fire-resistance rating of an exterior wall is determined based upon the fire separation distance of the exterior wall and the story in which the wall is located.
f. For special requirements for Group H occupancies, see Section 415.5.
g. For special requirements for Group S aircraft hangars, see Section 412.4.1.
h. Where Table 705.8 permits nonbearing exterior walls with unlimited area of unprotected openings, the required fire-resistance rating for the exterior walls is 0 hours.

Group H Exterior Walls Introduction

- In addition, Group H occupancies, more specifically Group H-1, H-2 and H-3 occupancies, have required minimum setbacks from lot lines and public ways regardless of any exterior wall fire-resistance rating.

Group H Occupancies Introduction

- Section 415 identifies several hazardous uses where special fire-resistance is required:
  - Rooms for grinding or other operations that produce combustible dusts
  - Gas rooms (where compressed gases are used or stored)
  - Storage of highly toxic solids and liquids
  - Group H-5 fabrication areas, corridors, service corridors, HPM rooms and gas rooms

Group H-2 Grinding Rooms Section 415.8.1

- Group H-2 grinding rooms and rooms for similar operations that produce combustible dust shall be enclosed with minimum 2-hour fire barriers, horizontal assemblies, or both.
- Where the floor area exceeds 3000 square feet, the enclosure shall be not less than 4 hours.

Group H-3 and H-4 Gas Rooms Section 415.9.2

- Group H-3 and H-4 gas rooms, as defined by Section 202, shall be separated from other areas of the building by minimum 1-hour fire barriers, horizontal assemblies, or both.

Group H-4 Toxic Storage Section 415.9.4

- Group H-4 storage of highly toxic solids and liquids shall be separated from other hazardous materials storage by minimum 1-hour fire barriers, horizontal assemblies, or both.
  - Separation is not required where such solids and/or liquids are stored in approved hazardous materials storage cabinets.

Group H-5 Fabrication Areas Section 415.10.1.2

- Fabrication areas in Group H-5 occupancies shall be separated from each other, from corridors and from other parts of the building by minimum 1-hour fire barriers, horizontal assemblies, or both.
  - Doors within the fire barrier walls shall be self-closing fire door assemblies having a minimum fire protection rating of ¾-hour.
  - Windows between fabrication areas and corridors shall be fixed glazing listed and label for a minimum fire protection rating of ¾-hour.

Group H-5 HPM and Gas Rooms Section 415.10.5.1

- Group H-5 HPM rooms and gas rooms shall be separated from other areas by minimum 1-hour fire barriers, horizontal assemblies, or both.
- A minimum rating of 2 hours is required where the floor area exceeds 300 square feet.

Group H-5 Liquid Storage Rooms Section 415.10.5.2

- Group H-5 liquid storage rooms shall be separated from other areas by not less than 1-hour fire barriers, horizontal assemblies, or both.
- Enclosure by a minimum of 2 hours is required where the room is greater than 150 square feet in floor area.

Module 6

IFC Fire-Resistive Requirements for Special Uses and Materials

IFC Provisions Introduction

- The *International Fire Code* also includes a variety of provisions where fire-resistance-rated construction is mandated in some manner, including:
  - Spray finishing operations
  - High-piled combustible storage
  - Medical gas systems
  - Outdoor storage of liquids and toxics
  - Other miscellaneous applications

IFC Provisions Introduction

- The IFC provisions are generally limited to alternative approaches to a general requirement based upon the use of the building.
- Provisions include the following activities:
  - Spray finishing operations
  - High-piled combustible storage
  - Loose combustible fiber storage
  - Medical gas systems
  - Corrosive materials
  - Outdoor storage of various materials

Spray Finishing Operations Introduction

- In addition to the IBC provisions of Section 416.2 requiring the enclosure of spray rooms with minimum 1-hour fire barriers and/or horizontal assemblies, fire-resistance may also be required where spray booths are installed.
- As a general rule, no fire-resistive enclosure is mandated for spray booths. However, where adequate clearance is not provided between the booth and surrounding construction, a degree of fire-resistive separation is necessary.

Spray Finishing Operations IFC Section 2404.3.2.5

- As a general requirement, a clear space of at least 3 feet is required on all sides of a spray booth.
- The 3-foot separation is not required at an interior wall or partition, or at a floor/ceiling assembly, that has a minimum fire-resistance rating of 1 hour.
  - Where adjacent structure is exterior wall or roof assembly, only noncombustible construction is required to reduce separation.

High-piled Combustible Storage Introduction

- High-piled combustible storage facilities are considered hazardous due to the sheer mass of commodities in concentrated form.
- In addition to Section 3206 through 3210, Table 3206 defines prescriptively the fire protection requirements for high-piled storage.

High-piled Combustible Storage Section 3206.3.2

- Unless properly separated, the aggregate of all high-piled storage areas within a building shall be used for the application of Table 3206.2 (General Fire Protection and Life Safety Requirements).
- Such separations shall be minimum 1-hour fire barriers.
  - Openings within the fire barriers shall have a minimum 1-hour fire protection rating.

2012 IBC Fire Resistance and Hazardous Uses

High-piled Combustible Storage Section 3206.3.2

- Similar separation is required where multiclass storage is created.
- Where areas classified as Class I through IV are not separated by minimum 1-hour fire barriers from high hazard classification areas, the aggregate of all high-piled storage areas shall be considered as “high-hazard” for applying Table 3206.2.
  - Exception where engineering analysis is provided.

High-piled Combustible Storage Sections 3207.2, 3208.2

- Where shelf storage, solid-piled storage, bin box storage or rack storage is provided, sprinkler protection as required by Table 3206.2 shall be provided throughout the building.
  - As an alternative, such sprinkler protection need only to extend to minimum 1-hour fire barriers with any openings also protected at least 1 hour.

Tire Rebuilding Section 3403.2

- Unless three specific conditions are met, buffing operations in a tire rebuilding plant shall be located in a room separated from the remainder of the building by a minimum 1-hour fire barrier.

Loose Combustible Fiber Storage Section 5204

- Where loose combustible fibers not in suitable bales or packages are stored within a structure, a specified degree of fire-resistive separation is required where the quantity exceeds more than 100 cubic feet.
- Rooms contained the fibers shall be enclosed with fire-resistance based on the quantity of fibers in each room.
  - Storage of more than 100 cubic feet to 500 cubic feet
  - Storage of more than 500 cubic feet

2012 IBC Fire Resistance and Hazardous Uses

Loose Combustible Fiber Storage Section 5204

- Where the quantity of loose combustible fibers exceeds 100 cubic feet, but does not exceed 500 cubic feet, storage shall be in rooms enclosed by minimum 1-hour fire barriers, 1-hour horizontal assemblies, or both.
  - Openings are to be protected with approved opening protective assemblies having a minimum ¾-hour fire protection rating.

Loose Combustible Fiber Storage Section 5204

- Where the quantity of loose combustible fibers exceeds 500 cubic feet, but does not exceed 1000 cubic feet, storage shall be in rooms enclosed by minimum 2-hour fire barriers, 2-hour horizontal assemblies, or both.
  - Openings are to be protected with approved opening protective assemblies having a minimum 1½-hour fire protection rating.
- Where the storage quantity exceeds 1000 cubic feet, sprinkler protection is required in addition to the fire-resistance-rated separation.

Medical Gas Systems Section 5306

- Compressed gases intended for inhalation or sedation for health care purposes are regulated as medical gases.
- Within a building, such gases shall be stored in a dedicated room.
- Where the quantities of medical gases exceed the permitted amount, they shall be located in a:
  - 1-hour exterior room, or
  - 1-hour interior room, or
  - Complying gas cabinet.

Medical Gas Systems Section 5306

- One-hour exterior rooms shall be separated from the remainder of the building by minimum 1-hour fire barriers, 1-hour horizontal assemblies, or both.
- Openings to areas within the building shall be:
  - Self-closing
  - Smoke- and draft-control assemblies
  - Minimum 1-hour in fire protection rating
- Direct exterior venting shall be provided, as well as at least one sprinkler for container cooling in case of fire.

Medical Gas Systems Section 5306

- Interior rooms shall be protected in a similar manner as exterior rooms, however full sprinkler protection shall be provided throughout the room.
- Minimum 1-hour-rated shaft enclosures shall be used to protect supply and exhaust ducts that must extend to the exterior.

Storage of Corrosive Materials Section 5404

- Outdoor storage of corrosive materials must be located at least 20 feet from:
  - Buildings not associated with the manufacturing or distribution of such materials
  - Lot lines
  - Public streets, public alleys and other public ways
  - Means of egress
- As an alternative method of protection, a minimum 2-hour fire barrier shall be provided to isolate the storage area.

Storage of Corrosive Materials Section 5404

- The 2-hour fire barrier shall
  - Be without openings or penetrations.
  - Extend at least 30 inches above and to the sides of the storage area.
- The fire barrier can be:
  - An independent structure, or
  - The exterior wall of the building adjacent to the storage area.
- Similar requirements are applicable to the outdoor use of corrosive materials.

Storage of Small Arms Ammunition Components – Smokeless Propellant Section 5606.5.2

- Commercial stocks of smokeless propellants shall be stored based upon the quantities.
- Where the quantity exceeds 100 pounds, but is no more than 800 pounds, storage shall occur in nonportable storage cabinets.
- Cabinets shall have maximum capacity of 400 pounds, and where multiple cabinets are used, cabinets shall be separated by:
  - A distance of at least 25 feet, or
  - A fire partition having a minimum 1-hour rating.

Storage of Small Arms Ammunition Components – Smokeless Propellant Section 5606.5.2

- Where the quantities exceed 800 pounds, but are not more than 5000 pounds, a number of conditions apply.
- One of the conditions requires that the smokeless propellant be separated from materials classified as combustible liquids, flammable liquids, flammable solids or oxidizing materials by a:
  - Distance of at least 25 feet, or
  - Fire partition having a minimum 1-hour fire-resistance rating.

Outdoor Storage of Flammable and Combustible Liquids Section 5704.4

- The outdoor storage of flammable and combustible liquids in closed containers and portable tanks is strictly regulated for location on the property.
- The storage of up to 1100 gallons is permitted adjacent to a building on the same premises and under the same management where one of two conditions occur.

Outdoor Storage of Flammable and Combustible Liquids Section 5704.4

- The building shall be of:
  - Fire-resistance-rated construction with noncombustible exterior surfaces, or
  - Noncombustible construction, OR
- The exterior wall of the building adjacent to the storage area shall have a minimum 2-hour fire-resistance rating with no openings within:
  - 10 feet horizontally if above-grade, and
  - 50 feet horizontally where below-grade.

Cleaning with Flammable and Combustible Liquids Section 5705.3.6

- Parts cleaning and degreasing conducted in listed and approved machines is regulated fire separation or spatial separation where multiple machines are present.
- Multiple machines shall be separated by a:
  - Distance of at least 30 feet, or
  - Fire barrier with a minimum 1-hour fire-resistance rating.

Storage of Fine Magnesium Scrap Section 5906.4

- The storage of scrap magnesium shall be separated from other combustible materials.
- Where the quantities in storage exceed 50 cubic feet, but no more than 1000 square feet, the scrap shall be separated from other occupancies by an open space of at least 50 feet.
- Where a lesser distance is provided, a fire barrier shall be provided.
  - Although not specified, it is assumed a minimum 1-hour fire barrier is required.

Outdoor Requirements for Highly Toxic or Toxic Compressed Gases Section 6004.3.2.1

- As a base requirement, the outdoor storage or use of highly toxic or toxic compressed gases shall be located at least 75 feet from a:
  - Lot line
  - Public street, public alley or other public way
  - Exit discharge
  - Building not associated with the manufacture or distribution of such gases.
- As an option, a fire separation shall be provided.

Outdoor Requirements for Highly Toxic or Toxic Compressed Gases Section 6004.3.2.1

- The use of a minimum 2-hour fire barrier reduces the required 75-foot separation provided the fire barrier:
  - Interrupts the line of sight between the storage and the exposure, and
  - Is located at least 5 feet from any exposure, and
  - Has a maximum of two sides at approximately 90-degree directions, or three sides with connecting angles of approximately 135 degrees.

Indoor Storage of Oxidizing Materials Section 6304.1

- Where cutoff storage rooms house Class 2 and Class 3 oxidizer liquids or solids, the rooms shall be separated from the remainder of the building by 2-hour fire barriers.

Outdoor Storage of Oxidizing Materials Section 6304.2

- The outdoor storage for oxidizing gases shall be located at distances specified in Table 6304.2.2 from a:
  - Lot line
  - Public street, public alley or other public way
  - Building not associated with the manufacture or distribution of such gases.
- As an option, a fire separation shall be provided.

Outdoor Storage of Oxidizing Materials Section 6304.2

- The use of a minimum 2-hour fire barrier reduces the required separation provided the fire barrier:
  - Interrupts the line of sight between the storage and the exposure, and
  - Has no openings or penetrations, and
  - Is designed to allow natural ventilation to prevent the accumulation of hazardous gas concentrations.

Liquid Oxygen in Home Health Care Section 6306.4

- As a general rule, the maximum aggregate quantity of liquid oxygen allowed in storage and in use in each dwelling unit used for home health care in a Group I-1, I-4 or R occupancy shall be 31.6 gallons.
  - Where minimum 1-hour fire barriers and/or horizontal assemblies separate the individual sleeping rooms from the remainder of the dwelling unit, up to 31.6 gallons of liquid oxygen is allowed in each sleeping room.

Outdoor Storage of Unstable Materials Section 6604.2

- Outdoor storage of Class 2 or 1 unstable (reactive) materials must be located at least 20 feet from:
  - Buildings not associated with the manufacturing or distribution of such materials
  - Lot lines
  - Public streets, public alleys and other public ways
  - Means of egress
- As an alternative method of protection, a minimum 2-hour fire barrier shall be provided to isolate the storage area.

Outdoor Storage of Unstable Materials Section 6604.2

- The 2-hour fire barrier shall be without openings or penetrations.
- The fire barrier can be:
  - An independent structure, or
  - The exterior wall of the building adjacent to the storage area.

Outdoor Storage of Water-reactive Solids and Liquids Section 6704.2

- Outdoor storage of water-reactive solids and liquids must be located at least 20 feet from:
  - Buildings
  - Lot lines
  - Public streets, public alleys and other public ways
  - Means of egress
- As an alternative method of protection, a minimum 2-hour fire barrier shall be provided to isolate the storage area

Outdoor Storage of Water-reactive Solids and Liquids Section 6704.2

- The 2-hour fire barrier shall
  - Be without openings or penetrations.
  - Extend at least 30 inches above and to the sides of the storage area.
- The fire barrier can be:
  - An independent structure, or
  - The exterior wall of the building adjacent to the storage area.

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[F] 414.1.3 Information required. A report shall be submitted to the *building official* identifying the maximum expected quantities of hazardous materials to be stored, used in a *closed system* and used in an *open system*, and subdivided to separately address hazardous material classification categories based on Tables 307.1(1) and 307.1(2). The methods of protection from such hazards, including but not limited to *control areas*, fire protection systems and Group H occupancies shall be indicated in the report and on the *construction documents*. The opinion and report shall be prepared by a qualified person, firm or corporation *approved* by the *building official* and provided without charge to the enforcing agency.

For buildings and structures with an occupancy in Group H, separate floor plans shall be submitted identifying the locations of anticipated contents and processes so as to reflect the nature of each occupied portion of every building and structure.

[F] 414.2 Control areas. *Control areas* shall comply with Sections 414.2.1 through 414.2.5 and the *International Fire Code*.

[F] 414.2.1 Construction requirements. *Control areas* shall be separated from each other by *fire barriers* constructed in accordance with Section 707 or *horizontal assemblies* constructed in accordance with Section 711, or both.

[F] 414.2.2 Percentage of maximum allowable quantities. The percentage of maximum allowable quantities of hazardous materials per *control area* permitted at each floor level within a building shall be in accordance with Table 414.2.2.

[F] 414.2.3 Number. The maximum number of *control areas* within a building shall be in accordance with Table 414.2.2.

[F] 414.2.4 Fire-resistance-rating requirements. The required *fire-resistance rating* for *fire barriers* shall be in accordance with Table 414.2.2. The floor assembly of the *control area* and the construction supporting the floor of the *control area* shall have a *fire-resistance rating* of not less than 2 hours.

Exception: The floor assembly of the *control area* and the construction supporting the floor of the *control area* are allowed to be 1-hour fire-resistance rated in buildings of Types IIA, IIIA and VA construction, provided that both of the following conditions exist:

1. The building is equipped throughout with an *automatic sprinkler system* in accordance with Section 903.3.1.1; and
2. The building is three or fewer *stories above grade plane*.

[F] 414.2.5 Hazardous material in Group M display and storage areas and in Group S storage areas. The aggregate quantity of nonflammable solid and nonflammable or noncombustible liquid hazardous materials permitted within a single *control area* of a Group M display and storage area, a Group S storage area or an outdoor *control area* is permitted to exceed the maximum allowable quantities per *control area* specified in Tables 307.1(1) and 307.1(2) without classifying the building or use as a Group H occupancy, provided that the materials are displayed and stored in accordance with the *International Fire Code* and quantities do not exceed the maximum allowable specified in Table 414.2.5(1).

In Group M occupancy wholesale and retail sales uses, indoor storage of flammable and combustible liquids shall not exceed the maximum allowable quantities per *control area* as indicated in Table 414.2.5(2), provided that the materials are displayed and stored in accordance with the *International Fire Code*.

The maximum quantity of aerosol products in Group M occupancy retail display areas, storage areas adjacent to retail display areas and retail storage areas shall be in accordance with the *International Fire Code*.

[F] 414.3 Ventilation. Rooms, areas or spaces of Group H in which explosive, corrosive, combustible, flammable or

[F] TABLE 414.2.2
DESIGN AND NUMBER OF CONTROL AREAS

FLOOR LEVEL		PERCENTAGE OF THE MAXIMUM ALLOWABLE QUANTITY PER CONTROL AREA[a]	NUMBER OF CONTROL AREAS PER FLOOR	FIRE-RESISTANCE RATING FOR FIRE BARRIERS IN HOURS[b]
Above grade plane	Higher than 9	5	1	2
	7-9	5	2	2
	6	12.5	2	2
	5	12.5	2	2
	4	12.5	2	2
	3	50	2	1
	2	75	3	1
	1	100	4	1
Below grade plane	1	75	3	1
	2	50	2	1
	Lower than 2	Not Allowed	Not Allowed	Not Allowed

a. Percentages shall be of the maximum allowable quantity per control area shown in Tables 307.1(1) and 307.1(2), with all increases allowed in the notes to those tables.

b. Separation shall include fire barriers and horizontal assemblies as necessary to provide separation from other portions of the building.

WATER-REACTIVE MATERIAL.

Class 3.

Class 2.

Class 1.

[F] 307.3 High-hazard Group H-1. Buildings and structures containing materials that pose a detonation hazard shall be classified as Group H-1. Such materials shall include, but not be limited to, the following:

Detonable pyrophoric materials
Explosives:

Division 1.1
Division 1.2
Division 1.3
Division 1.4
Division 1.5
Division 1.6
Organic peroxides, unclassified detonable
Oxidizers, Class 4
Unstable (reactive) materials, Class 3 detonable and Class 4

[F] 307.3.1 Occupancies containing explosives not classified as H-1. The following occupancies containing explosive materials shall be classified as follows:

1. Division 1.3 explosive materials that are used and maintained in a form where either confinement or configuration will not elevate the hazard from a mass fire to mass explosion hazard shall be allowed in H-2 occupancies.
2. Articles, including articles packaged for shipment, that are not regulated as a Division 1.4 explosive under Bureau of Alcohol, Tobacco, Firearms and Exoplosives regulations, or unpackaged articles used in process operations that do not propagate a detonation or deflagration between articles shall be allowed in H-3 occupancies.

[F] TABLE 307.1(1)
MAXIMUM ALLOWABLE QUANTITY PER CONTROL AREA OF HAZARDOUS MATERIALS POSING A PHYSICAL HAZARD[a, j, m, n, p]

MATERIAL	CLASS	GROUP WHEN THE 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	N/A	H-2	Note q	N/A	N/A	Note q	N/A	N/A	Note q	N/A
Combustible liquid[c, i]	II IIIA IIIB	H-2 or H-3 H-2 or H-3 N/A	N/A	120[d, e] 330[d, e] 13,200[e, f]	N/A	N/A	120[d] 330[d] 13,200[f]	N/A	N/A	30[d] 80[d] 3,300[f]
Combustible fiber	Loose Baled[o]	H-3	(100) (1,000)	N/A	N/A	(100) (1,000)	N/A	N/A	(20) (200)	N/A
Consumer fireworks	1.4G	H-3	125[d, e, l]	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Cryogenics, flammable	N/A	H-2	N/A	45[d]	N/A	N/A	45[d]	N/A	N/A	10[d]
Cryogenics, inert	N/A	N/A	N/A	N/A	NL	N/A	N/A	NL	N/A	N/A
Cryogenics, oxidizing	N/A	H-3	N/A	45[d]	N/A	N/A	45[d]	N/A	N/A	10[d]
Explosives	Division 1.1 Division 1.2 Division 1.3 Division 1.4 Division 1.4G Division 1.5 Division 1.6	H-1 H-1 H-1 or H-2 H-3 H-3 H-1 H-1	1[e, g] 1[e, g] 5[e, g] 50[e, g] 125[d, e, l] 1[e, g] 1[d, e, g]	(1)[e, g] (1)[e, g] (5)[e, g] (50)[e, g] N/A (1)[e, g] N/A	N/A N/A N/A N/A N/A N/A N/A	0.25[g] 0.25[g] 1[g] 50[g] N/A 0.25[g] N/A	(0.25)[g] (0.25)[g] (1)[g] (50)[g] N/A (0.25)[g] N/A	N/A N/A N/A N/A N/A N/A N/A	0.25[g] 0.25[g] 1[g] N/A N/A 0.25[g] N/A	(0.25)[g] (0.25)[g] (1)[g] N/A N/A (0.25)[g] N/A
Flammable gas	Gaseous Liquefied	H-2	N/A	N/A (150)[d,e]	1,000[d,e] N/A	N/A	N/A (150)[d,e]	1,000[d,e] N/A	N/A	N/A
Flammable liquid[c]	1A 1B and 1C	H-2 or H-3	N/A	30[d, e] 120[d, e]	N/A	N/A	30[d] 120[d]	N/A	N/A	10[d] 30[d]
Flammable liquid, combination (1A, 1B, 1C)	N/A	H-2 or H-3	N/A	120[d, e, h]	N/A	N/A	120[d, h]	N/A	N/A	30[d, h]

(continued)

[F] TABLE 307.1(1)—(continued)
MAXIMUM ALLOWABLE QUANTITY PER CONTROL AREA OF HAZARDOUS MATERIALS POSING A PHYSICAL HAZARD[a, j, m, n, p]

MATERIAL	CLASS	GROUP WHEN THE MAXIMUM ALLOWABLE QUANTITY IS EXCEEDED	STORAGE[b]			USE-CLOSED SYSTEMS[b]			USE-OPEN SYSTEMS[b]	
			Solid pounds (cubic feet)	Liquid gallons (pounds)	Gas (cubic feet at NTP)	Solid pounds (cubic feet)	Liquid gallons (pounds)	Gas (cubic feet at NTP)	Solid pounds (cubic feet)	Liquid gallons (pounds)
Flammable solid	N/A	H-3	125[d, e]	N/A	N/A	125[d]	N/A	N/A	25[d]	N/A
Inert gas	Gaseous	N/A	N/A	N/A	NL	N/A	N/A	NL	N/A	N/A
	Liquefied	N/A	N/A	N/A	NL	N/A	N/A	NL	N/A	N/A
Organic peroxide	UD	H-1	1[e, g]	(1)[e, g]	N/A	0.25[g]	(0.25)[g]	N/A	0.25[g]	(0.25)[g]
	I	H-2	5[d, e]	(5)[d, e]	N/A	1[d]	(1)[d]	N/A	1[d]	(1)[d]
	II	H-3	50[d, e]	(50)[d, e]	N/A	50[d]	(50)[d]	N/A	10[d]	(10)[d]
	III	H-3	125[d, e]	(125)[d, e]	N/A	125[d]	(125)[d]	N/A	25[d]	(25)[d]
	IV	N/A	NL	NL	N/A	NL	NL	N/A	NL	NL
	V	N/A	NL	NL	N/A	NL	NL	N/A	NL	NL
Oxidizer	4	H-1	1[e, g]	(1)[e, g]	N/A	0.25[g]	(0.25)[g]	N/A	0.25[g]	(0.25)[g]
	3[k]	H-2 or H-3	10[d, e]	(10)[d, e]	N/A	2[d]	(2)[d]	N/A	2[d]	(2)[d]
	2	H-3	250[d, e]	(250)[d, e]	N/A	250[d]	(250)[d]	N/A	50[d]	(50)[d]
	1	N/A	4,000[e, f]	(4,000)[e, f]	N/A	4,000[f]	(4,000)[f]	N/A	1,000[f]	(1,000)[f]
Oxidizing gas	Gaseous	H-3	N/A	N/A	1,500[d,e]	N/A	N/A	1,500[d,e]	N/A	N/A
	Liquefied		N/A	(150)[d,e]	N/A	N/A	(150)[d,e]	N/A	N/A	N/A
Pyrophoric material	N/A	H-2	4[e, g]	(4)[e, g]	50[e, g]	1[g]	(1)[g]	10[g]	0	0
Unstable (reactive)	4	H-1	1[e, g]	(1)[e, g]	10[g]	0.25[g]	(0.25)[g]	2[e, g]	0.25[g]	(0.25)[g]
	3	H-1 or H-2	5[d, e]	(5)[d, e]	50[d, e]	1[d]	(1)[d]	10[d, e]	1[d]	(1)[d]
	2	H-3	50[d, e]	(50)[d, e]	250[d, e]	50[d]	(50)[d]	250[d, e]	10[d]	(10)[d]
	1	N/A	NL	NL	NL	NL	NL	NL	NL	NL
Water reactive	3	H-2	5[d, e]	(5)[d, e]	N/A	5[d]	(5)[d]	N/A	1[d]	(1)[d]
	2	H-3	50[d, e]	(50)[d, e]	N/A	50[d]	(50)[d]	N/A	10[d]	(10)[d]
	1	N/A	NL	NL	N/A	NL	NL	N/A	NL	NL

For SI: 1 cubic foot = 0.028 m^3, 1 pound = 0.454 kg, 1 gallon = 3.785 L.

NL = Not Limited; N/A = Not Applicable; UD = Unclassified Detonable

a. For use of control areas, see Section 414.2.

b. The aggregate quantity in use and storage shall not exceed the quantity listed for storage.

c. The quantities of alcoholic beverages in retail 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, foodstuffs, consumer or industrial products, and cosmetics containing not more than 50 percent by volume of water-miscible liquids with the remainder of the solutions not being flammable, shall not be limited, provided that such materials are packaged in individual containers not exceeding 1.3 gallons.

d. Maximum allowable quantities shall be increased 100 percent in buildings equipped throughout with an automatic sprinkler system in accordance with Section 903.3.1.1. Where Note e also applies, the increase for both notes shall be applied accumulatively.

e. Maximum allowable quantities shall be increased 100 percent when stored in *approved* storage cabinets, day boxes, gas cabinets or exhausted enclosures or in *listed* safety cans in accordance with Section 5003.9.10 of the *International Fire Code*. Where Note d also applies, the increase for both notes shall be applied accumulatively.

f. The permitted quantities shall not be limited in a building equipped throughout with an *automatic sprinkler system* in accordance with Section 903.3.1.1.

g. Permitted only in buildings equipped throughout with an *automatic sprinkler system* in accordance with Section 903.3.1.1.

h. Containing not more than the maximum allowable quantity per *control area* of Class IA, IB or IC flammable liquids.

i. The maximum allowable quantity shall not apply to fuel oil storage complying with Section 603.3.2 of the *International Fire Code*.

j. Quantities in parenthesis indicate quantity units in parenthesis at the head of each column.

k. A maximum quantity of 200 pounds of solid or 20 gallons of liquid Class 3 oxidizers is allowed when such materials are necessary for maintenance purposes, operation or sanitation of equipment. Storage containers and the manner of storage shall be *approved*.

l. Net weight of the pyrotechnic composition of the fireworks. Where the net weight of the pyrotechnic composition of the fireworks is not known, 25 percent of the gross weight of the fireworks, including packaging, shall be used.

m. For gallons of liquids, divide the amount in pounds by 10 in accordance with Section 5003.1.2 of the *International Fire Code*.

n. For storage and display quantities in Group M and storage quantities in Group S occupancies complying with Section 414.2.5, see Tables 414.2.5(1) and 414.2.5(2).

o. Densely packed baled cotton that complies with the packing requirements of ISO 8115 shall not be included in this material class.

p. The following shall not be included in determining the maximum allowable quantities:

1. Liquid or gaseous fuel in fuel tanks on vehicles.
2. Liquid or gaseous fuel in fuel tanks on motorized equipment operated in accordance with this code.
3. Gaseous fuels in piping systems and fixed appliances regulated by the *International Fuel Gas Code.*
4. Liquid fuels in piping systems and fixed appliances regulated by the *International Mechanical Code*.

q. Where manufactured, generated or used in such a manner that the concentration and conditions create a fire or explosion hazard based on information prepared in accordance with Section 414.1.3.

[F] TABLE 307.1(2)
MAXIMUM ALLOWABLE QUANTITY PER CONTROL AREA OF HAZARDOUS MATERIAL POSING A HEALTH HAZARD[a, b, c, i]

MATERIAL	STORAGE[d]			USE-CLOSED SYSTEMS[d]			USE-OPEN SYSTEMS[d]	
	Solid pounds (cubic feet)	Liquid gallons (pounds)[e, f]	Gas (cubic feet at NTP)[e]	Solid pounds[e]	Liquid gallons (pounds)[e]	Gas (cubic feet at NTP)[e]	Solid pounds[e]	Liquid gallons (pounds)[e]
Corrosive	5,000	500	Gaseous 810[f] Liquefied (150)[h]	5,000	500	Gaseous 810[f] Liquefied (150)[h]	1,000	100
Highly toxic	10	(10)[h]	Gaseous 20[g] Liquefied (4)[g,h]	10	(10)[i]	Gaseous 20[g] Liquefied (4)[g,h]	3	(3)[i]
Toxic	500	(500)[h]	Gaseous 810[f] Liquefied (150)[f,h]	500	(500)[i]	Gaseous 810[f] Liquefied (150)[f,h]	125	(125)

For SI: 1 cubic foot = 0.028 m^3, 1 pound = 0.454 kg, 1 gallon = 3.785 L.

a. For use of control areas, see Section 414.2.

b. In retail and wholesale sales occupancies, the quantities of medicines, foodstuffs, consumer or industrial products, and cosmetics, containing not more than 50 percent by volume of water-miscible liquids and with the remainder of the solutions not being flammable, shall not be limited, provided that such materials are packaged in individual containers not exceeding 1.3 gallons.

c. For storage and display quantities in Group M and storage quantities in Group S occupancies complying with Section 414.2.5, see Tables 414.2.5(1) and 414.2.5(2).

d. The aggregate quantity in use and storage shall not exceed the quantity listed for storage.

e. Maximum allowable quantities shall be increased 100 percent in buildings equipped throughout with an *approved automatic sprinkler system* in accordance with Section 903.3.1.1. Where Note f also applies, the increase for both notes shall be applied accumulatively.

f. Maximum allowable quantities shall be increased 100 percent when stored in approved storage cabinets, gas cabinets or exhausted enclosures as specified in the *International Fire Code*. Where Note e also applies, the increase for both notes shall be applied accumulatively.

g. Allowed only when stored in approved exhausted gas cabinets or exhausted enclosures as specified in the *International Fire Code*.

h. Quantities in parenthesis indicate quantity units in parenthesis at the head of each column.

i. For gallons of liquids, divide the amount in pounds by 10 in accordance with Section 5003.1.2 of the *International Fire Code*.

[F] 307.4 High-hazard Group H-2. Buildings and structures containing materials that pose a deflagration hazard or a hazard from accelerated burning shall be classified as Group H-2. Such materials shall include, but not be limited to, the following:

Class I, II or IIIA flammable or combustible liquids which are used or stored in normally open containers or systems, or in closed containers or systems pressurized at more than 15 psi (103.4 kPa) gage
Combustible dusts where manufactured, generated or used in such a manner that the concentration and conditions create a fire or explosion hazard based on information prepared in accordance with Section 414.1.3
Cryogenic fluids, flammable
Flammable gases
Organic peroxides, Class I
Oxidizers, Class 3, that are used or stored in normally open containers or systems, or in closed containers or sytems pressurized at more than 15 psi (103 kPa) gage
Pyrophoric liquids, solids and gases, nondetonable
Unstable (reactive) materials, Class 3, nondetonable
Water-reactive materials, Class 3

[F] 307.5 High-hazard Group H-3. Buildings and structures containing materials that readily support combustion or that pose a physical hazard shall be classified as Group H-3. Such materials shall include, but not be limited to, the following:

Class I, II or IIIA flammable or combustible liquids that are used or stored in normally closed containers or systems pressurized at 15 pounds per square inch gauge (103.4 kPa) or less
Combustible fibers, other than densely packed baled cotton
Consumer fireworks, 1.4G (Class C, Common)
Cryogenic fluids, oxidizing
Flammable solids
Organic peroxides, Class II and III
Oxidizers, Class 2
Oxidizers, Class 3, that are used or stored in normally closed containers or systems pressurized at 15 pounds per square inch gauge (103 kPa) or less
Oxidizing gases
Unstable (reactive) materials, Class 2
Water-reactive materials, Class 2

[F] 307.6 High-hazard Group H-4. Buildings and structures which contain materials that are health hazards shall be classified as Group H-4. Such materials shall include, but not be limited to, the following:

Corrosives
Highly toxic materials
Toxic materials

[F] 307.7 High-hazard Group H-5. 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 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 Section 415.10.

TABLE 509
INCIDENTAL USES

ROOM OR AREA	SEPARATION AND/OR PROTECTION
Furnace room where any piece of equipment is over 400,000 Btu per hour input	1 hour or provide automatic sprinkler system
Rooms with boilers where the largest piece of equipment is over 15 psi and 10 horsepower	1 hour or provide automatic sprinkler system
Refrigerant machinery room	1 hour or provide automatic sprinkler system
Hydrogen cutoff rooms, not classified as Group H	1 hour in Group B, F, M, S and U occupancies; 2 hours in Group A, E, I and R occupancies.
Incinerator rooms	2 hours and automatic sprinkler system
Paint shops, not classified as Group H, located in occupancies other than Group F	2 hours; or 1 hour and provide automatic sprinkler system
Laboratories and vocational shops, not classified as Group H, located in a Group E or I-2 occupancy	1 hour or provide automatic sprinkler system
Laundry rooms over 100 square feet	1 hour or provide automatic sprinkler system
Group I-3 cells equipped with padded surfaces	1 hour
Waste and linen collection rooms located in either Group I-2 occupancies or ambulatory care facilities	1 hour
Waste and linen collection rooms over 100 square feet	1 hour or provide automatic sprinkler system
Stationary storage battery systems having a liquid electrolyte capacity of more than 50 gallons for flooded lead-acid, nickel cadmium or VRLA, or more than 1,000 pounds for lithium-ion and lithium metal polymer used for facility standby power, emergency power or uninterruptable power supplies	1 hour in Group B, F, M, S and U occupancies; 2 hours in Group A, E, I and R occupancies.

For SI: 1 square foot = 0.0929 m^2, 1 pound per square inch (psi) = 6.9 kPa, 1 British thermal unit (Btu) per hour = 0.293 watts, 1 horsepower = 746 watts, 1 gallon = 3.785 L.

pancy uses, each with an *occupant load* of less 300, or Group B, M, R or S occupancies.

6. The building below the *horizontal assembly* shall be protected throughout by an *approved automatic sprinkler system* in accordance with Section 903.3.1.1, and shall be permitted to be any of the following occupancies:
   6.1. Group S-2 parking garage used for the parking and storage of private motor vehicles;
   6.2. Multiple Group A, each with an *occupant load* of less than 300;
   6.3. Group B;
   6.4. Group M;
   6.5. Group R; and
   6.6. Uses incidental to the operation of the building (including entry lobbies, mechanical rooms, storage areas and similar uses).
7. The maximum *building height* in feet (mm) shall not exceed the limits set forth in Section 503 for the building having the smaller allowable height as measured from the *grade plane*.

510.3 Group S-2 enclosed parking garage with Group S-2 open parking garage above. A Group S-2 enclosed parking garage with not more than one *story* above *grade plane* and located below a Group S-2 *open parking garage* shall be classified as a separate and distinct building for the purpose of determining the type of construction where all of the following conditions are met:

1. The allowable area of the building shall be such that the sum of the ratios of the actual area divided by the allowable area for each separate occupancy shall not exceed 1.
2. The Group S-2 enclosed parking garage is of Type I or II construction and is at least equal to the *fire-resistance* requirements of the Group S-2 *open parking garage*.
3. The height and the number of tiers of the Group S-2 *open parking garage* shall be limited as specified in Table 406.5.4.
4. The floor assembly separating the Group S-2 enclosed parking garage and Group S-2 *open parking garage* shall be protected as required for the floor assembly of the Group S-2 enclosed parking garage. Openings between the Group S-2 enclosed parking garage and Group S-2 *open parking garage*, except *exit* openings, shall not be required to be protected.
5. The Group S-2 enclosed parking garage is used exclusively for the parking or storage of private motor vehicles, but shall be permitted to contain an office, waiting room and toilet room having a total area of not more than 1,000 square feet (93 m^2), and mechanical equipment rooms incidental to the operation of the building.