



AIHA
CONNECTTM
2024

MAY 20-22 | Columbus, OH

**C3: FIRE CODE, OCCUPATIONAL
SAFETY, GHS, AND CHEMICAL HAZARDS**



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CONNECT™
2024

**C3: FIRE CODE, OCCUPATIONAL SAFETY,
GHS, AND CHEMICAL HAZARDS**

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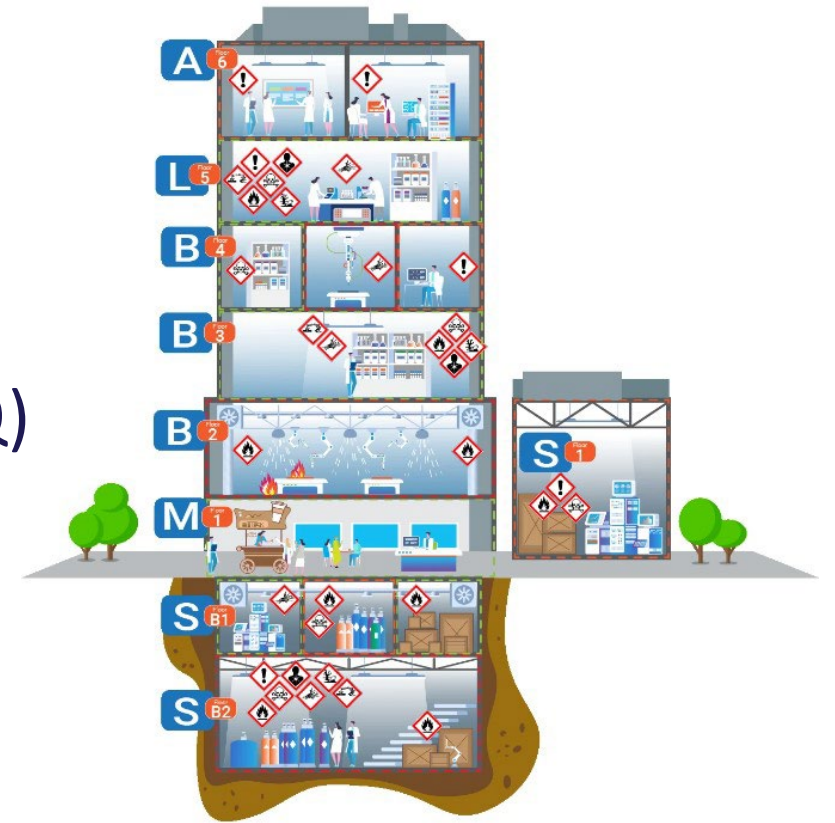
RESOURCES/E-HANDOUTS

<https://riskandsafety.com/rss-talks>

- GHS Pictogram Guide for CFC Hazard Classes
- GHS Pictograms & Hazard Statements to Fire Code Hazard Classes
- Fire Code Hazard Class Definitions
- IFC 2024 Appendix E <https://codes.iccsafe.org/s/IFC2024P1/part-vii-appendices/IFC2024P1-Pt07-AppxE-SecE104.2>
- PubChem <https://pubchem.ncbi.nlm.nih.gov/ghs/>
- Risk and Safety Solutions <https://riskandsafety.com/>

AGENDA

- Why I care
- History of Fire Losses and Prevention Strategy
- What are Maximum Allowable Quantities (MAQ)
- Classification Schemes for Chemical Hazards
 - Fire Code separates Physical & Health Hazards
 - Fire code focuses on acute hazards
- Application Examples



WHY I CARE

- The rules seem arbitrary
- The MAQ concept is new to most people
- The rules are complicated
- UC has a major focus on MAQ compliance
- Most space managers have no ideas about chemical limits
- In academia, new faculty have very little control over where their rooms are assigned
- RSS chemical inventory solves challenges



HISTORY OF LOSSES

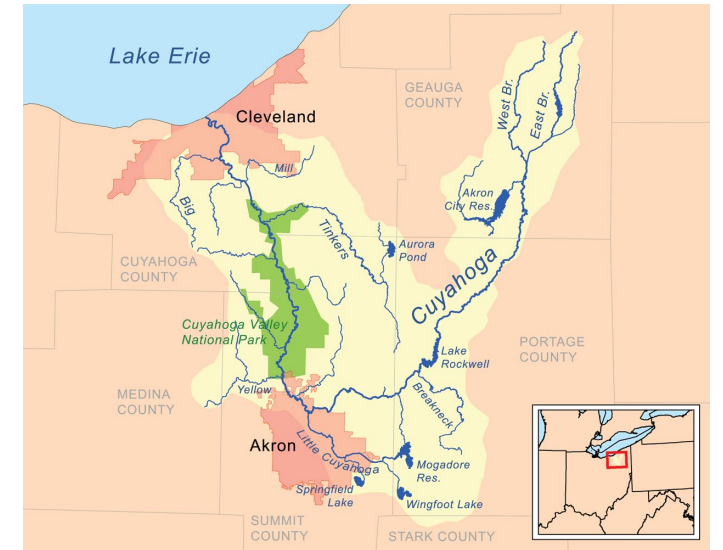
- 48 BCE Great Library of Alexandria
- 64 CE Great Fire of Rome – ‘Nero Fiddled’
- 1666 Great Fire of London
- 1835 Great Fire of New York
- 1871 Great Chicago Fire ~300 deaths
- 1903 Iroquois Theatre Fire 602 Deaths
- 1911 Triangle Shirtwaist Factory Fire 147 Deaths



By Josepha Jane Battlehooke - museumoflondonprints.com, Public Domain, <https://commons.wikimedia.org/w/index.php?curid=1303944>

CLEVELAND'S CUYAHOGA RIVER FIRE

- John D. Rockefeller's first oil refinery was built along a stream that fed into the Cuyahoga River. While Rockefeller's Standard Oil was dumping gasoline into the river, it was also being used as Cleveland's sewer. The river burned nine times between 1868 and 1952.
- The fire that broke out on June 22, 1969, was relatively small compared to the previous fires, but with one critical difference: "Many rivers were severely polluted during the 1960s, but the Cuyahoga River caught on fire"



https://en.wikipedia.org/wiki/Cuyahoga_River#/media/File:Cuyahogarivermap.png

RULES THAT RESULTED...

- Fire resistive construction
- Active automatic suppression
- Compartmentalization to prevent spread
- Awareness of hazards
- Improved safety of response



STANDARDIZING CODES IN THE US

- Prior to 1994
 - the National Fire Prevention Code
 - the Standard Fire Prevention Code
 - the Uniform Fire Code,
 - National Fire Protection Association (NFPA) 1
 - Fire Prevention Code
- 1994, International Code Council created IFC (International Fire Code)



Image Generated with AI (MS Copilot) · May 2, 2024 at 1:28 PM

IFC IS THE MODEL CODE IN MOST US STATES



3/10/2020

<https://blog.koorsen.com/the-international-fire-code-its-history-and-role-in-fire-safety-today>

Koorsen Fire & Security

COMPLEX ISSUES

- Prior to 2000, IFC has no comprehensive MAQ limits
- Starting in 2001 California Fire Codes systematically limits the maximum quantities of chemicals in 'control areas'
- Limits are by physical state at NTP, hazard type & class, locations in or near a building, type of storage, use and design of the building
- There can be up to four control areas in a building, not exceeding 10,000 sq ft each



CHANGES CAN OCCUR EVERY THREE YEARS

- In 2015 IFC (2016 CFC) MAQ rules changed again
- Now, more control areas (or lab suites) are allowed and varies in allowed number by floor
- A percentage reduction is imposed by floor
- These are all added to the 2001 hazardous hazard class limits



MAQ TABLES ... 5003.1.1(1-4)

<https://codes.iccsafe.org/content/IFC2024P1/chapter-50-hazardous-materials-general-provisions>

Indoor Control Areas

TABLE 5003.1.1(1) MAXIMUM ALLOWABLE QUANTITY PER CONTROL AREA OF HAZARDOUS MATERIALS POSING A PHYSICAL HAZARD^{a, b, c, d, e, f}

MATERIAL	CLASS	GROUP WHEN THE MAXIMUM QUANTITY IS EXCEEDED	STORAGE ^g			USE-CLOSED SYSTEMS ^h			USE-OPEN SYSTEMS ⁱ	
			Solid pounds (cubic feet)	Liquid gallons (cubic feet)	Gas (cubic feet at 77°F)	Solid pounds (cubic feet)	Liquid gallons (cubic feet)	Gas (cubic feet at 77°F)	Solid pounds (cubic feet)	Liquid gallons (cubic feet)
Combustible dust	NA	H-2	See Note 4)	NA	NA	See Note 4)	NA	NA	See Note 4)	NA
Combustible liquid ^j	Flammable-Liquor	H-3	(100) (1,000)	NA	NA	(100) (1,000)	NA	NA	(70) (700)	NA
Combustible liquid ^j	H	H-2 or H-3	120 ^g 3,00 ^g or 11-3	NA	NA	120 ^g 3,00 ^g or 13,200 ^g	NA	NA	30 ^g 30 ^g or 3,300 ^g	NA
Combustible liquid ^j	HA	H-3	NA	NA	NA	NA	NA	NA	NA	NA
Consumer fireworks	L-4C	H-3	125 ^g ^k	NA	NA	NA	NA	NA	NA	NA
Cryogenic flammable	NA	H-2	NA	45 ^g	NA	NA	45 ^g	NA	NA	10 ^g
Cryogenic inert	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Cryogenic oxidizing	NA	H-3	NA	45 ^g	NA	NA	45 ^g	NA	NA	10 ^g
Explosives	Division 1.1	H-1	1 ^g	11 ^g	NA	0.25 ^g	0.25 ^g	0.25 ^g	0.25 ^g	(0.25) ^g
Explosives	Division 1.2	H-1	1 ^g	11 ^g	NA	0.25 ^g	0.25 ^g	0.25 ^g	0.25 ^g	(0.25) ^g
Explosives	Division 1.3	H-1 or H-2	1 ^g	11 ^g	NA	1 ^g	1 ^g	1 ^g	1 ^g	(1) ^g
Explosives	Division 1.4	H-3	50 ^g	50 ^g	NA	50 ^g	50 ^g	50 ^g	50 ^g	NA
Explosives	Division 1.5	H-3	125 ^g ^k	125 ^g ^k	NA	125 ^g ^k	125 ^g ^k	125 ^g ^k	125 ^g ^k	125 ^g ^k
Explosives	Division 1.6	H-1	1 ^g	1 ^g	NA	0.25 ^g	0.25 ^g	0.25 ^g	0.25 ^g	(0.25) ^g
Flammable gas	Gaseous-Liquefied	H-2-3	NA	NA	1,000 ^g	NA	NA	1,000 ^g	NA	NA
Flammable liquid	HA	H-2	NA	NA	120 ^g	NA	NA	120 ^g	NA	30 ^g
Flammable liquid	H and IC	H-2	NA	NA	120 ^g	NA	NA	120 ^g	NA	30 ^g
Flammable liquid	H and IC	H-2	NA	NA	120 ^g	NA	NA	120 ^g	NA	30 ^g
Flammable liquid	HA	H-2	NA	NA	120 ^g	NA	NA	120 ^g	NA	30 ^g
Flammable liquid	H and IC	H-2	NA	NA	120 ^g	NA	NA	120 ^g	NA	30 ^g
Flammable solid	NA	H-3	125 ^g ^k	NA	NA	125 ^g ^k	NA	NA	25 ^g	NA

TABLE 5003.1.1(1)-continued MAXIMUM ALLOWABLE QUANTITY PER CONTROL AREA OF HAZARDOUS MATERIALS POSING A PHYSICAL HAZARD^{a, b, c, d, e, f}

MATERIAL	CLASS	GROUP WHEN THE MAXIMUM QUANTITY IS EXCEEDED	STORAGE ^g			USE-CLOSED SYSTEMS ^h			USE-OPEN SYSTEMS ⁱ	
			Solid pounds (cubic feet)	Liquid gallons (cubic feet)	Gas (cubic feet at 77°F)	Solid pounds (cubic feet)	Liquid gallons (cubic feet)	Gas (cubic feet at 77°F)	Solid pounds (cubic feet)	Liquid gallons (cubic feet)
Inert Gas	Gaseous-Liquefied	NA	NA	NA	NA	NA	NA	NA	NA	NA
Organic peroxide	UD	H-1	1 ^g	11 ^g	0.25 ^g	0.25 ^g	0.25 ^g	0.25 ^g	(0.25) ^g	
	I	H-2	2 ^g	22 ^g	0.5 ^g	0.5 ^g	0.5 ^g	0.5 ^g	(0.5) ^g	
	II	H-2	50 ^g	50 ^g	NA	50 ^g	50 ^g	50 ^g	50 ^g	NA
	III	H-3	125 ^g ^k	125 ^g ^k	NA	125 ^g ^k	125 ^g ^k	125 ^g ^k	125 ^g ^k	125 ^g ^k
	IV	NA	NA	NA	NA	NA	NA	NA	NA	NA
Oxidizer	O	H-2 or H-3	1 ^g	11 ^g	0.25 ^g	0.25 ^g	0.25 ^g	0.25 ^g	(0.25) ^g	
	I	H-3	2,500 ^g	4,000 ^g	NA	2,500 ^g	4,000 ^g	2,500 ^g	4,000 ^g	1,000 ^g
Oxidizing gas	Gaseous-Liquefied	H-3	NA	NA	1,500 ^g	NA	NA	1,500 ^g	NA	NA
	HA	H-3	NA	NA	1,500 ^g	NA	NA	1,500 ^g	NA	NA
Pyrophoric	NA	H-2	4 ^g	4 ^g	0 ^g	0 ^g	0 ^g	0 ^g	0	0
Unstable (reactive)	3	H-1 or H-2	2 ^g	22 ^g	0.25 ^g	0.25 ^g	0.25 ^g	0.25 ^g	(0.25) ^g	
Water reactive	1	H-2	NA	NA	0 ^g	0 ^g	0 ^g	0 ^g	0	0
	2	H-3	NA	NA	0 ^g	0 ^g	0 ^g	0 ^g	0	0
	3	H-2	NA	NA	0 ^g	0 ^g	0 ^g	0 ^g	0	0

For SI: 1 cubic foot = 0.02832 m³, 1 pound = 0.454 kg, 1 gallon = 3.785 L, 1 cubic foot = 0.02832 m³.
 NA = Not Applicable, NL = Not Limited, UD = Unclassified Detonable.
 a. For use of control areas, see Section 5003.8.6.
 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 providing the liquids are packaged in individual containers not exceeding 1.2 gallons. In retail and wholesale sales occupancies, the quantities of alcoholic beverages in use and storage shall not exceed the maximum allowable quantity per control area listed for storage.
 d. (SMA) In other than Group I occupancies, 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 a also applies, the increase for both notes shall be applied cumulatively.
 e. Maximum allowable quantities shall be increased 100 percent where stored in approved storage cabinets, day boxes, gas cabinets, gas cylinders, gas rooms, exhausted enclosures or in lined safety cans in accordance with Section 5003.9.10. Where Note a also applies, the increase for both notes shall be applied cumulatively.
 f. Quantities shall not be limited in a building equipped throughout with an approved automatic sprinkler system in accordance with Section 903.3.1.1.
 g. Allowed only in buildings equipped throughout with an approved automatic sprinkler system.
 h. Containing not more than the maximum allowable quantity per control area of Class I, A, Class II, or Class III flammable liquids.
 i. The maximum allowable quantity shall not apply to fuel in storage equipment with Section 503.7.2.
 j. Quantities in parentheses indicate quantity units in parentheses at the head of each column.
 k. A maximum quantity of 200 pounds of solid or 10 gallons of liquid Class 3 oxidizer is allowed where such materials are necessary for maintenance purposes, operation or calibration of equipment where the storage containers and the number of storage are approved.
 l. Net weight of pyrophoric composition of the fireworks. Where the net weight of the pyrophoric composition of the fireworks is not known, 75 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.
 n. For storage and display quantities in Group M and storage quantities in Group S occupancies complying with Section 5003.1.1, see Table 5003.1.1.
 o. Except-packed bulk liquid that complies with the packing requirements of 49 CFR 173 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 *California Mechanical Code*.
 4. Liquid fuels in piping systems and fixed appliances, regulated by the *California Mechanical Code*.
 5. Alcohol-based hand sanitizer in Class I, A or II dispensers that are installed in accordance with Sections 2703.2 and 2703.3.1. The location of the alcohol-based hand rub (ABHR) dispensers shall be provided in the construction documents.
 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 104.7.2.

Outdoor Control Areas

TABLE 5003.1.1(3) MAXIMUM ALLOWABLE QUANTITY PER CONTROL AREA OF HAZARDOUS MATERIALS POSING A PHYSICAL HAZARD IN AN OUTDOOR CONTROL AREA^{a, b, c, d, e, f}

MATERIAL	CLASS	STORAGE ^g			USE-CLOSED SYSTEMS ^h			USE-OPEN SYSTEMS ⁱ	
		Solid pounds (cubic feet)	Liquid gallons (cubic feet)	Gas cubic feet at NTP	Solid pounds (cubic feet)	Liquid gallons (cubic feet)	Gas cubic feet at NTP	Solid pounds (cubic feet)	Liquid gallons (cubic feet)
Flammable gas	Gaseous-Liquefied	Not Applicable	Not Applicable (300)	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable
Flammable solid	Not Applicable	500	Not Applicable	Not Applicable	250	Not Applicable	Not Applicable	50	Not Applicable
Inert Gas	Gaseous-Liquefied	Not Applicable	Not Applicable	Not Limited	Not Applicable	Not Applicable	Not Limited	Not Applicable	Not Applicable
Cryogenic inert	Not Applicable	Not Applicable	Not Applicable	Not Limited	Not Applicable	Not Applicable	Not Limited	Not Applicable	Not Applicable
Organic peroxide	Unclassified Detonable	1	(1)	Not Applicable	0.25	(0.25)	Not Applicable	0.25	(0.25)
Organic peroxide	I	20	(20)	Not Applicable	10	(10)	Not Applicable	2	(2)
	II	200	(200)	Not Applicable	100	(100)	Not Applicable	20	(20)
	III	500	(500)	Not Applicable	250	(250)	Not Applicable	50	(50)
	IV	1,000	(1,000)	Not Applicable	500	(500)	Not Applicable	100	(100)
	V	Not Limited	Not Limited	Not Applicable	Not Limited	Not Limited	Not Applicable	Not Limited	Not Limited
Oxidizer	4	2	(2)	Not Applicable	1	(1)	Not Applicable	0.25	(0.25)
	3	40	(40)	Not Applicable	20	(20)	Not Applicable	4	(4)
	2	1,000	(1,000)	Not Applicable	500	(500)	Not Applicable	100	(100)
	1	Not Limited	Not Limited	Not Applicable	Not Limited	Not Limited	Not Applicable	Not Limited	Not Limited
Oxidizing gas	Gaseous-Liquefied	Not Applicable	Not Applicable (600)	Not Applicable	6,000	Not Applicable	Not Applicable	1,500	Not Applicable
Pyrophoric materials	Not Applicable	8	(8)	100	4	(4)	10	0	0
Unstable (reactive)	4	2	(2)	20	1	(1)	2	0.25	(0.25)
	3	20	(20)	200	10	(10)	10	1	(1)
	2	200	(200)	1,500	100	(100)	250	10	(10)
Water reactive	1	20	(20)	Not Applicable	10	(10)	Not Applicable	1	(1)
	2	200	(200)	Not Applicable	100	(100)	Not Applicable	10	(10)
		1	Not Limited	Not Limited	Not Limited	Not Limited	Not Limited	Not Limited	Not Limited

For SI: 1 pound = 0.454 kg, 1 gallon = 3.785 L, 1 cubic foot = 0.02832 m³.
 a. For gallons of liquids, divide the amount in pounds by 10 in accordance with Section 5003.1.2.
 b. The aggregate quantities in storage and use shall not exceed the quantity listed for storage.
 c. The aggregate quantity of nonflammable solid and nonflammable or noncombustible liquid hazardous materials allowed in outdoor storage per single property under the same ownership or control used for retail or wholesale sales is allowed to exceed the maximum allowable quantity per control area where such storage is in accordance with Section 5003.1.1.
 d. Quantities in parentheses indicate quantity units in parentheses at the head of each column.

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

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

For SI: 1 cubic foot = 0.02832 m³, 1 pound = 0.454 kg, 1 gallon = 3.785 L, 1 pound per square inch absolute = 6.895 kPa, °C = [(°F)-32]/1.8.
 a. For gallons of liquids, divide the amount in pounds by 10 in accordance with Section 5003.1.2.
 b. The aggregate quantities in storage and use shall not exceed the quantity listed for storage.
 c. The aggregate quantity of nonflammable solid and nonflammable or noncombustible liquid hazardous materials allowed in outdoor storage per single property under the same ownership or control used for retail or wholesale sales is allowed to exceed the maximum allowable quantity per control area where such storage is in accordance with Section 5003.1.1.
 d. Allowed only where used in approved exhausted gas cabinets, exhausted enclosures or under fume hoods.
 e. The maximum allowable quantity per control area for toxic liquids with vapor pressures in excess of 1 psia at 77°F shall be the maximum allowable quantity per control area listed for highly toxic liquids.
 f. Quantities in parentheses indicate quantity units in parentheses at the head of each column.

LIMITS BY STORAGE & USE

TABLE 5003.1.1(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)
Inert Gas	Gaseous Liquefied	NA	NA	NA	NL	NA	NA	NL	NA	NA
		NA	NA	NA	NL	NA	NA	NL	NA	NA
Organic peroxide	UD	H-1	1 ^{c, g}	(1) ^{c, g}		0.25 ^g	(0.25) ^g		0.25 ^g	(0.25) ^g
	I	H-2	5 ^{d, e}	(5) ^{d, e}		1 ^d	(1) ^d		1 ^d	(1) ^d
	II	H-3	50 ^{d, e}	(50) ^{d, e}	NA	50 ^d	(50) ^d	NA	10 ^d	(10) ^d
	III	H-3	125 ^{d, e}	(125) ^{d, e}		125 ^d	(125) ^d		25 ^d	(25) ^d
	IV	NA	NL	NL		NL	NL		NL	NL
	V	NA	NA	NL	NL		NL		NL	NL
Oxidizer	4	H-1	1 ^g	(1) ^{c, g}		0.25 ^g	(0.25) ^g		0.25 ^g	(0.25) ^g
	3 ^k	H-2 or H-3	10 ^{d, e}	(10) ^{d, e}	NA	2 ^d	(2) ^d	NA	2 ^d	(2) ^d
	2	H-3	250 ^{d, e}	(250) ^{d, e}		250 ^d	(250) ^d		50 ^d	(50) ^d
	1	NA	4,000 ^{e, f}	(4,000) ^{e, f}		4,000 ^f	(4,000) ^f		1,000 ^f	(1,000) ^f
Oxidizing gas	Gaseous Liquefied	H-3	NA	NA	1,500 ^{d, e}	NA	NA	1,500 ^{d, e}	NA	NA
				(150) ^{d, e}	NA	(150) ^{d, e}	NA			
Pyrophoric	NA	H-2	4 ^{c, g}	(4) ^{c, g}	50 ^{c, g}	1 ^g	(1) ^g	10 ^{c, g}	0	0
Unstable (reactive)	4	H-1	1 ^{c, g}	(1) ^{c, g}	10 ^{c, g}	0.25 ^g	(0.25) ^g	2 ^{c, 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}	750 ^{d, e}	50 ^d	(50) ^d	750 ^{d, e}	10 ^d	(10) ^d
	1	NA	NL	NL	NL	NL	NL	NL	NL	NL
Water reactive	3	H-2	5 ^{d, e}	(5) ^{d, e}		5 ^d	(5) ^d		1 ^d	(1) ^d
	2	H-3	50 ^{d, e}	(50) ^{d, e}	NA	50 ^d	(50) ^d	NA	10 ^d	(10) ^d
	1	NA	NL	NL		NL	NL		NL	NL

**MAQ
REDUCTIONS BY FLOOR B OCCUPANCY**

Floor level (B Occupancy)		Percentage of the Maximum Allowable Quantity per Control Area	Number of Control Areas Per Floor
Above grade plane	Higher than 9	5	1
	7 thru 9	5	2
	6	12.5	2
	5	12.5	2
	4	12.5	2
	3	50	2
	2	75	3
	1	100	4
Below grade plane	-1	75	3
	-2	50	2
	Lower than -2	Not Allowed	Not Allowed

COMPLIANCE CHALLENGES BY FLOOR

- Flammable liquid IA – MAQ
- B Occupancy, no sprinkler, not in approved storage

Floor <i>(Story above grade plane)</i>	MAQ <i>(gallons)</i>
7 th & higher	1.5
4 th through 6 th	3.75
3 rd	15
2 nd	22.5
1st	30

If there were 4 groups in one control area on the 7th floor, it is possible that each would get less than 1.5 L for all IA flammable liquids

**MAQ LIMITS FOR CHAPTER 38
(OCCUPANCY)
PER LAB SUITES ARE LIMITED BY
FLOOR & CONSTRUCTION TYPE**

	Floor Level	% of MAQ per lab suite
Above grade plane	Above 20	0
	15 thru 20	25
	11, 12, 13, 14	50
	7, 8, 9, 10	50
	6	75
	4,5	75
	3	100
	1, 2	100
Below grade plane	-1	75
	-2	50
	-3 and below	0

IFC 2024, TABLE 3804.1.1 DESIGN AND NUMBER OF LAB SUITES/FLOOR

Floor Level		% MAQ	# Lab Suites/Floor	Fire Barrier Ratings (hr)
Above grade plane	21+	0	Not Allowed	Not Allowed
	16-20	25	1	2
	11-15	50	1	2
	7-10	50	2	2
	4-6	75	4	1
	3	100	4	1
	1-2	100	6	1
Below grade plane	1	75	4	1
	2	50	2	1
	Lower than 2	0	Not Allowed	Not Allowed

FORBIDDEN CLASSES *(MAQ = 0)*

- **Only allowed with a fully sprinklered building**
- Most explosives except commercial fireworks
- Organic Peroxides (UD), Oxidizer 4, Pyrophoric, Unstable (reactive) 4

- **Only allowed in approved exhausted gas cabinets or exhausted enclosures**
- Highly Toxic Gas and Liquefied Gas

CLASSES NOT LIMITED

Regardless of sprinklers

- Cryogenic Inert, Inert Gas both Gaseous & Liquefied gas, Organic Peroxide classes IV and V, Unstable (reactive) class 1, Water reactive class 1
- Combustible Dust limited to:
 - Where manufactured, generated, or used in such a manner that the concentration and conditions create a fire or explosion hazard (reviewed by a PE)

CHEMICAL HAZARDS IN FIRE CODE MAQ LIMITS

Physical Hazards (8)

- Combustibles
- Flammables
- Pyrophorics
- Oxidizers
- Explosives
- Organic peroxides
- Unstables (reactive)
- Water reactives



Health Hazards (3)

- Corrosives
- Toxics
- Highly Toxics
- Irritant
- Sensitizer
- Other Health Hazard Material

OTHER HAZARD CLASSIFICATION SYSTEMS

US Department of Transportation – Pipeline and Hazardous Materials Safety Administration:

<https://www.ecfr.gov/current/title-49/subtitle-B/chapter-I/subchapter-C/part-176>

- 17 major shipping groups

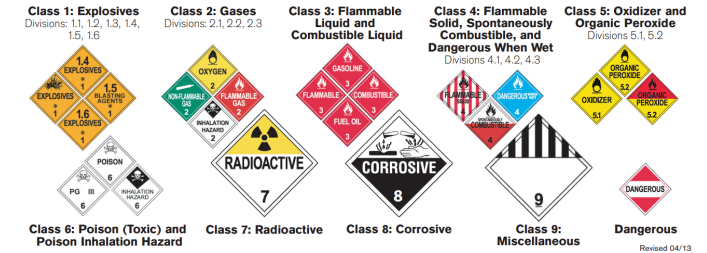
UN Globally Harmonized System:

<https://unece.org/transport/dangerous-goods/ghs-rev10-2023>

- 17 Physical Hazard classes, 10 Health Hazard classes & 2 Environmental Hazard classes

US Environmental Protection Administration

- 107 Compatibility mixing categories: <https://www.epa.gov/sites/default/files/2016-03/documents/compat-haz-waste.pdf>
- Listed & Characteristic Waste: <https://www.epa.gov/hw/defining-hazardous-waste-listed-characteristic-and-mixed-radiological-wastes> & <https://dtsc.ca.gov/defining-hazardous-waste/>

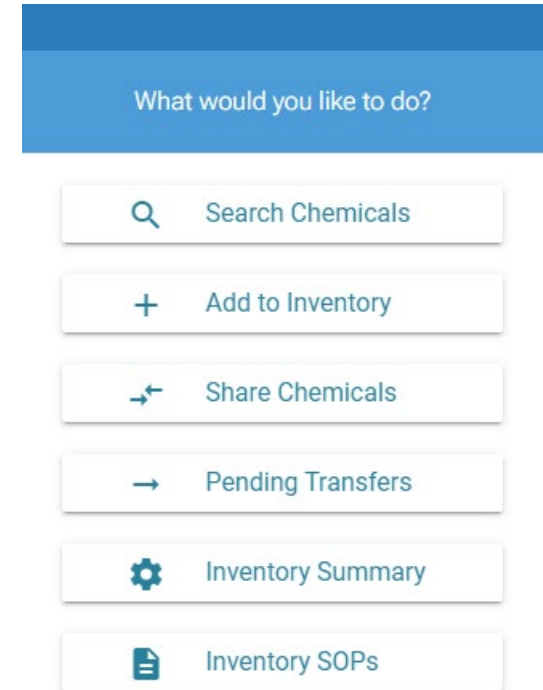


CLASSIFICATION COMPARISON

Fire Code	OSHA
Flammable Liquid, FP 38 C	Liquid, Flammable, FP ≤ 93 C
Class IA , FP < 22.8 C, BP < 37.8 C	Category 1 , FP < 23 C, BP ≤ 35 C
Class IB , FP < 22.8 C, BP ≥ 37.8 C	Category 2 , FP < 23 C, BP > 35 C
Class IC , FP ≥ 22.8 C < 37.8 C Combustible Liquids, FP ≥ 37.8 C Class II , FP ≥ 37.8 C, BP < 60 C	Category 3 , FP ≥ 23 C, BP ≤ 60 C
Class IIIA , FP ≥ 60 C & < 93.3 C Class IIIB , FP ≥ 93.3 C	Category 4 , FP ≥ 60 C & ≤ 93.3 C

RISK AND SAFETY SOLUTIONS ADDRESSES MAQ

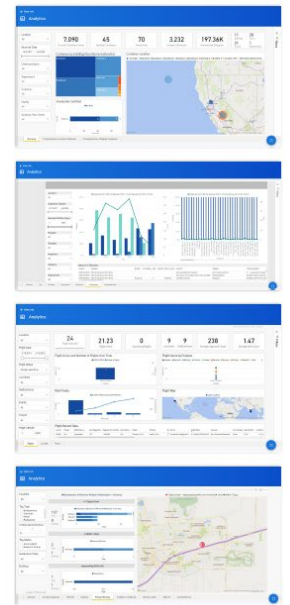
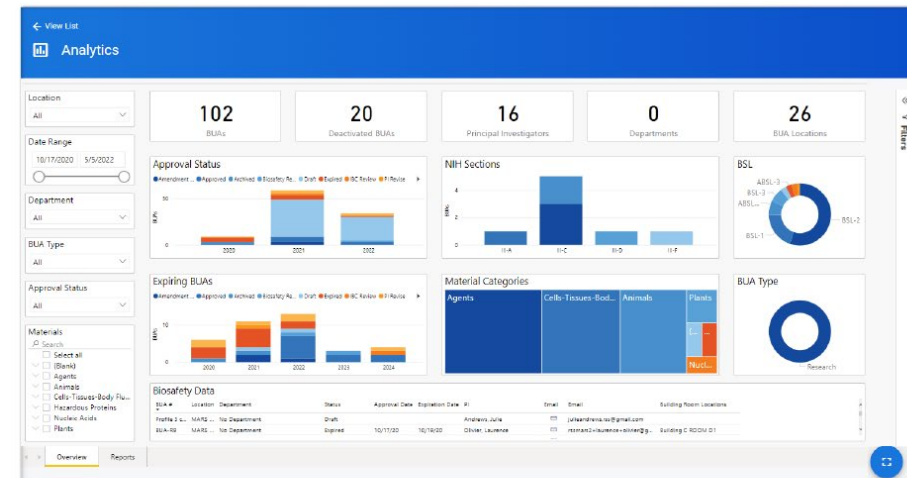
- Based on our award-winning Chemicals Platform
- Classify based upon their physical and chemical properties
- Use most recent available SDS and other reliable resources
- Apply exact data when available to fire code definitions
- Compare to relevant GHS hazard statements, codes, cat.
- Combine container amounts in each control by fire code class
- Compare totals to allowable amounts & report



RSS CHEMICALS COMPLIANCE SOLUTIONS

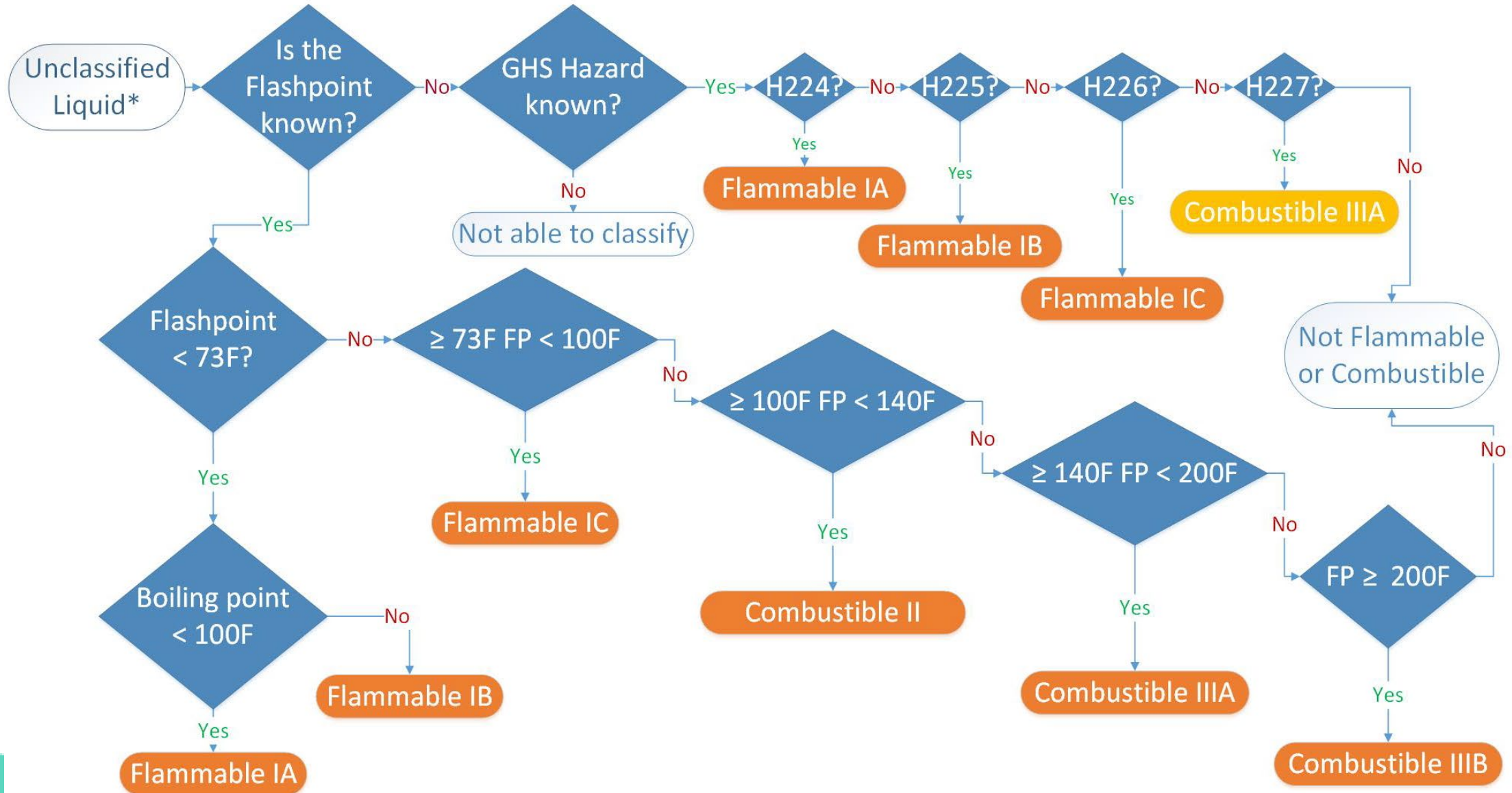
- Hazard Communication (Lab Hazard Assessment, SDS)
- Laboratory Standard (Chemical SOPs)
- Fire Code Compliance → MAQ & HMIS
- California Environmental Reporting System (CERS/CUPA), Tier II equiv.
- Risk Management Plan
- Toxic Release Inventory
- Hazardous Air Pollutants
- Extremely Hazardous Substances
- F-, P- & U-Lists

RISK & SAFETY SOLUTIONS RSS Analytics



Fire Code

Flammable & Combustible Decision Flowchart



FIRE CLASSIFICATION BASED ON DATA FIRST, THE GHS HAZARDS

RESOURCES/E-HANDOUTS


<https://riskandsafety.com/rss-talks>

- GHS Pictogram Guide for CFC Hazard Classes
- GHS Pictograms & Hazard Statements to Fire Code Hazard Classes
- Fire Code Hazard Class Definitions
- IFC 2024 Appendix E <https://codes.iccsafe.org/s/IFC2024P1/part-vii-appendices/IFC2024P1-Pt07-AppxE-SecE104.2>
- PubChem <https://pubchem.ncbi.nlm.nih.gov/ghs/>
- Risk and Safety Solutions <https://riskandsafety.com/>



EXAMPLE GHS PICTOGRAM GUIDE TO CFC HAZARD CLASSES

FLAMMABLE LIQUIDS

Pictogram	Signal Word	Hazard Statement	Hazard Code	Hazard Class
	Danger	Extremely flammable liquid and vapor	H224, Category 1	IA
	Danger	Highly flammable liquid and vapor	H225, Category 2	IB
	Warning	Flammable liquid and vapor	H226, Category 3	IC

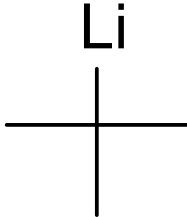
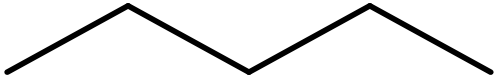
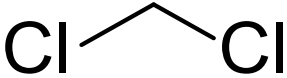
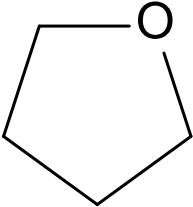
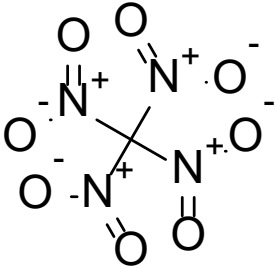
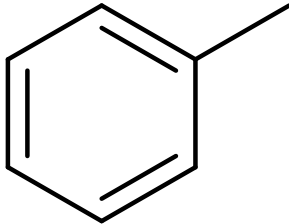
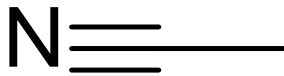
<https://codes.iccsafe.org/content/IFC2024P1/appendix-e-hazard-categories>

<https://riskandsafety.com/sites/default/files/inline-files/GHS%20Pictogram%20Guide%20to%20CFC%20Hazard%20Classes.pdf>

FIRE CODE DEFINITIONS

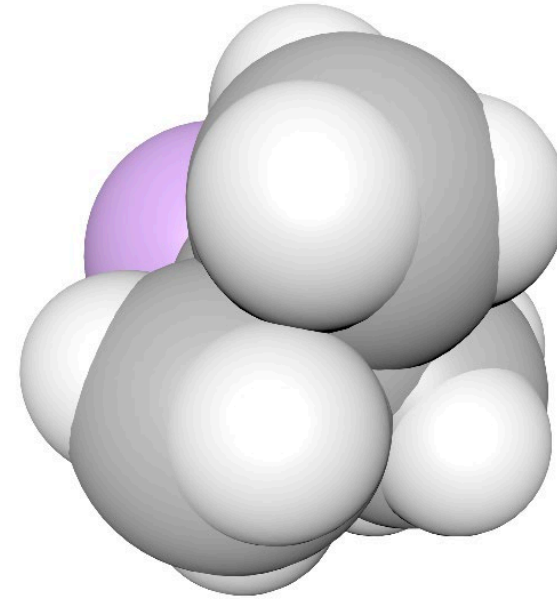
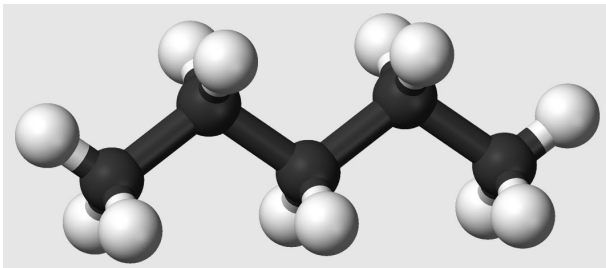
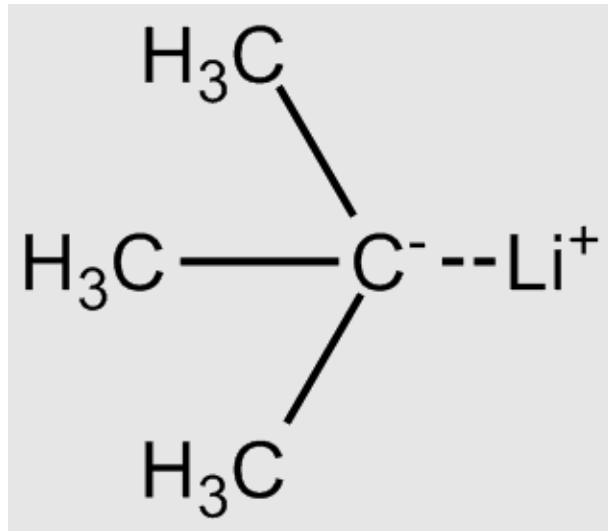
Fire Code	Definition
NTP state	Liquid (boiling point > 20 C, melting point < 20 C) @ 1atm
Toxic	<p><u>LD50</u> is greater than <u>50 mg/kg</u> and less than <u>500 mg/kg</u> in <u>rat, oral</u></p> <p><u>LC50</u> is greater than or equal to <u>200 ppmv</u> and less than <u>2000 ppmv</u> OR <u>LC50</u> is greater than <u>2 mg/L</u> and less than <u>20 mg/L</u> in rat, inhalation, 1 hr or less</p> <p><u>LD50</u> is greater than 200 mg/kg and less than 1000 mg/kg, rabbit, dermal</p>
Corrosive	...visible destruction of, or irreversible alterations in, living tissue by chemical action at the point of contact. ... intact skin of albino rabbits...following an exposure period of 4 hours. This term does not refer to action on inanimate surfaces.

CLASSIFICATION EXAMPLES

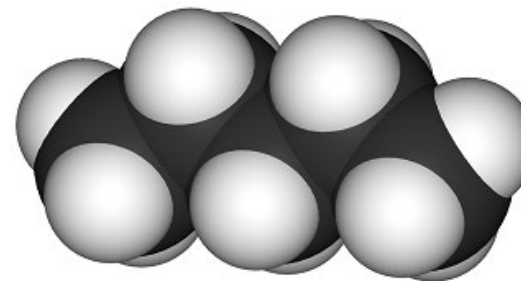
- ***t*-butyllithium 1.7 M in pentane**  
- **dichloromethane (methylene chloride)** 
- **tetrahydrofuran (THF)** 
- **tetranitromethane** 
- **toluene (methylbenzene)** 
- **acetonitrile (methyl cyanide)** 

LETS' CLASSIFY 😊

- t-butyllithium 1.7 M in pentane



tert-butyllithium
[594-19-4]
10-20%



pentane
109-66-0
70-90%

FROM 2020 SIGMA-ALDRICH SDS



- Highly flammable liquid and vapor. (H225 Cat 2)
- Catches fire spontaneously if exposed to air. (H250 Cat 1)
- In contact with water releases flammable gases which may ignite spontaneously. (H260 Cat 1)
- May be fatal if swallowed and enters airways. (H304 Cat 1)
- Causes severe skin burns and eye damage. (H314 Cat 1B)
- May cause drowsiness or dizziness. (H336 Cat 3)
- Toxic to aquatic life with long lasting effects. (H411 Cat 2)







FROM 2020 SIGMA-ALDRICH SDS

- Autolgnition Temperature – No Data
- Flash Point -49 C, Boiling Point – No Data

Acute Toxicity Estimate (ATE)

- Inhalation – 4 h = 30.1 mg/L (vapor) → 1 h ≈ 60.2 mg/L

FIRE CODE CLASS: T-BUTYLLITHIUM 1.7 M IN PENTANE

Pictogram	Hazard Statement	GHS Class	Fire Code Class
	Highly flammable liquid and vapor	Flammable liquids (Cat 2), H225	Flammable liquid IB
	Catches fire spontaneously if exposed to air	Pyrophoric liquids (Cat 1), H250	Pyrophoric
	In contact with water releases flammable gases which may ignite spontaneously	Chemicals which, in contact with water, emit flammable gases (Cat 1), H226	Water Reactive 3
	May be fatal if swallowed and enters airways	Aspiration hazards (Cat 1), H304	Other Health Hazard Material
	May cause drowsiness or dizziness	Specific Target organ toxicity – single exposure (Cat 3), Central Nervous system, H336	Other Health Hazard Material
	Causes severe skin burns and eye damage	Skin corrosion (Cat 1B), H314 Serious eye damage (Cat 1), H318	Corrosive

MAQ IMPACTS: T-BUTYLLITHIUM 1.7 M IN PENTANE

Fire Code Hazard Class	MAQ 1 st floor B occupancy, no sprinklers
Corrosive	500 lbs
Flammable Liquid: IB, IC	120 gal
Flammable Liquid: IA, IB, IC	120 gal
Irritant (IFC 2000)	No Limit
Other Health Hazard Material	No Limit
Pyrophoric	Not Allowed
Water Reactive: 3	5 lbs

LET'S CLASSIFY AGAIN 😊 DICHLOROMETHANE

- Pubchem <https://pubchem.ncbi.nlm.nih.gov/compound/6344>
- H302 (24%): Harmful if swallowed [**Warning** Acute toxicity, oral]
- H315 (29%): Causes skin irritation [**Warning** Skin corrosion/irritation]
- H319 (52%): Causes serious eye irritation [**Warning** Serious eye damage/eye irritation]
- H335 (11%): May cause respiratory irritation [**Warning** Specific target organ toxicity, single exposure; Respiratory tract irritation]
- H336 (34%): May cause drowsiness or dizziness [**Warning** Specific target organ toxicity, single exposure; Narcotic effects]
- H341 (23%): Suspected of causing genetic defects [**Warning** Germ cell mutagenicity]
- H351 (100%): Suspected of causing cancer [**Warning** Carcinogenicity]
- H373 (20%): May causes damage to organs through prolonged or repeated exposure [**Warning** Specific target organ toxicity, repeated exposure]



DICHLOROMETHANE (METHYLENE CHLORIDE)

Fisher Scientific (SDS 012/24/2021) [75-09-2] Signal Word: **Danger**



- Causes skin irritation (Skin Corrosion/Irritation, Cat 2)
- Causes serious eye irritation (Serious Eye Damage/Eye Irritation, Cat 2)
- May cause drowsiness or dizziness (Specific target organ toxicity (single exposure) Target Organs - Central nervous system, Cat 3)
- May cause cancer (Carcinogenicity Cat 1B)
- May cause damage to organs through prolonged or repeated exposure (Specific target organ toxicity - (repeated exposure) Target Organs - Liver, Kidney, Blood, Cat 2)

DICHLOROMETHANE (METHYLENE CHLORIDE)



Sigma-Aldrich (SDS 03/02/2024) [75-09-2], Signal Word: **Warning**

- Warning Causes skin irritation. Skin irritation (Cat 2), H315
- Causes serious eye irritation. Eye irritation (Cat 2A), H319
- May cause drowsiness or dizziness. Specific target organ toxicity - single exposure (Cat 3), Central nervous system, H336
- Suspected of causing cancer. Carcinogenicity (Cat 2), H351

MAQ IMPACTS: DICHLORMETHANE

Fire Code Hazard Class	MAQ 1 st floor B occupancy, no sprinklers
Irritant (IFC 2000)	No Limit
Other Health Hazard Material	No Limit

Occupationally Regulated Carcinogen – US [29CFR1910.1052](#) CA [8CCR5202](#)

Environmental Protection Agency - [TSCA](#)

LETS' CLASSIFY 😊 TETRAHYDROFURAN

Millipore Sigma SDS 03/02/2024



- Danger
- Highly flammable liquid and vapor. H225
- Harmful if swallowed. H302
- Causes serious eye irritation. H319
- May cause respiratory irritation. H335
- May cause drowsiness or dizziness. H336
- Suspected of causing cancer. H351

THF (MILLIPORE SIGMA SDS 03/02/2024)

- Melting Point -108.44 C
- Boiling Point 65 C
- Flash Point -21.2 C
- Upper Explosive Limit 12.4 %
- Lower Explosive Limit 1.5 %
- Autoignition Temperature 215 C

Liquid

Flammable

Not pyrophoric

MAQ IMPACTS: TETRAHYDROFURAN

Fire Code Hazard Class	MAQ 1 st floor B occupancy, no sprinklers
Flammable Liquid IB, IC	120 gallons
Irritant (IFC 2000)	No Limit
Other Health Hazard Material	No Limit

Other Non-Fire Code Hazards

Peroxide Former : With Concentration

LETS' CLASSIFY 😊 TETRANITROMETHANE

Millipore Sigma SDS 10/27/2023 [509-14-8]



- Danger
- May cause fire or explosion; strong oxidizer. H271
- Toxic if swallowed. H301
- Causes skin irritation. H315
- Causes serious eye irritation. H319
- Fatal if inhaled. H330
- May cause respiratory irritation. H335
- Suspected of causing cancer. H351

TETRANITROMETHANE (SDS)

- Appearance Form: liquid; Color: light yellow
- Melting point/range: 13 - 14 C (55 - 57 °F)
- Initial boiling point: 126 C (259 °F)
- Flash point 113 °C (235 °F)

Acute toxicity

- LD50 Oral - Rat - 130 mg/kg

MAQ IMPACTS: TETRANITROMETHANE

Fire Code Hazard Class	MAQ 1 st floor B occupancy, no sprinklers
Combustible Liquid: IIIB	13200 gal
Oxidizers: 4	Not Allowed
Highly Toxic: Inhalation	10 lbs
Irritant	No Limit
Other Health Hazard Material	No Limit

LET'S CLASSIFY 😊 TOLUENE

- H225 - Highly Flammable liquid and vapor (Category 2)
- H315 - Causes skin irritation (Category 2)
- H336 - May cause drowsiness or dizziness (Category 3)
- H304 - May be fatal if swallowed and enters airways (Category 1)
- H361 - Suspected of damaging fertility or the unborn child (Category 2)
- H373 - May cause damage to organs through prolonged or repeated exposure (Category 2)
- H401 - Toxic to aquatic life (Category 2)
- H412 - Harmful to aquatic life with long lasting effects (Category 3)



MAQ IMPACTS: TOLUENE

Fire Code Hazard Class	MAQ 1st floor B occupancy, no sprinklers
Flammable Liquid: IB, IC	120 gal
Irritant	No Limit
Other Health Hazard Material	No Limit

LET'S CLASSIFY 😊 ACETONITRILE

- H225 - Highly Flammable liquid and vapor (Category 2)
- H302 - Harmful if swallowed (Category 4)
- H312 - Harmful in contact with skin (Category 4)
- H319 - Causes serious eye irritation (Category 2A)
- H332 - Harmful if inhaled (Category 4)



MAQ IMPACTS: ACETONITRILE

Fire Code Hazard Class	MAQ 1st floor B occupancy, no sprinklers
Flammable Liquid: IB, IC	120 gal
Irritant	No Limit

Product	RSS Fire Code Classification for MAQ
t-butyllithium 1.7 M in pentane	Flammable Liquid IB; Pyrophoric; Water reactive 3; Irritant; Corrosive; Other Health Hazard Material
dichloromethane	Irritant; Other Health Hazard Material
tetrahydrofuran	Flammable Liquid IB; Irritant; Other Health Hazard Material
tetranitromethane	Combustible Liquid IIIB; Oxidizers Class 4; Highly Toxic; Irritant; Other Health Hazard Material
toluene	Flammable Liquid IB; Irritant; Other Health Hazard Material
acetonitrile	Flammable Liquid IB; Irritant

CLASSIFICATION EXAMPLE SUMMARY

QUESTIONS?



RESOURCES/E-HANDOUTS

<https://riskandsafety.com/rss-talks>

- GHS Pictogram Guide for CFC Hazard Classes
- GHS Pictograms & Hazard Statements to Fire Code Hazard Classes
- Fire Code Hazard Class Definitions
- IFC 2024 Appendix E <https://codes.iccsafe.org/s/IFC2024P1/part-vii-appendices/IFC2024P1-Pt07-AppxE-SecE104.2>
- PubChem <https://pubchem.ncbi.nlm.nih.gov/ghs/>

RESOURCES

NIST

- <https://webbook.nist.gov/chemistry/>
- <https://www.nist.gov/pml/productsservices/physical-reference-data>

UNECE GHS

- <https://unece.org/transport/dangerous-goods/ghs-rev10-2023>

NIH NLM PubChem

- <https://pubchem.ncbi.nlm.nih.gov/ghs/>
- All suppliers who sell to people who are required to provide SDS to the people who obtain use the hazardous material* in their work

**as defined by OSHA, excludes 'articles', additives and alcoholic beverages, cosmetics, drugs and pharmaceuticals, hazardous wastes & remediation, tobacco & tobacco products, wood & lumber, consumer products, non-hazardous nuisance particulates & dust, ionizing & non-ionizing radiation, biological hazards, office & school supplies*

RISK AND SAFETY SOLUTIONS

- We want to hear from you!
- <https://calendly.com/saroper/15min>
- Risk and Safety Solutions
<https://riskandsafety.com/>

