California Fire Code Chemical Hazard Classification discussion with examples

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W-L1

Wednesday 2/28/2024

https://riskandsafety.com/rss-talks

26th California Unified Program Annual Training Conference
February 26-29, 2024

Poll #1 Training/Experience

- ❑ Hazardous Materials Incident Commander
- ❑ Hazardous Materials Technician
- ❑ Hazardous Materials Instructor
- ❑ Haz Mat Technical Reference Specialist
- ❑ Haz Mat Specialist
- ❑ Haz Mat Assistant Safety Officer
- ❑ Chemistry Degree or Industrial Hygienist

Why I Care?

- UC has a major focus on MAQ compliance
- The MAQ concept is new to most people
- The rules are complicated
- In academia, new faculty have very little control over where their rooms are assigned
- The rules seem arbitrary

Poll #2 Familiarity with MAQ

- ❑ Architect or building design planner
- ❑ Fire Marshal
- ❑ Fire Protection Engineer
- ❑ Involved in Construction
- ❑ I've heard of it
- ❑ What's MAQ?

History of loss

- 48 BCE Great Library of Alexandria Fire
- 64 CE Great Fire of Rome – Nero
- 1871 Great Chicago Fire ~300 deaths
- 1903 Chicago Iroquois Theatre Fire 602 deaths
- 1911 Triangle Shirtwaist Factory fire 147 deaths

The Fire of Rome, 18 July 64 AD' by Hubert Robert, 1733-1808 CE.
(Musee des Beaux-Arts Andre Malraux, Le Havre, France)

Rules that result…

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

Standardizing Codes in 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

MAQ Limits are Complex

- Prior to 2000, no comprehensive limits
- Starting in 2001 California Fire Codes limits quantities of chemicals
- 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

Changes in MAQ

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

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

IFC is model code in most states

3/10/2020 https://blog.koorsen.com/the-international-fire-code-its-history-and-role-in-fire-safety-today
Koorsen Fire & Security

Chemical Hazards in Fire Code MAQ limits

Health Hazards

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

Physical Hazards

- Combustibles
- Flammable
- Pyrophoric
- Oxidizer
- Explosives
- Organic peroxide
- Unstable (reactive)
- Water reactive

MAQ CFC Tables 5003.1.1(1-4)

RISK & SAFETY SOLUTIONS

Indoor Control Areas

TABLE 5003.1.1(1)
MAXIMUM ALLOWABLE QUANTITY PER CONTROL AREA OF HAZARDOUS MATERIALS POSING A PHYSICAL HAZARD[a, j, m, n, p]

MATERIAL	CLASS	GROUP WHEN THE MAXIMUM ALLOWABLE QUANTITY IS EXCEEDED	STORAGE[b] Solid pounds (cubic feet)	STORAGE[b] Liquid gallons (pounds)	STORAGE[b] Gas (cubic feet at NTP)	USE-CLOSED SYSTEMS[b] Solid pounds (cubic feet)	USE-CLOSED SYSTEMS[b] Liquid gallons (pounds)	USE-CLOSED SYSTEMS[b] Gas (cubic feet at NTP)	USE-OPEN SYSTEMS[b] Solid pounds (cubic feet)	USE-OPEN SYSTEMS[b] Liquid gallons (pounds)
Combustible dust	NA	H-2	See Note q	NA	NA	See Note q	NA	NA	See Note q	NA
Combustible fibers[o]	Loose Baled[o]	H-3	(100) (1,000)	NA	NA	(100) (1,000)	NA	NA	(20) (200)	NA
Combustible liquid[c, i]	II IIIA IIIB	H-2 or H-3 H-2 or H-3 NA	NA	120[d, e] 330[d, e] 13,200[e, f]	NA	NA	120[d] 330[d] 13,200[f]	NA	NA	30[d] 80[d] 3,300[f]
Consumer fireworks	1.4G	H-3	125[e, l]	NA	NA	NA	NA	NA	NA	NA
Cryogenic Flammable	NA	H-2	NA	45[d]	NA	NA	45[d]	NA	NA	10[d]
Cryogenic Inert	NA	NA	NA	NA	NL	NA	NA	NL	NA	NA
Cryogenic Oxidizing	NA	H-3	NA	45[d]	NA	NA	45[d]	NA	NA	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] 10[e, g] 50[e, g] 125[d, e, l] 1[e, g] 1[e, g]	(1)[e, g] (1)[e, g] (10)[e, g] (50)[e, g] NA (1)[e, g] NA	NA	0.25[g] 0.25[g] 1[g] 50[g] NA 0.25[g] NA	(0.25)[g] (0.25)[g] (1)[g] (50)[g] NA (0.25)[g] NA	NA	0.25[g] 0.25[g] 1[g] NA NA 0.25[g] NA	(0.25)[g] (0.25)[g] (1)[g] NA NA (0.25)[g] NA
Flammable gas	Gaseous Liquefied	H-2	NA	NA (150)[d, e]	1,000[d, e] NA	NA	NA (150)[d, e]	1,000[d, e] NA	NA	NA
Flammable liquid[c]	IA IB and IC	H-2 or H-3	NA	30[d, e] 120[d, e]	NA	NA	30[d] 120[d]	NA	NA	10[d] 30[d]
Flammable liquid, combination (IA, IB, IC)	NA	H-2 or H-3	NA	120[d, e, h]	NA	NA	120[d, h]	NA	NA	30[d, h]
Flammable solid	NA	H-3	125[d, e]	NA	NA	125[d]	NA	NA	25[d]	NA

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] Solid pounds (cubic feet)	STORAGE[b] Liquid gallons (pounds)	STORAGE[b] Gas (cubic feet at NTP)	USE-CLOSED SYSTEMS[b] Solid pounds (cubic feet)	USE-CLOSED SYSTEMS[b] Liquid gallons (pounds)	USE-CLOSED SYSTEMS[b] Gas (cubic feet at NTP)	USE-OPEN SYSTEMS[b] Solid pounds (cubic feet)	USE-OPEN SYSTEMS[b] Liquid gallons (pounds)
Inert Gas	Gaseous Liquefied	NA NA	NA NA	NA NA	NL NL	NA NA	NA NA	NL NL	NA NA	NA NA
Organic peroxide	UD I II III IV V	H-1 H-2 H-3 H-3 NA NA	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	NA	0.25[g] 1[d] 50[d] 125[d] NL NL	(0.25)[g] (1)[d] (50)[d] (125)[d] NL NL	NA	0.25[g] 1[d] 10[d] 25[d] NL NL	(0.25)[g] (1)[d] (10)[d] (25)[d] NL NL
Oxidizer	4 3[k] 2 1	H-1 H-2 or H-3 H-3 NA	1[g] 10[d, e] 250[d, e] 4,000[e, f]	(1)[e, g] (10)[d, e] (250)[d, e] (4,000)[e, f]	NA	0.25[g] 2[d] 250[d] 4,000[f]	(0.25)[g] (2)[d] (250)[d] (4,000)[f]	NA	0.25[g] 2[d] 50[d] 1,000[f]	(0.25)[g] (2)[d] (50)[d] (1,000)[f]
Oxidizing gas	Gaseous Liquefied	H-3	NA	NA (150)[d, e]	1,500[d, e] NA	NA	NA (150)[d, e]	1,500[d, e] NA	NA	NA
Pyrophoric	NA	H-2	4[e, g]	(4)[e, g]	50[e, g]	1[g]	(1)[g]	10[e, g]	0	0
Unstable (reactive)	4 3 2 1	H-1 H-1 or H-2 H-3 NA	1[e, g] 5[d, e] 50[d, e] NL	(1)[e, g] (5)[d, e] (50)[d, e] NL	10[e, g] 50[d, e] 750[d, e] NL	0.25[g] 1[d] 50[d] NL	(0.25)[g] (1)[d] (50)[d] NL	2[e, g] 10[d, e] 750[d, e] NL	0.25[g] 1[d] 10[d] NL	(0.25)[g] (1)[d] (10)[d] NL
Water reactive	3 2 1	H-2 H-3 NA	5[d, e] 50[d, e] NL	(5)[d, e] (50)[d, e] NL	NA	5[d] 50[d] NL	(5)[d] (50)[d] NL	NA	1[d] 10[d] NL	(1)[d] (10)[d] NL

For SI: 1 cubic foot = 0.02832 m^3, 1 pound = 0.454 kg, 1 gallon = 3.785 L.
NA = Not Applicable, NL = Not Limited, UD = Unclassified Detonable.
a. For use of control areas, see Section 5003.8.3.
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 1.3 gallons. In retail and wholesale sales occupancies, the quantities of medicines, foodstuff or consumer products and cosmetics containing not more than 50 percent by volume of water-miscible liquids with the remainder of the solutions not being flammable shall not be limited, provided that such materials are packaged in individual containers not exceeding 1.3 gallons.
d. *[SFM] In other than Group L 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 e also applies, the increase for both notes shall be applied accumulatively.

TABLE 5003.1.1(1)—continued
MAXIMUM ALLOWABLE QUANTITY PER CONTROL AREA OF HAZARDOUS MATERIALS POSING A PHYSICAL HAZARD[a, j, m, n, p]

e. Maximum allowable quantities shall be increased 100 percent where stored in approved storage cabinets, day boxes, gas cabinets, gas rooms, exhausted enclosures or in listed safety cans in accordance with Section 5003.9.10. Where Note d also applies, the increase for both notes shall be applied accumulatively.
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 IA, Class IB or Class IC flammable liquids.
i. The maximum allowable quantity shall not apply to fuel oil storage complying with Section 603.3.2.
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 where such materials are necessary for maintenance purposes, operation or sanitation of equipment where the storage containers and the manner of storage are approved.
l. Net weight of 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.
n. For storage and display quantities in Group M and storage quantities in Group S occupancies complying with Section 5003.11, see Table 5003.11.1.
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 *California Mechanical Code*.
   4. Liquid fuels in piping systems and fixed appliances, regulated by the *California Mechanical Code*.
   5. Alcohol-based hand rubs classified as Class I or II liquids in dispensers that are installed in accordance with Sections 5705.5 and 5705.5.1. 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]

MATERIAL	CLASS	STORAGE[b] Solid pounds (cubic feet)	STORAGE[b] Liquid gallons (pounds)[d]	STORAGE[b] Gas cubic feet at NTP	USE-CLOSED SYSTEMS[b] Solid pounds (cubic feet)	USE-CLOSED SYSTEMS[b] Liquid gallons (pounds)[d]	USE-CLOSED SYSTEMS[b] Gas cubic feet at NTP	USE-OPEN SYSTEMS[b] Solid pounds (cubic feet)	USE-OPEN SYSTEMS[b] Liquid gallons (pounds)[d]
Flammable gas	Gaseous Liquefied	Not Applicable	Not Applicable (300)	3,000 Not Applicable	Not Applicable	Not Applicable (150)	1,500 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 Applicable Not Applicable	Not Limited Not Limited	Not Applicable Not Applicable	Not Applicable Not Applicable	Not Limited Not Limited	Not Applicable Not Applicable	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 II III IV V	20 200 500 1,000 Not Limited	(20) (200) (500) (1,000) Not Limited	Not Applicable	10 100 250 500 Not Limited	(10) (100) (250) (500) Not Limited	Not Applicable	2 20 50 100 Not Limited	(2) (20) (50) (100) Not Limited
Oxidizer	4 3 2 1	2 40 1,000 Not Limited	(2) (40) (1,000) Not Limited	Not Applicable	1 20 500 Not Limited	(1) (20) (500) Not Limited	Not Applicable	0.25 4 100 Not Limited	(0.25) (4) (100) Not Limited
Oxidizing gas	Gaseous Liquefied	Not Applicable	Not Applicable (600)	6,000 Not Applicable	Not Applicable	Not Applicable (300)	1,500 Not Applicable	Not Applicable	Not Applicable
Pyrophoric materials	Not Applicable	8	(8)	100	4	(4)	10	0	0
Unstable (reactive)	4 3 2 1	2 20 200 Not Limited	(2) (20) (200) Not Limited	20 200 1,000 1,500	1 10 100 Not Limited	(1) (10) (100) Not Limited	2 10 250 Not Limited	0.25 1 10 Not Limited	(0.25) (1) (10) Not Limited
Water reactive	3 2 1	20 200 Not Limited	(20) (200) Not Limited	Not Applicable	10 100 Not Limited	(10) (100) Not Limited	Not Applicable	1 10 Not Limited	(1) (10) Not Limited

For SI: 1 pound = 0.454 kg, 1 gallon = 3.785 L, 1 cubic foot = 0.02832 m^3.
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 5003.11.
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, f]

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

For SI: 1 cubic foot = 0.02832 m^3, 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 5003.11.
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.

Compliance Challenges

- Flammable liquid IA MAQ
- 1st floor - 30 gallons
- 2nd floor - 22.5 gallons
- 3rd floor - 15 gallons
- 4th thru 6th floors - 3.75 gallons
- 7th floor and higher - 1.5 gallons

- If there are 4 lab groups in one control area, it is possible that each would get 1/3rd of a gallon for all IA flammable liquids

Forbidden Classes

- Only allowed with sprinklers
  - 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)

Resources

https://linktr.ee/riskandsafetysolutions

- Definitions from California Fire Code about Hazard Classes (https://codes.iccsafe.org/content/CAFC2022P2/california-code-of-regulations-title-24)
- GHS Pictogram Guide to CFC Hazard Classes
- GHS Pictograms & Hazard Statement to IFC Hazard Class (https://codes.iccsafe.org/s/IFC2024P1/part-vii-appendices/IFC2024P1-Pt07-AppxE-SecE104.2)
- GHS Classification Summary – PubChem (https://pubchem.ncbi.nlm.nih.gov/ghs/)

Resources in pdf

https://riskandsafety.com/rss-talks

- Definitions from California Fire Code about Hazard Classes.pdf
- GHS Pictogram Guide to CFC Hazard Classes .pdf
- GHS Pictograms & Hazard Statement to IFC Hazard Class.pdf
- GHS Classification Summary – PubChem.pdf
- ToxicFlammable Notes.pdf

SDS Resources

https://riskandsafety.com/rss-talks

Dibenzylamine MilliporeSigma SDS 2023.06.06.pdf

DIBENZYLAMINE-ThermoFisher SDS 2021.12.24.pdf

ethyl alcohol Millipore Sigma SDS 2023.08.23.pdf

tert-butyllithium 1.7 M in pentane Millipore Sigma SDS.pdf

Acetone MilliporeSigma SDS 2023.07.25.pdf

RISK & SAFETY SOLUTIONS

10 min

BREAK TIME!

https://riskandsafety.com/rss-talks

CALIFORNIA CUPA FORUM

Classes w/ quantitative definitions

- Flammable & combustive Liquids
- Pyrophorics
- Toxic & Highly Toxic

Flammable & Combustible Liquids

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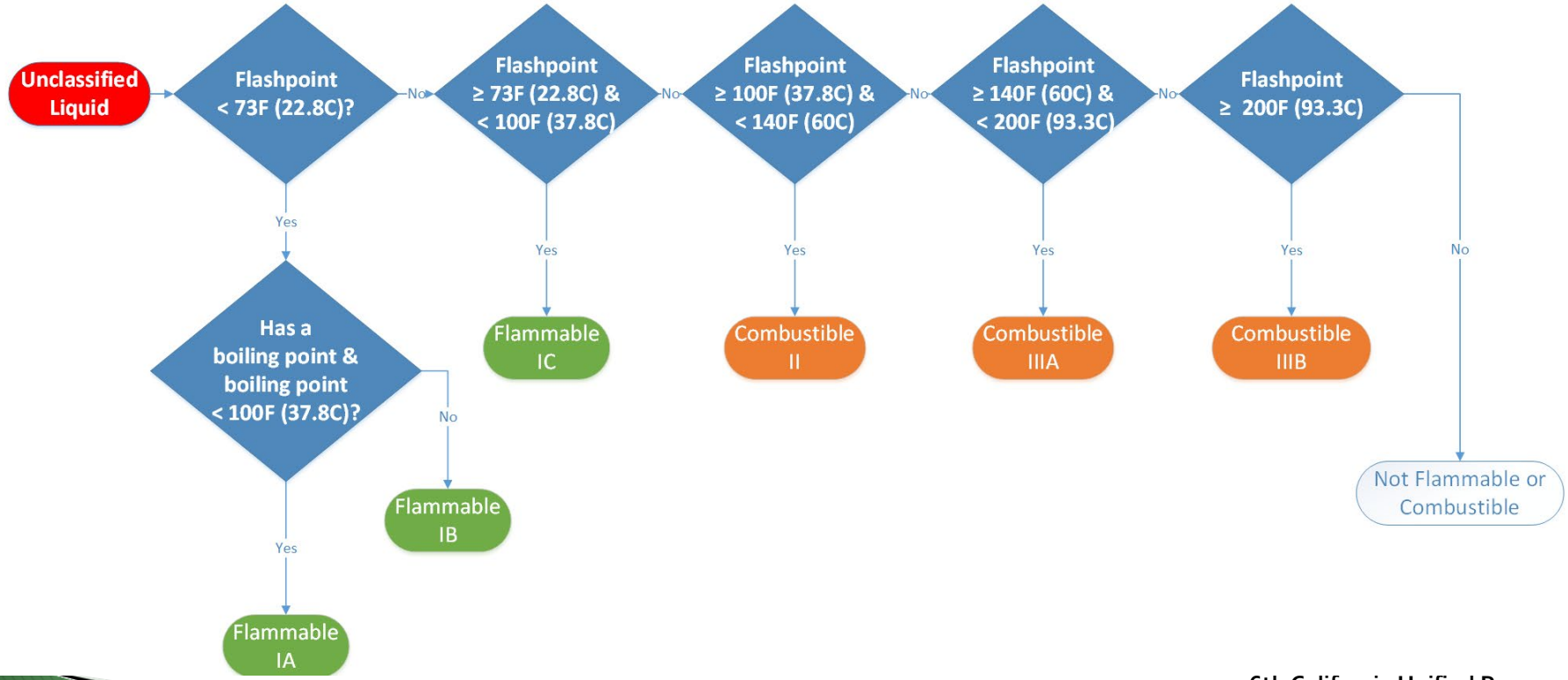

Classification Comparison

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	≈	• Category 3, FP ≥ 23 C & ≤ 60 C
• Class II, FP ≥ 37.8 C & < 60 C		
• Class IIIA, FP ≥ 60 C & 93.3 C	≈	• Category 4, FP > 60C & ≤ 93C
• Class IIIB, FP ≥ 93.3 C		

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

Unstable (reactive) Material

A material, other than an explosive, which in the pure state or as commercially produced, will vigorously polymerize, decompose, condense or become self-reactive and undergo other violent chemical changes, including explosion, when exposed to heat, friction or shock, or in the absence of an inhibitor, or in the presence of contaminants, or in contact with incompatible materials.

Unstable (reactive) materials are subdivided as follows:

- Class 4; Class 3; Class 2; Class 1

Unstable (reactive) Material

Class 4. Materials that in themselves are **readily capable of detonation** or explosive decomposition or explosive reaction at normal temperatures and pressures. This class includes materials that are sensitive to mechanical or localized thermal shock at normal temperatures and pressures.

MAQ 1st floor, B occupancy, only allowed with sprinklers:

1 pounds for solid & liquids, 10 cubic feet for gas

Unstable (reactive) Material

Class 3. Materials that in themselves are **capable of detonation** or of explosive decomposition or explosive reaction but which require a strong initiating source or which must be heated under confinement before initiation. This class includes materials that are sensitive to thermal or mechanical shock at elevated temperatures and pressures.

MAQ 1st floor, B occupancy, no sprinklers:

5 pounds for solid & liquids, 50 cubic feet for gas

Unstable (reactive) Material

Class 2. Materials that in themselves are normally unstable and readily undergo violent chemical change but **do not detonate**. This class includes materials that can undergo chemical change with rapid release of energy at normal temperatures and pressures, and that can undergo violent chemical change at elevated temperatures and pressures.

MAQ 1st floor, B occupancy, no sprinklers:

50 pounds for solid & liquids, 750 cubic feet for gas

Unstable (reactive) Material

Class 1. Materials that in themselves are normally stable but which can become unstable at elevated temperatures and pressure.

MAQ 1st floor, B occupancy, no sprinklers:

No limit

Unstable (reactive) w/ GHS

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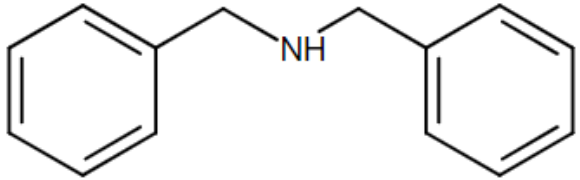
Pictogram	Signal word	Hazard Statement	Hazard Code	Hazard Class
	Danger	Heating may cause an explosion	H240, Type A	4
	Danger	Heating may cause a fire or explosion	H241, Type B	3
	Danger	Heating may cause a fire	H242, Type C *or* H242, Type D	2
	Warning	Heating may cause a fire	H242, Type E *or* H242, Type F	1

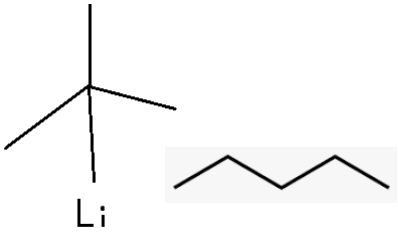
Let's classify ☺

- dibenzylamine

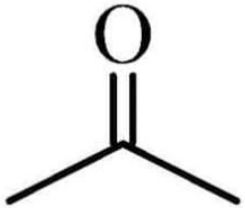


- ethyl alcohol

- tert-butyllithium



- acetone



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5 min Stretch Time!

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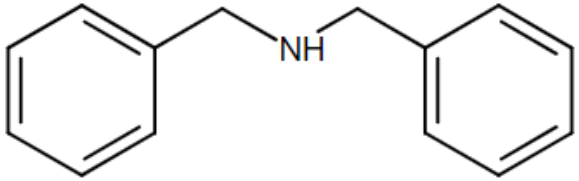
26th California Unified Program Annual Training Conference
February 26-29, 2024

Poll #3 Which Hazard Classes?

Dibenzylamine *(liquid)*



Please complete the poll with all of the hazard classes you think apply

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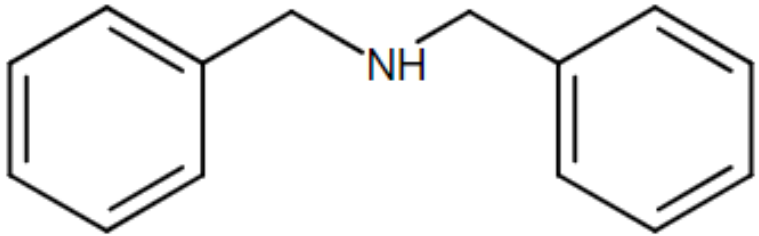
Create word cloud

Poll #3 Word Cloud
Dibenzylamine

Discuss word cloud

Dibenzylamine

- https://commonchemistry.cas.org/
- CAS: 103-49-1
- Boiling Point 270 °C
- Melting Point -26 °C



Dibenzylamine *(continued)*

- https://pubchem.ncbi.nlm.nih.gov/
  - » https://pubchem.ncbi.nlm.nih.gov/compound/7656

- GHS Hazard Statements

H302 (**99.58%**)**: Harmful if swallowed** [**Warning** Acute toxicity, oral]
H314 (73.31%): **Causes severe skin burns and eye damage** [**Danger** Skin corrosion/irritation]
H315 (26.69%): **Causes skin irritation** [**Warning** Skin corrosion/irritation]
H318 (36.86%): **Causes serious eye damage** [**Danger** Serious eye damage/eye irritation]
H319 (26.69%): **Causes serious eye irritation** [**Warning** Serious eye damage/eye irritation]
H410 (39.41%): Very toxic to aquatic life with long lasting effects [Warning Hazardous to the aquatic environment, long-term hazard]
H412 (20.34%): Harmful to aquatic life with long lasting effects [Hazardous to the aquatic environment, long-term hazard]

Dibenzylamine *(continued 2)*

- Search for SDS “Dibenzylamine SDS”
- Millipore Sigma
  https://www.sigmaaldrich.com/US/en/sds/aldrich/d34108
- ThermoFisher
  https://www.fishersci.com/store/msds?partNumber=AC112612500&productDescription=DIBENZYLAMINE%2C+98%25+250MLDIBEN&vendorId=VN00032119&countryCode=US&language=en

Extracted data

Sigma-Aldrich (6/6/2023)

Danger

Harmful if swallowed.

Causes severe skin burns and eye damage.

Toxic to aquatic life.

Very toxic to aquatic life with long lasting effects.

Flash point 143 C (289 F)

Autoignition Temp 395 C (743 F)

Fisher Scientific (12/24/2021)

Danger

Harmful if swallowed

Causes severe skin burns and eye damage

May cause respiratory irritation

Flash point 138 C (280 F)

Autoignition Temp 425 C (797 F)

NFPA 704

GHS Pictogram Guide to CFC Hazard Classes

RISK & SAFETY SOLUTIONS

Corrosion

Pictogram	Signal Words	Hazard Statement	Code	Fire Code Material
	Danger	Causes severe skin burns and eye damage	**H314, Category 1 (1A, 1B, 1C)**	Corrosive

Sigma-Aldrich

Danger

Harmful if swallowed.

Causes severe skin burns and eye damage.

Toxic to aquatic life.

Very toxic to aquatic life with long lasting effects.

Fisher Scientific

Danger

Harmful if swallowed

Causes severe skin burns and eye damage

May cause respiratory irritation

CALIFORNIA CUPA FORUM

Extracted Toxicity Data

MilliporeSigma-Aldrich

Acute toxicity

LD50 Oral - Rat - female - 632 mg/kg

Inhalation: No data available

LD50 Dermal - Rat - > 2,000 mg/kg

Skin corrosion/irritation

Skin – Rabbit: Corrosive, category 1C

ThermoFisher Scientific

Acute toxicity

LD50 Oral 632 mg/kg (Rat)

LC50 Inhalation Not listed

LD50 Dermal>2000 mg/kg (Rat)

CFC Definitions

NTP state = Liquid *(boiling point > 20 C, melting point < 20 C) @ 1atm*

Toxic

- LD50 is greater than 50 mg/kg and less than 500 mg/kg in rat, oral
- LC50 is greater than or equal to 200 ppmv and less than 2000 ppmv OR LC50 is greater than 2 mg/L and less than 20 mg/L in rat, inhalation, 1 hr or less
- LD50 is greater than 200 mg/kg and less than 1000 mg/kg, rabbit, dermal

Corrosive

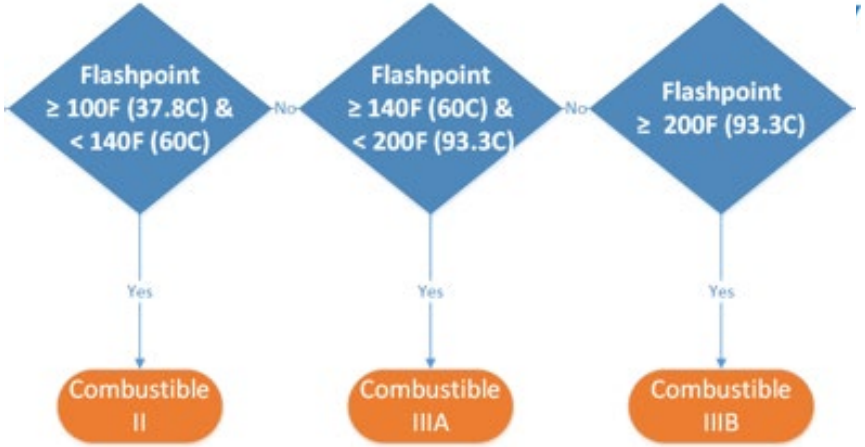
…visible destruction of, or irreversible alterations in, living tissue by chemical action at the point of contact. … intact skin of albino rabbits…following an exposure period of 4 hours. This term does not refer to action on inanimate surfaces.

Combustible Liquid IIIB

No GHS Hazard Statement or pictogram

Fire Code Based on IFC		OSHA Based on GHS
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	≈	• Category 3, FP ≥ 23 C & ≤ 60 C
• Class II, FP ≥ 37.8 C & < 60 C		
• Class IIIA, FP ≥ 60 C & 93.3 C	≈	• Category 4, FP > 60C & ≤ 93C
• Class IIIB, FP ≥ 93.3 C		

CFC Definitions



Combustible Liquids

A liquid having a closed cup flash point at or above 100°F (38°C). Combustible liquids shall be subdivided as follows:

Class II. Liquids having a closed cup flash point at or above 100°F (38°C) and below 140°F (60°C).

Class IIIA. Liquids having a closed cup flash point at or above 140°F (60°C) and below 200°F (93°C).

Class IIIB. Liquids having closed cup flash points at or above 200°F (93°C).

RSS Dibenzylamine Classifications at UC

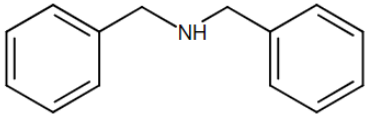
Fire Code Hazard Class

- Combustible Liquid : IIIB
- Irritant (CFC2001)
- Corrosive Liquid

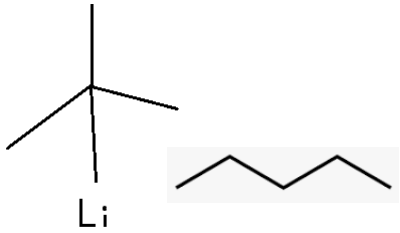
MAQ 1st floor B, No Sprinklers

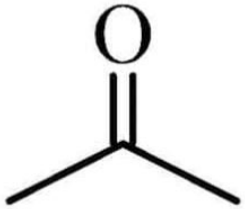
- 13,200 gal
- No Limit (2001 CFC)
- 500 gal

Let's classify ☺

- ✓dibenzylamine 

- ethyl alcohol 

- tert-butyllithium 

- acetone 

Poll #4 Which Hazard Classes?

Ethyl alcohol *(liquid)*

Please complete the poll with all of the hazard classes you think apply

---

Create word cloud

Poll #4 Word Cloud
Ethyl alcohol

Discuss word cloud

Ethyl alcohol

- Sigma-Aldrich (8/23/2023) CAS [64-17-5]
- Danger
- Highly flammable liquid and vapor.
- Causes serious eye irritation.
- Flammable liquids (Category 2)H225
- Eye irritation (Category 2A), H319

BP: 78 C (172 F)
FP: 13 C (55 F)
AIT: 363-425 C (685-797 F)
UEL: 27.7 %
LEL: 3.1 %

LD50 Oral – Rat: 10,470 mg/kg
LC50 Inhalation – Rat, 4h: 124.7 mg/L
Skin - Rabbit: No skin irritation

Ethyl alcohol compare to resources

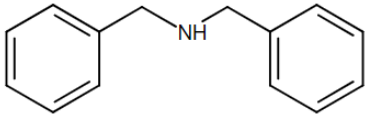
From SDS	GHS guide	CFC Definition
Danger; Highly flammable liquid and vapor.” 	Flammable Liquid IB	
FP: 13 C (55 F); BP: 78 C (172 F)”		Flammable Liquids Class IB. Liquids flash point < 73°F (23°C) and boiling point ≥ 100°F (38°C).
Flammable liquids (Category 2), H225	Flammable Liquid IB	
Eye irritation (Category 2A), H319 	Irritant (CFC2001)	eye irritant 16 C.F.R. 1500.42 or other approved techniques.

RSS Ethanol Classifications at UC

Fire Code Hazard Class		MAQ 1st floor B, No Sprinklers
Flammable Liquid : IB, IC		120 gal
Flammable Liquid : IA, IB, IC		120 gal
Irritant (CFC2001)		No Limit (2001 CFC)

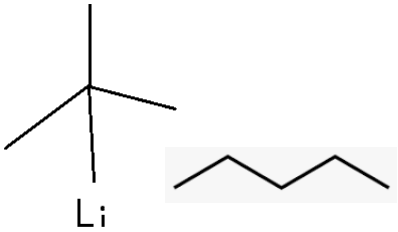
Let's classify ☺

- ✓dibenzylamine

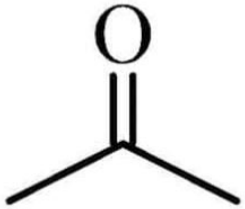


- ✓ethyl alcohol

- tert-butyllithium



- acetone

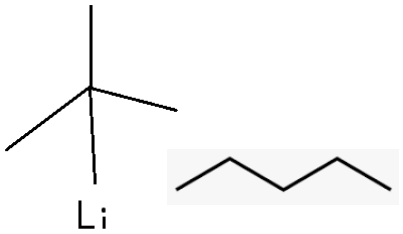


Poll #5 Which Hazard Classes?
tert-butyllithium 1.7 M in pentane *(liquid)*

Please complete the poll with all of the hazard classes you think apply

---

Create word cloud



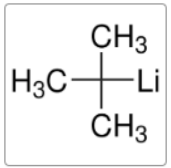
Poll #5 Word Cloud

tert-butyllithium 1.7 M in pentane

Discuss word cloud

tert-butyllithium 1.7 M in pentane

- Sigma-Aldrich



***tert*-Butyllithium solution**

Synonym(s): Lithium-2-methyl-2-propanide, t-BuLi

Linear Formula: $(CH_3)_3CLi$

CAS No.: 594-19-4 **Molecular Weight:** 64.06

Beilstein No.: 3587204

- H225 Highly flammable liquid and vapor.
- H250 Catches fire spontaneously if exposed to air.
- H260 In contact with water releases flammable gases which may ignite spontaneously.
- H304 May be fatal if swallowed and enters airways.
- H314 Causes severe skin burns and eye damage.
- H336 May cause drowsiness or dizziness.

Autoignition Temperature (AIT) = No data available
Flash Point= -49 C (-56 F)
Boiling Point = No data
Acute toxicity estimate
Inhalation - 4 h - 30.1 mg/l - vapor

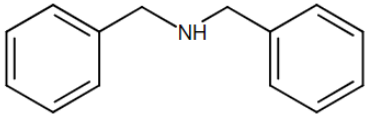
t-butyllithium 1.7 M in pentane

Pictogram	Hazard Statements (Signal Word - Danger)	GHS Classification	CFC Hazard 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), H260	Water Reactive 3
	May be fatal if swallowed and enters airways.	Aspiration hazard (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

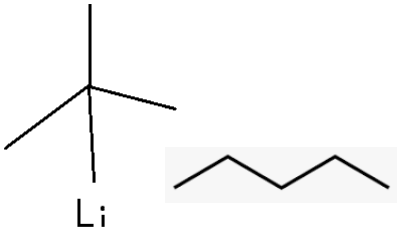
RSS *t*-butyllithium 1.7 M in pentane Classifications at UC

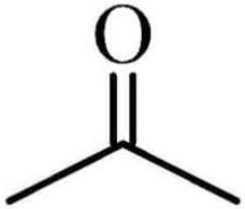
Fire Code Hazard Class		MAQ 1st floor B, No Sprinklers
Flammable Liquid : IB, IC		120 gal
Flammable Liquid : IA, IB, IC		120 gal
Pyrophoric		0 gal
Irritant (CFC2001)		No Limit (2001 CFC)
Other Health Hazard Material		No Limit (2001 CFC)

Let's classify ☺

- ✓dibenzylamine 

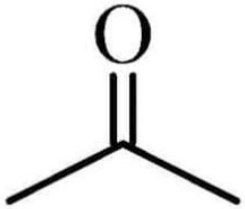
- ✓ethyl alcohol 

- ✓tert-butyllithium 

- acetone 

Poll #6 Which Hazard Classes?

Acetone *(liquid)*



Please complete the poll with all of the hazard classes you think apply

---

Create word cloud

Poll #6 Word Cloud

Acetone

Discuss word cloud

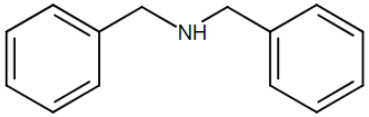
Acetone

- Sigma-Aldrich
- Highly flammable liquid and vapor.
  - Flammable liquids (Cat 2), H225
- 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

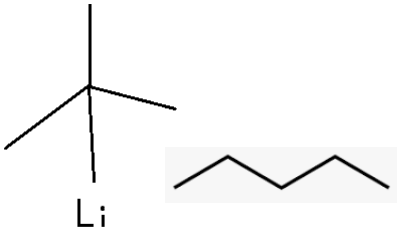
RSS *Acetone* Classifications at UC

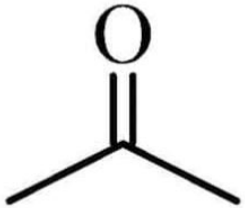
Fire Code Hazard Class		MAQ 1st floor B, No Sprinklers
Flammable Liquid : IB, IC		120 gal
Flammable Liquid : IA, IB, IC		120 gal
Irritant (CFC2001)		No Limit (2001 CFC)
Other Health Hazard Material		Not Included

Let's classify ☺

- ✓dibenzylamine 

- ✓ethyl alcohol 

- ✓tert-butyllithium 

- ✓acetone 

Common Chemicals *Extra Credit*

RISK & SAFETY SOLUTIONS

Solid	**Liquid**	**Gas**
Sodium hydroxide	Sulfuric acid	Ethylene
Aluminum oxide	Benzene	Ammonia
Sodium bicarbonate	Ethanol	Propylene
Calcium carbonate	Ethylene glycol	Chlorine
	Acetic acid	Nitrogen
	Acetone	Formaldehyde
	Hydrochloric acid	
	Formaldehyde (aq)	
	Ammonia (aq)	
	Sodium hydroxide (aq)	

Summary

- No need to have a chemistry degree
- Seemingly arbitrary and complicated regulations can be the basis for employment
- Making reasonable approximations of hazard classes can be fun ☺

Additional 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
- **CFC 2022**
  - https://codes.iccsafe.org/content/CAFC2022P2/california-code-of-regulations-title-24
- **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

Any Questions?

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