SafetyStratus

Fire Code and Maximum Allowable Quantities (MAQ)

A Need-to-Know Guide for Safe Chemical Storage

The safe and secure storage of chemicals in a laboratory is a fundamental component of daily operations. As with most industries, each laboratory that handles chemicals must adhere to specific regulations when it comes to chemical storage. How and where chemicals can be stored is dictated and monitored by two different regulatory bodies, the National Fire Protection Association (NFPA) and the International Code Council's (ICC) International Building Code/ International Fire Code (IBC/IFC).

The unified goal for the NFPA and the IBC/IFC is to set standards for building construction and layout, ensuring the safety of anyone who is working within or occupying a facility. Because chemical inventory is such an intricate detail within laboratory functionality, both the NFPA and IBC/IFC have their sections dedicated to hazardous chemical storage (NFPA 45, and Chapter 50 of the ICC.) Each regulatory body has individually set standards for chemical storage that do not spell out the same limitations. Therefore, when a facility that will operate with chemicals is being planned, both sets of codes must be scrutinized to maintain that it falls within operation allowances.

Created in 1975, NFPA's 45 specifically deals with the "Standard on Fire Protection for Laboratories Using Chemicals." The 2019 revision is the latest version from a previous 2015 edition of the NFPA 45 documentation. When it comes to hazardous chemical storage, NFPA focuses on rating different laboratory units based on the amount of flammable and combustible liquids in use within the unit.

These laboratory units fall within a class rating system:

Class A (high fire hazard)
Class B (moderate fire hazard)
Class C (low fire hazard)
Class D (minimal fire hazard)

All chemicals are to adhere to NFPA 400 storage regulations unless there are exceptions present.

Table of the class of flammable/combustible liquids as per NFPA 30.

Class	Flash Point (Boiling Point)
IA	<73°F (<100°F)
IB	<73°F (≥ 100°F)
IC	73°F ≤ Flash Point < 100°F
II	100°F ≤ Flash Point < 140°F
IIIA	140°F ≤ Flash Point < 200°F
IIIB	≥ 200°F

When it comes to flammable or combustible liquids, the NFPA sets a Maximum Allowable Quantity (MAQ) for these chemicals based on the square footage of the containment facility. When a laboratory or a building with a laboratory unit exceeds a certain floor threshold, the Maximum Allowable Quantity (MAQ) will be reduced per floor depending on the class of hazard it falls under. This causes the quantity of a certain chemical to be limited by the floor it is stored on, with decreasing permissible quantities beyond the third floor.

Lab Unit Fire Class	Flammable and Combustible Liquid Class	Max Qty per 100ft2 of Lab Unit (gal) [Use]	Max Qty per Lab Unit (gal) [Use]	Max Qty per 100ft2 of Lab Unit (gal) [Use and Storage]	Max Qty per Lab Unit (gal) [Use and Storage]
A	I	10	480	20	450
	I, II, IIIA	20	800	40	1600
B	I	5	300	10	480
	I, II, IIIA	10	400	20	800
C	I	2	150	4	300
	I, II, IIIA	4	200	8	400
D	I	1	75	2	150
	I, II, IIIA	1	75	2	150

Reduction of the MAQ above a certain floor:
MAQ reduced by 50% for Class B lab units above the 3rd floor.
MAQ reduced by 25% for Class C and Class D lab units located on the 4th through the 6th floor.
MAQ reduced by 50% for Class C and Class D lab units above the 6th floor.

The NFPA also sets a Maximum Allowable Container Capacity (MACC) per type of container:

	Flammable Liquids			Combustible Liquids	
Container Type	IA	IB	IC	II	IIIA
Glass	500 mL (1 pt)	1 L (1 qt)	4 L (1gal)	4 L (1gal)	20 L (5 gal)
Metal other than (DOT/UN drums) or approved plastics	4 L (1 gal)	20 L (5 gal)	20 L (5 gal)	20 L (5 gal)	20 L (5 gal)
Safety Cans	10 L (2.6 gal)	20 L (5 gal)	20 L (5 gal)	20 L (5 gal)	20 L (5 gal)
Metal container (DOT/UN specification)	4 L (1 gal)	20 L (5 gal)	20 L (5 gal)	227 L (60 gal)	227 L (60 gal)
Polyethylene	4 L (1 gal)	20 L (5 gal)	20 L (5 gal)	227 L (60 gal)	227 L (60 gal)
Pressurized liquid dispensing container	20 L (5 gal)	227 L (60 gal)	227 L (60 gal)	227 L (60 gal)	227 L (60 gal)

International Building Code/ International Fire Code

The International Building Code's first draft was published in 1997 and outlined a comprehensive set of building codes free of regional limitations. Although the collective parties that originally wrote the code were localized to the United States, the base standards were adopted by other nations instead of redeveloping codes from scratch.

Chapter 50 of the IFC deals specifically with the storage of hazardous chemicals. Unlike the NFPA 45, which only outlines flammable and combustible chemicals, the IFC also details regulations for explosives, combustibles, flammables, organic peroxides, oxidizers, pyrophorics, unstable chemicals, water, reactive materials, and cryogenic fluids.

Classifications to identify different **Combustible Liquids.**

Class	Flash Point
II	100°F ≤ Closed Cup Flash Point < 140° F
IIIA	140°F ≤ Closed Cup Flash Point < 200° F
IIIB	Closed Cup Flash Point > 200° F

Classifications to identify different **Organic Peroxides.**

Class	Description
I	Capable of deflagration, not detonations
II	High rapid burning and pose moderate reactivity hazard
III	Rapid burning and pose moderate reactivity hazard
IV	Burns in same manner as ordinary combustibles and minimal reactivity hazard
V	Burns less intensely than ordinary combustibles or no combustion. No reactivity hazard.
Unclassified Detonable	Capable of detonation. High explosion hazard, rapid explosive decomposition.

Classifications to identify **different Oxidizers.**

Class	Description
1	Does NOT moderately increase the burning rate of a combustible.
2	Causes a moderate increase in the burning rate of contacted combustible materials.
3	Causes a severe increase in the burning rate of contacted combustible materials.
4	Can undergo explosive reaction due to contamination exposure to thermal or physical shock and cause severe increase in the burning rate of contacted combustible materials. May cause spontaneous combustion.

A series of hazard classifications are additionally used in setting the MAQs for each type of hazardous material.

- Materials that pose a detonation hazard. This entails Division 1.1 explosives (maximum explosive hazard) to Division 1.6 (extremely insensitive explosives.)
- Materials that pose a deflagration hazard, or hazard from accelerated burning.
- Materials that are readily combustible or pose a physical hazard.
- Materials that pose a health hazard.
- Materials used in semiconductor fabrication and comparable research and development areas.

Chapter 50 of the IBC also has an extensive list of Maximum Allowable Quantities when it comes to the storage and handling of hazardous chemicals. Each type of hazardous chemical has sub-classifications to further identify the risks associated with hazardous chemicals.

The IFC also allows the thresholds of the MAQs to increase depending on safety measures taken throughout the building. The addition of a fire suppressant sprinkler system and/or the use of approved storage cabinets, day boxes, gas cabinets, gas

rooms, or exhausted enclosures can increase the normal MAQ for a hazardous chemical by 100 percent.

Both the NFPA and ICC set rules and regulations for the storage and use of hazardous chemicals. Each organization has different limitations for the amount of hazardous chemicals within a given space that a facility can operate with. In determining how and where to store these chemicals, consulting with both the NFPA and ICC is essential for maintaining the allowable limits.

References:

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4. “5003.1.1 Maximum Allowable Quantity Per Control Area.” District of Columbia Building Codes, UpCodes, 2015, https://up.codes/viewer/district-of-columbia/ifc-2015/chapter/50/hazardous-materials-general-provisions#5003.1.1.

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