Chemical Storage and Segregation

Overview

The proper segregation and storage of chemicals is an important safety measure because accidentally mixing incompatible chemicals may cause fires, explosions, or the production of toxic gases. Environmental Health and Safety (EHS) uses the chemical inventory system within Salute to facilitate storage and segregation, which categorizes each chemical into one of 12 storage groups. Salute can generate a report for all chemicals in an inventory, making segregation simpler and more efficient.

Applicability

This Update applies to all laboratories, clinics, service areas, mechanical rooms, and print shops that store or use chemicals. Exemption: working solutions that are less than 1 liter, are non-toxic, and non-reactive are exempt from these requirements.

Responsibilities

Principal Investigators, Directors, Managers, and other chemical owners must ensure that all chemicals are segregated and safely stored in compatible groups.

Chemical Users must comply with the chemical storage practices of their work area and ensure that all chemical containers are labeled and stored in their proper location.

Environmental Health and Safety (EHS) provides assistance and training on chemical segregation and storage upon request.

Procedure for Chemical Segregation

Follow the steps below to segregate chemicals based on their storage groups:

1. **Storage Groups**:
   - A storage group is a group of chemicals that will not react violently if mixed.
   - Determine the storage group of a chemical by referring to the chemical safety information available in Salute or to the "Hazards Identification" and "Toxicological Information" sections of the Safety Data Sheet (SDS).
   - Salute assigns a storage group code A to X to each solid, liquid, or gaseous chemical included in the chemical inventory. See Table 1 below for group codes, descriptions and examples.
   - Chemicals with multiple hazards are stored according to their primary hazard.

Table 1 – Storage codes, descriptions and examples:

Code	Storage Groups	Examples
A	Compatible Organic Bases	BIS TRIS, Diethylamine, Imidazole, Triethanolamine
B	Compatible Pyrophoric and Water Reactive Materials	Tert-Butyllithium, Sodium Borohydride,
C	Compatible Inorganic Bases	Sodium Hydroxide, Ammonium Hydroxide
D	Compatible Organic Acids	Acetic Acid , Maleic Acid
E	Compatible Oxidizers including Peroxides	Hydrogen peroxide, Permanganates, Halogens
F	Compatible Inorganic Acids not including Oxidizers or Combustibles	Phosphoric Acid, Hydrochloric Acid, Sulfuric Acid
G	Not Intrinsically Reactive or Flammable or Combustible	Acrylamide, Sodium Bisulfate, Coomassie Blue, Sugars, Dyes, Buffers, Dilute Aqueous Solutions, Amino Acids
I	Compatible Strong, Oxidizing Acids	Chloric acid, Chromic acid, Nitric acid, Perchloric acid, Selenic acid, Nitrosulfuric acid
J	Poison Compressed Gases	Ethylene Oxide, Hexafluoropropylene, Sulfur Dioxide, Trifluoromethyl Iodide
K	Compatible Explosive or other highly unstable materials	Picric Acid Dry, Tetrazole, Ammonium Permanganate
L	Non-Reactive Flammables and Combustibles, including solvents	Hydrocarbons (saturated and unsaturated), Alcohols, Ketones, Aldehydes, Benzene, Toluene, Methanol, 1-Butanol, 1-Propanol, Acetic Anhydride , Acrolein, Formamide, Sigmacote
X	Incompatible with ALL Other Storage Groups	Sodium Azide , Picric Acid Moist, Arsine, Phosphorus, Benzyl azide, Sodium hydrogen sulfide

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2. **Chemical Inventory Report from Salute**:

Salute generates a summary which includes the storage group for materials listed in the chemical inventory. The inventory can be accessed using the steps outlined below. More detailed guidance for maintaining chemical inventories can be found in the Salute: Chemical Inventory System EHS Update.

a. Login to Salute using your WCM email, CWID and password;
b. Select Chemical Safety from the menu on the left-hand side of the page;
c. Select the inventory to view based on the Chemical Owner;
d. Select the Storage Code header to sort chemicals by storage group

3. **Chemical Storage and Segregation**:

- Storage groups **must be stored separately** according to the *WCMC Compatible Storage Group Classification System,* as shown below.
- If space is limited, multiple groups can be stored on the same shelf or within the same cabinet **if each group is stored in its own secondary container**.

WCM Compatible Storage Group Classification System

Should be used in conjunction with specific storage conditions taken from the manufacturer's label and SDS

STORAGE GROUPS

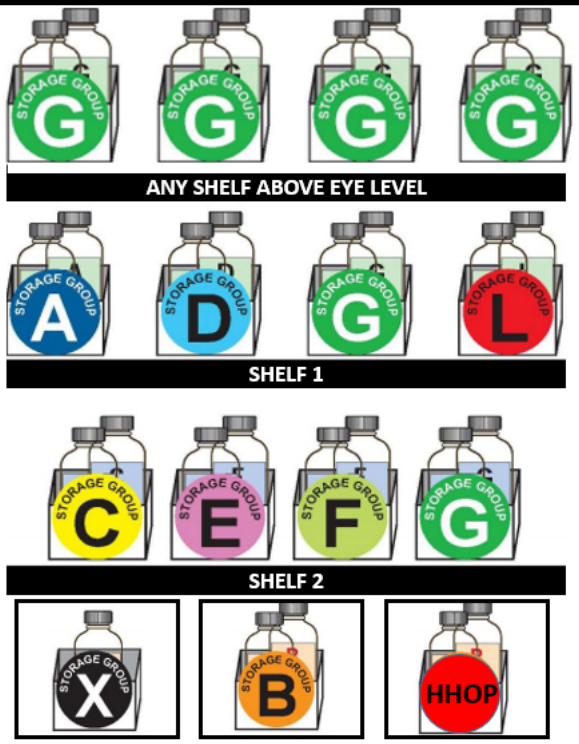
Store chemicals in separate secondary containment and cabinets
Find Storage Group Information in Salute

A	Compatible Organic Bases
B	Compatible Pyrophoric & Water Reactive Materials
C	Compatible Inorganic Bases
D	Compatible Organic Acids
E	Compatible Oxidizers Including Peroxides
F	Compatible Inorganic Acids not Including Oxidizers and Combustibles
G	Not Intrinsically Reactive or Flammable or Combustible
I	Compatible Strong, Oxidizing Acids
K*	Compatible Explosive or other highly Unstable Materials
L	Non-Reactive Flammables and Combustibles, Including Solvents
X*	Incompatible with ALL other storage groups

*Storage Groups K and X: Contact EHS 1-7233
For specific storage – consult manufacturer's SDS

Section 7 of the chemical's SDS provides information on safe storage requirements
ehs.weill.cornell.edu/sds

If space does not allow Storage Groups to be kept in separate cabinets the following scheme can be used with extra care taken to provide stable, uncrowded, and carefully monitored conditions.



Storage Group X: Segregate from all other chemicals
Storage Group B: Not compatible with any other storage group
High Hazard Substances: must be stored in secure location

4. **General Storage Requirements**:
   - Label all containers with the name of the contents.
   - Label the storage location with the assigned Storage Group.
   - Store reactive and/or hazardous chemicals below eye level (i.e., below 5 feet), specifically Groups A, B, C, D, E, F, L, and X.
   - Do not store chemicals under sinks. Only store standard detergents and dry supplies in that area.
   - Return chemicals to their designated storage location after each use.
   - Limit chemical storage in fume hoods to avoid blocking rear baffles and interfering with airflow.
   - Do not store liquid chemicals and toxic powders on the floor; store all containers upright.
   - Large containers should be stored on lower levels.
   - Store larger chemical bottles at the back of shelves and smaller bottles at the front and make the labels face forward so they can be easily read.
   - Do not overload shelves to prevent collapse.
   - Store High Hazard Substances (HHS) [1] in a secure location not accessible by non-laboratory personnel.
   - Minimize storing chemicals on bench tops where they are unprotected from potential fire and more easily knocked over.

5. **FDNY Storage Limits:**
   - Maintain storage below the limits set by the Fire Department of New York City (FDNY) shown in Tables 2 to 6 of Appendix A. Refer to the space's Health and Safety Door Sign (HSDS) for the FDNY Lab Rating (e.g., Type I, II, III, IV, B or D).
   - Type I, II, III, and IV labs are subject to **old fire code** requirements. Type B and D labs are subject to the **new fire code**.

6. **Storage Group-Specific Requirements**:
   - **Flammables, Combustibles, and Organic Solvents (Group L)**
     - The capacity of **glass containers** must not exceed one gallon. Metal containers are required for storage of flammable liquids exceeding one gallon.
     - Store flammable materials in **vented flammable cabinets** whenever possible (e.g., under fume hoods).
     - Refrigerators used to store flammable liquids must be **explosion-proof or flammable-proof**.
     - Keep flammables away from all ignition sources, such as open flames, hot surfaces, direct sunlight and sparks.
     - Flammable gases are prohibited from use or storage below grade (i.e., below street level).
     - Peroxide-forming chemicals [2] are typically classified as Flammables (Group L). Peroxide-forming chemicals must be labeled with the date received, date opened, and expiration date. They must also be recorded in Salute in order to be included in the EHS testing program.
   - **Compatible Water-Reactive and Pyrophoric Chemicals (Group B)**

     Water-reactive chemicals
     - Store water-reactive chemicals in closed, watertight containers and in a manner to prevent direct contact with water and fire sprinkler systems (i.e., not under sinks or on open shelving).
     - Segregate water-reactive chemicals from corrosives and aqueous liquids.
     - Label the storage location "Water-Reactive Chemicals."

     Pyrophoric chemicals
     - Prevent pyrophoric chemicals from contacting air by ensuring no leaking or breaking. For additional protection, consider keeping the chemicals in the manufacturer's original shipping package (i.e., surrounded by vermiculite inside a metal can).
   - **Corrosive Chemicals (Group A, C, D, F)**
     - Store corrosive chemicals (Group A, C, D, and F) in dedicated corrosion-resistant and ventilated cabinets.
     - Place in secondary non-metallic containment when storing acids on bare metal shelves.
     - Organic acids (Group D), such as acetic acid, lactic acid, and formic acid, are considered combustible and corrosive and can be stored in flammable storage cabinets.
     - Do not store acids near any cyanide- or sulfide-containing chemicals to prevent the generation of highly toxic hydrogen cyanide or hydrogen sulfide gases.
     - Do not store concentrated acids next to household bleach, as mixing will generate highly toxic chlorine gas.

- Do not store concentrated acids next to window cleaner (e.g., Windex) or ammonium hydroxide (e.g., Lysol) as mixing will generate highly toxic chlorinated amine gases.

- **Compatible Strong, Oxidizing Acids (I)**
  - This storage group includes materials that are strong acids as well as relatively strong oxidizing agents. Strong oxidizing acids are inorganic.
  - Acids that are not strong oxidizers belong in Storage Group D or F.
  - Oxidizers that are not strong acids typically belong in Storage Group E.
- **Incompatible with ALL Other Chemicals (Group X)**
  - Segregate Group X chemicals from all other storage groups and other materials within Storage Group X. In most cases, multiple containers of the EXACT same Storage Group X chemical can be stored together.
  - Seal containers tightly to minimize exposure to personnel and contamination of other chemicals.
  - Maintain the lowest possible inventories of highly reactive chemicals.
- **Compatible Oxidizers and Peroxides not including Strong Oxidizing Acids (Group E)**
  - Do not store oxidizing acids such as perchloric and nitric acid on wooden shelves or cardboard boxes.
  - Segregate (i.e., separate cabinet or secondary container) oxidizing acids such as nitric, perchloric, chromic acid, and chromerge from organic acids such as acetic acid and formic acid to prevent fires.
- **Compressed Gas (Group E, G, L)** [3], [4]
  - Limit the quantity of compressed gas cylinders to what will be used within a reasonable period of time. Refer to Table 3 below for maximum storage limits.
  - Store cylinders upright and secure them with a chain, strap, or cable to a stationary building support (i.e., chain and hook) or to a cylinder cart to prevent cylinders from tipping or falling.
  - Store cylinders in a dry, well-ventilated area away from flames, sparks, or any source of heat or ignition.
  - Place cylinders in a location where they will not be subject to mechanical or physical damage, heat, or electrical circuits to prevent possible explosion or fire.
  - Cylinders should not be exposed to continuous dampness stored near salt or other corrosive chemicals or fumes. Corrosion may damage cylinders and cause their valve protection caps to stick.
  - Mark the cylinder storage areas with precautionary signs, such as “Storage of flammable, oxidizing, or toxic materials.”
  - Caps used for valve protection should always be kept on the cylinders, except when the cylinder is being used or charged. Cylinder valves should remain closed.
  - Segregate empty cylinders from full cylinders, mark empties “Empty,” and request pick up by vendor.

7. Training and Assistance:

EHS is available to provide on-site assistance to all chemical users, including Salute user training and segregation/storage assistance. Contact EHS for any questions at 646-962-7233 or at EHS@med.cornell.edu.

8. References:

[1] WCM High Hazard Operating Procedure https://ehs.weill.cornell.edu/sites/default/files/highhazard.pdf.

[2] WCM EHS Peroxide-Forming Chemicals https://ehs.weill.cornell.edu/sites/default/files/peroxide_formers.pdf.

[3] WCM EHS Compressed Gas Cylinder Storage and Handling https://ehs.weill.cornell.edu/sites/default/files/compressed_gases.pdf.

[4] WCM EHS Liquid Nitrogen Handling and Use https://ehs.weill.cornell.edu/sites/default/files/ln2.pdf.

[5] WCM EHS Salute Chemical Inventory https://ehs.weill.cornell.edu/sites/default/files/salute_chemical_inventory_0.pdf

[6] FDNY C14 Study Material

Appendix A: FDNY storage limit tables

Table 2 – FDNY storage limits for flammable liquids and solids, oxidizing, unstable and reactive materials under **old fire code**

Lab Type	Fire Rating	Fire Protection	Flammable Liquids (gallons)	Flammable Solids (pounds)	Oxidizing Materials (pounds)	Unstable & Reactive (pounds)
I	2 hour	Sprinklers	30	15	50	12
II	1 hour	Sprinklers	25	10	40	6
III	2 hour	No sprinklers	20	6	30	3
IV	1 hour	No sprinklers	15	3	20	2

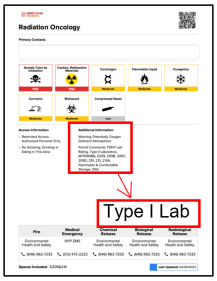


Table 3 – FDNY storage limits for flammable liquids and solids, oxidizing, unstable and reactive materials under **new fire code**

Chemicals	Max. quantity in 1-hour fire-rated lab	Max. quantity in 2-hour fire-rated lab
Water-Reactive	2.5 lbs.	5 lbs.
Pyrophoric	0.5 lbs.	1 lb.
Highly Toxic	5 lbs.	5 lbs.
Toxic	250 lbs.	250 lbs.
Corrosive	250 gallons	250 gallons
Flammable Solids	10 lbs.	15 lbs.
Oxidizers / Organic Peroxides	40 lbs.	50 lbs.
Unstable Reactives	6 lbs.	12 lbs.

Table 4 – FDNY storage limits for flammable and combustible liquids under **new fire code**

	Excluding Quantities in Storage Cabinet or Safety Cans		Including Quantities in Storage Cabinet or Safety Cans	
Lab Unit Hazard Class	Max. quantity Class I Liquids alone per Lab Unit (gal / 100 ft²)	Max. quantity Class I, II, IIIA Liquids per Lab Unit (gal / 100 ft²)	Max. quantity Class I Liquids alone per Lab Unit (gal / 100 ft²)	Max. quantity Class I, II, IIIA Liquids per Lab Unit (gal / 100 ft²)
Class B	5 (25 gal max)	10 (25 gal max)	10 (25 gal max)	20 (25 gal max)
Class D	1 (75 gal max)	1 (75 gal max)	2 (150 gal max)	2 (150 gal max)

Table 5 – FDNY storage limits for flammable gases under the **old fire code**

Area of laboratory in square feet	Up to 500 ft²	Per additional 100 ft²	Maximum per laboratory unit*
Maximum Capacity in cubic feet (*water container capacity)	9.24	1.54	15.4

Table 6 – FDNY storage limits for gases under the **new fire code**

Gas Types	Lab Up to 500 ft² (cu. ft.)	Per additional 100 ft² (cu. ft.)
Flammable	12.0	2.4
Oxidizing	12.0	2.4
Liquid flammable	2.4	0.36
Health hazard 3 or 4	0.3	0.06