

Chemical Storage Segregation Guidelines

University of Wisconsin Milwaukee
University Safety and Assurances
– Laboratory Safety

Chemical Segregation

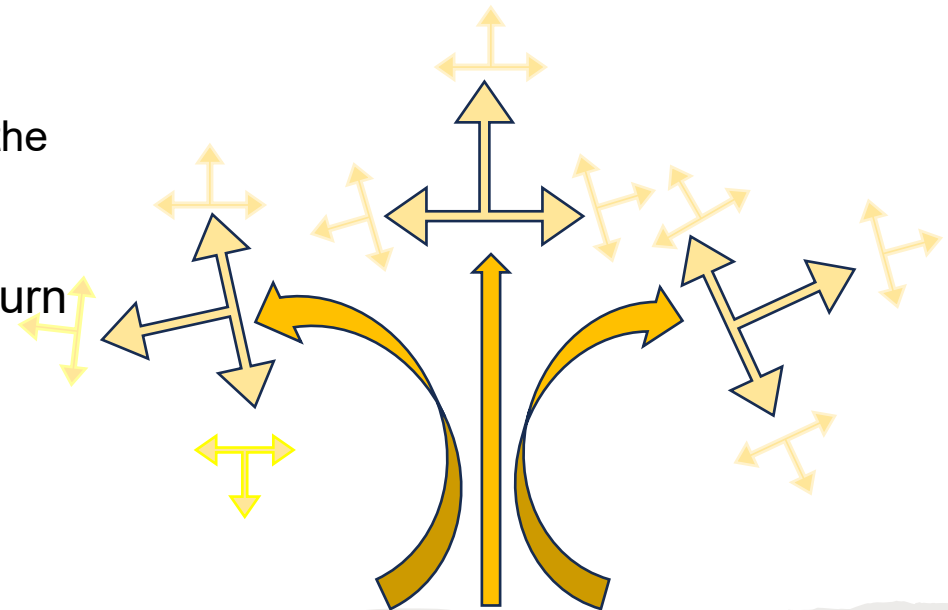


- Chemicals need to be physically segregated from incompatible chemicals.
- Set up storage areas so that workflow is not disrupted and to minimize travel between storage and use locations.
 1. First materials are **sorted by physical state** (solids, liquids, and gases).
 2. Next materials are **sorted from other incompatible materials**.
 3. Finally, the **compatible materials within a Chemical Storage Group** should be organized so that it will be easy to find and return containers.

Chemical Segregation

Set up storage areas so that workflow is not disrupted and to minimize travel between storage and use locations.

- First materials are **sorted by physical state** (solids, liquids, and gases).
 - Hazardous gases have particular storage requirements.
It is preferred that they are stored in a gas cabinet or approved exhausted enclosure.
- Next materials are **sorted from other incompatible materials**.
 - This is typically accomplished by grouping together materials with the same chemical reactivities (see Chemical Storage Groups).
- Finally, the **compatible materials within a Chemical Storage Group** should be organized so that it will be easy to find and return containers.
 - Organization approaches such as alphabetical (by name),
 - carbon-length, and
 - metal/counter-ion are commonly and effectively used.



Chemical Segregation

Single Hazard Class

- The first source for chemical-specific information should be the [labels](#) and [safety data sheets \(SDSs\)](#) from the manufacturer.
- Chemicals should always be segregated according to their specific hazard(s) to prevent unintended reactions. Begin by categorizing and separating chemicals by the following categories. Note that the order is intentional, as discussed below.
 1. Pyrophoric
 2. Water reactives
 3. Flammables
 4. Corrosives
 - Subcategories (Organic Acids, Inorganic Acids, Organic Bases, Inorganic Bases, Oxidizing Acids)
 5. Oxidizers
 6. Toxics
- Other types of materials require more specific storage requirements such as
 - Explosives
 - Compressed gases
 - Cryogenes

Chemical Segregation

Multiple Hazard Classes

- Many chemicals belong to more than one chemical family or hazard class.
 - Evaluated on a case-by-case basis.
 - Ideally, guidelines for each category should be observed, when possible.
- One strategy is to prioritize the hazards of a specific chemical. The hazards listed below are prioritized for this purpose, from most severe to least.
 1. Pyrophoric
 2. Water reactives
 3. Flammables
 4. Corrosives (Organic Acids, Inorganic Acids, Organic Bases, Inorganic Bases, Oxidizing Acids)
 5. Oxidizers
 6. Toxics

- Here are a few examples:

Chemical Segregation

Multiple Hazard Classes

- Example 1:
 - A pyrophoric chemical, for example, may also be a flammable liquid, but the pyrophoric property should outweigh the flammability for storage purposes.

Chemical Segregation

Multiple Hazard Classes

- Example 2:
- Glacial acetic acid is a common example, as it is both a corrosive acid and a combustible liquid. It should be stored away from corrosive bases, such as sodium hydroxide, and also from oxidizing acids, such as nitric acid. Storing acetic acid in a flammable storage cabinet would be appropriate, prioritizing the combustibility over the corrosivity. NOTE: If flammable storage space is at a premium, storage in a corrosive cabinet would also be acceptable; however, it would need to be further segregated from the other incompatible corrosives by utilizing multiple cabinets or secondary containment.

Chemical Segregation Priority /Storage Classes

Segregation Priority

1. Pyrophoric
2. Water reactive
3. Flammable
4. Corrosive

Subcategories (Organic Acids, Inorganic Acids, Organic Bases, Inorganic Bases, Oxidizing Acids)

5. Oxidizer
6. Toxics

- Types of materials require more specific storage
 - Explosive
 - Compressed gas
 - Cryogen

Code	Storage Groups
A	Compatible Organic Bases
B	Compatible Pyrophoric and Water Reactive Materials
C	Compatible Inorganic Bases
D	Compatible Organic Acids
E	Compatible Oxidizers including Peroxides
F	Compatible Inorganic Acids <u>not including</u> Oxidizers or Combustibles
G	Not Intrinsically Reactive or Flammable or Combustible
I	Compatible Strong, Oxidizing Acids
J	Poison Compressed Gases
K	Compatible Explosive or other highly unstable materials
L	Non-Reactive Flammables and Combustibles, including solvents
X	Incompatible with ALL Other Storage Groups

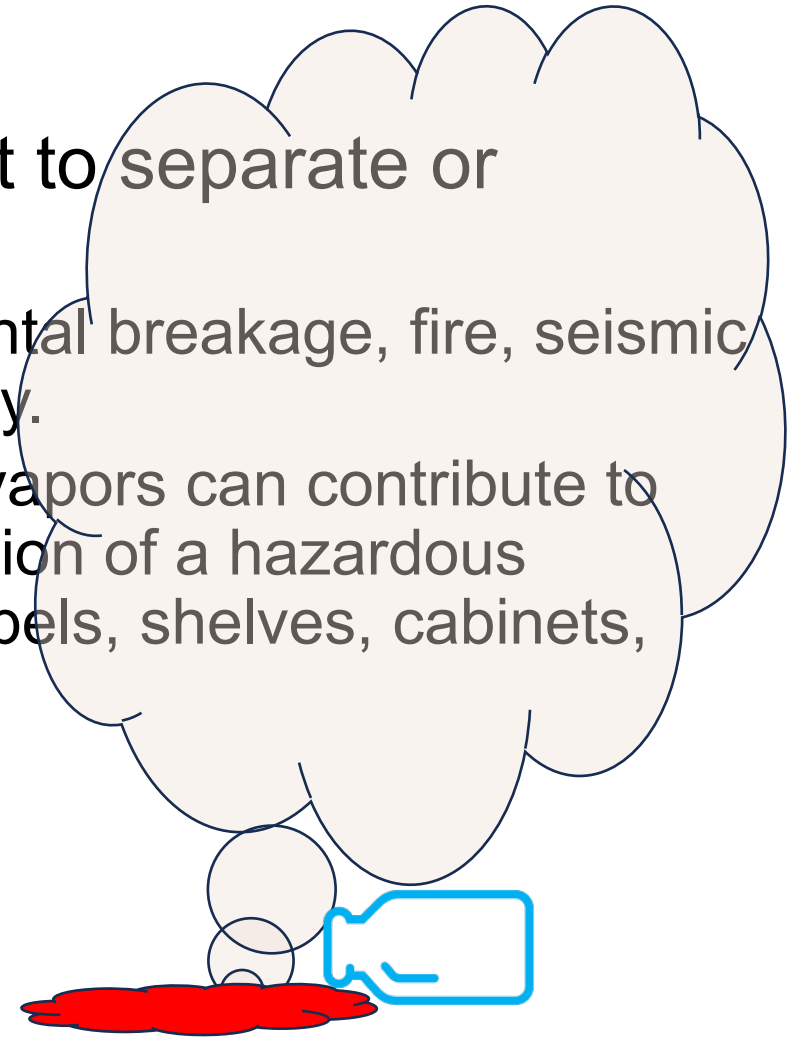
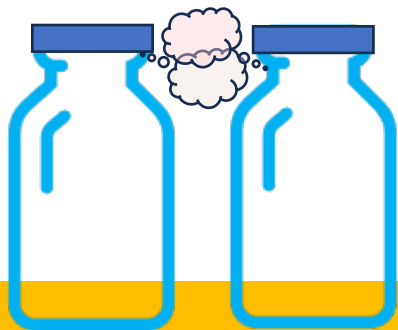
Chemical Storage Codes and Examples

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 <u>not including</u> Oxidizers or Combustibles	Phosphoric Acid, Hydrochloric Acid, Sulfuric Acid
G	Not Intrinsicly 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

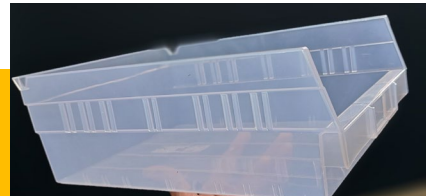
Chemical Segregation

- Chemicals should be stored with an effort to separate or segregate incompatible materials.
 - Reduces the risk of mixing in case of accidental breakage, fire, seismic event, or response to a laboratory emergency.
 - When containers are tightly closed, fugitive vapors can contribute to incompatibility reactions, leading to the creation of a hazardous condition or accelerate the degradation of labels, shelves, cabinets, and the containers themselves.



Chemical Segregation

- Key requirements to separate or segregate incompatible materials are listed below.
 - Store flammable liquids in *approved* safety containers or cabinets in the lab. Do not store anything but flammable or combustible liquids in these
 - Segregate Acids from Organics.
 - Keep Oxidizers away from Flammables and Combustibles.
 - Keep Corrosives away from substances that they may react with and release corrosive, toxic, or flammable vapors
 - **Do not** store chemicals alphabetically unless they are compatible.
 - Use Secondary Containment (tubs that will contain 110% of container volume) to segregate chemicals by hazard.
 - If breakage occurs, the spill will be contained and easy to clean.



Storage Cabinets/ Cans

- Flammable storage cabinets
- Safety Cans
- Corrosive Storage Cabinets



Storage Cabinets/ Cans

- **Flammable storage cabinets**
 - Flammable storage cabinets are designed to meet specific requirements outlined by various standards such as [OSHA](#), [NFPA](#), [IFC](#), and [UL](#). They are specifically constructed to contain flammable materials and slow the spread of a fire towards the materials in the cabinet.
 - Cabinet which is OSHA and NFPA approved (which will fulfill UL 1275) and has self-closing doors to comply with IFC., It should be labeled if it meets any of these standards. Contact Chemical Safety if you need further information on your available storage cabinets.
 - Flammable storage cabinets are not required to be vented, and it is not recommended to do so in most cases. Improper venting can negate the fire protection provided by a cabinet.





Storage Cabinets/ Cans

- **Safety Cans**

- A safety can is a rated container of not more than 5 gallons (20 liters) capacity having a screen or strainer in each fill-and-pour opening and having a spring-closing lid and spout cover designed to safely relieve internal pressure when exposed to fire.
- UL or FM approved as well as OSHA approved. They make appear similar, but typical home gasoline storage cans are not the same and should not be used in laboratories.

Storage Cabinets/ Cans

- **Corrosive Storage Cabinets**

- Do not have specific regulatory requirements. They should be designed by the manufacturer to resist corrosion. Polyethylene cabinets are generally the most resistant, while steel cabinets will have a corrosion-resistant coating and often times contain polyethylene liners.
- As an added benefit, ***some*** steel cabinets also meet the requirements of flammable storage cabinets, which may be necessary if you are storing flammable corrosives such as pyridine, triethylamine, or glacial acetic acid—always *confirm this rating with the manufacturer*.
- Wooden cabinets will generally resist corrosion (except for the metal hardware), but they should never be used for storing any oxidizing acids, such as nitric or perchloric acid.
- Venting of corrosive cabinets may be beneficial if storing volatile corrosives such as hydrochloric acid, but it is not a requirement. Many cabinets below fume hoods have ventilation connections for this purpose. If you have questions about your existing cabinets, or if you would like additional information about corrosives storage, contact Chemical Safety.



Storage Guidelines

- Avoid storing materials on top of cabinets. Clearance from the ceiling must be 18 inches for sprinklered labs and 24 inches for not sprinklered.
- Chemicals should be readily accessible and to reduce accidents, materials should not be stored on shelves higher than 5 feet (~1.5m).
- Ensure container weight does not exceed the load rating of the shelves. Heavier items and larger containers should be stored on lower shelves.
- Corrosive liquids and Particularly Hazardous Substances (PHS) shall be stored below eye level.
- Do not store chemicals in fume hoods.
- Provide adequate storage space for chemicals within your lab.
- Keep chemicals away from sources of heat or direct sunlight.
- Use secondary containment when possible.
- Use properly rated and labeled refrigerators and freezers when storing flammable materials.

Refrigerator/ Freezer Storage Guidelines

- Requires secondary containment for holding liquids within the Unit.
- Follow the same segregation rules as for non refrigerated chemicals.
- A sign indicating “Research Use Only”, and an inventory must be posted on the door
- **Standard Unit**
 - Like the refrigerators we have in our homes.
 - They have lights and fans on the inside.
 - They are designed to hold aqueous, nonvolatile, nonflammable solutions (i.e. buffer or salt solutions.) that do not produce flammable vapors.
 - Flammables, volatiles, oxidizers are not to be stored in them.
- **Flammable Storage Unit**
 - Is designed to hold flammable and organic solvents inside the refrigerator.
 - The fumes will be inside of the unit.
 - It is designed to have no sparks in the unit(intrinsically safe) that could cause a fire/explosion.
 - Most have locked doors that will not fly off or open in a fire event.
- **Explosion-proof Unit**
 - Designed to sit in a room that has solvent fumes in the room.
 - The unit doesn't have a power cord and must be hard-wired.
 - It is built intrinsically safe on the inside and outside of the unit.
 - A unit with a power cord and plug could cause a spark in the room causing an explosion.
 - Most have locked doors that will not fly off or open in a fire event.
- **Cold rooms**
 - Designed for performing cold test environments or to store aqueous, nonvolatile, nonflammable solutions (i.e. buffer or salt solutions.) that do not produce flammable vapors.
 - Flammables, volatiles, oxidizers are not to be stored in them.

NOTICE

Research Materials
Storage Only

NOT for human
consumption products!



Consult manufacturer's label and Safety Data Sheets to confirm hazard classification.

- Sort by physical state
- When possible, isolate all storage groups in separate cabinets.
- If space does not allow, use the following cabinet scheme to combine storage groups.
- Use secondary containment as shown to prevent spilled materials from contacting containers of incompatibles that are in the same cabinet.

A. Compatible Organic Base

B. Compatible Pyrophoric and Water Reactive Materials 

C. Compatible Inorganic Bases

D. Compatible Organic Acids

E. Compatible Oxidizers including Peroxides*

F. Compatible Inorganic Acids not including Oxidizers or Combustibles

G. Not intrinsically Reactive or Flammable or combustible

I. Compatible Strong Oxidizing Acids

J. Poison Compressed Gasses*

K. Compatible Explosives or other highly unstable materials (Excluding Oxidizing Explosives)*

L. Non-Reactive Flammables and Combustibles including Solvents 

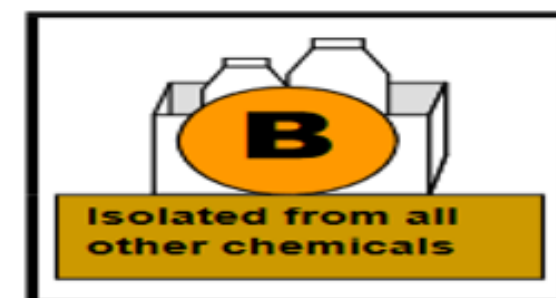
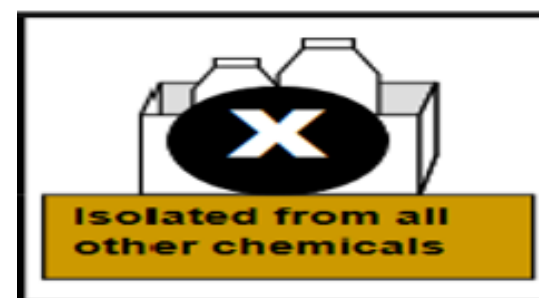
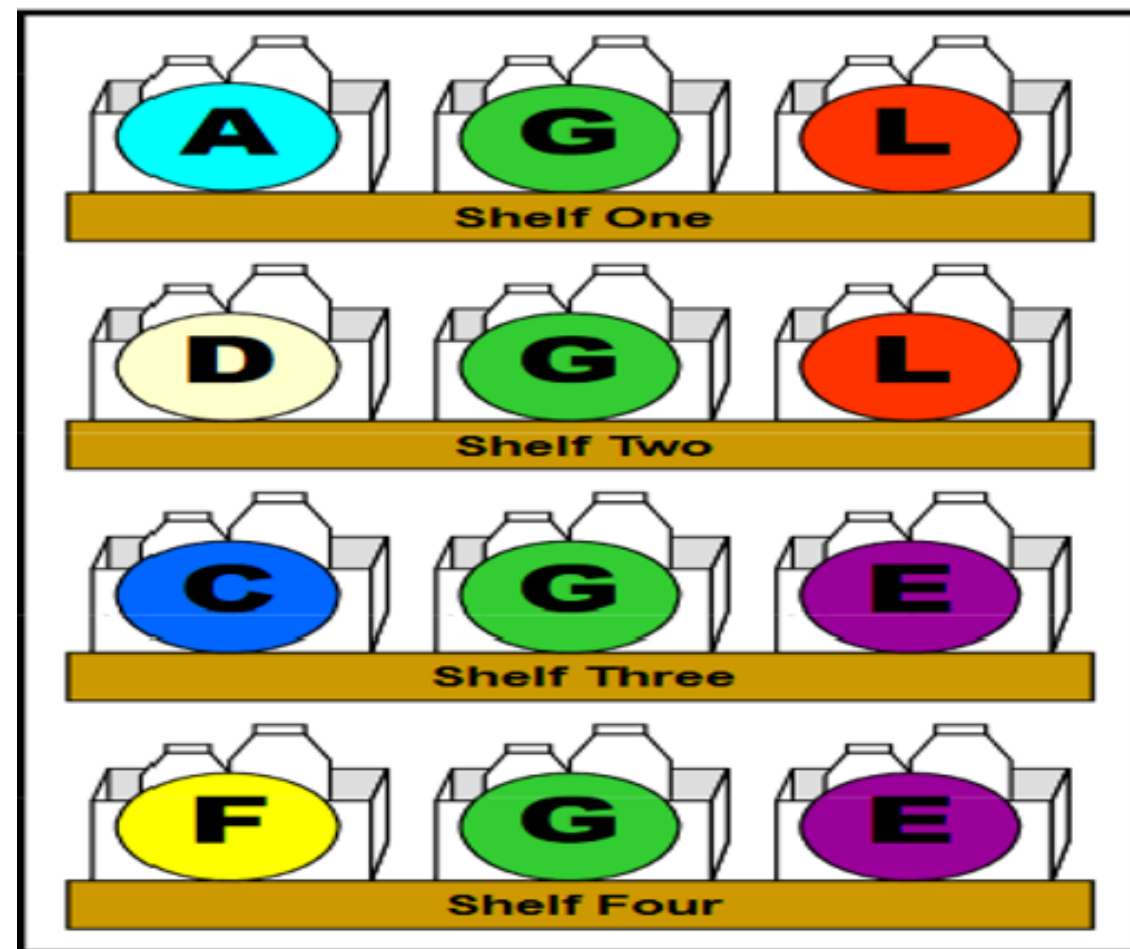
X. Incompatible withal other Storage Groups*

- Storage Groups K, and X should be stored and segregated from all other items contact
- *Particular Storage Groups –Storage Groups B, E, F, I, K and X should be segregated from all other items. Contact US&A for additional assistance for assessing the storage needs for these materials.

 Storage Group B and L should be in a flammable Storage Cabinet or Flammable storage Refrigerator

• Storage Group J should be stored in a vented gas cabinet

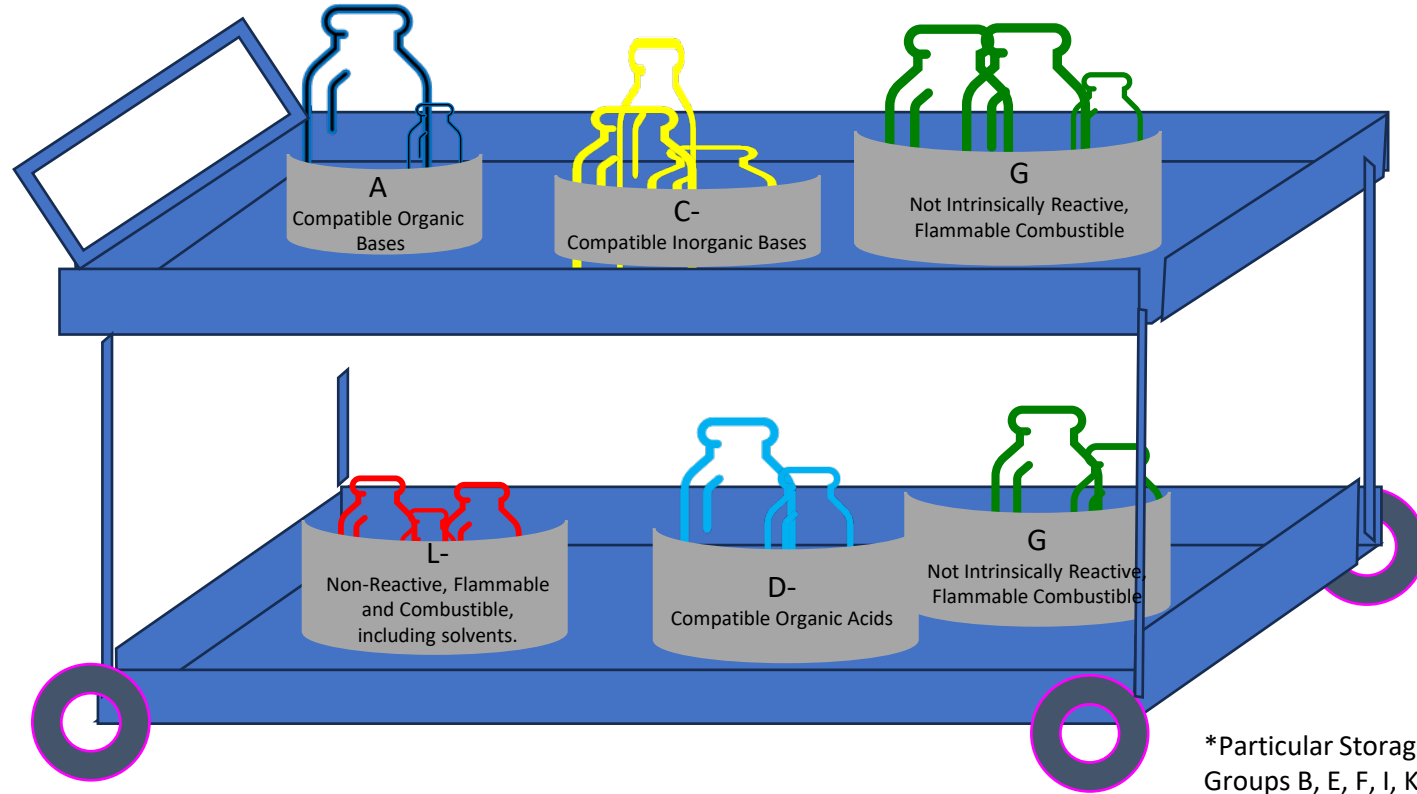
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How to Transport on a Cart and segregate

What hazards to segregate

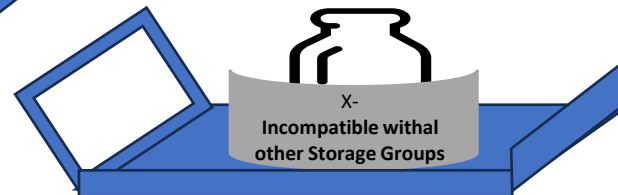
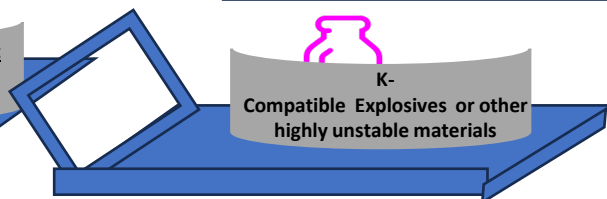
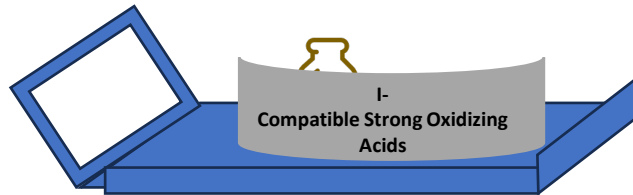
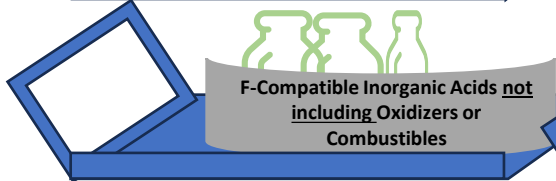
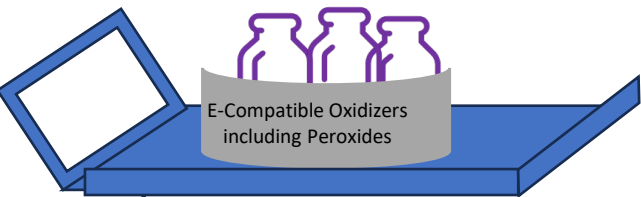
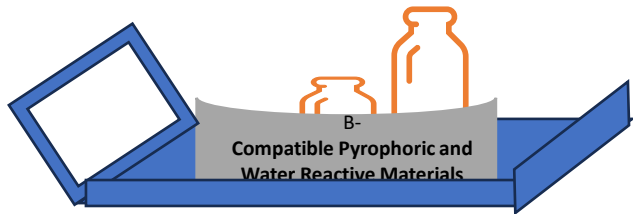
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- G. Not intrinsically Reactive or Flammable or combustible
- I. Compatible Strong Oxidizing Acids
- J. Poison Compressed Gasses*
- K. Compatible Explosives or other highly unstable materials (Excluding Oxidizing Explosives)*
- L. Non-Reactive Flammables and Combustibles including Solvents
- X. Incompatible with other Storage Groups*



Cart is clean before and after.

PPE carried with, not worn.

Use appropriate packing materials, if necessary



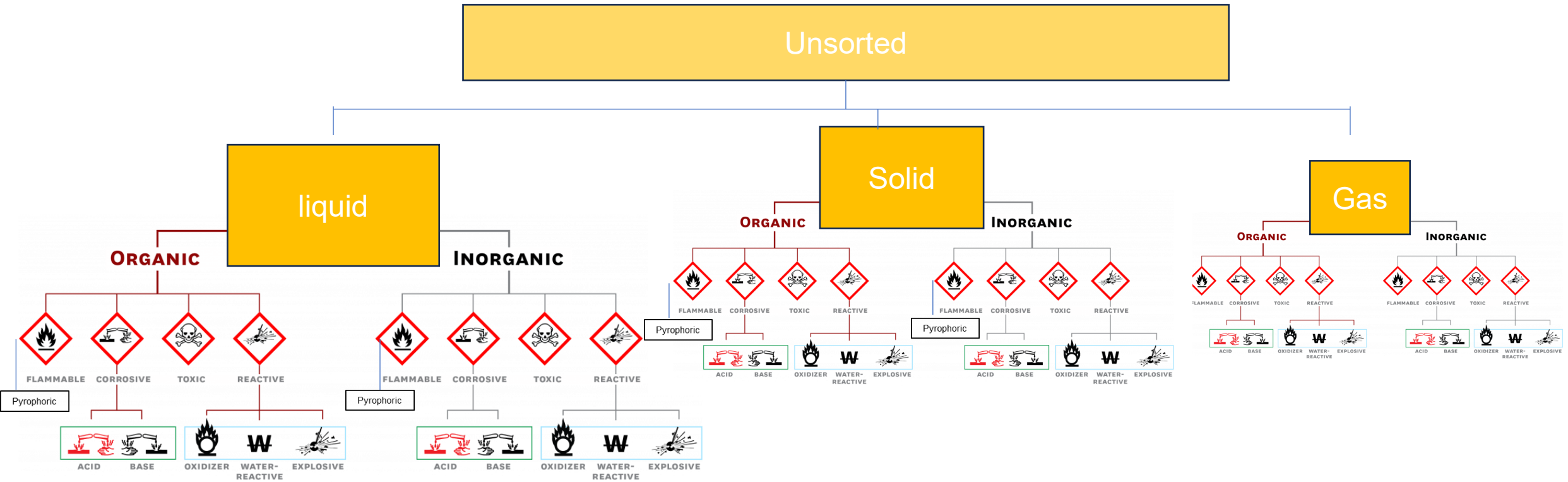
*Particular Storage Groups –Storage Groups B, E, F, I, K and X should be transported separately.

Group X items - each compound in its own secondary containment

Airgas will transport all Gases (Group G)

Contact US&A for additional assistance for assessing the transport / storage needs for these materials.

Chemical Segregation



Contact

- Contact University Safety and Assurances with any questions or concerns regarding Chemical Storage Guidelines.
 - Phone: (414) 229-6339
 - Web: www.safety.uwm.edu