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Chemical Storage

Chemical Hygiene Plan

The safe storage of hazardous chemicals is an essential part of laboratory safety. Chemical storage is complex—there is no one-size-fits-all plan to store chemicals—but there are regulations, campus requirements, and best practices that can guide the process. The general concept is to prevent chemicals from causing harm to people, property, other chemicals, or the environment.

In order to fully understand the hazards associated with stored chemicals you first need to know what chemicals are being stored. Safe storage begins with an up-to-date inventory of chemicals and knowledge of the hazards posed by each chemical.

General Storage Requirements:

- All chemicals must be labeled and stored in a safe, secure location.
- Shelves should be level, stable, and secured to the wall or another stable.
- Store chemicals away from direct sunlight, sources of heat, and egress pathways.
- Hazardous chemicals must be stored below eye level.
- Do not store chemicals on the floor, window ledges, or balconies.
- Keep containers closed unless you are dispensing a chemical or adding to the container.
- Provide secondary containment for liquids whenever possible. Dishpans or polyethylene trays work best.
- Don’t store chemicals in a sink or fume hood, except for certain toxic gases that are so dangerous they can only be stored in a gas cabinet or fume.
- Label containers, and be sure container is compatible with the chemical.
- Use rated storage cabinets or safety cans whenever possible—required for 1 gallon or more of flammables.
- Cold rooms, refrigerators, and freezers have additional requirements, particularly for flammables.

Chemical Segregation:

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.

- Pyrophorics
- Water reactive
- Flammables
- Corrosives
- Oxidizers
- Toxics

Other types of materials require more specific storage requirements such as

- Explosives
- Compressed gases
- Cryogens

As a general rule, chemicals need to be physically segregated from incompatible chemicals; some key requirements are listed below.

- Store flammable liquids in approved safety containers. Do not store anything but flammable or combustible liquids in these.
- Segregate acids from bases.
- 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.

See Appendix A: The Hazard Communication Standard Pictograms and Appendix B: Chemical Compatibility chart for reference.

Multiple Hazard Classes:

Many chemicals belong to more than one chemical family or hazard class. In many cases, chemicals need to be evaluated on a case-by-case basis. Ideally, guidelines for each category should be observed, but this may not be possible in all instances.

One strategy is to prioritize the hazards of a specific chemical. The hazards listed above are prioritized for this purpose, from most severe to least. A pyrophoric chemical, for example, may also be a flammable liquid, but the pyrophoric property should outweigh the flammability for storage purposes.

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. If flammable storage space is at a premium, storage in a corrosives 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.

Storage Limitations:

It is best practice to minimize the quantities of hazardous chemicals on hand whenever possible. Minimization of stored chemicals is a key way to reduce the likelihood and severity of an incident involving said chemicals. It is important to note that storage limitations, particularly based on fire code, often extend to large groupings of labs or even entire floors of buildings. Each space is different, so contact EHS staff for an evaluation.

Secondary Containment:

Hazardous liquid chemicals require secondary containment while being stored. Secondary containment is any form of outer container or structure capable of holding the contents of a primary container in the event of a chemical release or accidental spill. Containment prevents chemicals from entering drains, reduces the chance of injuries to personnel, and helps facilitate cleanup.

Secondary Containment must meet the following requirements:

- All secondary containers must be constructed of a material that is chemically compatible with the contents of the primary container.
- Secondary containers must be maintained in good condition. Periodic inspections should be performed to look for cracking or other damage that could compromise containment ability.
- Spills or overflow into a secondary containment must be cleaned up as soon as possible. At a minimum, secondary containment capacity must be large enough to contain at least 10% of the total volume of the primary containers or 100% of the volume of the largest container. Whichever is greater.
    - For example:
        - 2 - 5 Gallon pails are in storage on a shelf. You need to place both pails into an appropriate secondary containment. Together both pails equal 10 gallons of material:
            - 10% of 10 Gallons = 1 Gallon.
            - 100% of the largest container = 5 Gallons.
        - To properly store these two containers in the same containment, you would need a secondary containment with a capacity of at least 5 Gallons.

Secondary Container Construction: A secondary container must be constructed of a material that is compatible with the chemical(s) that it may need to contain. Secondary containment products can be purchased commercially or be made of items such as storage bins or trays.

- Note: Most modern storage cabinets for flammables, corrosives, or other chemicals feature an integrated secondary containment sump built into the bottom. As long as chemicals are stored following the manufacturer's specifications, you will have sufficient secondary containment using a chemical storage cabinet.

Storage Cabinets and Safety 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.

  When purchasing a cabinet for your lab, look for a cabinet which is OSHA and NFPA approved (which will fulfill UL 1275) and has self-closing doors to comply with IFC. If you have an existing cabinet, it should be labeled if it meets any of these standards. Contact EHS 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.

- **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. They should be 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.

- **Corrosive Storage Cabinets**: 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 oftentimes 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 EHS.

Where to find information?

The first source for chemical-specific information should be the labels and safety data sheets (SDSs) from the manufacturer. You may also contact EHS for advice.

Appendix A: The Hazard Communication Standard

 **Flammable liquids**	 **Acids**	 **Bases**	 **Oxidizers**	 **Toxics**	 **Compressed gases**	 **Poison inhalation**	 **Water reactive**	 **Liquid nitrogen**
Do not store with acids or oxidizers Only store in refrigerators rated for flammables Keep quantities to a minimum (no 5 gallon cans permitted) Amounts over One (1) gallon: Stored in an approved flammable cabinet.	Do not store with bases, flammables, or cyanides Do not store under the sink	Do not store with acids May be kept with flammable liquids if in secondary containment	Do not store with flammable liquids or solids Do not store under the sink Avoid storage on wooden shelves	 And other **Health Hazards** Store on sturdy shelves below eye level or in secured cabinets Store separate from other hazard classes	Secure at all times even when empty Store away from heat sources Store with cap when regulator is removed Incompatible gases must be separated by a 30 minute fire barrier or 20 feet or line of sight	Store in a vented gas cabinet or a chemical fume hood Secure at all times Store with cap or plug in place	Do not store under the sink Store away from aqueous solutions Keep separate from other hazard classes	Store in a well ventilated area Consult EHS before storing 240L tanks
Examples Acetone Methanol Ether Hexane	**Examples** Sulfuric acid Hydrochloric acid Nitric acid Acetic acid	**Examples** Sodium hydroxide Potassium hydroxide Bleach	**Examples** Silver nitrate Ammonium persulfate Sodium periodate	**Examples** Sodium cyanide Sodium azide Aniline Ethidium bromide	**Examples** Helium Nitrogen Oxygen Hydrogen	**Examples** Carbon monoxide Chlorine gas Ethylene oxide Ammonia gas	**Examples** Sodium borohydride Hydrazine Sodium metal Phosphorus	**Example** LN
Special circumstances Combustible liquids (i.e. toluene) can be stored in the flammable cabinet if there is room.	**Special circumstances** Some acids are flammable (i.e. Acetic acid) but still store them with the acids.	**Special circumstances** Some bases are flammable (i.e. ethanol amine) but still store them with the bases.	**Special circumstances** Some acids are oxidizers (i.e. nitric acid) but still store them with the acids.	**Special circumstances** Inspect containers regularly.	**Special circumstances** Container volumes less than 5 liters (i.e. lecture bottles) can be stored lying down.	**Special circumstances** Consult with EHS when storing or using these materials.	**Special circumstances** There may be enough moisture in the air to react these materials. Use caution.	**Special circumstances** Liquid nitrogen tanks vent loudly periodically. Do not be concerned.

Appendix B: Chemical Compatibility chart

Chemical Hazard	Flammable	Acid	Base	Oxidizer	Toxic
Flammable					
Acid					
Base					
Oxidizer					
Toxic