



CHEMICAL STORAGE GUIDELINES

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Chemical Storage Guidelines

In addition to eliminating hazards that may arise with the use of chemicals, an appropriate chemical storage system must be developed. Improper storage will increase the chances of an accident occurring. Examples of improper storage include storage of chemicals in alphabetical order or other categories that may bring incompatibles in contact, storage of flammables in an ordinary refrigerator, and storage of chemicals with food. The following guidelines can be used to implement a safe storage system for chemicals.

A. Rotational Stock System

1. Limit the amount of chemicals present in the laboratories.
2. Ensure that all containers have the following:
 - a. Proper IUPAC Name
 - b. Manufacturer's Name
 - c. Chemical label with associated precautions
 - d. Date the chemical was received
 - e. Date the chemical was first used
3. A first-in, first-out system using the oldest chemicals first should be implemented. This will avoid degradation of older chemicals and their containers.
4. Use the following for maximum storage times:
 - a. When storing untreated chemicals that degrade to unstable forms (e.g. peroxide formers), limit the maximum storage time to one year from purchase or six months from first use.
 - b. For other hazardous chemicals, use the manufacturer's recommended storage time or other indications of degradation (e.g., discoloring of liquids).
 - c. Innocuous material (e.g., sodium chloride, sodium bicarbonate, Buffer Solutions, etc.) can be stored indefinitely or until no further use is desired.

When you have exceeded these periods of time or have no further use of the chemical, contact EHS at x4-2949 or at safety@towson.edu to have the chemicals removed for proper disposal.

B. Storage

1. General

- a. Do not store anything in the hallway, stairwells, on the floor or in any area accessible to the general public.
- b. Properly label all storage areas (e.g., “Chemical Storage Area”) to warn personnel of the hazards that are present.
- c. Do not store incompatible chemicals in areas where there exists the possibility of reaction. See attached list for examples of incompatible chemicals. Secondary containers may be used to segregate incompatibles stored in the same area.
- d. Ensure that all containers are not corroded, broken, rusted, or leaking. If the container loses its integrity, transfer the chemical to another container or, when transfer is not possible or safe, use secondary containers. Contact EHS at x4-2949 or at safety@towson.edu for disposal.
- e. In general, limit container size to one gallon in the laboratory. Larger containers should be kept in chemical storage rooms.
- f. Routinely check chemicals that are being stored for possible hazards.
- g. Store reactive chemicals in areas to reduce the possibility of reaction. For instance, keep water reactive chemicals in a controlled, low humidity environment.

2. Shelves

- a. If possible, avoid storing chemicals above shoulder height. Large containers (one gallon or larger), liquids, and corrosive materials should be stored on lower shelves below eye level.
- b. Ensure that shelves are capable of storage. Do not store chemicals on unsteady shelves.
- c. Do not overcrowd shelves.
- d. Shelves should be impervious to spilled liquids. This can be accomplished by coating the shelves with an epoxy.

- e. See attached illustration for possible guidelines for storage on shelves. If this is not possible, a system of storage should be developed to ensure that incompatible chemicals are not stored together. Alphabetical storage occasionally brings incompatibles into contact and should be avoided. If this method for storage is chosen, secondary containers must be used to separate incompatibles.

3. Refrigerators and Freezers

- a. Do **not** store chemicals and food together.
- b. When storing flammables, use an approved explosion proof or flammable storage refrigerator.
- c. Only use refrigerators or freezers for storage of chemicals that need to be kept refrigerated or frozen.
- d. Label the refrigerator as to the intended use. Examples of labels can be found in Appendix A.

4. Flammable and Combustible Liquids

- a. Flammable and combustible liquids are separated into the following classes according to the National Fire Protection Association (NFPA):

Class 1A (Highly Flammable)	Flash Point <73° F (22.8° C) Boiling Point <100° F (37.8° C)	Ex: Ethyl ether, Dimethyl sulfide, Petroleum ether
Class 1B Flammable	Flash Point <73° F (22.8° C) Boiling Point ≥100° F (37.8°)	Ex: Acetone, Toluene, Ethanol, Ethyl acetate, Hexane, Gasoline
Class 1C Flammable	Flash Point ≥73° F (22.8° C) Boiling Point <100° F (37.8° C)	Ex: Amyl acetate, Bromopentane, Butyric acid, Hexene, Xylene
Class II Combustible	Flash Point ≥100° F (37.8° C) & <140° (60° C)	Ex: Acetic acid, Cumene, Formaldehyde
Class IIIA Combustible	Flash Point ≥140° F (60° C) & <200° F (93.4° C)	Ex: Benzaldehyde, Ethanolamine, Nitrobenzene

- b. The NFPA has set limits for the storage of flammable liquids. Table 1 provides the maximum container size for each class of flammable liquid.

Table 1 Maximum Container Sizes for Flammables & Combustibles

CONTAINER TYPE:	FLAMMABLE LIQUID CLASS:			COMBUSTIBLE LIQUID CLASS:	
	1A	1B	1C	II	IIIA
GLASS	1 pt	1 qt	1 gal	1 gal	5 gal
METAL	1 gal	5 gal	5 gal	5 gal	5 gal
SAFETY CANS	2 gal	5 gal	5 gal	5 gal	5 gal
METAL DRUM (DOT)	60 gal	60 gal	60 gal	60 gal	60 gal

- c. Do not store flammable or combustible liquids near sources of ignition.
- d. The following are other NFPA specifications for storage. For chemical stockrooms, individual evaluations will be necessary and, as a result, may not be bound to these requirements.
- e. The following are other NFPA specifications for storage. For chemical stockrooms, individual evaluations will be necessary and, as a result, may not be bound to these requirements.
 - 1. Not more than 10 gallons of Class I or Class II liquids combined shall be stored outside of a storage cabinet or storage room, except in safety cans.
 - 2. Not more than 25 gallons of Class I or Class II liquids combined shall be stored in safety cans outside of a storage room or storage cabinet.
 - 3. Not more than 60 gallons of Class IIIA liquids shall be stored outside of a storage room or storage cabinet.
 - 4. Any quantity of liquids over this limit must be stored in an inside storage room or storage cabinet.
 - 5. Approved storage cabinets shall not exceed 120 gallons of combustible and flammable liquids and not more than 60 gallons of the total may be flammable liquid. Not more than 3 storage cabinets will be within one fire area of a building.

(Note: A fire area, as defined by NFPA, is “an area of a building separated from the remainder of the building by construction having a fire resistance of at least one hour and having all communicating openings properly protected by an assembly having a fire resistance rating of at least one hour.”)

Chemical Incompatibilities

GENERALLY, DO NOT STORE:

WITH:

Acids (Strong)

Bases (Strong)

Alkali Metals

Water, Carbon Dioxide, Carbon Tetrachloride, and other chlorinated Hydrocarbons

Arsenical Materials

Any reducing agent

Azides

Acids, Heavy Metals and their salts, Oxidizing agents

Chlorates

Ammonium Salts, Acids, Metal Powders, Sulfur, Carbon, finely divided organics or combustibles

Cyanides

Acids, Strong bases

Flammable Liquids

Ammonium Nitrate, Chromic Acid, Hydrogen Peroxide, Nitric Acid, Sodium Peroxide, Halogens

Hydrocarbons

Fluorine, Chlorine, Bromine, Chromic Acid, Sodium Peroxide

Hypochlorites Nitrates

Acids, Activated Carbon Sulfuric Acid, Reducing Agents, Other Acids

Nitrites

Acids, Oxidizing Agents

Nitroparaffins

Inorganic Bases, Amines

Organic Peroxides

Acids (Organic or mineral)

Oxidizers

Metal Powders, Ammonium Salts, Phosphorous, Flammable Liquids, Acids Sulfur, Sulfides, Sulfites

Oxidizing Agents

Reducing Agents

Selenides

Any reducing agents

Sulfides

Acids

GENERALLY, DO NOT STORE:

Tellurides

WITH:

Any reducing agents

SPECIFICALLY, DO NOT STORE:

Acetic Acid

Chromic Acid, Nitric Acid, Hydroxyl containing compounds, Ethylene Glycol, Perchloric acid, Peroxides, and Permanganates

Acetone

Concentrated Sulfuric and Nitric Acid Mixtures

Acetyl Bromide

Water, Alcohols

Acetyl Chloride

Water, Alcohols, Acetic Acid, Phosphorous trichloride

Acetylene

Copper (tubing), Bromine, Fluorine, Chlorine, Iodine, Silver, Mercury, and their salts

Ammonia, anhydrous

Mercury, Iodine, Chloride, Bromine, Calcium Hypochlorite, and Hydrofluoric Acid, Silver

Ammonium Nitrate

Acids, Metal Powders, Flammable Liquids, Chlorates, Nitrates, Sulfur, and finely divided organics or combustibles

Aniline

Nitric Acid, Hydrogen Peroxide, and other strong oxidizers

Bromine

Ammonia, Acetylene, Butadiene, Butane, Hydrogen, Sodium Carbide, Turpentine, Benzene, and finely divided metals

Calcium Oxide

Water

Carbon, activated

Calcium hypochlorites, all oxidizing Agents

Carbon Tetrachloride

Alkali metals

SPECIFICALLY, DO NOT STORE:

WITH:

Chromic Acid

Acetic Acid, Naphthalene, Camphor, Alcohols, Glycerine, Turpentine, Benzaldehyde, Ethyl Acetate, Acetic Anhydride, and other flammable liquids

Chromium Trioxide

Metals

Chlorine

Ammonia, Acetylene, Butadiene, Butane, Methane, Propane, Benzene and other Petroleum fractions, Hydrogen, Sodium Carbide, Turpentine, and finely divided Powdered metals.

Chlorine Dioxide

Ammonia, Methane, Phosphine, Hydrogen Sulfide

Copper

Acetylene, Hydrogen Peroxide

Cumene Hydroperoxide

Acids (Organic or Inorganic)

Fluorine

Anything

Hydrocyanic Acid

Nitric Acid

Hydrofluoric Acid,
Anhydrous

Ammonia (Aqueous or Anhydrous)

Hydrogen Peroxide

Copper, Chromium, Iron, Phosphorous, other metals and their salts, Alcohols, Acetone, Organic Materials, Aniline, Nitromethane, Flammable Liquids, Combustibles

Hydrogen Sulfide

Fuming Nitric Acid, Oxidizing Gases

Iodine

Ammonia, Acetylene, Butadiene, Benzene and other petroleum fractions, Hydrogen, Sodium Carbide, Turpentine, and finely divided powdered metals

Lithium Aluminum
Hydride

Water

Mercury

Acetylene, Fulminic Acid, Hydrogen, Ammonia, Halogens

SPECIFICALLY, DO NOT STORE:

WITH:

Nitric Acid,
Concentrated

Acetic Acid, Chromic Acid, Hydrocyanic Acid, Hydrazine, Zinc, Aluminum, Magnesium, Aniline, Carbon, Hydrogen Sulfide, Flammable Liquids or Gases, Bases, Chromates, Metals, Permanganates Reducing Agents, Sulfides, Sulfuric Acid and substances that are readily nitrated

Oxalic Acid

Silver, Mercury, and their salts

Oxygen

Oils, grease, Hydrogen, Flammable Liquids, Solids or Gases

Perchloric Acid

Sulfuric Acid, Acetic Anhydride, Bismuth and its alloys, Alcohols, Paper, Wood and other organic materials

Phosphorous (White)

Air, Oxygen, Alkali Metals, reducing Agents, Strong bases

Phosphorous Anhydride

Water

Phosphorous Oxychloride

Water

Phosphorous Pentoxide

Water, Alcohols, Strong bases

Potassium

Carbon Tetrachloride, Carbon Dioxide, Water

Potassium Chlorate
And Perchlorate

Sulfuric and other acids (See Chlorates)

Potassium Permanganate

Glycerine, Ethylene Glycol, Benzaldehyde, Sulfuric Acid

Silver

Acetylene, Oxalic Acid, Tartaric Acid, Ammonium compounds

Sodium

Carbon Tetrachloride, Carbon Dioxide, Water, Organic Halides, Warm Alcohols

Sodium Nitrite

Ammonium Nitrate and other Ammonium Salts

SPECIFICALLY, DO NOT STORE:

WITH:

Sodium Peroxide

Any oxidizable substance (e.g. Methanol, Glacial Acetic Acid, Acetic Anhydride, Benzaldehyde, Carbon Disulfide, Glycerine, Ethylene Glycol, Ethyl Acetate, and Furfural)

Sulfuric Acid

Chlorates, Perchlorates, Permanganates, Water, Bases

Water

Alkali metals, Acetyl Bromide, Acetyl Chloride, Benzoyl Chloride, Boron Hydride, Calcium, Barium Peroxide, Concentrated Sulfuric Acid, Sodium Hydroxide, Potassium Hydroxide, Sodium Peroxide, Sodium Amide, Phosphorous Oxychloride, Phosphorous Trichloride, Phosphorous Anhydride, Sulfuryl Chloride, Thionyl Chloride, Chlorosulfonic Acid.

SUGGESTED SHELF STORAGE PATTERN — ORGANIC

<p>ORGANIC #2 ALCOHOLS, GLYCOLS, AMINES, AMIDES, IMINES, INIDES (Store flammables in a dedicated cabinet.)</p>	<p>ORGANIC #3 HYDROCARBONS, ESTERS, ALDEHYDES (Store flammables in a dedicated cabinet.)</p>	<p>ORGANIC #4 ETHERS, KETONES, KETENES, HALOGENATED HYDROCARBONS, ETHYLENE OXIDE (Store flammables in a dedicated cabinet.)</p>	<p>ORGANIC #5 EPOXY COMPOUNDS, ISOCYANATES</p>	<p>ORGANIC #7 SULFIDES, POLYSULFIDES, ETC.</p>
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If possible avoid using the floor.

<p>ORGANIC #8 PHENOL, CRESOLS</p>	<p>ORGANIC #6 PEROXIDES, AZIDES, HYDROPEROXIDES</p>	<p>ORGANIC #1 ACIDS, ANHYDRIDES, PERACIDS (Store certain organic acids in acid cabinet.)</p>	<p>MISCELLANEOUS</p>	<p>MISCELLANEOUS</p>
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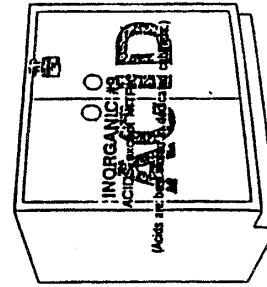
SUGGESTED SHELF STORAGE PATTERN — INORGANIC

<p>INORGANIC #10 SULFUR, PHOSPHORUS, ARSENIC, PHOSPHORUS PENTOXIDE</p>	<p>INORGANIC #2 HALIDES, SULFATES, SULFITES, THIOSULFATES, PHOSPHATES, HALOGENS, ACETATES</p>	<p>INORGANIC #3 AMIDES, NITRATES, (Not AMMONIUM NITRATE), NITRITES, AZIDES (Store Ammonium Nitrate from all other substances — ACUTE / H)</p>	<p>INORGANIC #1 METALS & HYDRIDES (Store away from any water) (Store flammable solids in flammables cabinet.)</p>	<p>INORGANIC #4 HYDROXIDES, OXIDES, SILICATES, CARBONATES, CARBON</p>
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If possible avoid using the floor.

<p>INORGANIC #7 ARSENATES, CYANIDES, CYANATES (Store away from any water)</p>	<p>INORGANIC #5 SULFIDES, SELENIDES, PHOSPHIDES, CARBIDES, NITRIDES</p>	<p>INORGANIC #8 BORATES, CHROMATES, MANGANATES, PERMANGANATES</p>	<p>INORGANIC #6 CHLORATES, PERCHLORATES, CHLORITES, PERCHLORIC ACID, PEROXIDES, HYPOCHLORITES, HYDROGEN PEROXIDE</p>	<p>MISCELLANEOUS</p>
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- #### STORAGE SUGGESTIONS
1. Avoid floor chemical storage (even temporary)
 2. No too shelf chemical storage
 3. No chemicals stored above eye level
 4. Shelf assemblies are firmly secured to walls. Avoid island shelf assemblies.
 5. Use proper anti-rack-tips on all shelves
 6. Use proper assembly methods to avoid wood construction
 7. Avoid metal, adjustable shelf supports and clips. Better fixed, wooden supports.
 8. Store acids in dedicated acid cabinet. Store nitric acid in that same cabinet only if isolated from other acids. Store both inorganic and some organic acids in the acid cabinet.
 9. Store flammables in a dedicated flammables cabinet.
 10. Store poisons in a dedicated poisons cabinet.
- OTHER STORAGE SUGGESTIONS ARE COVERED THROUGHOUT THIS CATALOG/REFERENCE MANUAL.



Store Nitric acid away from other acids unless your acid cabinet provides a separate compartment for Nitric Acid.

