

- OSHA 29 CFR 1910.1450, Occupational Exposure to Hazardous Chemicals in Laboratories

New laboratory construction and renovation projects require a system test and balance report to verify proper heating, ventilating, and air-conditioning (HVAC) system and fume hood operation *before* the building or area will be accepted, or occupied, by the institution.

Fume hoods shall not be installed or used primarily for chemical storage. Laboratories where potentially hazardous chemicals or agents are used shall have negative air pressurization relative to surrounding space, and HVAC systems shall be designed to provide 6-10 air changes per hour, depending on use of laboratory space.

In addition, chemical storage cabinets (e.g., flammable, corrosive, acid, caustic) will be used to segregate chemicals and to provide additional protection in the case of an emergency.

2.7 STORAGE REQUIREMENTS

Chemicals must be stored in a manner suited for each chemical's properties. All chemicals have specific properties that may make them incompatible with other chemicals or materials. This section outlines several different types of chemicals and the storage requirements associated with each:

- | | |
|--------------------|-------------------------------|
| 1. Acids | 6. Pyrophorics |
| 2. Bases | 7. Peroxide Forming Chemicals |
| 3. Flammables | 8. Toxic Chemicals |
| 4. Oxidizers | 9. Carcinogens |
| 5. Water Reactives | 10. Teratogens |

The lists below are not all inclusive, but include many of the most-commonly used materials in research laboratories.

2.7.1 Acids

- Store on low shelves or in acid cabinets.

- Segregate oxidizing acids from organic acids as well as flammable or combustible materials (see lists below).
- Use bottle carriers for transporting acid bottles.
- Have spill control materials available which will absorb and neutralize an acid spill.

Strong Oxidizing Acids—nitric acid, sulfuric acid, chromic acid, perchloric acid, hydrobromic acid

Organic Acids—acetic acid, acetic anhydride, phenol, trichloroacetic acid, trifluoroacetic acid

Other Common Acids—hydrochloric acid, phosphoric acid, formic acid, maleic acid, phosphotungstic acid

2.7.2 Bases

- Store bases on low shelves or in designated caustics cabinets.
- Segregate bases from acids.
- Have spill control materials available which will absorb and neutralize a base spill.

Common Bases—ammonium hydroxide, calcium hydroxide, potassium hydroxide, sodium hydroxide, bicarbonate salts (potassium bicarbonate, sodium bicarbonate, etc.), carbonate salts (calcium carbonate, sodium carbonate, etc.)

2.7.3 Flammables

- Store volumes greater than one gallon (four liters) in approved safety cans.
- Store in flammable storage cabinets.
- Keep away from heat and ignition sources (burners, heat-producing equipment, sunny windows, etc.)
- Keep firefighting equipment such as extinguishers accessible and unobstructed.
- Have flammable spill materials available. Activated charcoal absorbent is recommended.
- If flammables must be kept cold, use only a lab-safe refrigerator or freezer (electrical components mounted on the outside) or keep flammables on ice for as long as they are needed cold.

- Never store flammables in cold rooms. Most cold rooms are not sprinklered and all have recirculating air, which can allow dangerous levels of ignitable vapors to build up.

Flammable Solids—benzoyl peroxide, picric acid

Flammable Gases—acetylene, ammonia, butane, carbon monoxide, ethane, ethylene oxide, formaldehyde, hydrogen, hydrogen sulfide, methane, propane, propylene

Flammable Liquids—acetaldehyde, acetone, acetyl chloride, alcohols, benzene, butanol, p-dioxane, ethanol, ethyl acetate, ethylamine, ethyl benzene, ethyl ether, ethyl formate, furans, gasoline, hexane, hydrazine, isopentane, isopropyl ether, methanol, methyl acrylate, 2-methylbutane, methyl butyl ketone, methyl ethyl ketone, methyl methacrylate, morpholine, naphtha solvents, octane, piperidine, propanol, pyridine, Sigmacote, styrene, TEMED, tetrahydrofuran, toluene, turpentine, vinyl acetate, xylene

2.7.4 Oxidizers

- Store in a cool, dry place.
- Keep away from flammable and combustible materials.
- Keep away from reducing agents.
- Dispose of as hazardous waste.

Oxidizing Liquids—bromine, chromic acid, hydrogen peroxide, nitric acid, perchloric acid, sulfuric acid

Oxidizing Solids—ammonium dichromate, ammonium perchlorate, ammonium persulfate, benzoyl peroxide, calcium hypochlorite, salts of chlorates, chromium trioxide, ferric nitrate, salts of iodates, iodine, magnesium perchlorate, manganese dioxide, salts of nitrates, periodic acid, salts of peroxides, potassium dichromate, potassium permanganate, potassium persulfate, silver nitrate, sodium chlorite, sodium dichromate, sodium nitrite, sodium perborate

Oxidizing Gases—chlorine, chlorine dioxide, fluorine, nitrogen dioxide, nitrogen oxide, oxygen, ozone

2.7.5 Water Reactive Chemicals

(React strongly with water, yielding flammable or toxic gases or other hazardous condition).

- Store in a cool dry place.
- Do not store on shelves over sinks or water baths or near any other sources of moisture.
- In case of fire, keep water away.
- Dispose of as hazardous waste.

Solids—anhydrous aluminum chloride, ferrous sulfide, lithium*, lithium aluminum hydride, magnesium, maleic anhydride, phosphorus, phosphorus pentachloride, phosphorous pentasulfide, potassium*, sodium*, sodium borohydride

* Lithium, potassium and sodium should be stored under kerosene.

Liquids—acetyl chloride, chlorosulfonic acid, hydrofluoric acid, phosphoryl trichloride, Sigmacote, silicon tetrachloride, stannic chloride, sulfur chloride, sulfuryl chloride, thionyl chloride, titanium tetrachloride, triethylaluminum

2.7.6 Pyrophoric Chemicals

(Ignite spontaneously upon contact with air)

- Must be stored in accordance with manufacturer's recommendations under an inert atmosphere and at the appropriate designated temperature.
- Pyrophorics that are required to be kept cold must be stored in a explosion-proof refrigerator or freezer that is rated for flammable storage.
- In case of fire, a Class D fire extinguisher must be available. Pyrophoric materials are also often water-reactive, keep water away.

Boron	Cobalt*	Iron*	Phosphorus*
Cadmium*	Diborane	Lead*	tert-butyl lithium
Calcium*	Dichloroborane	Manganese*	Titanium*
Chromium*	2-Furaldehyde	Nickel*	Zinc*

* Finely divided metals form a pyrophoric hazard

2.7.7 Peroxide Forming Chemicals

(Chemicals that, over time, can auto oxidize to form explosive levels of peroxides)

- Store in airtight containers in a dark, cool and dry place.
- Label containers with date received, date opened and date of recommended disposal.
- Dispose of peroxide forming chemicals on or before their expiration date. If no expiration date is listed, contact [add client number] for assistance.
- Peroxide inhibitors, often added to these chemicals, may not be sufficient to control peroxide formation once a container is opened.
- Test periodically for the presence of peroxides. Test strip kits are available through laboratory safety suppliers, contact [add client number] for more information.
- Do not attempt to open containers that are very old, visibly crystallized or cracked.
- Dispose of as hazardous waste.

If testing for peroxides is not done, do not keep chemicals for longer than the following times:

3 Months—Isopropyl ether, potassium metal

12 Months—Acetal, butadiene, cumene, cyclohexane, 4-Dioxane (p-Dioxane), diacetalyn, dicyclopentadiene, ethyl ether, methyl butyl dimethyl ether, tetrahydrofuran, vinyl acetate, vinyl chloride, vinyl ethers, vinyl pyridine

2.7.8 Carcinogens

(Chemicals proven or suspected to cause cancer in humans)

- Label all containers 'Carcinogen' or 'Cancer Suspect Agent'.
- Take proper precautions to avoid exposures.
- Dispose of as hazardous waste.

OSHA Subpart Z lists the following compounds as carcinogens.

4-Nitrobiphenyl	bis-Chloromethyl ether	beta-Propiolactone
alpha-Naphthylamine	beta-Naphthylamine	2-Acetylaminofluorene
methyl chloromethyl ether	Benzidine	N-Nitrosodimethylamine

3,3'-Dichlorobenzidine (and its salts)	4-Aminodiphenyl Ethyleneimine	4-Dimethylaminoazobenzene
--	----------------------------------	---------------------------

2.7.9 Teratogens

(Chemicals known or suspected to cause reproductive harm including the potential to disturb the development of the embryo or fetus or cause birth defects)

- Label all containers 'Teratogen' or 'Reproductive Toxin'.
- Take proper precautions to avoid exposures.
- Dispose of as hazardous waste.

Aniline	Carbon monoxide	Lead	Radioactive substances
Benzene	Carbon tetrachloride	Mercury	Toluene
Carbon disulfide	Chloroform	Phosphorous	Turpentine

2.8 CHEMICAL HYGIENE PLAN

2.8.1 Purpose

The following section presents the Chemical Hygiene Plan (CHP) required by the above mentioned regulations. The purpose of the CHP is to describe proper practices, procedures, equipment, and facilities for employees, students, visitors, or other persons working in each laboratory at the University to protect them from potential health hazards presented by chemicals used in the laboratory workplace and to keep exposures below specified limits. It is the responsibility of administration, research, and supervisory personnel to know and to follow the provisions of this plan. The CHO, or Department Chair, is responsible for developing, implementing, monitoring, and updating the plan annually. Affected departments are all those maintaining laboratories that contain and use hazardous chemicals, as defined by the regulations.

2.8.2 Development, Implementation and Update

The CHO oversees the preparation of the CHP, specifically the standard operating procedures (SOPs) for the laboratory. The CHO is responsible (per OSHA regulation) for