



HAZARDOUS MATERIALS MANAGEMENT PROGRAM

Section 1. Chemical Safety

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1.0 PURPOSE

The purpose of this Section is to provide general guidelines on reasonable measures to control and minimize the risks associated with handling and disposing of hazardous materials.

2.0 DEFINITIONS

Chemicals are classified according to the primary hazard they pose. The following classes are defined in 29 CFR Parts 1910, 1915, 1917, 1918, 1926, and 1928.

2.1 *Flammable*

Flammable means a chemical that falls into one of the following categories:

1. Aerosol, flammable means an aerosol that, when tested by the method described in 16 CFR 1500.45, yields a flame projection exceeding 18 inches at full valve opening, or a flashback (a flame extending back to the valve) at any degree of valve opening;
2. Gas, flammable means:
 - a. A gas that, at ambient temperature and pressure, forms a flammable mixture with air at a concentration of 13 percent by volume or less; or
 - b. A gas that, at ambient temperature and pressure, forms a range of flammable mixtures with air wider than 12 percent by volume, regardless of the lower limit.
3. Liquid, flammable means any liquid having a flashpoint below 100 deg F (37.8 deg. C), except any mixture having components with flashpoints of 100 deg. C) or higher, the total of which make up 99 percent or more of the total volume of the mixture.
4. Solid, flammable means a solid, other than a blasting agent or explosive as defined in § 1910.109(a), that is liable to cause fire through friction, absorption of moisture, spontaneous chemical change, or retained heat from manufacturing or processing, or which can be ignited readily and when ignited burns so vigorously and persistently as to create a serious hazard. A chemical shall be considered to be a flammable solid if, when tested by the method described in 16 CFR 1500.44, it ignites and burns with a self-sustained flame at a rate greater than one-tenth of an inch per second along its major axis.

2.2 *Corrosive*

Corrosive means a chemical that causes visible destruction of or irreversible alterations in living tissue by chemical action at the site of contact. For example, a chemical is considered to be corrosive if, when tested on the intact skin of albino rabbits by the method described by the U.S. Department of Transportation in appendix A to 49 CFR part 173, it destroys or changes irreversibly the structure of the tissue at the site of contact following an exposure period of four hours.

2.3 *Oxidizer*

Oxidizer means a chemical other than a blasting agent or explosive as defined in § 1910.109(a), that initiates or promotes combustion in other materials, thereby causing fire either of itself or through the release of oxygen or other gases. In chemistry terms, it is an agent that receives electrons from a reducing agent during an oxidation-reduction reaction.

2.4 *Toxic*

Toxic means a chemical falling within any of the following categories:

1. A chemical that has a median lethal dose (LD₅₀) of more than 50 milligrams per kilogram but not more than 500 milligrams per kilogram of body weight when administered orally to albino rats weighing between 200 and 300 grams each.
2. A chemical that has a median lethal dose (LD₅₀) of more than 200 milligrams per kilogram but not more than 1,000 milligrams per kilogram of body weight when administered by continuous contact for 24 hours (or less if death occurs within 24 hours) with the bare skin of albino rabbits weighing between two and three kilograms each.

A chemical that has a median lethal concentration (LD₅₀) in air of more than 200 parts per million but not more than 2,000 parts per million by volume of gas or vapor, or more than two milligrams per liter but not more than 20 milligrams per liter of mist, fume, or dust, when administered by continuous inhalation for one hour (or less if death occurs within one hour) to albino rats weighing between 200 and 300 grams each.

2.4.1 PROP 65 Chemicals

The Safe Drinking Water and Toxic Enforcement Act of 1986 (Prop 65) requires the Governor of the State of California to revise and republish the list of chemicals known to the State to cause cancer or reproductive toxicity. The list is available at <http://www.oehha.ca.gov/prop65.html>.

See the Safe Work Practices/Standard Operating Procedure on Carcinogens in the SOP section for more information.

2.5 Reactive

Reactive (unstable) means a chemical which is the pure state, or as produced or transported, will vigorously polymerize, decompose, condense, or will become self-reactive under conditions of shocks, pressure or temperature.

2.5.1 Organic Peroxide Formers

Organic peroxide formers react with oxygen to form peroxy compounds (usually hydroperoxides) that are very unstable and decompose continuously. These organic peroxides are sensitive to light, heat, friction, and impact, as well as to strong oxidizing and reducing agents, and they are extremely flammable. There are four main groups of peroxide formers:

- a. Ethers with primary and/or secondary alkyl groups attached to the oxygen, including open chain and cyclic ethers, acetals, and ketals.
- b. Hydrocarbons with allylic, benzylic, or propargylic hydrogens.
- c. Conjugated dienes, enynes, and diynes.
- d. Saturated hydrocarbons with exposed tertiary hydrogens.

3.0 RESPONSIBILITIES

The responsibilities of all groups, entities, or individuals affected by this program are defined below.

3.1 Employee, Student, or Volunteer Responsibilities

It is the responsibility of the employee, student, or volunteer to:

1. Understand and comply with all provisions set forth in this section; and
2. Comply with all University safety policies.

3.2 Supervisor Responsibilities

It is the responsibility of the supervisor to:

1. Ensure that all staff under the supervisor's purview understand and comply with this section;
2. Create a chemical inventory for each laboratory;
3. Provide easy access to Material Safety Data Sheets (MSDSs);
4. Prepare Standard Operating Procedures (SOP) including Safe Work Practices for all routine processes involving hazardous materials conducted in the facility. See Section 3 SOP;
5. Ensure that all hazardous materials storage and use areas are posted with accurate warning labels.

6. Comply with all University safety policies.

4.0 WORKING WITH HAZARDOUS CHEMICALS

1. Consult the Standard Operating Procedure (or Material Safety Data Sheet) for a specific chemical before using it. General SOPs (e.g. corrosives, toxics, compressed gas, etc.) are available in Section 3 SOP.
2. Minimize chemical exposure by reducing the amount of time working with them;
3. Substitute highly toxic chemicals for ones of low toxicity. This enhances personal safety and reduces impact to the environment in terms of waste disposal;
4. Employ universal precautions when working with substances of unknown toxicity (i.e. regard unknowns to be toxic). Also, any mixture of toxic compounds is presumed to have a synergistic effect, namely, the toxicity of the whole is greater than the sum of each component;
5. Use a ventilation device (e.g. chemical fume hood, snorkel, canopy, etc.) if exposure levels exceed recommended limits. The recommended limit for a specific material is published in the MSDS. Contact EH&S if it is believed that levels exceed recommended limits; and
6. Wear appropriate personal protective equipment (PPE). It is essential for each laboratory worker to wear the appropriate clothing and to use the proper eye, face, hand, and foot protection at all times when working with hazardous materials. Respiratory protection should only be used when effective engineering or administrative controls are not possible and users must follow the USC Respiratory Protection Program.

4.1 Material Safety Data Sheet (MSDS)

29 CFR 1920.1200 requires that copies of material safety data sheets for each hazardous chemical be available in the workplace and readily accessible to employees. Electronic access, microfiche, and other alternatives to maintaining paper copies are permitted as long as no barriers to immediate employee access are in place. Hard copy MSDSs are recommended for the laboratory as a back-up resource in the event that electronic access is interrupted.

The MSDS may be obtained from EH&S STO 101, Laboratory Safety CHP 148, the manufacturer, or the internet at the following URLs:

1. Vermont Safety Information Resources, Inc. <http://hazard.com/msds/index.php> ;
2. VWR <http://www.vwrsp.com/search/index.cgi?tmpl=msds> ;
3. Fisher Scientific
[http://www.fishersci.ca/homepage4.nsf/\(waSearch\)?openagent&lang=E&DB=msds2.nsf](http://www.fishersci.ca/homepage4.nsf/(waSearch)?openagent&lang=E&DB=msds2.nsf) ;
4. NIOSH Pocket Guide to Chemical Hazards <http://www.cdc.gov/niosh/npg/npg.html> ;
5. Agency for Toxic Substances and Disease Registry <http://www.atsdr.cdc.gov/toxfaq.html> ;
6. Chemfinder <http://www.chemfinder.com> .

5.0 GOOD LABORATORY PRACTICES

1. **Always plan experiments with SAFETY as the first priority;**
2. Ensure that proper safety equipment is close and accessible (e.g. fire extinguisher, spill kits, safety showers, etc.);
3. Inform co-workers of hazardous work being conducted;
4. Coordinate with research staff to ensure active surveillance of employees working alone in the laboratory after business hours;

5. Never leave equipment running unattended or overnight without having some fail-safe mechanism to prevent disaster;
6. Place warning labels by hot surfaces;
7. When setting up lattices, ensure that mounts to the lab bench are secured properly;
8. Glass reaction vessels attached to lattices should be equipped with protective pans to contain spillage in the event the vessel breaks;
9. High vacuum systems should be assembled with due care. Sample vessels or ampoules should be wrapped with cloth or electrical tape in the event of an implosion/explosion. Blast shields or windows constructed of polycarbonate or Plexiglas should be mounted directly in front of the sample vessel being used;
10. Equipment and/or chemicals stored on open shelves should have Plexiglas lips to prevent "walk-off" during an earthquake or spillage from accidental contact when removing other containers;
11. Ensure that vacuum pumps are equipped with proper and functional guards for safe operation. Guards should be placed over belts;
12. Use digital or non-mercury thermometers for laboratory use;
13. For work involving radioactive, carcinogenic, or highly toxic materials, designate a specific area and label accordingly;
14. **NEVER** throw chemicals into the trash; and
15. **Report all safety hazards to the supervisor.**

5.1 Fire Safety

1. Laboratory doors are fire-rated and cannot be propped, wedged, or blocked open unless they are equipped with automatic door closers that are integrated with the fire alarm system;
2. All egress isles and corridors must be kept clear and maintained according to the LAMC fire code;
3. No egress doors, entry or exit, are allowed to be blocked for any reason;
4. No storage is allowed closer than 18 inches from the ceiling;
5. All pressurized containers will be strapped at top and bottom to a wall (See SOP Compressed Gas);
6. All wall penetrations will be sealed with fire caulk or fire putty; and
7. Fire extinguishers are required in every lab and every 75 feet in exit hallways.

5.2 Electrical Safety

1. All electrical equipment must be kept in good working order;
2. Multiple devices plugged into an outlet must be on surge protection;
3. Electrical wiring must comply with the National Electric Code;
4. Cube adaptors, multiple strip sockets, or "octopus" arrays at outlets are prohibited;
5. Power strips within fume hoods are prohibited;
6. Remove damaged wires (e.g. frayed, cut, spliced, etc.) from service;
7. Power cords running through walls are illegal;
8. Do not allow wires to lay in puddles of water or other liquids;
9. Keep electrical wires away from heat, flame, or oxidation;
10. Do not use plugs that are corroded or become hot when used;
11. When working close to water with electrical equipment, use ground fault circuit interruption protection for all circuits; and
12. Use grounding straps and mats as required by NFPA 30, Flammable and Combustible Liquids Code when transferring flammable liquids from bulk storage to NFPA approved containers.

5.3 *Housekeeping*

1. Clean work areas regularly and properly label and store all chemicals. Remember “A Clean Lab is a Safe Lab.” Accidents are reduced in laboratories where good housekeeping practices are followed;
2. Never obstruct access to exits and emergency equipment;
3. Do not use floors, stairways, or hallways as storage areas;
4. Secure all compressed gas cylinders to walls or benches (See SOP Compressed Gas);
5. Do not store chemical containers on the floor; and
6. Return chemicals to proper storage area after use.

5.4 *Labeling*

1. Personnel who use hazardous materials are responsible for properly labeling all containers including beakers, flasks, reaction vessels, and process equipment. Consult the University’s Hazard Communication Standard for labeling requirements;
2. Food products used in experiments must be labeled accordingly; and
3. If collecting the chemical as waste, use the hazardous waste labels available through EH&S.

5.5 *Personal Hygiene*

1. Do not pipet by mouth;
2. Do not use lab glassware to prepare or store food;
3. Do not smoke, apply cosmetics, eat or consume beverages in the laboratory;
4. Do not store food or beverages in laboratory refrigerators;
5. Leave lab coats in the laboratory before exiting the building;
6. Discard disposable gloves before exiting the laboratory;
7. Maintain soap and towels at sink; and
8. Wash hands thoroughly before leaving the laboratory.

6.0 *PROCUREMENT, INVENTORY, STORAGE, AND TRANSPORTATION*

The procurement of chemicals by University research groups may be coordinated through the following:

1. Directly through USC’s contract vendor (VWR at SGM 105) UPC;
2. Letters, Arts, and Sciences business center (UPC); and
3. Purchasing Services (HSC & UPC).

6.1 *Chemical Inventory*

An inventory must be maintained for all areas storing hazardous materials including compressed gas cylinders. Each research group will be assigned an on-line chemical inventory account by Laboratory Safety. Researchers must input their chemical inventories into their account and provide annual updates. Instructions for setting up the inventory and a quick-start guide are available in the Appendices.

6.2 *Storage*

Proper segregation of stored chemicals is essential to reduce or eliminate hazardous chemical reactions. Consult chemical labels, material safety data sheets, or standard operating procedures to determine the best storage practices.

1. Segregate chemicals into organic and inorganic families;
2. **Within each family, separate each chemical into its hazard class e.g. flammables, corrosives, etc.** Once in their respective hazard classes, chemicals may be stored alphabetically. Store each hazard class in a different location;

3. Store corrosive liquid containers in secondary containment such as a high density polyethylene tub. The secondary containment volume must exceed the combined volume of stored containers by at least 10 %;
4. Store chemicals inside a closeable cabinet or on a shelf that has a lip restraint to prevent the containers from sliding off in the event of an earthquake;
5. Store corrosive liquids below shoulder height;
6. Store chemicals away from heat or direct sunlight;
7. Flammable and combustible liquids that exceed an aggregate volume of ten gallons must be stored in grounded flammable storage cabinets. It is recommended that flammable cabinets be ventilated to reduce exposure to employees. NOTE: Flammable and combustible liquids that require refrigeration must be stored in a UL listed "explosion-proof" refrigerator;
8. Ensure that chemical storage does not obstruct access to safety showers, eyewashes, exit doors, fire extinguishers and other safety equipment; and
9. **Contact EH&S to remove excess inventory.**

6.2.1 *Highly Reactive Substances*

1. Segregate strong oxidizing agents from reducing agents and combustibles;
2. Segregate pyrophoric compounds from flammables;
3. Store highly reactive liquids in secondary containers such as high density polyethylene tubs;
4. Store peroxidizable materials away from heat and light;
5. Protect and store water-reactive materials away from possible contact with water;
6. Store thermally unstable materials in an explosion-proof refrigerator; and
7. Consult the SOP Reactive and Explosive Materials for more information.

6.3 *Transportation*

University staff may be required to transport small quantities of chemicals from one laboratory to another or from one of the on-campus stockrooms to the location where they will ultimately be used. Observing safe work-practices is essential when performing this task in order to prevent accidental releases or exposures.

The following guidelines serve as the minimum acceptable practices for transporting toxic, flammable, reactive, or corrosive chemicals on campus. However, individual academic or administrative departments may establish more stringent requirements for transportation of such materials. Note: These guidelines do not apply to radioactive materials or gas cylinders. For information on transporting these items contact EH&S.

1. Use bottle carriers for transporting chemicals which are in glass containers and ensure that the caps are securely tightened. **NOTE: Never transport in-compatible chemicals in the same secondary containment.**
2. While being transported, chemicals should be placed in a basin or tray and moved on carts to contain any spill.
3. If available, a freight elevator should be used to transport chemicals between floors. If chemicals are being transported in a passenger elevator, ensure that the car is unoccupied.
4. For off-campus relocation or over-the-road transportation, contact EH&S for assistance. **NOTE: The use of personal vehicles to transport chemicals is strictly prohibited.**
5. Containers must be labeled with the material's chemical name and its hazards and attended at all

times while being transported.

6. Individuals transporting chemicals must be familiar with the material's hazards and know what to do in the event of a release or spill.
 7. Wear appropriate Personal Protective Equipment (PPE) such as safety glasses, lab coats, and impermeable gloves.
- Immediately update the chemical inventory to reflect the relocation of chemicals.

7.0 FUME HOOD OPERATION

A properly designed and operated fume hood reduces exposure to hazardous fumes, vapors, gases and dusts. It also serves to shield the worker from a runaway reaction.

1. The fume hood must be operational 24 hours a day, 7 days a week, and must be uninterrupted by the fire alarm system according to NFPA 45;
2. Verify that the exhaust system is operating before working in the hood. Taping a strip of paper, tissue, or ribbon at the face of the hood will indicate the direction of air flow;
3. Keep the sash between 12 and 16 inches when setting up, running, or dismantling an experiment;
4. Set up equipment at least six (6) inches from the sash within the fume hood;
5. Elevate hot plates, ovens, and other large objects one or two inches above the work surface to allow air to flow underneath them;
6. Keep your head outside the fume hood;
7. Containers placed in fume hoods to collect hazardous liquid waste must be capped after each use;
8. Use perchloric acid only in fume hoods designed and labeled for perchloric acid work;
9. If a fire occurs in the fume hood during a process or experiment, quickly shut the sash if it is safe to do so and contact DPS;
10. **DO NOT** overcrowd or clutter the fume hood. Overcrowding creates vortices and dead spots. Vortices may cause hazardous material to flow back out of the fume hood thus exposing the employee; dead spots may allow ignitable concentrations of flammable and combustible materials to accumulate;
11. **DO NOT** erect shelves in a fume hood for chemical or equipment storage;
12. **DO NOT** place electrical receptacles, power strips, or other spark producing sources inside the hood;
13. **DO NOT** store chemicals inside the fume hood. Fume hoods should contain only working volumes of chemicals;
14. **DO NOT** use fume hoods to vent or dispose of hazardous materials through air dilution. This is in violation of the EPA Clean Air Act.

7.1 Fume Hood Inspection

1. EH&S and Laboratory Safety inspect and certify fume hoods annually (every six months for those designated for radioactive work). The inspection determines if the fume hood is operating properly and drawing air at the required velocity. Measurements are taken with the sash height between 12 and 16 inches;
2. The average face velocity must be between 100 and 125 feet per minute (fpm) for normal use; between 125 and 150 fpm for work involving volatile radioactive, carcinogenic, or highly toxic materials. If these specifications cannot be met, Facilities Management Services (FMS) will adjust the air flow; and
3. Immediately report any fume hood that is not working properly to EH&S or Laboratory Safety. FMS will repair the hood and it will be re-inspected to ensure proper operation.

8.0 HAZARDOUS MATERIALS DOOR SIGN

All spaces housing hazardous materials must have a door sign that provides hazard information to emergency responders. It features the following:

- ▶ Emergency after-hours phone number
- ▶ PI name and phone number
- ▶ Assistant name and phone number
- ▶ Hazardous chemical classes
- ▶ Examples of specific chemicals
- ▶ NFPA fire diamond

An example is illustrated on the following page. If a door sign is not displayed, notify Laboratory Safety or EH&S.

AHF B9		LABORATORY SAFETY	
3616 Trousdale Parkway Los Angeles, CA 90089-0376			
CONTACT INFORMATION			
Chuck Pickering, Director		323.442.2204	
Alfred M. Bouziane, Assistant Director		213.740.6351	
Department of Public Safety		213.740.4321	
HAZARD INFORMATION			
FLAMMABLE		TOXIC	
Acetone	Benzene Butane Ethanol	Arsine	Mercuric chloride
Heptane	Hexanes Methane Methanol	Phosphine	Dimethyl mercury
CORROSIVE		PROP 65	
Acetic Acid	Acetyl Chloride	Benzene	1,4-Dioxane
Sulfuric Acid	Hydrochloric Acid	Furan	Nitropyrene
REACTIVE		COMPRESSED GAS	
Acetic Anhydride	Phosphorus Pentoxide	Argon	Nitrogen Air
<small>WARNING: This area contains chemicals known to the State of California to cause cancer, birth defects, or other reproductive harm.</small>			

9.0 APPROVAL AND REVIEW

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By: Alfred M. Bouziane, Ed Becker, Hilary Polak,
Jane Bartlett, Anthony Rodriguez, Alan Gordon,
Michelle Lee, John Hagthorp

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By: Alfred M. Bouziane