



# Laboratory Safety Plan (includes Chemical Hygiene Plan)



Approved By: \_\_\_\_\_ Title: \_\_\_\_\_

Signature: \_\_\_\_\_ Date: \_\_\_\_\_

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## **Introduction**

The Laboratory Safety Plan (LSP) is intended to prevent injuries by helping laboratory personnel recognize, evaluate and control hazards in their laboratory. This is UC Merced's chemical hygiene plan and injury illness prevention plan for laboratories, and applies to all laboratories that use, store or handle potentially hazardous chemicals and all personnel who work in these facilities as required by the University Policy on Health, Safety and the Environment (<https://www.ucop.edu/research-policy-analysis-coordination/resources-tools/contract-and-grant-manual/chapter3/chapter-3-200.html>). Its effectiveness depends on the cooperation of faculty, staff, students, and the Office of Environmental Health and Safety (EH&S). It reflects Federal and State health and safety standards and published practices, standards, and guidelines of nationally recognized health and safety groups. Laboratory research and teaching must be done safely, as described in this plan.

## **Rights**

UC Merced faculty, staff, students, and visitors have a right to:

- A safe, healthful work environment.
- Information about potential hazards in the work areas.
- Training, in order to work safely in these environments.
- File a complaint with Cal/OSHA if they feel they are being exposed to unsafe or unhealthy work conditions and cannot be discharged, suspended, or otherwise disciplined by their employer for filing a complaint or exercising these rights. Workers are encouraged to first report to EHS at <https://ehs.ucmerced.edu/form/report-incident-or-concern>

## **Scope**

This plan applies to UC Merced faculty, staff, hosted visitors, students, guests and volunteers, and contractors at locations where UC Merced has management control. This includes off site laboratories if the PI is compensated by UC.

## **UC Merced Laboratory Safety Plan**

Each laboratory is required to have a health and safety plan that addresses chemical and physical hazards in the laboratory. This requirement is satisfied when all members of the laboratory have read and are familiar with all applicable sections of the Laboratory Safety Plan (LSP) and a completed Laboratory Safety Plan Supplement (LSPS). The LSP describes the proper use and handling practices and procedures to be followed by faculty, staff, students, visiting scholars, and all other personnel working with potentially hazardous chemicals in laboratory settings. The information presented in the LSP represents best practices and provides a broad overview of the information necessary for the safe operation of laboratories that utilize potentially hazardous chemicals. It is not intended to be all inclusive. Additional laboratory specific hazards and mitigation strategies should be listed in the LSPS. This plan is based on best practices identified in, among others sources, "Prudent Practices for Handling Hazardous Chemicals in Laboratories," published by the National Research Council, and the American Chemical Society's "Safety in Academic Chemistry Laboratories" ([www.acs.org](http://www.acs.org)). All laboratory members should sign a LSP Training Sheet (Form 4 in the LSPS) and keep a copy in the lab's safety binder. The PI or an assigned laboratory member should update the LSPS annually and whenever laboratory operations change. All laboratory personnel should review the LSPS whenever there are changes. All laboratory spaces should be self-audited for compliance with the LSP at least once per year using the Self-

Assessment Form (Form 3 of the LSPS) or at [ehs.ucop.edu/inspect](https://ehs.ucop.edu/inspect). This self-audit must be documented.

### Regulatory Requirements

Implementation of the necessary work practices, procedures, and policies outlined in this CHP is required by the following:

- *Title 8, California Code of Regulations (CCR), Section 5191, "Occupational Exposures to Hazardous Chemicals in Laboratories"* (<http://www.dir.ca.gov/title8/5191.html>)
- *Title 8, CCR, Section 5209, "Carcinogens"* (<http://www.dir.ca.gov/title8/5209.html>)
- *Section 5203 "Carcinogen Report of Use Requirements"* (<http://www.dir.ca.gov/title8/5203.html>),
- *Title 8, CCR, Section 5154.1, "Ventilation Requirements for Laboratory-Type Hood Operations"* ([http://www.dir.ca.gov/title8/5154\\_1.html](http://www.dir.ca.gov/title8/5154_1.html))

Other applicable regulations include those promulgated by the U.S. Department of Labor including 29 CFR 1910.1450 "Occupational Exposure to Hazardous Chemicals in Laboratories" (the "Laboratory Standard"). These regulations require that the Chemical Hygiene Plan be readily available wherever potentially hazardous chemicals are used, handled or stored. EH&S will review and evaluate the effectiveness of this Plan at least annually and update it as necessary. The most current version of the plan can be found at <http://ehs.ucmerced.edu/researchers-labs/chemical-safety> UC Merced acknowledges the assistance of the UCLA Office of Environmental Health and Safety, whose Chemical Hygiene Plan has served as a useful resource. All responsibility for the content and use of the LSP, including any errors or omissions, rests, however, solely with UC Merced.

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## OFFICE OF ENVIRONMENTAL HEALTH & SAFETY

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### **Instructions for Completing the UC Merced Laboratory Safety Plan**

There are two components to a complete Laboratory Safety Plan: this document, referred to as the Laboratory Safety Plan, and the Laboratory Safety Plan Supplement (LSPS), found at <http://ehs.ucmerced.edu/researchers-labs>. The LSPS is designed to contain laboratory-specific information and must be completed by each PI or an assigned laboratory member. Once complete, each member of the laboratory should read the LSP and LSPS and sign a copy of the LSP Training Sheet (Form 3 in the LSPS). Copies of all documentation (LSPS, Training Sheets) should be kept in the lab's safety binder. EH&S will review these documents during laboratory audits.

#### **Purpose:**

The LSP provides health and safety information to laboratory personnel that is tailored to their operations. If laboratory members read this LSP, complete the LSPS and implement its provisions, the laboratory will have satisfied all requirements for basic laboratory safety, including the Injury and Illness Prevention Program (IIPP) and Cal-OSHA Chemical Hygiene Plan.

The LSP covers general safety, chemical safety, and biosafety (BSL-1) issues. Additional authorizations are still necessary for work with biological hazards (BSL-2 and higher), lasers, radiation, controlled substances, select agents, and research using animals and human subjects.

#### **Procedures for completing a laboratory-specific LSP:**

- Read this LSP.
- Complete a LSPS (one for each PI). Once the LSPS is completed, each laboratory member must review the generic LSP, LSPS and sign the LSP Training Sheet.
- Copies of completed LSPS and training sheets should be kept in the lab's safety binder.
- All laboratories should also conduct semi-annual self-assessments, using the LSP self-assessment form. Copies of completed self-assessments should also be kept in the lab's safety binder.

#### **Procedures for updates and changes:**

Laboratories are required to notify EH&S and update their LSPS when operations, locations, or contact information changes. In addition, each laboratory member must review the LSP and associated LSPS and complete a training sheet (at the end of the LSPS).

### **Laboratory Safety Roles and Responsibilities**

Employees and other personnel who work in laboratories have the right to be informed about the potential health hazards of the chemicals in their work areas and to be properly trained to work safely with these substances. This includes custodial staff and other personnel who work to clean and maintain laboratories. Employees have the right to file a complaint with Cal/OSHA if they feel they are being exposed to unsafe or unhealthy work conditions and cannot be discharged, suspended, or otherwise disciplined by their employer for filing a complaint or exercising these rights. All personnel working with potentially hazardous

chemicals are encouraged to report (anonymously, if preferred) any concerns about unsafe work conditions to your health and safety officer.

Responsibilities for the health and safety of the campus community extend to the highest administrative levels of UC. The Chancellor and Vice Chancellor are responsible for broad implementation and enforcement of UC's environmental health and safety policies at all facilities and properties under campus control. Deans and Department Heads are responsible for establishing and maintaining programs in their areas and for providing a safe and healthy working environment.

Day-to-day responsibility for the management of laboratory safety and adherence to safe laboratory practices rests with the PI/Laboratory Supervisor within individual laboratory units and associated departments. All personnel, including PIs/Laboratory Supervisors, employees, and students have a duty to fulfill their obligations with respect to maintaining a safe working environment.

All employees and other personnel working with potentially hazardous chemicals have the responsibility to conscientiously participate in training, and to review and be familiar with the contents of this Laboratory Safety Plan. Those working with chemicals are responsible for staying informed about the chemicals in their work areas, safe work practices, and proper personal protective equipment (PPE) requirements required for the safe performance of their job. Failure to comply with these requirements will result in progressive disciplinary action in accordance with UC policy, and may result in temporary suspension of laboratory activities until corrective action is implemented.

Specific duties and responsibilities of personnel who work in areas where potentially hazardous chemicals are present have been compiled in "General Rules for Laboratory Work with Chemicals" found in Appendix A.

### **RESPONSIBILITIES OF PRINCIPAL INVESTIGATOR (PI)/ LABORATORY SUPERVISOR**

The PI/Laboratory Supervisor is responsible for the health and safety of all personnel working in the laboratory who handle hazardous chemicals. The PI/Laboratory supervisor may delegate safety duties, but remains responsible for ensuring those duties are adequately performed. The PI/Laboratory Supervisor is responsible for:

1. Knowing all applicable health and safety rules and regulations, training and reporting requirements, and standard operating procedures associated with chemical safety for regulated substances;
2. Identifying hazardous conditions or operations in the laboratory or other facility containing hazardous chemicals and determining safe procedures and controls, and implementing and enforcing standard safety procedures;
3. Establishing standard safety operating procedures (general and protocol specific) and performing literature searches relevant to health and safety for laboratory specific work;
4. Providing approval for work with hazardous materials in your laboratory or other facility with hazardous chemicals
5. Consulting with EH&S and/or Departmental Safety Committee on use of higher risk materials



such as particularly hazardous substances, or high-risk experimental procedures so that additional safety precautions may be taken;

6. Maintaining an updated chemical inventory on UC Chemicals for the laboratory or facility;
7. Ensuring laboratory or other personnel under your supervision have access to and are familiar with the appropriate safety manual(s);
8. Training all laboratory or other personnel you supervise to work safely with hazardous materials including applicable SOPs, and maintain written records of laboratory-specific or other specialized training in the Lab Safety Binder before students begin work;
9. Promptly notifying EH&S and/or facilities management should you become aware that engineering controls (e.g., fume hoods) and safety equipment (e.g., emergency showers/eyewashes, fire extinguishers, etc.) become non-operational;
10. Ensuring appropriate personal protective equipment (PPE) is available (e.g. lab coats, gloves, eye protection, etc.), the PPE is maintained in working order, and the [Lab Hazard Assessment \(LHAT\)](#) has been completed for the lab;
11. Conducting periodic self-inspections of the laboratory or facility and maintaining records of inspections;
12. Promptly reporting accidents and injuries to EH&S. Serious injuries MUST be reported to EH&S immediately to comply with the Cal/OHSA 8-hour reporting timeframe. If you are unsure if an injury is serious or not, report it.
13. Provide funding for medical surveillance and/or medical consultation and examination for laboratory and other personnel as required;
14. Inform facilities personnel, other non-laboratory personnel and outside contractors of laboratory hazards when they are required to work in your laboratory;
15. Identify and minimize potential hazards to provide a safe work environment for repairs and renovations;
16. Delegate authority for the laboratory to another PI or the Department Dean if you will be away from the laboratory for more than two weeks.

## **RESPONSIBILITIES OF ALL PERSONNEL WHO HANDLE POTENTIALLY HAZARDOUS CHEMICALS**

All personnel in research or teaching laboratories that use, handle, or store potentially hazardous chemicals are responsible for:

1. Reviewing and following requirements of the LSP and all appropriate safety manuals and policies;
2. Following all verbal and written laboratory safety rules, regulations, and standard operating procedures required for the assigned tasks;
3. Developing good personal chemical hygiene habits, including but not limited to keeping the work areas safe and uncluttered.
4. Planning, reviewing, and understanding the hazards of materials and processes in their laboratory

research or other work procedures prior to conducting work;

5. Utilizing appropriate measures to control identified hazards, including consistent and proper use of engineering controls, personal protective equipment and engineering controls;
6. Understanding the capabilities and limitations of PPE issued to them;
7. Gaining prior approval from the PI/Laboratory Supervisor for the use of restricted chemicals and other materials;
8. Consulting with PI/Laboratory Supervisor before using particularly hazardous substances (PHS), explosives, and other highly hazardous materials, or conducting certain higher risk chemical procedures;
9. Immediately reporting all accidents and unsafe conditions to the PI/Laboratory Supervisor;
10. Completing all required EH&S training and providing written documentation to the supervisor;
11. Participate in the medical surveillance program when required;
12. Informing the PI/Laboratory Supervisor of any work modifications ordered by a physician as a result of medical surveillance, occupational injury, or exposure;
13. When working autonomously or performing independent research or work:
14. Review the scope of work with the PI/Laboratory Supervisor including deviations from SOPs, preparing SOPs and literature searches.
15. Notifying in writing and consulting with the PI/Laboratory Supervisor in advance if the work will significantly deviate from previously reviewed procedures. (Note: Significant change may include but is not limited to change in objectives, PI, duration, quantity, frequency, temperature, location, PPE, or reduction or elimination of engineering controls.)
16. Preparing SOPs and performing literature searches relevant to safety and health that are appropriate for their work;
17. Providing appropriate oversight, training, and safety information to laboratory or other personnel they supervise or direct.

#### **RESPONSIBILITIES OF EH&S AND CHEMICAL HYGIENE OFFICER (CHO)**

EH&S is responsible for administering and overseeing institutional implementation of the Laboratory Safety Program. The Chemical Hygiene Officer (CHO) 209 205-8176 has primary responsibility for ensuring the implementation of all components of the LSP. In case of life safety or matters with imminent danger to life and health, the Director of EH&S or designee has the authority to order the cessation of the activity until the hazardous condition is abated. EH&S provides technical guidance to personnel at all levels of responsibility on matters pertaining to the laboratory use of hazardous materials. The CHO is a member of EH&S and, with support from other EH&S personnel is responsible for:

1. Informing PIs/Laboratory Supervisors of all health and safety requirements and assisting with the selection of appropriate safety controls, including laboratory and other workplace practices, personal protective equipment, engineering controls, training, etc.;
2. Conducting periodic inspections and immediately taking steps to abate hazards that may pose risk to life or safety upon discovery of such hazards;
3. Perform hazard assessments upon request;
4. Maintaining area and personal exposure-monitoring records;
5. Helping develop and implement appropriate chemical hygiene policies and practices;
6. Having working knowledge of current health and safety rules and regulations, training, reporting requirements, and standard operating procedures associated with regulated substances. Such knowledge may be supplemented and developed through research and training materials;
7. Reviewing existing and developing new SOPs for handling hazardous chemicals;
8. Providing technical guidance and investigation, as appropriate for laboratory and other types of accidents and injuries;
9. Helping to determine medical surveillance requirements for potentially exposed personnel;
10. Reviewing plans for installation of engineering controls and new facility construction/renovation as requested;
11. Reviewing and evaluating the effectiveness of the CHP at least annually and updating it as appropriate;
12. Providing management oversight and assistance with environmental compliance, transport, and disposal of hazardous waste.

## Section 1 Responding to and Reporting Worker Injuries

This section provides information on responding to and reporting workplace injuries. All laboratory personnel should be familiar with the procedures and emergency contact information described below.

### Medical Emergency

#### In the event of a medical emergency:

- Remain calm and begin lifesaving measures as necessary.
- Call for emergency response, dial **9-911 from a campus phone** or CAT-COPS (228-2677), or 911 from a cell phone.
- Keep injured person warm
- Do not remove injured person unless there is a danger of further harm.

Contact one or more of the following for further assistance:

Student Health Center (students only) \_\_\_\_\_ (209) 228-2273

**Patients First (Urgent Care) ----- (209) 383-3990 394 Yosemite Ave, Merced**

**Mercy Hospital (Emergency Room) ----- (209) 385-7000 333 Mercy Ave, Merced**

**Castle Medical Center (Urgent Care) ----- (209) 726-1235 3605 Hospital Road,**

**Atwater California Poison Center----- (800) 876-4766**

Injured employees at the UC Merced Campus should go to Patients First urgent care or the Mercy Medical Center emergency room and injured employees at the Castle Facility should go to the Castle Medical Center Urgent Care Center. Evaluation and treatment should be without cost to the employee. After treatment, injured employees should report their injuries to the Human Resource Office (228-2946) and their supervisor. Accidents or severe injuries, defined as hospitalization for 8 hours or more, severe burns, permanent impairment or disfigurement, amputation, or death, must be reported to EH&S within 8 hours. During non-business hours, report emergencies to CAT-COPS.

### Medical Surveillance

Medical surveillance is needed when working with infectious agents such as bloodborne pathogens and risk group 3 agents, regulated carcinogens, live animals, radiation or when using a respirator. Contact EH&S at 228-4639 to access the program.

## First Aid Kit

All first aid kits used at UC Merced should have, at a minimum, the items listed below. Personnel should supplement their kits according to their own needs. Items shall never be expired. Where special hazards are present (e.g. hydrofluoric acid, etc.) additional items may be necessary. Contact EH&S for further information at 205-8176.

### First Aid Kit Required Contents

<u>Description</u>	<u>Quantity</u>
Fingertip bandage	10
Knuckle bandage	8
1" x 3" adhesive bandage	16
Adhesive tape, 1/2" x 5yds	1
Alcohol preps	10
2" x 5 yds sterile gauze	1
5" x 9" gauze compress	2
3" x 3" sterile gauze pads	4

The Laboratory First Aid kit is only intended for minor injuries; seek medical attention by dialing 9-911 from a campus phone or 911 from a cell phone for all medical emergencies. PIs are responsible for restocking the First Aid kits after each use and for annual inventory. Additional First Aid kits may be purchased from Grainger (Item # 39P25 or 39N817) is appropriate for laboratory use.

All laboratory workers should also be familiar with the Emergency Procedures outlined in Section 2 and know the locations of emergency showers, fire extinguishers and other emergency equipment. Proper use of this equipment will save lives and minimize damage to personnel and property.

The first response for most chemical spills splashed on the skin or in the eyes is to rinse the affected area with fresh water for at least 15 minutes (the exposed person will need assistance with this) using an eyewash/shower (2 minutes for HF exposure, and always call an ambulance). If an eyewash or shower is not immediately available, wash hoses on many laboratory sinks can be used as a temporary substitute. Seek medical attention if necessary. Call 9-911 and request an ambulance if needed.

Certain chemicals pose hazards that require a specific antidote in the laboratory. All laboratory personnel working with *hydrofluoric acid* should have *calcium gluconate gel* in case of exposure and should understand its use. Laboratory personnel working with organophosphates or cyanide may also need specific antidotes. Contact EH&S for more information.

## Section 2 – Emergency Preparedness

This section provides information to help individuals and laboratories prepare for a variety of emergencies. The Principal Investigator should review the material and fill in appropriate information in their LSPS.

Fires, earthquakes, and natural disasters are a constant reality. Three large earthquakes have struck the west coast of North America in the last several years – Mexico City (1985), Loma Prieta (1989), and Northridge (1994). The Loma Prieta earthquake was strong enough in Merced to slosh water out of swimming pools. All workers should prepare a “grab and go” bag with basic supplies (see the Individual Preparedness Checklist in this Section). In addition, each laboratory should take basic steps to prepare for a disaster to mitigate damage and to speed recovery after a disaster (see the Laboratory Preparedness Checklist in this Section).

Each laboratory should designate a primary and secondary emergency contact for after-hours emergencies in the LSPS. Home phone numbers are confidential and are only available to EH&S and emergency personnel.

### Evacuation Procedures

All laboratory members need to know the location of the emergency gathering point for their laboratories. Additionally, each should maintain a current list of all laboratory personnel that is easily accessible, preferably near a door or exit, to keep track of personnel during an evacuation. Contact EH&S at 209-205-8176 for assistance with evacuation routes and other preparedness issues.

To minimize damage in an earthquake:

- Tall objects should be secured to a wall or other support.
- Shelves, especially chemical storage shelves, should have lips to keep containers from falling
- Heavy equipment should never be stored overhead.
- Computers and other equipment (freezers, large centrifuges) should be secured to prevent damage in an earthquake.
- Access and egress pathways leading from the laboratory to the hallway and from the hallway out of the building should not be blocked with stored equipment, boxes, or furniture.

Please refer to the Lab Safety Plan Supplement (LSPS) for the List of Laboratory Personnel and the location of the Gathering Point in case of an evacuation. Please keep your list of laboratory personnel updated in the Lab Hazard Assessment Tool (LHAT), located at <http://ehs.ucop.edu/>

In the event of a major disaster, the Emergency Action Plan will be followed. Obtain a copy at <https://emergency.ucmerced.edu/node/7> Priority will be to first protect life and safety, second maintain life support and assess damages, and third to restore campus operations. This document describes when the Emergency Operations Center (EOC) will be activated, when buildings must be evacuated, and the roles of students, faculty and staff, and building managers.

## **2.1 Individual Emergency Preparedness**

Major disasters could strand personnel at UC Merced for as long as three days. Prepare yourself and your family by gathering the supplies indicated below for yourself at work and for your family at home.

### Individual Preparedness

Everyone should be prepared for emergencies wherever they are. You could be stuck in your car, unable to travel for many hours, or forced to leave your car and walk. Damage to bridges, roads, and freeways could strand you at home or work for several days. Preparation will help keep you and those who depend on you safe and comfortable.

EH&S strongly recommends that each member of the University community carefully consider obtaining the following items:

#### In Your Car

Keep in your trunk several days' supply of food bars, water, first aid kit, all required medications, flashlight, emergency space blanket, warm jacket, flares, good pair of walking shoes, and money.

#### At Home

Develop a family earthquake plan, including out-of-state contacts. Store a sturdy pair of shoes, gloves and flashlight with fresh batteries under your bed. Store food, water, and emergency supplies adequate for at least 72 hours. These supplies are available in commercial kits, discussed below. Sufficient cash should also be available.

#### Food

Select foods that your family enjoys and will meet special dietary restrictions or infant needs. Rotate food items and don't forget about pets!

#### Water

Each person in your family will need from one-half to one gallon of water per day. Water should be stored in sealed plastic containers and kept in cool, dark locations. Date each container and change the water every three months.

#### Medical Supplies

Individuals should have at least a basic first aid kit, plus supplies of any required medications.

#### Storage of Supplies

Small materials and supplies should be bagged in categories and stored inside of a sealed plastic or metal trash container, storage locker, or heavy wooden box. Containers should be stored in cool, dry locations.

#### Preparedness Kits

Departments are also strongly encouraged to consider the purchase of emergency supplies (pre-packaged food, water, and first aid supplies) for their personnel.

## 2.2 Laboratory Emergency Preparedness

Minimize impact of disasters on laboratory operations by taking simple steps to prepare. Planning and preparation can minimize damage and get the laboratory operating as soon as possible.

### Laboratory Preparedness

Preparation for emergencies is essential within our research community at UC Merced; prepared laboratories will suffer less damage and restore laboratory operations in a timely manner. Taking action before emergencies occur can save lives, time and money. Be sure to include the following items in your emergency preparations:

- Store all critical research documentation outside the laboratory to avoid the total loss of research data in the event of a fire, etc.
- Obtain information regarding backup resources (i.e. other freezers, refrigerators, incubators, or emergency power, etc.) to preserve critical cell lines, organisms, etc.
- Secure all large pieces of equipment to the walls and remove any large heavy objects from shelving units for protection in an earthquake.
- Mount power strips to the wall and keep a roll of plastic sheeting on hand in case of flooding.
- Assign a “buddy” to help evacuate any disabled persons working in the laboratory.
- Emergency phone numbers should be posted in the laboratory. A form is in Appendix U.

Items that everyone in the laboratory should have:

- Names, phone numbers (home and cell), and travel time to campus of key laboratory personnel.
- Location and inventory of all laboratory emergency supplies (first aid kits, etc.), including a laboratory spill kit (see Section 11), along with combinations to locks and/or location of keys for access.
- Location of nearest fire extinguishers, alarm pull boxes, showers, etc.
- Evacuation map of all possible exits out of the structure. Include the location of designated gathering points away from the building.

Laboratory emergency preparedness is critically dependent on every individual within the laboratory. Only through careful and thoughtful preparation can a laboratory diminish the hazards.



## Section 3 – Fire Safety

It is better to prevent fires than to fight fires. Review the materials on Electrical Safety (Section 4), Chemical Safety (Section 7), Chemical Storage (Section 8) and other applicable topics to reduce the potential for fires.

In case a fire occurs, all laboratory personnel should know how to report fires, the location and proper use of fire extinguishers in their work areas, and how to evacuate the building.

To report a fire - call 9-911, then quickly evacuate the area (see Evacuation Procedures, Section 2), closing the laboratory door as you leave.

Personnel should only use an extinguisher for small (trash-can or lab bench size) fires and only if there is an escape route behind you. It is important to be aware of the locations and types of fire extinguishers in the laboratory. Fire extinguishers will be serviced annually by a contractor and inspected monthly by Facilities Management to verify that they are charged, that the seal is intact and that they are accessible.

Please refer to the attached LSPS for the location of fire extinguishers in your laboratory.

Pyrophoric chemicals, air and water reactive chemicals, and chemicals that give off toxic by-products or that rapidly polymerize when burned require special fire-fighting procedures. Please indicate the presence of any of these materials in Section 3 of your laboratory-specific LSPS. These require specific standard operating procedures (SOPs).

**Used or partially charged extinguishers must be immediately reported to Facilities Management Help Desk at 228-2986. Report all fires to UCM police even if the fire is out.**

### 3.1 Fire Extinguisher Selection

Take the time to learn about the extinguishers in your area. Having the right extinguisher, knowing its location and how to use it can save lives and property.

#### Fire Extinguisher Selection

The National Safety Council estimates that most fires occurring in the United States are easily contained with a single fire extinguisher at the time the fire is first discovered. UC Merced utilizes three basic types of extinguishers: water, carbon dioxide, and dry chemical, depending on the material burning. One type of extinguisher cannot be used safely on all types of fires!

**A**

**Class A Fire** - involves ordinary combustible materials  
(trash, wood or paper).

**B**

**Class B Fire** - involves burning liquids (gas, paint, etc.)

**C**

**Class C Fire** - involves energized electrical equipment

Each extinguisher contains a "letter" rating (A, BC or ABC) on its label, which guides the user to the proper class of fire for that specific extinguisher. Water extinguishers are only to be used on "Class A" fires; CO<sub>2</sub> extinguishers can be used on "B" and "C" fires; and dry chemical types ("Class ABC") can be used on all classes of fire (except for combustible metals). If there are combustible metals in the laboratory, contact EH&S at 209 205-8176 to see if you need a special Class D extinguisher. A bucket of sand can be used in lieu of a Class D extinguisher. The fire-fighting agent in ABC extinguishers is a very fine mixture of ammonium phosphate and anti-caking agents. If an ABC extinguisher is discharged, carefully sweep or vacuum the residue and wipe all flat surfaces thoroughly. This material has a very low toxicity; however, the dust can be irritating so ensure that there is plenty of fresh air during cleanup.

Review the extinguishers in your area to make sure they are appropriate for the materials used. In addition, visually inspect each extinguisher every month to make sure it is still in place and that the indicator arrow on ABC extinguishers is in the green area. Every extinguisher will be serviced annually by Facilities.

Call Facilities Management help desk at (209) 228-2986 to report fire extinguisher problems.

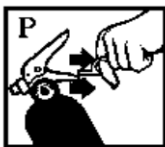
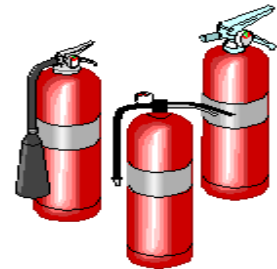
### 3.2 Using a Fire Extinguisher Safely – PASS

Learn about extinguisher operation before you need the extinguisher. They are very simple to use, but practice can prevent a disaster.

**P**ull-**A**im-**S**queeze-**S**weep ... **PASS**

#### **Extinguisher Operation**

Although extinguishers vary in size, color, and type of extinguishing agent, the vast majority of devices operate basically the same way. Stand six to eight feet from the fire with your back to an unblocked exit. If the fire is small, heavy smoke is NOT present and you have an exit available for evacuation, grab the nearest appropriate extinguisher and operate the following P-A-S-S procedure:



**P** - Pull the pin located in the extinguisher's handle. (Twist to break the seal.)



**A** - Aim the nozzle, horn or hose at the base of the fire.



**S** - Squeeze or press the handle.



**S** - Sweep from side to side at the base of the fire until it is out.

Used or partially charged extinguishers must be immediately reported to Facilities Management Help Desk at (209) 228-2986.

## Section 4 - Electrical Safety

This section provides information about electrical safety in research laboratories. Laboratory-specific information is described in the LSPS, which should be completed by the PI.

Electrical hazards cause many fires on university campuses each year; and are one of the leading causes of workplace fatalities in the United States. To protect against electrical hazards and to respond to electrical emergencies, it is important to identify the electrical panels that serve each laboratory space. Access to these panels must be unobstructed, with a clearance of 36," and they must be clearly labeled. Each room will be serviced by one or more electrical panels. These will be identified by panel- and circuit-labels near the outlet in each laboratory. The location of the electrical panel(s) that serves your laboratory is described in the attached LSPS. Please note that most panels are locked and only Facilities has access. In addition, it is important that laboratories prevent fire and shock hazards by observing the following precautions:

- Do not use extension cords for permanent wiring (extension cords should not supply power to permanent equipment like refrigerators) and do not run extension cords through walls.
- Electrical cords on equipment must be in good condition, not frayed or cracked. Damaged cords must be removed or repaired, not taped over.
- Multi-outlet power strips must have overload protection (circuit breakers) and must not be connected to other power strips or extension cords.
- Electrical cords and extension cords must plug directly into the wall without adapters. An electrician should do all repairs and modifications.
- Ground Fault Circuit Interrupters (GFCI) must be used in wet areas around sinks, tanks, etc.
- Power strips should be located off the floor in case of flooding.

## Section 5 – Laboratory Ergonomics

This section provides information about ergonomics in laboratories. Laboratory-specific information is described in the attached completed LSPS.

The purpose of an ergonomics program is to reduce or eliminate hazards that contribute to the development of Cumulative Trauma Disorders (CTDs), a class of disorders related to repetitive motions. Ergonomic injuries are the fastest growing category of workplace-related injuries.

Applying ergonomic principles can help reduce the risk of injuries for those who work with computers, laboratory equipment, and in any other jobs that require repetitive activities or heavy materials handling. Pipetting, microscope work, computer use, and improper lifting techniques are common causes of ergonomic injuries in laboratories and can be avoided by following the guidelines described in the following pages.

Risk factors for CTDs include: repetitive tasks, awkward postures, vibration, forceful exertions and heavy lifting. Allow your body to recover after these activities:

- Take frequent breaks
- Move around
- Don't repeat the same motions for hours on end
- Avoid awkward motions and postures
- Perform relief exercises
- Expand the tasks each person performs to minimize the constant repetition of any one particular task

Awkward postures, repetitions, and use of force are not always harmful. They are likely to cause injury, however, when sustained over time when your body doesn't have a chance to recover. The result can lead to overexertion, injury and perhaps permanent damage.

One of the key aspects of the ergonomics program is identifying and educating employees who have a high risk of developing cumulative trauma disorders. Early identification of symptoms with prompt intervention helps prevent serious or chronic problems.

To schedule an ergonomic evaluation or for further information please contact EH&S at 209 500-9461.

## 5.1 Ergonomics in Research Laboratories

Pipetting and microscopy present a variety of ergonomic hazards. Apply the general guidelines below to minimize the risk associated with these activities. Contact EH&S for more information.

### The Pressures of Pipetting

Pipetting involves several ergonomic stresses that can be exacerbated by the mental pressure resulting from the accuracy, precision and timing demanded in the procedures. If you spend more than one hour per day pipetting:

- Rotate pipetting tasks among several people.
- Take short pauses of a few seconds, when you can't take a longer break.
- Choose pipettors requiring the least pressure and use only the force necessary to operate.
- Work with arms close to the body to reduce strain on shoulders. Don't elevate your arm without support for lengthy periods. Keep head and shoulders in a neutral position (bent forward no more than 30 degrees).
- Use adjustable chairs or stools with built-in solid footstools. Don't use a foot ring, which could compress blood vessels in feet, and don't use a high stool that can force you to work with a bent neck.
- Use shorter pipets and low-profile waste receptacles for used tips. This decreases hand elevation and awkward postures.

### Microscopes

If you spend more than one hour per day using a microscope:

- Spread your use over the entire day if you will use it for more than five hours in a day.
- Keep microscope clean and use illuminators and shadow boxes properly to avoid visual and musculoskeletal strain.
- Adjust chair height so thighs are horizontal and feet are flat on the floor.
- Make sure the backrest provides proper lumbar support and be sure to readjust when you change positions.
- Select chairs with padded armrests to avoid compressing the ulnar nerve in your arm.
- Position work surfaces high enough to allow close inspection without inclining your head beyond 17-29 degrees.
- Use a cutout worktable. This puts you close to the microscope and provides area for supporting forearms.

## 5.2 Healthy Computer Use

Workers are spending an increasing amount of time sitting at computers. Follow the guidelines below to minimize the impact of this activity.

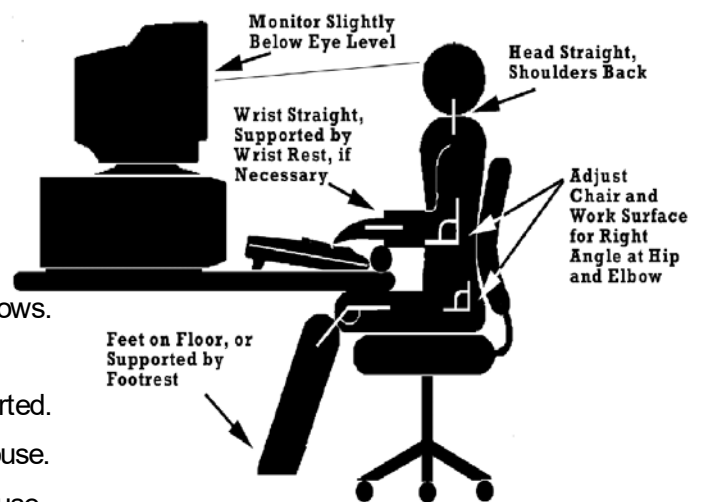
### Computer Self-help Checklist

It is the responsibility of each computer operator to recognize the risks associated with computer use and to take proactive, corrective measures to reduce potential injuries.

The following is a "quick reference" checklist that identifies some ergonomic issues associated with computer use.

Follow the guidelines below to achieve a neutral, relaxed posture:

- Sit directly in front of monitor and keyboard.
- Make sure the top of the screen is at eye level.
- Check for glare. To minimize glare, close blinds, reposition monitor to be perpendicular to the window, or install an anti-glare or privacy screen.
- Maintain an approximately 90-degree angle in elbows.
- Keep wrists straight and aligned with forearm.
- Sit "snugly" in chair to keep lower back well supported.
- Keep arms close to body when typing or using mouse.
- Move entire hand/wrist area when operating a mouse.
- Bring frequently used items close to work area to avoid overreaching and repetitive stretching.
- Place feet firmly on the floor or footrest.
- Move yourself around the work area using your feet, rather than pulling with your hands.
- Allow adequate legroom under workstation for stretching and periodic position changes.



To schedule an ergonomic evaluation or for more information, please contact EH&S at 228-ERGO.

## 5.3 Lifting and Materials Handling Guidelines

### Proper Lifting Techniques Can Help Prevent Injuries

The human back is a column of 33 vertebrae separated by small, round discs filled with a thick fluid, all held together by ligaments and muscles. If the ligaments and muscles are weak, the vertebrae and discs can become misaligned. Excessive lifting, a sudden fall, or other traumatic action can injure the back, or, over a period of years, the discs may simply "wear out". You can also "strain" or "sprain" the muscles and ligaments in your back.

Poor physical condition, excessive body weight, poor posture, and poor lifting technique contribute to the number and severity of back injuries. Degeneration of the spine due to aging is a major contributor to lower back pain, but is frequently misdiagnosed as a sprain or strain.

Before you lift anything, think about the load you'll be lifting. Ask yourself, can I lift it alone? Do I need mechanical help? Is it too awkward for one person to handle, or should I ask a coworker for help?

If the load is manageable, there are seven rules for safe lifting to help minimize injuries to the back:

- **Lift Comfortably.** Choose the position that feels best, with a straight back.
- **Avoid Unnecessary Bending.** Do not place objects on the floor if they must be picked up again later.
- **Avoid Unnecessary Twisting.** Turn your feet, not your hips or shoulders. Leave enough room to shift your feet so as not to have to twist.
- **Avoid Reaching Out.** Handle heavy objects close to the body. Avoid a long reach to pick up an object.
- **Avoid Excessive Weight.** If the load is too heavy, get help or use a mechanical device, if possible.
- **Lift Gradually.** Lift slowly, smoothly and without jerking.
- **Keep in Good Physical Shape.** Get proper exercise and maintain a good diet.

Be sure to use the same safe techniques when you set the load down. It takes the same time to lift safely as it does to do an unsafe lift, so why not play it safe and lift it right?



## Section 6 – Laboratory Relocation

This section describes requirements for laboratory moves, relocations, and equipment clearances. Supplementary information is included on the following pages.

Laboratory moves and relocations create the potential for a variety of problems, including accidents, injuries and chemical, biological and/or radiation spills. Before any relocations or closures of laboratory space, review these requirements and notify EH&S.

The Principal Investigator vacating laboratory space is responsible for removing ALL hazards from that laboratory space. Any hazards removed by EH&S will be recharged to the lab, or the school if the lab is not available. Laboratory areas cannot be re-occupied and work cannot be performed by contractors until a green Clearance Card is posted by EH&S. Notify EH&S in advance of the move and use the UC Merced Laboratory Clearance Checklist (next page) to keep track of all the details.

### Before You Move:

- Careful planning minimizes the time and expense of the move.
- Notify EH&S to begin clearance process.
- Dispose of as much hazardous waste as possible; see Sections 12 and 24 for more information.
- Pack hazardous materials securely, according to the guidelines in Section 18. Do not ship materials off-site without contacting EH&S.
- All equipment must be decontaminated prior to the move. Some equipment may be cleaned by laboratory personnel, other equipment such as biological safety cabinets, must be decontaminated by an appropriate contractor. Refer to the Laboratory Safety Plan, Biosafety Manual or Radiation Safety Manual for complete information. These can be found on the EH&S website under Research Safety.

### When you move:

- Sort materials according to compatibility, store in appropriate containers and keep a packing list for each box.
- Proper packaging will prevent spills of hazardous materials. If a spill or release does occur, call EH&S at 205-8176 or 9-911 immediately.
- Use proper lifting techniques when moving. If injuries occur, seek treatment and report them promptly to the Human Resources Office at 228-2949. See Section 5 for information on lifting techniques.
- Do not move chemicals or hazardous materials, including compressed gases or radioactive materials (RAM), outside of buildings and never use personal vehicles to transport hazardous materials. EH&S or a hazardous materials vendor will move all hazardous materials.

**REMEMBER** – An important part of the clearance process is removing items, such as razor blades, needles and even dust on shelves that could be perceived as hazardous by workers unfamiliar with research laboratories, such as movers, contractors and other personnel. Investigators vacating or relocating within UC Merced facilities are responsible for leaving laboratories in a state suitable for reoccupation or renovation. EH&S must be notified of all moves in laboratory spaces. Upon notification, EH&S will post a red “Not Clear of Hazards” tag. Once the items below have been completed the red tag will be replaced with a green “Clearance” tag. Space cannot be reoccupied and no work can be done in a space until the green “Clearance” tag is posted.

## 6.1 UC Merced Laboratory Clearance Checklist

### General Housekeeping

- Notify EH&S of move and ensure new space is cleared for occupancy.
- Broken glassware and clean sharps removed in puncture-resistant containers.
- Laboratory equipment and supplies decontaminated before removal from laboratory.

### Biohazardous Materials

- Work surfaces cleaned/ disinfected.
- All potentially biohazardous waste disinfected and removed from laboratory, including sharps containers.
- All media and supplies removed from drawers, shelves, and cabinets.
- Biosafety cabinets decontaminated prior to moving and recertified after the move. Contact EH&S at (209) 382-4535 for details.

### Radioactive Materials

- Survey facilities and equipment by meter and wipe test for contamination. Forward a copy of the wipe test, LSC printout, and corresponding map to EH&S.
- Surfaces and equipment cleaned, with radiation levels less than or equal to twice instrument background. If non-removable contamination is detected, contact EH&S.
- Radioactive waste appropriately packaged and removed.
- EH&S contacted for final clearance and survey.

### Chemical Safety

- All laboratory chemicals, including wastes, must be removed from the laboratory.
- All empty bottles and cans removed. Containers should be defaced and the caps removed.
- Bench coat and disposable liners/covers removed from work surfaces.
- Laboratory bench tops washed with soap and water.
- Debris removed from fume hoods and fume hood surfaces wiped down.
- Water run into all sinks and floor drains to fill traps. It is recommended that you pour several tablespoons of mineral in each drain to inhibit evaporation from the trap.
- Notify EH&S if perchloric acid has been used in fume hoods.
- Once the lab has been decontaminated, remove any hazardous material signage (i.e., carcinogens, biohazards).

## 6.2 Contractor Safety Sheet

### **Procedures When Contractors Work in Your Laboratory**

Laboratory personnel should understand the work the contractors are doing, especially any actions that could affect laboratory operations. Contractors should not move laboratory equipment or chemicals without assistance and approval from laboratory workers.

If contractors are working in the laboratory, help them understand that:

- Biohazard signs indicate the use of biological organisms. These are generally well-contained and researchers are trained to decontaminate work areas after use.
- Radiation is used in many laboratories, usually in very small amounts. All laboratories are checked regularly by EH&S and by laboratory staff to make sure they are not contaminated.
- Chemicals are found in most laboratories. These are used mostly in fume hoods, and are stored throughout the laboratory. Laboratory staff should remove all chemicals from the work area.
- Laboratory personnel should be available to answer any questions from the contractor.

Entering a Laboratory – Contractors should not enter any area or laboratory with a sign that warns against unauthorized entry or that says “keep out,” unless specifically directed to do so.

Working In Fume Hoods - If the project involves significant work inside a fume hood, laboratory staff must remove chemicals, equipment, and supplies and wipe the inside surface of the hood prior to the work being performed; EH&S personnel must clear the hood and post the green “Clearance Tag.”

Working in an Unoccupied Space - When laboratory personnel leave an area, EH&S will post a red tag and laboratory staff must remove materials, decontaminate surfaces and wipe down work areas. After hazards are removed, EH&S will post a green “Clearance Card.” Contractors should contact laboratory personnel, EH&S or Facilities Management with questions about potential hazards.

- How should contractors protect themselves from hazards in laboratories?
- Do not eat or drink in a laboratory and wash hands after leaving laboratory.
- Wear gloves, such as single use, surgical-type nitrile gloves.
- Wear eye protection and protective clothing such as a laboratory coat or coveralls.
- When working with equipment that might generate heat or sparks, it is extremely important that flammable materials are removed from the work area before they begin work. All gas cylinders should be removed before work begins.

### **What should contractors do if an emergency occurs?**

Fire - use a fire extinguisher if trained and the fire is small enough. For all other fires, evacuate the area, close the door, pull the fire alarm and call 9-911 from a campus phone.

Spill - If any chemical, biological, or radioactive materials are spilled, notify others in the area, close the door and call EH&S for assistance at (209) 228-2EHS, or 209 205-8176.

Injury – If a significant injury occurs, call 9-911. For minor injuries contact your supervisor and Human Resources.

## 6.3 Clearance Tag

A green "Clearance Tag" indicates the removal of identified hazards from a space. The tag must be posted at the end of laboratory relocations before custodial services or other service individuals can enter the premises.

### Remember –

Personnel vacating laboratory space are responsible for removing all hazards from that space. Use the Relocation Checklist to assist you in this process.

When all hazardous materials have been removed, a green "CLEARANCE TAG" will be posted by EH&S staff indicating that the space is ready for the next occupant.

**Laboratories that do not meet the relocation guidelines will not have a green "CLEARANCE TAG" posted.**

If you have any questions regarding this process, call EH&S at (209) 228-2EHS for assistance.

Green tags are also used to identify areas that are in need of repair where all hazards have been removed to allow work to proceed. EH&S will be notified by facilities of a work order for a hazardous area. EH&S will contact the lab and indicate what needs to be cleaned and how. EH&S will work with the lab and facilities to determine a schedule for the work. Items will be green tagged the afternoon before the work is scheduled. Upon green tagging, no lab work can take place in the cleaned area until the repair is complete. If repair will take an extended period of time, the green tag can be removed and the process started again when repairs are ready to proceed.

### ENVIRONMENTAL, HEALTH & SAFETY CLEARANCE

This room (item) has been surveyed to ensure that hazardous items or conditions have been removed. This posting indicates that the area (item) has been CLEARED so that clearing, construction and/or repair work may proceed. Labs may not use item/ area until work is complete.

Date: \_\_\_\_\_

Location (BLDG, ROOM): \_\_\_\_\_

Item(s): \_\_\_\_\_

EH&S Contact Person: \_\_\_\_\_

Phone Number: \_\_\_\_\_

## Section 7 –Chemical Safety

This section begins the chemical safety section of the LSP. The Principal Investigators should review this material and develop a set of safety practices suitable for their laboratories. It is especially important that each laboratory develops procedures or Standard Operating Procedures (SOPs) in the LSPS. Laboratory personnel should review this LSP, the laboratory-specific LSPS, and sign their copies of the LSP Training Sheet.

### **Standard Operating Procedures\***

Standard operating procedures or SOPs for use of hazardous chemicals (CCR, Title 8, Section 5191 (e)(3)(A) or marked "SOP required" on the chemical inventory tag. They must be written by persons most knowledgeable of the process and included into the LSPS. The development and implementation of SOPs is a core component if promoting a strong safety culture in the laboratory and helps ensure a safe working environment. SOPs are written in UC Chemicals ([ehs.ucop.edu/chemicals](http://ehs.ucop.edu/chemicals)). On the UC Chemicals homepage, click "inventory SOPs", then click the top button "new SOP".

Safety issues to be addressed in the SOPs include:

- Identification of the chemicals involved (use the exact name that appears on the chemical inventory)
- A detailed procedure of how the chemical(s) is/are used in the lab process, including quantities. Procedures should be detailed enough that an organic chemistry student can follow them and complete the operation.
- Hazards
- Engineering controls used – Section 9 of this document
- Personal Protective Equipment (PPE) necessary – Section 10 of this document
- Spill and emergency procedures – Section 11 of this document
- Waste disposal procedures – Section 12 of this document
- Any additional approvals necessary, specific decontamination procedures or designated areas for specific operations
- Personnel that will use the material and their signatures indicating they have read and will follow the SOP. (electronic is acceptable)

Items above may be included in the LSPS by reference to the appropriate section of this Laboratory Safety Plan. A template is available in appendix D.

Written procedures for work with carcinogens and acutely hazardous substances should include sufficient detail to ensure the safety of all laboratory personnel. In particular, procedures should include:

- Storage and security requirements (if any)
- Procedures to prevent contamination (e.g. leaving gloves and other PPE in work area)
- Any specific decontamination procedures
- Notification and evacuation procedures in the event of a spill

## Hazard Communication

UC has an established Hazard Communication Program that complies with 8 CCR 5194 (<http://www.dir.ca.gov/title8/5194.html>), the Cal/OSHA Hazard Communication Standard.

The purpose of UC's Hazard Communication Program is to ensure that all employees and, upon request, their personal physicians, have the right to receive information regarding the hazardous substances to which they may have been exposed at work. UC is responsible for providing information about the hazardous substances in our workplace, the associated hazards, and the control of these hazards, through a comprehensive hazard communication program that is summarized briefly below. The requirements of the Hazard Communication Program apply to laboratory environments at UC due to the potential for large scale experiments and for activities that may occur outside of areas where engineering controls are available. Proper hazard communication involves the active participation of the PI/Laboratory Supervisor, the EH&S Chemical Hygiene Officer, and the Laboratory/Facility Safety Coordinator, who are each responsible for providing consultation and safety information to employees working with hazardous chemicals.

### List of Hazardous Substances

All labs are required to keep an updated copy of their chemical inventory at [ehs.ucop.edu/chemicals](https://ehs.ucop.edu/chemicals). For each hazardous substance on the inventory, specific information on any associated health or safety hazards must be made readily available to all laboratory personnel. Compressed gases need to be included in the inventory list. Inventory should be certified by the PI at least annually.

### Hazard Determination

PIs/Laboratory Supervisors are responsible for verifying if any items on their chemical inventory are subject to the requirements of the hazard communication regulation.

The term "hazardous substance" refers to any chemical for which there is statistically significant evidence based on at least one study conducted in accordance with established scientific principles that acute or chronic health effects may occur in exposed individuals. Hazardous substances include, but are not limited to, those chemicals listed in the following:

- "The Hazardous Substance List", commonly known as the Directors List of Hazardous Substances, 8 CCR 339 (<http://www.dir.ca.gov/title8/339.html>);
- "Toxic and Hazardous Substances, Air Contaminants", 8 CCR, Section 5155 <https://www.dir.ca.gov/title8/5155.html>
- "Threshold Limit Values for Chemical Substances in the Work Environment", ACGIH, 2004;
- "Fourteenth Annual Report on Carcinogens", NTP, 2016 [https://ntp.niehs.nih.gov/ntp/roc/content/listed\\_substances\\_508.pdf](https://ntp.niehs.nih.gov/ntp/roc/content/listed_substances_508.pdf)
- "Monographs", IARC, WHO <https://monographs.iarc.fr/>
- "Chemicals Known to the State to Cause Cancer or Reproductive Toxicity" (Proposition 65), 22 CCR 12000.

Any novel chemical should be presumed hazardous. Chemical derivatives of known materials should be assumed at least as hazardous as their known parent compound. Novel compounds should be treated with extreme caution to prevent exposure. Inventory items found on the above lists are subject to the requirements outlined below.



## SAFETY DATA SHEETS (SDS)

A SDS must be available for each hazardous substance in a laboratory's chemical inventory. SDSs are available from the UC online SDS library: <https://ehs.ucop.edu/sds/>

PIs/Laboratory Supervisors are responsible for keeping SDSs current and making them available to all laboratory employees throughout the work day. SDSs must be in a central location that can be accessed immediately in the event of an emergency. Electronic copies may be kept in a file on a group drive, or hard copies maintained in a central location in the laboratory.

New chemical substances synthesized or produced in a laboratory, and used or shared outside of a laboratory suite, require the preparation of an SDS for each synthesized substance. The UC-system wide SDS library has the capability of developing new SDSs based on the known chemical and physical properties of that substance. Contact your health and safety officer for more information on preparing new SDSs.

A sample SDS and information on its contents is available in Appendix B

The New Global Harmonization System (GHS) of 2012 requires the standardization of SDSs. The minimum information required for an SDS is:

**1. Identification of the substance or mixture and of the supplier**

- GHS product identifier.
- Other means of identification.
- Recommended use of the chemical and restrictions on use.
- Supplier's details (including name, address, phone number, etc.).
- Emergency phone number.

**2. Hazards identification**

- GHS classification of the substance/mixture and any national or regional information.
- GHS label elements, including precautionary statements. (Hazard symbols may be provided as a graphical reproduction of the symbols in black and white or the name of the symbol, e.g., flame, skull and crossbones.). Symbols are required to be in a diamond with a red border.
- Other hazards which do not result in classification (e.g., dust explosion hazard) or are not covered by the GHS.

**3. Composition/information on ingredients  
Substance**

- Chemical identity.
- Common name, synonyms, etc.
- CAS number, EC number, etc.
- Impurities and stabilizing additives which are themselves classified and which

**ScienceLab.com**  
Chemicals & Laboratory Equipment

**Material Safety Data Sheet**  
**Formaldehyde 37% solution MSDS**

**Section 1: Chemical Product and Company Identification**

Product Name: Formaldehyde 37% solution  
Catalog Codes: SLF1425  
CAS#: Mixture.  
RTECS: LP8925000  
TSCA: TSCA 8(b) inventory: Formaldehyde; Methyl alcohol; Water  
CBI: Not applicable.  
Synonym: Formalin  
Chemical Name: Formaldehyde  
Chemical Formula: HCHO

Contact Information:  
ScienceLab.com, Inc.  
14025 Smith Rd.  
Houston, Texas 77336  
US Sales: 1-800-901-7247  
International Sales: 1-281-441-4400  
Order Online: [ScienceLab.com](http://ScienceLab.com)  
CHEMTREC (24HR Emergency Telephone), call: 1-800-424-9300  
International CHEMTREC, call: 1-703-527-3887  
For non-emergency assistance, call: 1-281-441-4400

**Section 2: Composition and Information on Ingredients**

Composition:

Name	CAS #	% by Weight
Formaldehyde	50-00-0	36.5-38
Methyl alcohol	67-56-1	10-15
Water	7732-18-5	47-53.5

Toxicological Data on Ingredients: Formaldehyde: ORAL (LD50): Acute: 100 mg/kg [Rat], 42 mg/kg [Mouse], 200 mg/kg [Guinea pig], MIST (LC50): Acute: 454000 mg/m<sup>3</sup> 4 hours [Mouse], Methyl alcohol: ORAL (LD50): Acute: 5628 mg/kg [Rat], DERMAL (LD50): Acute: 15800 mg/kg [Rabbit], VAPOR (LC50): Acute: 64000 ppm 4 hours [Rat].

**Section 3: Hazards Identification**

Potential Acute Health Effects:  
Very hazardous in case of eye contact (irritant), of ingestion, . Hazardous in case of skin contact (irritant, sensitizer, permeator), of eye contact (corrosive). Slightly hazardous in case of skin contact (corrosive). Severe over-exposure can result in death. Irritation of the eye is characterized by redness, watering, and itching.

Potential Chronic Health Effects:  
Hazardous in case of skin contact (sensitizer). CARCINOGENIC EFFECTS: Classified A2 (Suspected for human.) by ACGIH, 2A (Probable for human.) by IARC [Formaldehyde]. MUTAGENIC EFFECTS: Mutagenic for mammalian somatic cells. [Formaldehyde]. Mutagenic for bacteria and/or yeast. [Formaldehyde]. Mutagenic for mammalian somatic cells. [Methyl]

contribute to the classification of the substance.

**Mixture**

- The chemical identity and concentration or concentration ranges of all ingredients which are hazardous within the meaning of the GHS and are present at or above their cutoff levels.

**4. First aid measures**

- Description of necessary measures, subdivided according to the different routes of exposure, e.g., inhalation, skin and eye contact, and ingestion.
- Most important symptoms/effects, acute and delayed.
- Indication of immediate medical attention and special treatment needed, if necessary.

**5. Firefighting measures**

- Suitable (and unsuitable) extinguishing media.
- Specific hazards arising from the chemical (e.g., nature of any hazardous combustion products).
- Special protective equipment and precautions for firefighters.

**6. Accidental release measures**

- Personal precautions, protective equipment and emergency procedures.
- Environmental precautions.
- Methods and materials for containment and cleaning up.

**7. Handling and storage**

- Precautions for safe handling.
- Conditions for safe storage, including any incompatibilities.

**8. Exposure controls/personal protection.**

- Control parameters (e.g., occupational exposure limit values or biological limit values).
- Appropriate engineering controls.
- Individual protection measures, such as personal protective equipment.

**9. Physical and chemical properties**

- Appearance (physical state, color, etc.).
- Odor.
- Odor threshold.
- pH
- Melting point/freezing point.
- Initial boiling point and boiling range.
- Flash point.
- Evaporation rate.
- Flammability (solid, gas).
- Upper/lower flammability or explosive limits.
- Vapor pressure.
- Vapor density.
- Relative density.
- Solubility(ies).
- Partition coefficient: n-octanol/water.
- Auto-ignition temperature.



- Decomposition temperature.

#### **10. Stability and reactivity**

- Chemical stability.
- Possibility of hazardous reactions.
- Conditions to avoid (e.g., static discharge, shock or vibration).
- Incompatible materials.
- Hazardous decomposition products.

#### **11. Toxicological information**

- Concise but complete and comprehensible description of the various toxicological (health) effects and the available data used to identify those effects, including:
- Information on the likely routes of exposure (inhalation, ingestion, skin and eye contact);
- Symptoms related to the physical, chemical and toxicological characteristics;
- Delayed and immediate effects and also chronic effects from short- and long-term exposure;
- Numerical measures of toxicity (such as acute toxicity estimates).

#### **12. Ecological information**

- Eco-toxicity (aquatic and terrestrial, where available).
- Persistence and degradability.
- Bio-accumulative potential.
- Mobility in soil.
- Other adverse effects.

#### **13. Disposal considerations**

- Description of waste residues and information on their safe handling and methods of disposal, including the disposal of any contaminated packaging.

#### **14. Transport information**

- UN Number.
- UN Proper shipping name.
- Transport Hazard class(es).
- Packing group, if applicable.
- Marine pollutant (Yes/No).
- Special precautions which a user needs to be aware of or needs to comply with in connection with transport or conveyance either within or outside their premises.

#### **15. Regulatory information**

- Safety, health and environmental regulations specific for the product in question.

#### **16. Other information including information on preparation and revision of the SDS**

## **LABELS AND OTHER FORMS OF WARNING**

Labeling requirements for all hazardous substances are summarized as follows:

1. All containers of hazardous materials must be labeled with the identity of the hazardous substance
2. The label must contain all applicable hazard warning statements
3. The name and address of the chemical manufacturer or other responsible party must be present
4. Manufacturer's product labels must remain on all containers, and must not be defaced in any way.
5. Appropriate hazard warning statements and Proposition 65 warnings must be present, if not that information must be added
6. Labels must be legible, in English, and prominently displayed
7. Symbols and/or other languages are required for non-English speaking employees
8. Dispensed containers (such as spray bottles) must be labeled with the identity of the substance and appropriate hazard warnings
9. New synthesized compounds must be labeled with the appropriate hazard warnings based on the knowledge of the chemical and physical properties of that substance.

Additional information on container labeling is provided in Appendix C.

## **PERSONAL PROTECTIVE EQUIPMENT (PPE) AND LAB HAZARD ASSESSMENT TOOL**

See section 10

### **Other Resources**

- "Occupational Exposure to Hazardous Chemicals in Laboratories." California Code of Regulations (CCR) Title 8, Section 5191;
- Standard Operating Procedures (SOPs) for handling toxic chemicals (Appendix D);
- General information on the signs and symptoms associated with exposure to hazardous substances used in the laboratory or facility (consult SDS)
- Identity labels, showing contents of containers (including waste receptacles) and associated hazards;
- Label hazardous waste containers through WASTE ([ehs.ucop.edu/waste](http://ehs.ucop.edu/waste)). See the EH&S website for information about identifying hazardous waste  
<http://ehs.ucmerced.edu/researchers-labs/chemical-safety/hazardous-waste>)
- Warnings at areas or equipment where special or unusual hazards exist (e.g., particularly hazardous substances);
- Procedures to follow in case of an emergency; including call 9-911, inform your supervisor, and notify EH&S within 8 hours.
- Emergency telephone numbers of emergency personnel/facilities, supervisors, and laboratory workers; and
- Location signs for safety showers, eyewash stations, other safety and first aid equipment, exits and areas where food and beverage consumption and storage are permitted.

## 7.3 Classes of Hazardous Chemicals

### Identification & Classification of Hazardous Chemicals

Chemicals can be divided into several different hazard classes, which determines how these materials should be stored and handled and what special equipment and procedures are needed to use them safely. Each chemical container, whether supplied by a vendor or produced in the laboratory, must include labels that clearly identify the hazards associated with that chemical. In addition to specific chemical labels, hazard information for specific chemicals can be found by referencing the Safety Data Sheet (SDS) for that chemical.

Rooms containing hazardous chemicals must be labeled with the name of the PI responsible for the space, a contact phone number, protective equipment that must be worn in that lab, and any hazards found in the lab. An example placard is shown in figure 7.1. Placards can be printed from UC Chemicals – [ehs.ucop.edu/chemicals](http://ehs.ucop.edu/chemicals). Select “inventory summary”, then “print door hazard sign” half way down the page.

**Figure 7.1 - Door Posting**

IN CASE OF EMERGENCY DIAL 911 IMMEDIATELY

Castle Building 1200: Room106 (1 - First Floor)

Inventory Owner Emergency Contacts

Name	Role	Phone #	Alternate Phone #
Karen Smith	Inventory Owner	(209) 228-7864	

Emergency Contacts

Name	Role	Department	Phone #	Alternate Phone #

Last Certified: May 28, 2019 (EHS)



Gases Under Pressure



Flammables



Narcotic Effects



Oxidizers

Additional Hazards or Special Concerns

Additional Details

It is essential that all laboratory workers understand the types of hazards, recognize the routes of exposure, and are familiar with the major hazard classes of chemicals. In many cases, the specific hazards associated with new compounds and mixtures will not be known, so it is recommended that all chemical compounds be treated as if they were potentially harmful and to use appropriate eye, inhalation and skin protection equipment.

## FLAMMABILITY HAZARDS

A number of highly flammable substances are in common use in campus laboratories. Flammable liquids include those chemicals that have a flashpoint of less than 100 degrees Fahrenheit. These materials must be stored in flammable storage cabinets when in aggregate quantities of 10 gallons or more. Flame-resistant laboratory coats must be worn when working with large quantities (1 liter or more) of flammable materials and/or with procedures where a significant fire risk is present (e.g., when working with open flame, etc.). These materials can constitute a significant immediate threat and should be treated with particular care, even though the use of these materials is fairly common in the laboratory setting. Particular attention should be given to preventing static electricity and sparks when handling flammable liquids. Bonding and grounding is required when dispensing class 1A liquids from containers 5 gallons or larger.

## REACTIVITY HAZARDS

Reactive and explosive substances are materials that decompose under conditions of mechanical shock, elevated temperature, or chemical action, and release of large volumes of gases and heat. Some materials, such as peroxide formers, may not be explosive, but may form explosive substances over time. These substances pose an immediate potential hazard and procedures which use them must be carefully reviewed. These materials must also be stored in a separate flame-resistant storage cabinet or, in many cases, in laboratory grade refrigerator or freezer that are designed for flammable and reactive chemicals. Pyrophoric chemicals are a special classification of reactive materials that spontaneously combust when in contact with air and require laboratory-specific training. Flame-resistant laboratory coats and flame resistant gloves must always be worn when working with pyrophoric chemicals.

## HEALTH HAZARDS

Cal/OSHA uses the following definition for health hazards:

“The term ‘health hazard’ includes chemicals which are carcinogens, toxic or highly toxic agents, reproductive toxins, irritants, corrosives, sensitizers, hepatotoxins, nephrotoxins, neurotoxins, agents which act on the hematopoietic systems, and agents which damage the lungs, skin, eyes, or mucous membranes.”

The major classes of “hazardous” and “particularly hazardous substances” and their related health and safety risks are detailed below.

### Corrosive Substances

As a health hazard, corrosive substances cause destruction of, or alterations in, living tissue by Chemical action at the site of contact. Major classes of corrosive substances include:

- Strong acids – e.g., sulfuric, nitric, hydrochloric and hydrofluoric acids
- Strong bases – e.g., sodium hydroxide, potassium hydroxide and ammonium hydroxide
- Dehydrating agents – e.g., sulfuric acid, sodium hydroxide, phosphorus pentoxide and calcium oxide
- Oxidizing agents – e.g., hydrogen peroxide, chlorine and bromine.



Symptoms of exposure for inhalation include a burning sensation, coughing, wheezing, laryngitis, shortness of breath, nausea, and vomiting. For eyes, symptoms include pain, blood shot eyes, tearing, and blurring of vision. For skin, symptoms may include reddening, pain, inflammation, bleeding, blistering and burns. As a physical hazard, corrosive substances may corrode materials they come in contact with and may be highly reactive with other substances. It is important to review information regarding the materials they may corrode, and their reactivity with other substances, as well as information on health effects. In most cases, these materials should be segregated from other chemicals and require secondary containment when in storage.

### Irritants

Irritants are defined as non-corrosive chemicals that cause reversible inflammatory effects on living tissue by chemical action at the site of contact. A wide variety of organic and inorganic compounds, including many chemicals that are in a powder or crystalline form, are irritants. The most common example of an irritant may ordinary smoke which can irritate the nasal passages and respiratory system. Consequently, eye and skin contact with all laboratory chemicals should always be avoided. Symptoms of exposure can include reddening or discomfort of the skin and irritation to respiratory systems.

### Sensitizers

A sensitizer (allergen) is a substance that causes exposed people to develop an allergic reaction in normal tissue after repeated exposure to the substance. Examples of sensitizers include diazomethane, chromium, nickel, formaldehyde, isocyanates, arylhydrazines, benzylic and allylic halides, and many phenol derivatives. Sensitizer exposure can lead to all of the symptoms associated with allergic reactions, or can increase an individual's existing allergies.

### Hazardous Substances with Toxic Effects on Specific Organs

Substances included in this category include:

- Hepatotoxins –substances that produce liver damage, such as nitrosamines and carbon tetrachloride
- Nephrotoxins – agents causing damage to the kidneys, such as certain halogenated hydrocarbons
- Neurotoxins – substances which produce their primary toxic effects on the nervous system, such as mercury, acrylamide and carbon disulfide
- Agents which act on the hematopoietic system – carbon monoxide and cyanides which decrease hemoglobin function and deprive the body tissues of oxygen
- Agents which damage lung tissue - asbestos and silica.



Symptoms of exposure to these materials vary. Staff working with these materials should

review the SDS for the specific material being used and should take special note of the associated symptoms of exposure.

### Particularly Hazardous Substances

OSHA recognizes that some classes of chemical substances pose a greater health and safety risk than others. To differentiate this different risk characteristic, OSHA identifies two categories of hazardous

chemicals:

- **hazardous chemicals;** and
- **particularly hazardous substances.**

Substances that pose such significant threats to human health are classified as "particularly hazardous substances" (PHSs). The OSHA Laboratory Standard and Cal/OSHA regulation require that special provisions be established to prevent the harmful exposure of researchers to PHSs, including the establishment of designated areas for their use.

See UC's Particularly Hazardous Substances Policy (*Appendix E*) for more information, which also includes a list of common particularly hazardous chemicals used inside laboratories.

Particularly hazardous substances are divided into three primary types:

1. **Acute Toxins;**
2. **Reproductive Toxins;** and
3. **Carcinogens.**

### ***Acute Toxins***

Substances that have a high degree of acute toxicity are interpreted by OSHA as being substances that "may be fatal or cause damage to target organs as the result of a single exposure or exposures of short duration." The SDS will list H300 as the GHS code. These chemicals, associated chemical waste, and storage containers must be handled with care to prevent cross contamination of work areas and unexpected contact. These chemicals must be labeled as "Toxic." Empty containers of these substances must be packaged and disposed of as hazardous waste without rinsing trace amounts into the sanitary sewer system.

### ***Reproductive Toxins***

Reproductive toxins (<https://www.ehs.iastate.edu/publications/factsheets/CarcReproTerat.pdf>) include any Chemical that may affect the reproductive capabilities, including chromosomal damage (mutations) and effects on fetus (teratogenesis). The SDS will list H340, H341, H360, and H361 as the GHS code.

Reproductive toxins can affect the reproductive health of both men and women if proper procedures and controls are not used. For women, exposure to reproductive toxins during pregnancy can cause adverse effects on the fetus; these effects include embryoletality (death of the fertilized egg, embryo or fetus), malformations (teratogenic effects), and postnatal functional defects. For men, exposure can lead to sterility.

Examples of embryotoxins include thalidomide and certain antibiotics such as tetracycline.

Women of childbearing potential should note that embryotoxins have the greatest impact during the first trimester of pregnancy. Because a woman often does not know that she is pregnant during this period of high susceptibility, special caution is advised when working with all chemicals, especially those rapidly absorbed through the skin such as formamide. Pregnant women and women intending to become pregnant should consult with their laboratory supervisor and EH&S before working with substances that are suspected to be reproductive toxins.

## Carcinogens

Carcinogens are chemical or physical agents that cause cancer. Generally, they are chronically toxic substances; that is, they cause damage after repeated or long-duration exposure, and their effects may only become evident after a long latency period. Chronic toxins are particularly insidious because they may have no immediately apparent harmful effects. These materials are separated into two classes:

- **Select Carcinogens;** and
- **Regulated Carcinogens.**

Select carcinogens are materials which have met certain criteria established by the National Toxicology Program or the International Agency for Research on Cancer regarding the risk of cancer via certain exposure routes. (See definition Select Carcinogen.) It is important to recognize that some substances involved in research laboratories are new compounds and have not been subjected to testing for carcinogenicity. The following references (links provided) are used to determine which substances are select carcinogens by Cal/OSHA's classification:

- OSHA Carcinogen List [osha.gov/SLTC/carcinogens/standards.html](https://www.osha.gov/SLTC/carcinogens/standards.html)  
<https://www.osha.gov/SLTC/carcinogens/standards.html>
- Annual Report on Carcinogens published by the National Toxicology Program (NTP), including all of the substances listed as "known to be carcinogens" and some substances listed as "reasonably anticipated to be carcinogens"  
<https://ntp.niehs.nih.gov/pubhealth/roc/index-1.html#toc1>
- International Agency for Research on Cancer (IARC), including all of Group 1 "carcinogenic to humans" by the International Agency for Research on Cancer Monographs (IARC) (Volumes 1-48 and Supplements 1-8); and some in Group 2A or 2B, "reasonably anticipated to be carcinogens" by the National Toxicology Program (NTP), and causes statistically significant tumor incidence in experimental animals in accordance with any of the following criteria: (i) after inhalation exposure of 6- 7 hours per day, 5 days per week, for a significant portion of a lifetime to dosages of less than 10 mg/m<sup>3</sup>; (ii) after repeated skin application of less than 300 mg/kg of body weight per week; or (iii) after oral dosages of less than 50 mg/kg of body weight per day.
- The SDS will list H350 as the H code.

**Regulated Carcinogens** fall into a higher hazard class and have extensive additional requirements associated with them. The use of these agents may require personal exposure sampling based on usage. When working with Regulated Carcinogens, it is particularly important to review and effectively apply engineering and administrative safety controls as the regulatory requirements for laboratories that may exceed long term (8 hour) or short term (15 minutes) threshold values for these chemicals are very extensive. A complete list of Regulated Carcinogens can be found in *Appendix G*.



## 7.3 Exposure Control

### Introduction

Hazardous chemicals require a carefully considered, multi-tiered approach to ensure safety. There are four primary routes of exposure for chemicals which have associated health hazards (illustrated in Figure 7.2):

- Inhalation;
- Absorption (through the skin or eyes);
- Ingestion; and
- Injection (skin being punctured by a contaminated sharp object or uptake through an existing open wound).

Of these, the most likely route of exposure in the laboratory is by inhalation. Many hazardous chemicals may affect people through more than one of these exposure modes, so it is critical that protective measures are in place for each of these uptake mechanisms.

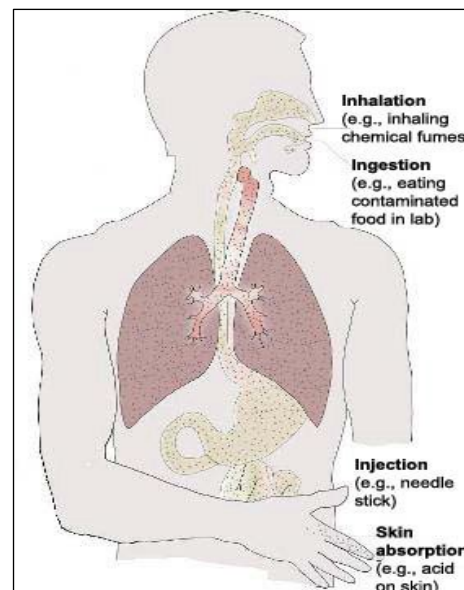


Figure 7.2 – Routes of Exposure

### Safety Controls

Safety controls are divided into three main classifications:

- Engineering Controls;
- Administrative Controls; and
- Protective Apparel and Equipment.

Elements of these three classes are used in a layered approach to create a safe working environment. The principles of each of these elements are detailed below.

### Engineering Controls

Engineering controls include all “built in” safety systems. These controls offer the first line of protection and are highly effective since they generally require minimal special procedures or actions on the part of the user except in emergency situations. A fundamental and very common example is the laboratory fume hood which is very effective at containing chemical hazards and protecting users from inhalation hazards. Other examples of engineering controls include general room ventilation, flammable material storage units, and secondary containment.

### General Laboratory Ventilation

All laboratory rooms in which hazardous materials are used must have fresh air ventilation with 100% of the exhaust venting to the outside; laboratory rooms should not be part of recycled air systems. In cases where this is not desirable, a formal hazard evaluation will be made by EH&S to determine what work can be done in the space and under what special conditions or limitations. Laboratory rooms should be kept at negative pressure compared to public areas to prevent the spread of hazardous vapors. General ventilation is not adequate protection from vapors of hazardous chemicals. See the University of California Environment, Health and Safety



(EH&S) Laboratory Safety Design Guide, available in the EH&S office, for additional information on laboratory ventilation.

**Fume Hoods - see section 9 for a complete discussion of fume hood use**

### **Other Engineering Controls**

In addition to the elements listed above, consideration must be given to providing sufficient Engineering controls for the storage and handling of hazardous materials. No more than 10 gallons total of flammable chemicals may be stored outside of an approved flammable storage cabinet.

When refrigerating or freezing flammable and explosive materials, refrigeration units specifically designed for storing these materials must be used. Generally, these units do not have internal lights or electronic systems that could spark and trigger an ignition; additionally, the cooling elements are external to the unit. These units should be labeled with a rating from Underwriters Laboratory or other certifying organization.

Secondary containment must be provided for corrosive and reactive chemicals and is recommended for all other hazardous chemicals. Secondary containment should be made of chemically resistant materials and should be sufficient to hold the volume of at least the largest single bottle stored in the container.

Laboratories that use hazardous materials must contain a sink, kept clear for hand washing to remove any final residual contamination. Hand washing is recommended whenever a lab worker who has been using hazardous materials plans to exit the laboratory or moves to work on a project that does not involve hazardous materials.

## **ADMINISTRATIVE CONTROLS**

Administrative Controls consist of policies and procedures; they are not generally as reliable as engineering controls since the user has to carefully follow the appropriate procedures and must be fully trained and aware in order to do so. Campus wide policies include not allowing minors or pets into laboratory spaces, laboratory training, PPE, use of tax-free ethanol and controlled substances.

Minors in lab policy:

[http://policies.ucmerced.edu/sites/policies.ucmerced.edu/files/page/documents/minors\\_in\\_labs\\_and\\_shops\\_june\\_2013.pdf](http://policies.ucmerced.edu/sites/policies.ucmerced.edu/files/page/documents/minors_in_labs_and_shops_june_2013.pdf)

Animals in campus buildings policy:

[http://policies.ucmerced.edu/sites/policies.ucmerced.edu/files/page/documents/animal\\_policy.pdf](http://policies.ucmerced.edu/sites/policies.ucmerced.edu/files/page/documents/animal_policy.pdf)

Laboratory training policy:

[http://policies.ucmerced.edu/sites/policies.ucmerced.edu/files/page/documents/labsafetytraining\\_june\\_2013.pdf](http://policies.ucmerced.edu/sites/policies.ucmerced.edu/files/page/documents/labsafetytraining_june_2013.pdf)

PPE policy:

[http://ehs.ucmerced.edu/sites/ehs.ucmerced.edu/files/documents/ppe/personalprotectiveequipment\\_june\\_2013.pdf](http://ehs.ucmerced.edu/sites/ehs.ucmerced.edu/files/documents/ppe/personalprotectiveequipment_june_2013.pdf)

EH&S requires that each laboratory have safety procedures, which include safety practices, for any work that involves hazardous materials. In many cases, a general safe operating procedure can be created in consultation with EH&S, for a class of chemicals that have similar properties. For example, a laboratory group may have one set of safety guidelines for using acids in their laboratory if the acids used have similar properties and/or if the significant differences are delineated in the general procedure. In addition to safety procedures, laboratory groups must submit proposed changes in procedures to EH&S for review prior to implementation if these changes could pose an additional or significantly greater hazard than the standard procedure. These reviews are especially important in cases where immediate hazards are present such as large quantities of flammable material, explosives or highly reactive material, or highly toxic substances.

Laboratory groups should also review their operations to minimize the amounts of hazardous substances in use or to replace them with less hazardous alternatives. Attention must also be paid to the appropriate segregation of incompatible materials.

### Standard Operating Procedures

Standard operating procedures (SOPs) (*Appendix D*) or Job Safety Analysis (JSAs) that are relevant to safety and health considerations must be developed and followed when laboratory work involves the use of hazardous chemicals (CCR, Title 8, Section 5191 (e)(3)(A)), especially for “particularly hazardous substances” (PHS). SOPs are written instructions that detail the steps that will be performed during a given experimental procedure and include information about potential hazards and how these hazards will be mitigated. SOPs should be written by laboratory personnel who are most knowledgeable and involved with the experimental process. The development and implementation of SOPs is a core component of promoting a strong safety culture in the laboratory and helps ensure a safe work environment.

While general guidance regarding laboratory work with chemicals is contained in this plan, PIs/Laboratory Supervisors are required to develop and implement laboratory-specific SOPs for certain hazardous chemicals and PHS that are used in their laboratories. These SOPs must be submitted and reviewed by EH&S prior to implementation. For certain hazardous chemicals, PHS, or specialized practices, consideration must be given to whether additional consultation with safety professionals is warranted or required.

Circumstances requiring prior approval from the PI/Laboratory Supervisor must also be addressed in laboratory specific SOPs. These circumstances are based on the inherent hazards of the material being used, the hazards associated with the experimental process, the experience level of the worker, and the scale of the experiment. Some examples of circumstances that may require prior approval include working alone in a laboratory, unattended or overnight operations, the use of highly toxic gas of any amount, the use of large quantities of toxic or corrosive gases, the use of extremely reactive chemicals (pyrophorics, water reactive chemicals), or the use of carcinogens.

UC maintains a website <https://ehs.ucmerced.edu/researchers-labs/chemical-safety/standard-operating-procedures> with tools and resources that may be referenced while developing SOPs, including fact sheets for the use of certain hazardous chemicals. Please create your SOP at [ehs.ucop.edu/chemicals](https://ehs.ucop.edu/chemicals). SOPs must be developed prior to initiating any experiments with hazardous chemicals identified with the tag “SOP required” in UC Chemicals, where they are available to all laboratory personnel. If the chemical is also marked “SOP complete”, you must sign off on the SOP before working with the chemical. EH&S is available to assist with the development of SOPs, which are checked at your annual lab safety audit.

When drafting an SOP, consider the type and quantity of the chemical being used, along with the frequency of

use. The procedure should be detailed enough that a chemistry or biology lab student can complete the task with the information given. The Safety data sheet (SDS) for each hazardous chemical or PHS that will be addressed in the SOP should be referenced during SOP development. The SDS lists important information that will need to be considered, such as exposure limits, type of toxicity, warning properties, and symptoms of exposure. If a new chemical

will be produced during the experiment, an SDS will not necessarily be available. In these cases, the toxicity is unknown and it must be assumed that the substance is particularly hazardous, as a mixture of chemicals will generally be more toxic than its most toxic component.

## Laboratory Safety Equipment

New personnel must be instructed in the location of fire extinguishers, safety showers, and other safety equipment *before* they begin work in the laboratory. This training is considered part of the laboratory specific training that all staff members must attend.

### Fire Extinguishers

All laboratories working with combustible or flammable chemicals must be outfitted with appropriate fire extinguishers. All extinguishers should be mounted on a wall in an area free of clutter or stored in a fire extinguisher cabinet. Research personnel should be familiar with the location, use and classification of the extinguishers in their laboratory.

Laboratory personnel are not required to extinguish fires that occur in their work areas and should not attempt to do so unless:

- It is a small fire (i.e., small trash can size fire)
- Appropriate training has been received
- It is safe to do so

Any time a fire extinguisher is used, no matter for how brief a period, the PI/Laboratory Supervisor, or most senior laboratory personnel present at the time of the incident, must immediately report the incident to the health and safety officer and UC Merced police. For more information, refer to section 3.

### Safety Showers and Eyewash Stations

All laboratories using corrosives or toxic chemicals must have immediate access to safety showers with eye or face wash stations without having to go through a closed door. Access must be available in **10 seconds** or less for a potentially injured individual and access routes must be kept clear. Safety showers must have a minimum clearance of 16 inches from the centerline of the spray pattern in all directions at all times; this means that no objects should be stored or left within this distance of the safety shower. Sink based eyewash stations and drench hoses are not adequate to meet this requirement and can only be used to support an existing compliant system.

In the event of an emergency, individuals using the safety shower should be assisted by an uninjured person to aid in decontamination and should be encouraged to stay in the safety shower for 15 minutes to remove all hazardous material. (If contaminated with HF, reduce wash time to 2 minutes, apply calcium gluconate gel and call 911). If clothing is contaminated, it must be removed.



Safety shower, eye/facewash stations are tested by EH&S on a monthly basis.

Any units which do not have a testing date within one month should be reported immediately to the health and safety officer. If an eyewash or safety shower needs repair, call Facilities Management and give the operator the specific location of the defective equipment. Work orders that have been generated as a result of a health and safety deficiency such as this must be flagged as "URGENT".

### **Fire Doors**

Many areas of research buildings may contain critical fire doors as part of the building design. These doors are an important element of the fire containment system and should remain closed unless they are on a magnetic self-closing or other automated self-closing system.

## **Safe Laboratory Habits**

As detailed above, a safety program must include layers of policies and protective equipment to allow for a safe working environment, but to achieve effectiveness, a number of fundamental elements must become basic working habits for the research community. Some of these elements are detailed below:

### **Personal Protective Equipment:**

- Wear closed-toe shoes and full-length pants, or equivalent, at all times when in the laboratory.
- Utilize appropriate PPE while in the laboratory and while performing procedures that involve the use of hazardous chemicals or materials.
- Confine long hair and loose clothing.
- Remove laboratory coats or gloves immediately upon significant contamination, as well as before leaving the laboratory.
- Avoid use of contact lenses in the laboratory unless necessary. If they are used, inform supervisor so special precautions can be taken.
- Use any other protective and emergency apparel and equipment as appropriate. Be aware of the locations of first aid kits and emergency eyewash and shower station.

### **Chemical Handling:**

- Properly label and store all chemicals. Use secondary containment at all times.
- Deposit chemical waste in appropriately labeled receptacles and follow all other waste disposal procedures of the Lab Safety Plan (Sections 7-12).
- Do not smell or taste chemicals.
- Never use mouth suction for pipetting or starting a siphon.
- Do not dispose of any hazardous chemicals through the sewer system.
- Hazardous materials may only be used in locations authorized by the university.
- Be prepared for an accident or spill and refer to the emergency response procedures for the specific material. Procedures should be readily available to all personnel. Information on minor chemical spill mitigation may also be referenced in *Appendix P*. For general guidance, the following situations should be addressed:
  - Eye Contact: Promptly flush eyes with water for a prolonged period (15 minutes) and seek medical attention.
  - Skin Contact: Promptly flush the affected area with water and remove any contaminated clothing. If symptoms persist after washing, seek medical attention.

○

***Equipment Storage and Handling:***

- Store laboratory glassware with care to avoid damage. Use extra care with Dewar flasks and other evacuated glass apparatus; shield or wrap them to contain chemicals and fragments should implosion occur.
- Use only fume hoods certified within the last year, glove boxes, or other ventilation devices for operations

which might result in release of toxic chemical vapors or dust. Preventing the escape of these types of materials into the working atmosphere is one of the best ways to prevent exposure.

- Keep hood closed when you are not working in the hood.
- Do not use damaged glassware or other equipment.
- Do not use uncertified fume hoods or glove boxes for hazardous chemical handling.
- Avoid storing materials in hoods.
- Do not allow the vents or air flow to be blocked.

***Laboratory Operations:***

- Keep the work area clean and uncluttered.
- Seek information and advice about hazards, plan appropriate protective procedures, and plan positioning of equipment before beginning any new operation.
- If unattended operations are unavoidable, and have been approved by the PI/Laboratory Supervisor, place an appropriate sign on the door, leave lights on, and provide for containment of toxic substances in the event of failure of a utility service (such as cooling water).
- Be alert to unsafe conditions and ensure that they are corrected when detected.
- Research staff and students should never work alone on procedures involving hazardous chemicals, biological agents, or other physical hazards.
- Do not engage in distracting behavior such as practical jokes in the laboratory. This type of conduct may confuse, startle, or distract another worker.
- Wash areas of exposed skin well before leaving the laboratory.
- Work must take place in approved spaces. Never take chemicals home to continue experiments.
- If headphones are used for music but not required for research, leave one ear unobstructed to allow for attention to the work, laboratory environment, and communication of emergencies.

***Food/Drink:***

- Do not eat, drink, smoke, chew gum, or apply cosmetics in areas where laboratory chemicals are present; wash hands before conducting these activities.
- Do not store, handle, or consume food or beverages in storage areas, refrigerators, glassware or utensils which are also used for laboratory operations.

## **7.4 Exposure Assessment**

### **Regulatory Overview**

It is UC policy to comply with all applicable health, safety and environmental protection laws, regulations and requirements. Cal/OSHA requires that all employers “*measure an employee’s exposure to any substance regulated by a standard which requires monitoring if there is reason to believe that exposure levels for that substance exceed the action level (or in the absence of an action level, the exposure limit).*” Repeated monitoring may be required if initial monitoring identifies employee exposure over the action level or exposure limit.

Cal/OSHA regulates Permissible Exposure Limits (PELs) for airborne contaminants to which “nearly all workers may be exposed daily during a 40-hour workweek for a working lifetime (of 40 years) without adverse effect”, and are based upon an 8-hour Time-Weighted Average (TWA) exposure. Thus, the PELs are the maximum permitted 8-hour TWA concentration of an airborne contaminant without the use of respiratory protection. Cal/OSHA has also defined Short Term Exposure Limits (STELs) as the maximum TWA exposure during any 15 -minute period, provided the daily PEL is not exceeded and Ceiling (C) exposures that shall not be exceeded at any time. PELs can be found on a chemical’s safety data sheet.

Cal/OSHA has listed established PELs, STELs and Ceiling exposures for chemical contaminants identified in CCR Title 8 Section 5155 (Airborne Contaminants) Table AC-1 (<http://www.dir.ca.gov/Title8/ac1.pdf>). In the absence of a published Ceiling limit, Cal/OSHA requires employee exposure to concentrations above the PEL be controlled to prevent harmful effects. Further, Cal/OSHA has promulgated specific standards covering several regulated carcinogens, which may include an Action Level (AL), triggering medical surveillance requirements or the imposition of a specific Excursion Limit (such as for asbestos) with a unique measurement of the duration of an exposure.

Additionally, the Safe Drinking Water and Toxic Enforcement Act of 1986 requires Cal/EPA to publish annually a list of Proposition 65 chemicals known to the State to cause cancer or other reproductive toxicity (<https://oehha.ca.gov/proposition-65/proposition-65-list>).

### **Exposure Assessment Overview**

All UC employees require protection from exposure to hazardous chemicals above PELs, STELs and Ceiling concentrations. Cal/OSHA requires the person supervising, directing or evaluating the exposure assessment monitoring be competent in the practice of industrial hygiene. Thus, exposure assessment should be performed only by representatives of EH&S and not the PI/Laboratory Supervisor. General questions regarding exposure assessment or the Industrial Hygiene Program can be directed to your health and safety officer.

Minimizing an exposure may be accomplished using a combination of engineering controls, administrative controls and personal protective equipment, listed in order of priority. Assessing exposure to hazardous chemicals may be accomplished through a number of methods performed by EH&S, including employee interviews, visual observation of chemical use, evaluation of engineering controls, use of direct reading instrumentation, or the collection of analytical samples from the employee’s breathing zone. Personal exposure assessment will be performed under either of the following situations:

1. EH&S determines whether an exposure assessment is warranted based on chemical inventories, review of Standard Operating Procedures (SOPs), types of engineering controls present, laboratory inspection results and/or review of the annual Lab Hazard Assessment Tool; or



2. User of a hazardous chemical has concern or reason to believe exposure is not minimized or eliminated through use of engineering controls or administrative practices (such as transfer of chemical through double needle performed entirely in a fume hood) and the potential for exposure exists. The user should then inform his or her PI/Laboratory Supervisor, who will in turn contact the EH&S Industrial Hygiene Program, EH&S Radiation Safety Division, EH&S Injury Prevention Division, or UC's Occupational Health Facility (OHF). EH&S and OHF will then determine the best course of action in assessing employee exposure, including visual assessment, air monitoring, medical evaluation, examination, or medical surveillance.

In event of any serious injury or exposure, including chemical splash involving dermal or eye contact, immediately call 9-911 from a campus phone or cell phone and obtain medical treatment immediately. Do not wait for an exposure assessment to be performed before seeking medical care.

## **EXPOSURE ASSESSMENT PROTOCOL – NOTIFICATION TO EMPLOYEES OR EMPLOYEE REPRESENTATIVES AND RIGHT TO OBSERVE MONITORING**

The EH&S Industrial Hygiene Program conducts exposure assessments for members of the campus community. Employees have a right to observe testing, sampling, monitoring or measuring of employee exposure. They are also allowed access to the records and reports related to the exposure assessment. Exposure assessments may be performed for hazardous chemicals, as well as for physical hazards including noise and heat stress to determine if exposures are within PELs or other appropriate exposure limits that are considered safe for routine occupational exposure. General protocol in conducting an exposure assessment may include any of the following:

1. Employee interviews;
2. Visual observation of chemical usage and/or laboratory operations;
3. Evaluation of simultaneous exposure to multiple chemicals;
4. Evaluation of potential for absorption through the skin, mucus membranes or eyes;
5. Evaluating existing engineering controls (such as measuring face velocity of a fume hood);
6. Use of direct reading instrumentation; and
7. Collection of analytical samples of concentrations of hazardous chemicals taken from the employees breathing zone, or noise dosimetry collected from an employee's shirt collar or various forms of radiation dosimetry.

If exposure monitoring determines an employee exposure to be over the action level (or the PEL) for a hazard for which OSHA has developed a specific standard (e.g., lead), the medical surveillance provisions of that standard shall be followed. It is the responsibility of the PI/Laboratory Supervisor to ensure that any necessary medical surveillance requirements are met. When necessary, EH&S will make recommendations regarding adjustments engineering controls or administrative procedures to maintain exposure below any applicable PEL. Where the use of respirators is necessary to maintain exposure below permissible exposure limits, UC will provide, at no cost to the employee, the proper respiratory equipment and training. Respirators will be selected and used in accordance with the requirements of CCR Title 8 Section 5144 (<http://www.dir.ca.gov/Title8/5144.html>) and the University's Respiratory Protection Program.

In assessing exposure to hazardous chemicals for which Cal/OSHA has not published a PEL, STEL or Ceiling exposure, EH&S defers to the Threshold Limit Values (TLVs) established by the American Conference of Governmental Industrial Hygienists (ACGIH) or the Recommended Exposure Limits (RELs) established by the National Institute of Occupational Safety & Health (NIOSH). Please contact your health and safety officer for more

information regarding these chemicals.

## NOTIFICATION

The Industrial Hygiene Program will promptly notify the employee and his/her PI/Laboratory Supervisor of the results in writing (within 15 working days or less if required) after the receipt of any monitoring results. The Industrial Hygiene Program will establish and maintain an accurate record of any measurements taken to monitor exposures for each employee. Records, including monitoring provided by qualified vendors, will be managed in accordance with CCR Title 8 Section 3204 "Access to Employee Exposure and Medical Records" (<http://www.dir.ca.gov/Title8/3204.html>).

## EXPOSURE ASSESSMENT USE TO DETERMINE AND IMPLEMENT CONTROLS

EH&S and the Occupational Health Facility (OHF) will use any of the following criteria to determine required control measures to reduce employee's occupational exposure:

1. Verbal information obtained from employees regarding chemical usage;
2. Visual observations of chemical use or laboratory operations;
3. Evaluation of existing engineering control measures or administrative practices;
4. Recommendations expressed in Safety data sheets;
5. Regulatory requirements of Cal/OSHA;
6. Recommendations from professional industrial hygiene organizations;
7. Direct reading instrumentation results;
8. Employee exposure monitoring results; and/or
9. Medical evaluation, examination and/or surveillance findings.

Particular attention shall be given to the selection of safety control measures for chemicals that are known to be extremely hazardous. Per Cal/OSHA CCR Title 8 Section 5141 "Control of Harmful Exposure to Employees" (<http://www.dir.ca.gov/Title8/5141.html>), the control of harmful exposures shall be prevented by implementation of control measures in the following order:

1. Engineering controls, whenever feasible;
2. Administrative controls whenever engineering controls are not feasible or do not achieve full compliance and administrative controls are practical; and
3. Personal protective equipment, including respiratory protection, during:
  - the time period necessary to install or implement feasible engineering controls
  - when engineering and administrative controls fail to achieve full compliance in emergencies.

### Medical Evaluation\*

All employees, student workers, medical health services volunteers, or laboratory personnel who work with hazardous chemicals shall have an opportunity to receive a free medical evaluation, including supplemental examinations which the evaluating physician determines necessary, under the following circumstances:



1. Whenever an employee develops signs or symptoms associated with a hazardous chemical to which an employee may have been exposed in a laboratory;
2. Where personal monitoring indicates exposure to a hazardous chemical is above a Cal/OSHA Action Level (AL) or Permissible Exposure Limit (PEL) or recommended exposure levels established by the National Institute for Occupational Safety & Health (NIOSH) or the American Conference of Governmental Industrial Hygienists (ACGIH) in the event Cal/OSHA has not established an AL or PEL for a particular hazardous

chemical;

3. Whenever an uncontrolled event takes place in the work area such as a spill, leak, explosion, fire, etc., resulting in the likelihood of exposure to a hazardous chemical; or
4. Upon reasonable request of the employee to discuss medical issues and health concerns regarding work-related exposure to hazardous chemicals.

All work-related medical evaluations and examinations will be performed under the direction of UC's Occupational Health Facility (OHF) by licensed physicians or staff under the direct supervision of a licensed physician. Evaluations and examinations will be provided without cost to the employee, without loss of pay, and at a reasonable time and place.

Any laboratory employee or student worker who exhibits signs and symptoms of adverse health effects from work-related exposure to a hazardous chemical should report to OHF immediately for a medical evaluation. Signs and symptoms can be found on the Safety Data Sheet and may include shortness of breath, coughing, blue lips, etc.

Refer to UC's Injury & Illness Prevention Program (IIPP) (Section 1 of this document) for procedures on how to obtain medical evaluation under the above-listed circumstances.

### **Information to Provide to the Clinician**

At the time of the medical evaluation, the following information shall be provided to OHF:

1. Personal information such as age, weight and campus employee ID number;
2. Common and/or IUPAC name of the hazardous chemicals to which the individual may have been exposed;
3. A description of the conditions under which the exposure occurred;
4. Quantitative exposure data, if available;
5. A description of the signs and symptoms of exposure that the employee is experiencing, if any;
6. A copy of the Safety data sheet (SDS) of the hazardous chemical in question;
7. History of exposure including previous employment and non-occupational (recreational) hobbies; and
8. Any additional information helpful to OHF in assessing or treating an exposure or injury such as a biological component of exposure or existence of an antitoxin.



### **Physician's Written Opinion**

For evaluation or examinations required by Cal/OSHA, the employer shall receive a written opinion from the examining physician which shall include the following:

1. Recommendations for further medical follow-up;
2. Results of the medical examination and any associated tests, if requested by the employee;
3. Any medical condition which may be revealed in the course of the examination which may place the employee at increased risk as a result of exposure to a hazardous chemical found in the workplace; and
4. A statement that the employee has been informed by the physician of the results of the consultation
5. Medical examination and any medical condition that may require further examination or treatment.

### **Confidentiality & Individual's Access to Personal Medical Records**

All patient medical information is protected by California and federal law and is considered strictly confidential. OHF is prohibited from disclosing any patient medical information that is not directly related to the work-related exposure under evaluation and should not reveal any diagnosis unrelated to exposure. Any patient information disclosed by OHF to the employee's supervisor will be limited to information necessary in assessing an employee's return to work, including recommended restrictions in work activities, if any. Any patient information disclosed by OHF to EH&S will be limited to information necessary to develop a course of exposure monitoring, or perform hazard assessments and incident investigations, if appropriate. OHF will otherwise disclose patient medical information only as required by California and Federal law, such as for Worker's Compensation Insurance claims. Each employee has the right to access his/her own personal medical and exposure records. OHF will provide an employee with a copy of his/her medical records upon written request.

### **Medical Surveillance**

Medical surveillance is the process of using medical examinations, questionnaires and/or biological monitoring to determine potential changes in health as a result of exposure to a hazardous chemical or other hazards. Certain Cal/OSHA standards require clinical examination as part of medical surveillance when exposure monitoring exceeds an established Action Level or PEL.

OHF and/or outside vendors may provide medical surveillance services. Medical surveillance is required of employees who are routinely exposed to certain hazards as part of their job description (such as asbestos) and may be offered to other employees based upon quantifiable or measured exposure. Individuals with questions regarding work-related medical surveillance are encouraged to contact their health and safety officer for more information.

Examples of hazards that are monitored through the medical surveillance program may include:

- Asbestos
- Beryllium
- Formaldehyde
- Lead
- Methylene Chloride
- Noise (Hearing Conservation Program)
- Radioactive Chemicals (Bioassay Program)
- Respirator Use (Respirator Protection Program)
- Other Particularly Hazardous Substances

## **7.5 Training**

### **EMPLOYEE INFORMATION AND TRAINING**

Effective training is critical to facilitate a safe and healthy work environment and prevent laboratory accidents. Employee training on specific workplace hazards must be provided at the time of initial assignment, whenever a new hazard is introduced into the workplace, and whenever employees may be exposed to hazards in other work areas, within 30 days of receiving the SDS or other safety information. Laboratory Safety Fundamentals is required for anyone working in a lab, before work begins. All PIs/Laboratory Supervisors must participate in formal safety training and ensure that all their employees have appropriate safety training before working in a laboratory. All training must be in the appropriate language, educational level, and vocabulary for laboratory personnel. The EH&S Training Program provides both classroom and online training to help meet this requirement. View the current schedule at <https://ehs.ucmerced.edu/general-safety/schedule> Register for classes at <http://ehs.ucmerced.edu/form/register-trainings> and follow the instructions listed. Registration is required to be admitted to the class. If you experience difficulty logging in, request an affiliate account at [hrtraining@ucmerced.edu](mailto:hrtraining@ucmerced.edu)

#### **Types of Training**

All laboratory personnel must complete general safety training before:

1. Beginning work in the laboratory;
2. Prior to new exposure situations; and
3. As work conditions change.

Refresher training is also required for all laboratory personnel. Most classes are valid for 3 years. Exceptions include bloodborne pathogens (1 year), shipping on dry ice (2 years), and radiation (2 years). EH&S offers general classroom and online training, plus resource materials to assist laboratories in implementing laboratory-specific training.

### **GENERAL LABORATORY SAFETY TRAINING**

Anyone working in a laboratory is required to complete General Laboratory Safety training prior to beginning work, which includes:

- Review of laboratory rules and regulations, including the Chemical Hygiene Plan (Lab Safety Plan).
- Recognition of laboratory hazards
- Use of engineering controls, administrative controls and personal protective equipment to mitigate hazards
- Exposure limits for hazardous chemicals
- Signs and symptoms associated with exposures to hazardous chemicals
- Chemical exposure monitoring
- Review of reference materials (e.g., SDS) on hazards, handling, storage and disposal of hazardous chemicals
- Procedures for disposing of hazardous chemical waste
- Fire safety and emergency procedures
- Information required by California Code of Regulations, Section 3204 regarding access to employee exposure and medical records (annually required)

All employees must take the following basic laboratory classes provided by EH&S as appropriate for their employment status:

- **Laboratory Safety Fundamentals**– for anyone working in a laboratory
- **Hazmat Spill Response** – for anyone working in a laboratory
- **Fire Safety – Labs** – for anyone working in a laboratory

General laboratory safety training requirements are summarized on the EH&S Safety Training Matrix for Laboratory Personnel (*Appendix J*). Additional information can be obtained on the EH&S website <http://ehs.ucmerced.edu/general-programs/safety-training/courses>

### LABORATORY-SPECIFIC TRAINING\*

PIs/Laboratory Supervisors must also provide laboratory or job-specific training. Topics that require specific training include:

- Location and use of the Laboratory Safety Plan, IIPP, SDS(s) and other regulatory information
- Review of IIPP and Emergency Management Plan, including location of emergency equipment and exit routes
- Specialized equipment
- Standard Operating Procedures
- Specialized procedures and protocols
- Particularly Hazardous Substances including physical and health hazards, potential exposure, medical surveillance, and emergency procedures
- Signs and symptoms of exposure
- The chance to ask questions.
- Prior approval may be required for certain procedures based on safety or other concerns. Activities which require special approval should be listed in the LSPS.
- All lab workers must sign the LSPS training sheet, indicating understanding of the applicable elements of the laboratory safety plan.

### Resources

EH&S has a number of tools available for laboratories to simplify the completion of appropriate training, including:

- Online training modules ( <http://ehs.ucmerced.edu/general-programs/safety-training/courses> )
- Respiratory Protection
- Laboratory Safety Fundamentals and refresher
- Laser Safety
- Shipping with Dry Ice
- Compressed Gases
- Hazmat Spill and DOT awareness

- Waste Management
- Bloodborne pathogen refresher
- Glove safety for pyrophoric chemicals
- Radiation Safety
- Lab Safety Tips of the Month (<http://ehs.ucmerced.edu/researchers-labs/tip-month>)

EH&S provides additional assistance in planning laboratory-specific training upon request. A list of available courses is located at <https://ehs.ucmerced.edu/general-programs/safety-training/courses>



Housekeeping;  
Chemical Storage;  
Fume Hoods;  
Chemical Waste Disposal and Transport;  
Seismic Safety; and  
Mechanical and Electrical Safety.

Planned, focused inspections are also conducted. Examples of these include unannounced PPE inspections and Biowaste inspection. Once the inspection is completed, EH&S issues a Laboratory Inspection Report via [Inspect](http://ehs.ucop.edu/inspect) <http://ehs.ucop.edu/inspect>. The report identifies deficiencies in the laboratory, both major and minor. Major deficiencies are those that have the potential to lead to serious injuries or be of critical importance in the event of an emergency. Major deficiencies must be immediately corrected. Minor deficiencies must be corrected within 30-days. A copy of the most recent *Laboratory Inspection Checklist* and *Inspection Report* should be maintained as part of the records inside the Laboratory Safety Plan.

## NOTIFICATION AND ACCOUNTABILITY

The compliance program requires that PIs/Laboratory Supervisors and other responsible parties take appropriate and effective corrective action upon receipt of written notification of inspection findings. Critical deficiencies are required to be corrected within 48-hours; non-critical deficiencies must be corrected within 30-days. Failure to take corrective actions within the required timeframe will result in a repeat deficiency finding and an escalation of the notification to the Department Chair, Dean and Vice-Chancellor for Research. Depending on the severity of the deficiency, the EH&S Director, in consultation with the Vice-Chancellor for Research may temporarily suspend research activities until the violation is corrected. In some cases, the PI may be required to provide a corrective action plan prior to resumption of research activities. Inspection reports will be posted at <http://ehs.ucop.edu/inspect>. Any corrective actions by the PI can be documented in the same location.

## RECORDKEEPING REQUIREMENTS

Accurate recordkeeping demonstrates a commitment to the safety and health of the UC community, integrity of research, and protection of the environment. EH&S is responsible for maintaining records of inspections, accident investigations, equipment calibration, and training conducted by EH&S staff. Per OSHA regulations, departments or laboratories must document health and safety training, including safety meetings, one-on-one training, and classroom and online training. Additionally, the following records must be retained in accordance with the requirements of state and federal regulations:

1. Accident records;
2. Measurements taken to monitor employee exposures;
3. Chemical Hygiene Plan records should document that the facilities and precautions were compatible with current knowledge and regulations;
4. Inventory and usage records for high-risk substances should be kept;
5. Any medical consultation and examinations, including tests or written opinions required by CCR, Title 8, Section 5191; and
6. Medical records must be retained in accordance with the requirements of state and federal regulations.



## Section 8 – Chemical Storage and Inventory Control

This section provides guidelines on chemical storage and inventory control

### Chemical Inventories

Each laboratory group is required to maintain a current chemical inventory at <http://ehs.ucop.edu/chemicals> that lists the compressed gases and chemicals used, locations stored in the labs and the quantity of these chemicals. Chemicals are barcoded and added to the PI inventory at receiving. The PI must remove spent chemicals from the inventory. The PI must update his/her inventory and certify its accuracy annually at a minimum, preferably in the fall. Chemical inventories are used to ensure compliance with Maximum Allowable Quantity (MAQ) storage limits and fire regulations, produce required state reports, and can be used in an emergency to identify potential hazards for emergency response operations. Failure to maintain an accurate chemical inventory in UC Chemicals may result in denial of chemical orders.

The chemical inventory and redistribution list should be reviewed prior to ordering new chemicals and only the minimum quantities of chemicals necessary for the research should be purchased. UC Chemicals also allows you to request chemicals from other labs, as an alternative to purchasing a new bottle. As new chemicals are added to the inventory, each laboratory group must confirm that they have access to the Safety data sheet (SDS) for that chemical. Where practical, each chemical should be dated so that expired chemicals can be easily identified for disposal. Inventory the materials in your laboratory frequently (at least annually) to avoid overcrowding with materials that are no longer useful and note the items that should be replaced, have deteriorated, or show container deterioration. Unneeded and compromised items should be discarded as chemical waste.

Indications for disposal include:

- Cloudiness in liquids
- Color change
- Evidence of liquids in solids, or solids in liquids
- "Puddling" of material around outside of containers
- Pressure build-up within containers
- Obvious deterioration of containers

Access to hazardous chemicals, including toxic and corrosive substances, should be restricted at all times. These materials must be stored in laboratories or storerooms that are kept locked when laboratory personnel are not present. Locked storage cabinets or other precautions are always recommended, and may be required in the case of unusually toxic or hazardous chemicals. Unusually toxic chemicals may include those that are associated with very low immediately dangerous to life or health (IDLH) conditions. For guidance on locked storage requirements, please contact your health and safety officer.

On termination or transfer of laboratory personnel, all related hazardous materials should be properly disposed of, or transferred to the laboratory supervisor or a designee.



## Chemical Labeling

Every chemical found in the laboratory must be properly labeled. Most chemicals come with a manufacturer's label that contains the necessary information, so care should be taken to not damage or remove these labels. Each chemical bottle, including diluted chemical solutions, must be labeled with its contents and the hazards associated with this chemical. It is recommended that each bottle also be dated when received and when opened to assist in determining which chemicals are expired and require disposal. When new chemicals and compounds are generated by laboratory operations, these new chemical bottles must be labeled with the full name (not molecular formula), date, and hazard information; the generator or other party responsible for this chemical should be named on the container so that they may be contacted if questions arise about the container's contents.

Peroxide forming chemicals such as ethers and those listed in *Appendix I* must be labeled with a date on receipt and on first opening the bottle. These chemicals are only allowed a one year shelf life and should be disposed of as waste in one year. These chemicals can degrade to form shock sensitive, highly reactive compounds and should be stored and labeled very carefully.



Particularly Hazardous Substances require additional labeling. Safety labels are available in S&E 1 255, SE2 110 door, SRE 10, Castle 1201 hallway, or from EH&S. which identify the specific hazard associated with each of these chemicals (carcinogen, reproductive toxin, acute toxin). In addition, the storage area where they are kept must be labeled with the type of hazard. These chemicals should be segregated from less hazardous chemicals to help with proper access control and hazard identification.

## Chemical Storage & Segregation

**Establish and follow safe chemical storage & segregation procedures for your laboratory.**

Storage guidelines are included for materials that are flammable, oxidizers, corrosive, water reactive, explosive and highly toxic. The specific Safety data sheet (SDS) should always be consulted when doubts arise concerning highly toxic chemicals. The specific Safety data sheet (SDS) should always be consulted when doubts arise concerning chemical properties and associated hazards. All procedures employed must comply with Cal/OSHA, Fire Code and building code regulations. Always wear appropriate personal protective equipment (e.g., laboratory coat, safety glasses, gloves, safety goggles, apron) when handling hazardous chemicals. Be aware of the locations of the safety showers and emergency eyewash stations. Each laboratory is required to provide appropriate laboratory-specific training on how to use this equipment prior to working with hazardous chemicals. Table 8.1 lists chemical safety storage priorities.

**Table 8.1 – Chemical Safety Storage Priorities**

Keep in mind that most chemicals have multiple hazards and a decision must be made as to which storage area would be most appropriate for each specific chemical. First determine your priorities:

1. **Flammability.** When establishing a storage scheme, the number one consideration should be the flammability characteristics of the material. If the material is flammable, it should be stored in a flammable cabinet.
2. **Isolate.** If the material will contribute significantly to a fire (e.g., oxidizers), it should be isolated from the flammables. If there were a fire in the laboratory and response to the fire with water would exaggerate the situation, isolate the water reactive material away from contact with water.
3. **Corrosivity.** Next look at the corrosivity of the material, and store accordingly. Segregate acids from bases.
4. **Toxicity.** Finally, consider the toxicity of the material, with particular attention paid to regulated materials. In some cases, this may mean that certain chemicals will be isolated within a storage area. For example, a material that is an extreme poison but is also flammable, should be locked away in the flammable storage cabinet to protect it against accidental release.

There will always be some chemicals that will not fit neatly in one category or another, but with careful consideration of the hazards involved, most of these cases can be handled in a reasonable fashion.

## GENERAL RECOMMENDATIONS FOR SAFE STORAGE OF CHEMICALS

Each chemical in the laboratory must be stored in a specific location and returned there after each use. Acceptable chemical storage locations may include corrosive cabinets, flammable cabinets, laboratory shelves, or appropriate refrigerators or freezers. Fume hoods should not be used as general storage areas for chemicals, as this may seriously impair the ventilating capacity of the hood. Figure 8.2 depicts improper fume hood storage. Chemicals should not be routinely stored on bench tops or stored on the floor.

Laboratory shelves should have a raised lip along the outer edge to prevent containers from falling. Hazardous liquids or corrosive chemicals should not be stored on shelves above eye-level and chemicals which are highly toxic or corrosive should be in unbreakable secondary containers.

Chemicals must be stored at an appropriate temperature and humidity level and should never be stored in direct sunlight or near heat sources, such as laboratory ovens. Incompatible materials should be stored in separate cabinets, whenever possible. If these chemicals must be stored in one cabinet due to space limitations, adequate segregation and secondary containment must be used to prevent adverse reactions.



Figure 8.2 Improper Fume Hood Storage

All stored containers and research samples must be appropriately labeled and tightly capped to prevent vapor interactions and to alleviate nuisance odors. Flasks with cork, rubber or glass stoppers should be avoided because of the potential for leaking.

Laboratory refrigerators and freezers must be labeled appropriately with "No Food/Drink" and must never be used for the storage of food. Freezers should be defrosted periodically so that chemicals do not become trapped in ice. New peroxide formers such as ether, can be stored in a refrigerator designed for flammable storage to slow the formation of peroxides. However, old, open bottles should not be refrigerated as peroxide crystals will precipitate.

## FLAMMABLE AND COMBUSTIBLE LIQUIDS

Large quantities of flammable or combustible materials should not be stored in the laboratory. The maximum total quantity of flammable and combustible liquids must not exceed 60 gallons within a flammable storage cabinet. The maximum quantity allowed to be kept outside a flammable storage cabinet, safety can, or approved refrigerator/freezer is 10 gallons. Only the amounts needed for the current procedure should be kept on bench tops and the remainder should be kept in flammable storage cabinets, explosion proof refrigerators/freezers that are approved for the storage of flammable substances, or approved safety cans or drums that are grounded. Always segregate flammable or combustible liquids from oxidizing acids and oxidizers. Flammable materials must never be stored in domestic-type refrigerators/freezers and should not be stored in a refrigerator/freezer if the chemical has a flash point below the temperature of the equipment. Flammable or combustible liquids must not be stored on the floor or in any exit access.

Handle flammable and combustible substances only in areas free of ignition sources and use the chemical in a fume hood whenever practical. Only the amount of material required for the experiment or procedure should be stored in the work area. Always transfer flammable and combustible chemicals from glass containers to glassware or from glass container/glassware to plastic. Transferring these types of chemicals between plastic containers may lead to a fire hazard due to static electricity.

Building codes limit the amount of flammable materials that may be stored in laboratories and the size of containers. Flammable liquids should be stored in approved safety cans or in fire-rated flammable storage cabinets wherever possible.

### Flammable Liquids – Maximum Size of Containers

<u>Container Type</u>	<u>Class 1A<sup>1</sup></u>	<u>Class 1B<sup>2</sup></u>	<u>Class 1C<sup>3</sup></u>
Glass <sup>4</sup>	1 pint	1 quart	1 gallon
Metal or approved plastic	1 gallon	5 gallon	5 gallon
Safety cans	2 gallon	2 gallon	2 gallon

Metal drums                      Contact EH&S for storage requirements

<sup>1</sup>Class 1A – Flash point < 73° F (22.78° C), boiling point < 100° F (37.78° C)

<sup>2</sup>Class 1B – Flash point < 73° F (22.78° C), boiling point > 100° F (37.78° C)

<sup>3</sup>Class 1C – Flash point > 73° F (22.78° C), boiling point < 100° F (37.78° C)

<sup>4</sup>Exceptions may be made to this requirement, upon application to EH&S, for storage of Class 1A and 1B liquids; quantities not to exceed 1 gallon.

Safety cans are the safest way to store flammable liquids. They have spring-loaded lids and an internal screen, which prevents combustion of the contents. Large polypropylene (“Nalgene”) containers with stopcocks or valves at the bottom should never be used to store flammable liquids. These valves frequently leak and are unsafe in a fire.

*Call EH&S for examples of liquids in different flammable classes.*

**Flammable Liquids – Maximum Quantities\***

<b><u>Location</u></b>	<b><u>Max. Amount</u></b>	<b><u>Conditions</u></b>
Open laboratory (including safety cans)	10 gallons	Must abide by above conditions
Fire rated storage Cabinet	60 gallons	

*\*Article 79 California Fire Code  
(1998)*

**Flammable Storage Refrigerators and Environmental Rooms**

**Never store flammable liquids in a standard or domestic refrigerator.**

If flammable liquids must be refrigerated or cooled they must be kept in an approved “flammable storage” refrigerator or freezer, available from many scientific supply vendors. Domestic refrigerators have a variety of ignition sources inside the cabinet, such as lights, switches, defrost coils, etc. that could ignite vapors. Flammable storage refrigerators have no ignition sources inside the cabinet. On extremely rare occasions it may be necessary to use an “explosion proof” refrigerator or freezer (i.e., one with no interior or exterior ignition sources). Refrigerators used for food storage should be labeled with a “Store No Chemicals” label. Refrigerators used for storage of other chemicals should be labeled with “Store No Food” label. Environmental rooms (cold/warm rooms) have many ignition sources and little or no air circulation from outside. They should never be used for storage of flammable or other hazardous materials. Small quantities of hazardous materials (e.g. 500 ml) may be used in these spaces but they should not be stored there.

**Pyrophoric & Water Reactive Substances**

Because pyrophoric substances can spontaneously ignite on contact with air and/or water, they must be handled under an inert atmosphere and in such a way that rigorously excludes air and moisture. Some pyrophoric materials are also toxic and many are dissolved or immersed in a flammable solvent. Other common hazards include corrosivity, teratogenicity, or peroxide formation.

Only minimal amounts of reactive chemicals should be used in experiments or stored in the laboratory. These chemicals must be stored as recommended in the SDS. Reactive materials containers must be clearly labeled with the correct chemical name, in English, along with a hazard warning.

Suitable storage locations may include inert gas-filled desiccators or glove boxes; however, some pyrophoric materials must be stored in a flammable substance approved freezer. If pyrophoric or water reactive reagents are received in a specially designed shipping, storage or dispensing container (such as the Aldrich Sure/Seal packaging system), ensure that the integrity of that container is maintained. Ensure that sufficient protective solvent, oil, kerosene, or inert gas remains in the container while pyrophoric materials are stored. Never store reactive chemicals with flammable materials or in a flammable liquids storage cabinet. Storage rooms must have fire sprinklers.

Storage of pyrophoric gases is described in the California Fire Code, Chapter 41. Gas cabinets, with remote sensors and fire suppression equipment, are required. Gas flow, purge and exhaust systems should have redundant controls to prevent pyrophoric gas from igniting or exploding. Emergency back-up power should be provided for all electrical controls, alarms and safeguards associated with the pyrophoric gas storage and process systems.

Never return excess reactive chemical to the original container. Small amounts of impurities introduced into the container may cause a fire or explosion. For storage of excess chemical, prepare a storage vessel in the following manner:

- Dry any new empty containers thoroughly;
- Insert the septum into the neck in a way that prevents atmosphere from entering the clean dry (or reagent filled) flask;
- Insert a needle to vent the flask and quickly inject inert gas through a second needle to maintain a blanket of dry inert gas above the reagent;
- Once the vessel is fully purged with inert gas, remove the vent needle then the gas line. To introduce the excess chemical, use the procedure described in the handling section, below;
- For long-term storage, the septum should be secured with a copper wire;
- For extra protection a second same-sized septa (without holes) can be placed over the first; and
- Use parafilm around the outer septa and remove the parafilm and outer septum before accessing the reagent through the primary septum.

The EH&S *Pyrophoric Liquid Safety* video provides information about the safe handling of pyrophoric chemicals and can be viewed online at:

<https://www.youtube.com/watch?v=21iC4YegOAs&t=29s>

## OXIDIZERS

Oxidizers (e.g., hydrogen peroxide, ferric chloride, potassium dichromate, sodium nitrate) should be stored in a cool, dry place and kept away from flammable and combustible materials, such as wood, paper, Styrofoam, plastics, flammable organic chemicals, and away from reducing agents such as zinc, alkaline metals, and formic acid.

## PEROXIDE FORMING CHEMICALS

Peroxide forming chemicals (e.g., ethyl ether, diethyl ether, cyclohexene) should be stored in airtight containers in a dark, cool, and dry place and must be segregated from other classes of chemicals that could create a serious hazard to life or property should an accident occur (e.g., acids, bases, oxidizers). The containers should be labeled with the date received and the date opened. This information, along with the chemical identity should face forward to minimize container handling during inspection. These chemicals must also be tested and documented for the presence of peroxides periodically. Minimize the quantity of peroxide forming chemicals stored in the laboratory and dispose of peroxide forming chemicals before peroxide formation (typically 1 year). Refer to Appendix I for specific guidelines and/or contact your health and safety officer with questions.

Carefully review all cautionary material supplied by the manufacturer prior to use. Avoid evaporation or distillation, as distillation removes the stabilizer added to solvents. Test for peroxide before heating a peroxide forming chemical. Ensure that containers are tightly sealed to avoid evaporation and that they are free of exterior contamination or crystallization. Never return unused quantities back to the original container and clean all spills immediately.

If old containers of peroxide forming chemicals are discovered in the laboratory, (greater than two years past the expiration date or if the date of the container is unknown), do not handle the container. If crystallization is present in or on the exterior of a container, do not handle the container. Secure it and contact your health and safety officer for pick-up and disposal. Labs will be recharged any disposal costs associated with mismanagement of peroxide formers.

## CORROSIVES

Store corrosive chemicals (i.e., acids, bases) below eye level and in secondary containers that are large enough to contain at least 10% of the total volume of liquid stored or the volume of the largest container, whichever is greater. Acids must always be segregated from bases and from active metals (e.g., sodium, potassium, magnesium) at all times and must also be segregated from chemicals which could generate toxic gases upon contact (e.g., sodium cyanide, iron sulfide).

Specific types of acids require additional segregation. Mineral acids must be kept away from organic acids and oxidizing acids must be segregated from flammable and combustible substances. Perchloric acid should be stored by itself, away from other chemicals. Picric acid is reactive with metals or metal salts and explosive when dry and must contain at least 10% water to inhibit detonation upon opening.

It is important that all laboratory personnel understand procedures for storage of hazardous materials, including where these materials are kept in the laboratory. Section 8 of the LSPS titled "Hazardous Materials Storage and Control" indicates dedicated locations for storage of hazardous materials, such as under a fume hood, or in a flammable storage cabinet or other area. Include mineral acids, oxidizers, bases, organics, chemical and radioactive wastes, and other categories of hazardous materials as necessary.



## UC Merced Chemical Compatibility Storage Guidelines

Separate each of the following classes of chemicals from each other by storing in separate cabinets or by using appropriate tubs or containers. Polypropylene tubs are commonly used for this purpose. All containers should be clearly labeled, and all storage locations should be labeled according to compatibility group.

1. **Mineral (Inorganic) Acids** - Examples: hydrochloric acid, sulfuric acid, phosphoric acid, boric acid, and hydrobromic acid.
2. **Oxidizers** - Examples: bromic acid, perchloric acid, chromic acid, nitric acid, many perchlorates, permanganates, bromine, chlorine, fluorine, silver nitrate.
  - Oxidizers should not be stored directly on wooden shelves or on paper shelf liners; spills may react and ignite spontaneously
  - Perchloric acid presents special hazards; it must be isolated from oxidizable materials and dehydrating agents
  - Hypochlorite solutions (e.g., bleach) are oxidizers; however, they will release chlorine gas on contact with acids, so store them separately
3. **Bases/Caustics** - Examples: aqueous ammonia, ammonium hydroxide, potassium hydroxide, and sodium hydroxide.
4. **Organic Solvents/Acids** - Examples: acetone, methanol, isopropyl ether, methylene chloride, carbon tetrachloride, acetic acid, citric acid, benzene, tetrahydrofuran.
  - If space is limited, laboratories may wish to separate flammable and non-flammable organic liquids in flammable storage cabinets
5. **Highly Toxic/Carcinogenic** - Examples: sodium azide, acrolein, arsenic pentoxide, pentachlorophenol, hydrazine, botulinum toxin, acrylamide, methyl isocyanate, phorbol esters.
6. **Pyrophoric Materials** - Examples: diethyl aluminum chloride, lithium, white or yellow phosphorus, trimethyl aluminum.
7. **General "Dry" Laboratory Chemicals** - Examples: This would include many of the relatively innocuous or un-reactive materials commonly found in laboratories.
8. **Gases** - Segregate according to hazard class. Acutely toxic and toxic gases should be stored in gas cabinets or fume hoods. Cylinders should be double-chained to a substantial, fixed surface. Cylinders should be turned off at the cylinder valve when not in use and should be capped when stored. See Section 18 for more information.
9. **Water Reactives** - Examples: sodium, potassium, calcium, aluminum tribromide, calcium oxide, acid anhydrides, and metal hydrides.



10. **Controlled Substances** - Narcotics and other controlled substances should be stored in a secure, locked location such as a drawer or safe. See Section 14 for information.

## **Chemical Abbreviations and Annotations Used on Secondary Containers in this Laboratory**

All containers must be clearly labeled with contents and a hazard indication. Laboratories can use abbreviations for labeling as long as the List of Abbreviations (which is included in the laboratory-specific LSPS) is prominently posted in the laboratory. This list includes common substances; extend the list as necessary with laboratory-specific abbreviations.

### **ACIDS:** *Corrosive to skin, eyes and respiratory tract*

HCl	hydrochloric acid
HF	hydrofluoric acid
TCA	trichloroacetic acid
H <sub>2</sub> SO <sub>4</sub>	sulfuric acid

### **BASES:** *Corrosive to skin, eyes and respiratory tract*

NH <sub>4</sub> OH	ammonium hydroxide
KOH	potassium hydroxide
NaOH	sodium hydroxide

### **FLAMMABLE LIQUIDS:** *Fire hazard*

EtOH	ethyl alcohol
MeOH	methanol
IPA	isopropyl alcohol

### **TOXIC:** *Harmful by ingestion or skin absorption*

DEPC	diethyl pyrocarbonate
DMSO	dimethyl sulfoxide <i>Carries hazardous materials through the skin</i>

### **LOW HAZARDS**

SDS	Sodium Dodecyl Sulfate, <i>Detergent</i>
TAE	Tris + acetic acid + Ethylenediaminetetra acetic acid
TBE	Tris + boric acid + Ethylenediaminetetra acetic acid
PBS	Phosphate buffered saline, <i>Buffer</i>
SSC	Sodium chloride sodium citric acid
TE	Tris Ethylenediaminetetraacetic acid
SSPE	Sodium chloride sodium phosphate + Ethylenediaminetetraacetic acid
STET	Sodium chloride ethylenediaminetetraacetic acid Tris Triton X-100
TNT	Tris sodium chloride Tween-20
TPE	Tris phosphoric ethylenediaminetetraacetic acid
STE/TEN	Sodium chloride tris ethylenediaminetetraacetic acid

DI

Deionized water

Abbreviations which are used for labeling chemicals should be included in the LSPS created for each laboratory and posted in the laboratory.

## SPECIAL STORAGE REQUIREMENTS

### Compressed Gas Cylinders

Compressed gas cylinders that are stored in the laboratory must be chained to the wall, with the safety cap in place. The cylinders must be restrained by two chains; one chain must be placed at one third from the top of the cylinder, and the other placed at one third from the bottom of the cylinder (see Figure 8.3). Store liquefied fuel-gas cylinders securely in the upright position. **Cylinders containing certain gases such as acetylene are prohibited from being stored in a horizontal position, including those which contain a water volume of more than 5 liters.** Do not expose cylinders to excessive dampness, corrosive chemicals or fumes.

Certain gas cylinders require additional precautions.

Flammable gas cylinders must use only flame-resistant gas lines and hoses which carry flammable or toxic gases from cylinders and must have all connections wired. Compressed oxygen gas cylinders must be stored at least 20 feet away from combustible materials and flammable gases.

Gas cylinder connections must be inspected frequently for deterioration and must never be used without a regulator. Never use a leaking, corroded or damaged cylinder and never refill compressed gas cylinders. When stopping a leak between cylinder and regulator, always close the valve before tightening the union nut. Replace the regulator with a safety cap when the cylinder is not in use. Only move gas cylinders with the safety cap in place using carts designed for this purpose.



Figure 8.3 – Cylinders Stored and Chained Correctly

Due to potential health, fire and reactivity hazards presented by the potential release of toxic gases, the UCM Toxic Gas Program has been written to indicate the special regulatory requirements mandated for these gases by the Fire Code, Cal/OSHA and other regulatory agencies. The program specifies safe and established procedures for the transportation, handling, storage, use, and disposal of toxic gases along with required engineering and administrative controls that reduce the likelihood of an unintended release. One additional topic of emphasis for toxic gas usage is emergency response procedures for their accidental release. As a result, labs are expected to devise an emergency response plan that suites their precautionary level and communicate it through training of all users and non-users. For more details see

<https://ehs.ucmerced.edu/researchers-labs/chemical-safety/toxic-gases>

### Liquid Nitrogen and other Cryogenics

Dewars should be chained to the wall. The primary risk to laboratory personnel from liquid cryogenics is skin or eye thermal damage caused by contact with the material. In addition, nitrogen expands 696:1 when changing from a cryogenic liquid to a room temperature gas. The gases usually are not toxic, but if too much oxygen is displaced, asphyxiation is a possibility. Always use appropriate thermally insulated gloves when handling liquid cryogenics. Face shields may be needed in cases where splashing can occur.

### On-Campus Distribution of Hazardous Chemicals

Precautions must be taken when transporting hazardous substances between laboratories. Chemicals must be transported between stockrooms and laboratories in break-resistant, secondary containers such as commercially available bottle carriers made of rubber, metal, or plastic, that include carrying handle(s) and which are large enough to hold the contents of the chemical container in the event of breakage. When transporting cylinders of compressed gases, always secure the cylinder with straps or chains onto a suitable hand truck and protect the valve with a cover cap. Avoid dragging, sliding, or rolling cylinders and use a freight elevator when possible. UCLA offers a "Compressed Cylinder" Fact Sheet (<https://research.mcdb.ucla.edu/Hartenstein/Safety/Compressed.pdf>) that may be referenced for the safe transport of compressed gases. Figure 8.4 illustrates correct cylinder transport.

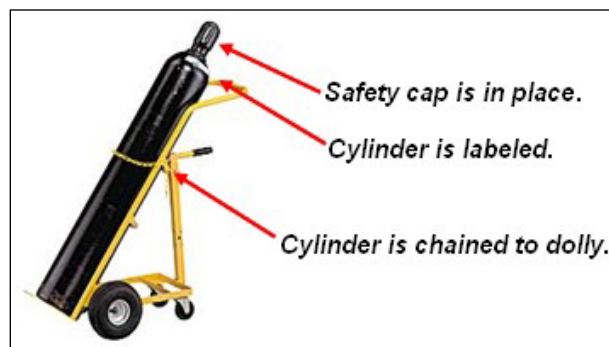
### Off-Campus Distribution of Hazardous Chemicals

The transportation of hazardous chemicals and compressed gases over public roads, or by air, is strictly governed by international, federal, and state regulatory agencies, including the U.S. Department of Transportation (DOT) and the International Air Transport Association (IATA). Any person who prepares and/or ships these types of materials must ensure compliance with pertinent regulations regarding training, quantity, packaging, and labeling.

Without proper training, it is illegal to ship hazardous materials. Those who violate the hazardous materials shipment regulations are subject to criminal investigation and penalties. UC campus personnel who sign hazardous materials manifests, shipping papers, or those who package hazardous material for shipment, must be trained and certified by EH&S.

Individuals who wish to ship or transport hazardous chemicals or compressed gases off-campus, even when using UC or personal vehicles, must contact your health and safety officer for assistance.

**All laboratories should complete Section 8 of the LSPS titled Hazardous Materials Storage and Control.**



## Security

Recently regulatory agencies have been implementing rules to ensure chemical security. While many of these rules are for large manufacturing facilities, it is critical that chemicals be secured to prevent theft from campus laboratories. Numerous federal agencies are involved in the maintenance of laboratory security, including the Drug Enforcement Agency and Department of Homeland Security.

Access to hazardous chemicals should be restricted at all times and must be stored in laboratories and storerooms that are locked when laboratory personnel are not present.

Laboratories are encouraged to conduct a Security Vulnerability Assessment (SVA). Aspects that should be covered in a SVA include:

- Existing threats, based on the history of the institution (e.g., theft of laboratory materials, sabotage, data security breaches, protests);
- The attractiveness of the institution as a target, and the potential impact of an incident;
- Chemicals, biological agents, radioactive materials, or other laboratory equipment or materials with dual-use potential
- Sensitive data or computerized systems;
- Animal care facilities;
- Infrastructure vulnerabilities (e.g., accessible power lines, poor lighting);
- Security systems in place (e.g., access control, cameras, intrusion detection);
- Access controls for laboratory personnel (e.g., background checks, authorization procedures, badges, key controls, escorted access);
- Institutional procedures and culture (e.g., tailgating, open laboratories, no questioning of visitors);
- Security plans in place; and
- Training and awareness of laboratory personnel.

Labs can increase their security by simply keeping lab doors closed and locked when unoccupied, maintaining a current and accurate chemical inventory, training personnel on security procedures, and controlling access to keys. Labs should report any suspicious activity to UCM Police at CAT-COPS and EH&S at 209 201-2163.

## Section 9 – Fume Hoods and Other Engineering Controls\*

This section contains important information on using fume hoods and other engineering controls to protect laboratory employees.

Fume hoods are the most commonly used local exhaust system on campus. Other methods include vented enclosures for large pieces of equipment or chemical storage, and portable exhaust systems for capturing contaminants near the point of release. Some systems are equipped with air cleaning devices (HEPA filters or carbon absorbers). Exhaust from fume hoods are designed to terminate at least ten feet above the roof deck or two feet above the top of any parapet wall, whichever is higher. The figure on the right displays the key components of a fume hood.

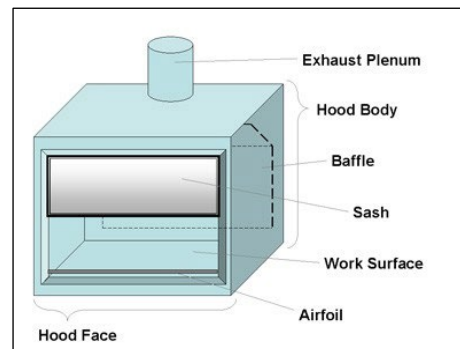


Figure 9.1 – Fume Hood

It is advisable to use a laboratory hood when working with all hazardous substances. In addition, a laboratory hood or other suitable containment device must be used for all work with "particularly hazardous substances." A properly operating and correctly used laboratory hood can reduce or eliminate vapors, dusts and mists. Fume hoods are evaluated for operation and certified by EH&S or external vendor on an annual basis. These annual evaluations check the fume hood air flow velocity to ensure that the unit will contain hazardous vapors. Data on annual fume hood monitoring will be maintained by EH&S. A complete report of fume hood monitoring data must be kept for one year; summary data must be maintained for 5 years.

Each fume hood should have a current calibration sticker and a marker indicating the highest sash height to be used when working with hazardous materials. Contact EH&S for a hood evaluation if these labels are missing.

Each fume hood must be equipped with at least one type of continuous quantitative monitoring device designed to provide the user with current information on the operational status of the hood. Do not use a hood whose monitor reads "air fail", or less than 100fpm. When hazardous materials are in a fume hood, but it is not under active use (e.g., during an unattended reaction or experiment), the sash should be closed. Fume hoods are not designed for storage of hazardous materials.

Routine maintenance and repairs of fume hoods are conducted by Facilities Management. Hood users may route requests for hood repair directly to Facilities via <http://fmhelp.ucmerced.edu/>. Make sure to indicate that the work order has been "generated as a result of a health and safety deficiency" and mark it "urgent" in order to expedite processing. EH&S does not initiate maintenance but will coordinate with Facilities Management to ensure that it is completed. Upon reported completion by Facilities, EH&S will re-inspect the fume hood following maintenance or repairs. The hood must be cleaned out before facilities will work on the unit. Contact EH&S to green tag when the hood is clean and ready for repair.

### General Rules for Fume Hood Use

The following general rules should be followed when using laboratory hoods:

1. Fume hoods should not be used for work involving hazardous substances unless they have a label indicating that they have been certified within the past year.
2. Always keep hazardous chemicals >6 inches behind the plane of the sash.
3. **Never** put your head inside an operating laboratory hood. The plane of the sash is the barrier between contaminated and uncontaminated air.
4. Work with the hood sash in the **lowest practical position**. The sash acts as a physical barrier in the event of an accident. Keep the sash closed when not conducting work in the hood.
5. Do not clutter your hood with unnecessary bottles or equipment. Keep it clean and clear. Only materials actively in use should be in the hood.
6. Do not make any modifications to hoods, duct work, or the exhaust system without first contacting the EH&S office.
7. Do not use large equipment in laboratory hoods unless the hood is dedicated for this purpose, as large obstructions can change the airflow patterns and render the hood unsafe. Elevate equipment on blocks.
8. Shut your sash! For energy efficiency, make sure to shut your sash when the hood is not in use.

Laboratory fume hoods are one of the most important pieces of equipment used to protect laboratory and other workers from exposure to hazardous chemicals. Chemical fume hoods should be inspected upon installation, renovation, when a deficiency is reported, or a change has been made to the operating characteristics of the hood. Since fume hoods used for regulated carcinogens (as listed in the UC Particularly Hazardous Substances Policy: appendix E and S) have additional requirements, such as increased face velocity, contact the *EH&S office* at 209 205-8176 if the intended use changes.

### Fume Hood Inspections

#### **Step 1 – Physical Inspection**

Evaluates the physical condition of the hood and the materials being used in the hood. This includes checking for:

- Improper storage of materials inside the fume hood
- Use of proper materials
- General hood cleanliness
- Physical damage to the fume hood (e.g., broken sash)
- Fully functioning lighting, fume hood indicator, airflow monitor, and alarm

#### **Step 2 – Hood Performance Inspection**

Evaluates the overall hood performance to ensure that it is functioning properly. This involves checking the:

- Average face velocity and set minimum face velocity, which is used to determine the rating of the hood and what the hood can be used for
- Noise generated by the fume hood, to ensure that it is below 85 dB
- If fume hood does not pass inspection, it will be labeled with a “DO NOT USE” sign until it can be repaired.

### Glove Boxes and Ventilation Devices

In addition to fume hoods, some laboratories use contained glove box units for working with reactive chemicals under an inert environment, working with very toxic substances in a completely closed system, or for creating a stable, breeze free, system for weighing hazardous or reactive materials. These units can be very effective because they offer complete containment.



## Section 10-Personal Protective Equipment\*

This section contains important information to assist laboratory personnel in choosing equipment that will protect against laboratory hazards.

Engineering controls (Section 9) and work practices (Chemical Safety, Section 7) are the most important measures to protect laboratory workers from the hazards they face. However, the variable nature of laboratory work requires that proper personal protective equipment (PPE) be used at all times.

### Personal Protective Equipment

Personal protective equipment (PPE) serves as a researcher's last line of defense against chemical exposures and is required by everyone entering a laboratory containing hazardous chemicals. Specific minimum requirements for PPE use for chemical operations are contained in UC Policy (*Appendix R*).

The PPE policy outlines the basic PPE requirements, which include but are not limited to:

- Full length pants and close-toed shoes, or equivalent
- Protective gloves, laboratory coats, & eye protection when working with, or adjacent to, hazardous chemicals
- Flame resistant laboratory coats for high hazard materials, pyrophorics, and  $\geq 1$  liter of flammables

The primary goal of PPE is to mitigate, the hazard associated with exposure to hazardous substances. EH&S policy requires each laboratory to complete a "Hazard Assessment Tool" prior to beginning work and to provide annual updates thereafter. The Lab Hazard Assessment Tool (LHAT), found at <http://ehs.ucop.edu/lhat>, captures information on the specific type of hazard(s), the location of the hazard(s), the name of the PI/Laboratory Supervisor who oversees the facility and helps identify the proper PPE that should be used by laboratory personnel to protect themselves against these hazards. Once the required PPE is identified, the laboratory personnel are required to complete training within the LHAT on the use of PPE. Lab members must bring a voucher from the LHAT to be issued any PPE. EH&S will issue lab coats and eyewear when presented with a voucher during PPE store hours. The current schedule can be found at <http://ehs.ucmerced.edu/researchers-labs/ppe/obtaining-ppe>

In some cases, additional, or more protective, equipment must be used. If a project involves a chemical splash hazard, chemical goggles are required; face shields may also be required when working with chemicals that may cause immediate skin damage such as concentrated acids or liquid nitrogen. Safety goggles differ from safety glasses in that they form a seal with the face, which completely isolates the eyes from the hazard. If a significant splash hazard exists, heavy gloves, protective aprons and sleeves may also be needed. Gloves should only be used under the specific condition for which they are designed, as no glove is impervious to all chemicals. It is also important to note that gloves degrade over time, so they should be replaced as necessary to ensure adequate protection. If you work with pyrophoric chemicals, contact EH&S for gloves. The EH&S website provides PPE Selection Guide (<http://ehs.ucmerced.edu/researchers-labs/ppe/selection>) to assist in selecting the appropriate glove type for the type of potential hazard.

### How to Use and Maintain PPE

Personal protective equipment (PPE) should be kept clean and stored in an area where it will not become contaminated. Inspect PPE prior to use to ensure it is in good condition, and fits properly. and is worn properly. If it becomes contaminated or damaged, it clean or repair when possible, otherwise discard and replace.

### Returning PPE

Any lab coats or safety glasses issued to workers by EHS must be returned when leaving the campus permanently. Coats are issued to a person. That person can have transcripts held until coats are paid for or returned. Cross out the name in the coat and drop in the laundry or return to EHS.

For additional requirements and information on selection of PPE, see UC Policy (*Appendix R*).

### Contaminated Clothing/PPE

Contaminated clothing/PPE should immediately be removed and placed in a closed container that prevents release of the chemical. Heavily contaminated clothing/PPE resulting from an accidental spill should be disposed of as hazardous waste. Non-heavily contaminated laboratory coats should be cleaned and properly laundered, as appropriate. Laboratory personnel should never take contaminated items home for cleaning or laundering. Persons or companies hired to clean contaminated items must be informed of potentially harmful effects of exposure to hazardous chemicals and must be provided with information to protect themselves.

### Respiratory Protection

Typically, respiratory protection is not needed in a laboratory. Under most circumstances, safe work practices, small scale usage, and engineering controls (fume hoods, biosafety cabinets, and general ventilation) adequately protect laboratory workers from chemical and biological hazards. Under certain circumstances, however, respiratory protection may be needed. These can include:

- An accidental spill such as:
  - a chemical spill outside the fume hood
  - a spill of biohazardous material outside a biosafety cabinet
- Performance of an unusual operation that cannot be conducted under the fume hood or biosafety cabinet
- When weighing powdered chemicals or microbiological media outside a glove box or other protective enclosure. Disposable filtering face-piece respirators are generally recommended for nuisance dusts. If the chemicals are toxic, contact EH&S for additional evaluation
- When exposure monitoring indicates that exposures exist that cannot be controlled by engineering or administrative controls
- As required by a specific laboratory protocol or as defined by applicable regulations

Because there are numerous types of respirators available, and each has specific limitations and applications, respirator selection and use requires pre-approval by EH&S. For either required or voluntary use of a respirator, the employee must fill out the Respiratory Hazard Assessment form (*Appendix H*), review it with his/her supervisor, and send the completed form to your health and safety officer. EH&S will contact the employee to evaluate the potential exposure. The review will include an evaluation of the work area and activities for the following:

- Provision of additional ventilation controls or enclosure of the airborne hazard
- Substitution with a less hazardous substance

- Qualitative or quantitative exposure assessment
- Respirator usage

Tasks with potential airborne hazards that cannot be eliminated by engineering or administrative controls will not be authorized by EH&S until affected employees can be incorporated into UC's Respiratory Protection Program. Respirator use requires a medical evaluation, fit test, and signature of OSHA's appendix D form found at [https://ehs.ucmerced.edu/sites/ehs.ucmerced.edu/files/documents/facilities-management/respiratory-protection/ucmerced\\_rpep\\_manual\\_-\\_appendix\\_d\\_-\\_training\\_for\\_voluntary\\_respirator\\_use.pdf](https://ehs.ucmerced.edu/sites/ehs.ucmerced.edu/files/documents/facilities-management/respiratory-protection/ucmerced_rpep_manual_-_appendix_d_-_training_for_voluntary_respirator_use.pdf)

must be completed before a respirator can be issued. Employees must complete all components prior to starting work that requires respirator use.

Because wearing respiratory equipment places a physical burden on the user, laboratory workers must be medically evaluated prior to wearing respiratory equipment. Certain individuals (e.g., persons with severe asthma, heart conditions, or claustrophobia) may not be medically qualified to wear a respirator. Upon enrollment in Respirator Training and Fit Testing, the employee will be sent the appropriate medical questionnaire. The completed medical questionnaire will be evaluated by a nurse practitioner before the employee proceeds with the training. NOTE: This medical questionnaire is confidential. The employee will be provided additional information on how to contact the nurse practitioner for follow up questions.

After successful completion of the medical evaluation, the employee will be trained and fit tested by EH&S. Training topics include:

- Why the respirator is necessary and how improper fit, usage, or maintenance can compromise the protective effect of the respirator
- What the limitations and capabilities of the respirator are
- How to use the respirator effectively in emergency situations, including situations in which the respirator malfunctions
- How to inspect, put on and remove, use, and check the seals of the respirator
- What the procedures are for maintenance and storage of the respirator
- How to recognize medical signs and symptoms that may limit or prevent the effective use of respirators
- The general requirements of the respiratory program

Finally, a qualitative or quantitative fit test is conducted by EH&S for each respirator user. The fit test ensures a proper face to face piece seal for each individual and his/her mask. Fit testing is done in accordance with [UC's Respiratory Protection Program](#) and Cal/OSHA regulations (8 CCR 5144) (<http://www.dir.ca.gov/title8/5144.html>).

An annual refresher is required for the medical evaluation, respirator training, and fit testing. In addition to the annual training refresher, a more frequent re-training, fit testing or medical evaluation must be performed when any of the following occur:

- Changes in the workplace or the type of respirator render previous training obsolete
- Inadequacies in the employee's knowledge or use of the respirator indicate that the employee has not retained the requisite understanding or skill
- Any other situation arises in which reevaluation appears necessary to ensure safe respirator use
- Facial scarring, dental changes, cosmetic surgery, or an obvious change in body weight
- An employee reports medical signs or symptoms related to their ability to use a respirator

The use of appropriate PPE should be written into laboratory procedures or safety SOPs (Section 7) and included on the PPE worksheet in the LSPS. Refer to the PPE worksheet, which is included in the LSPS, for a list of protective equipment available, where stored, and when it should be used.

## Glove Selection Guide

Chemically protective gloves are one of the most important tools to minimize dermal exposures to research laboratories. Laboratory personnel should use the information below to choose the type and glove. The type of glove, along with the other PPE required in their laboratory, should be included in Personal Protective Equipment, of their LSPS).

Latex gloves are used widely in laboratories. Unfortunately, latex gloves offer little protection from commonly used chemicals and up to 20 percent of the population is allergic to latex products.

Latex gloves are only suitable for biological materials, nonhazardous chemicals, very dilute, aqueous solutions of hazardous chemicals, clean area and medical or veterinary applications. In all cases single use, surgical type nitrile gloves can be substituted. Nitrile gloves are more durable and provide a clear indication when they tear or break. Nitrile gloves also offer a better set of chemical resistances and are non-allergenic. Staff required to wear latex gloves should receive training on the potential health effects related to latex. If latex is required, hypoallergenic, non-powdered gloves should be used.

Surgical-type gloves are suitable for "incidental contact." This means that no, or very little, actual contact with a chemical in use is anticipated. The gloves are there to prevent chemical contact with the skin when something goes wrong - a spill or splash to the hand, overspray from a dispensing device, etc. As soon as practical after the chemical makes contact with the gloved hand, the gloves must be removed and replaced. Often a glove specified for incidental contact is not suitable for extended contact (i.e., when the gloved hands come into substantial contact with or actually may become covered with or immersed in the chemical in use). Generally speaking, a more substantial glove is required for extended contact than for incidental contact.








Double gloving affords a double layer of protection. If the outer glove tears or starts to degrade, the inner glove offers protection until the gloves are removed and replaced. Best practice is to check the outer glove frequently, watching for signs of degradation (change of color, change of texture, etc.), and re-gloving as necessary.

For highly toxic materials and materials easily absorbed through the skin, Norfoil gloves (Silver Shield by North Hand Protection, 4H by Safety4, or New Barrier™ brand by Ansell Edmont) are generally recommended. They are somewhat bulky, but dexterity is regained by using a heavier weight (8 mil) disposable nitrile glove over the Norfoil glove. These gloves and others are also available from many vendors.

For non-incident contact, start with glove selection charts provided by glove manufacturers. Different manufacturers use different formulations, and a glove from one firm may not have the same chemical resistance as a similar glove from another firm. Glove selection based on the manufacturers' glove selection charts is often impossible, as only a limited range of chemicals have been tested for use with a specific manufacturer's glove. In particular, many research grade chemicals have not been tested by the various glove manufacturers.

If compatibility information is not available or for any questions, contact EH&S at 209 205-8176. Some manufacturer's charts are available at <http://ehs.ucmerced.edu/researchers-labs/ppe/selection>

This document is to be used as a supplement to the Laboratory Hazard Assessment Tool in the selection of appropriate PPE. PPE application should be based on risk assessment, which includes evaluation of the hazard and the procedure used, in consultation with the supervisor and safety officer.

Applicable PPE	Specific type (example)	Characteristics	Applications
Light latex, vinyl or nitrile gloves	Disposable latex gloves 	Powdered or un-powdered	Working with biological hazards (known or potentially known infectious materials including work with animals)
	Disposable nitrile gloves 	Puncture, abrasion resistant, protection from splash hazards	Working with biological hazards and chemical splash hazards
	Disposable vinyl gloves 	Economical, durable, similar to latex	Working with biological hazards
Light chemical resistant gloves	Natural rubber latex 	Chemical resistant, liquid-proof	Working with small volumes of corrosive liquids, organic solvents, flammable organic compounds
Light to heavy chemical resistant gloves	Nitrile gloves 	Chemical resistant, good puncture, cut, and abrasion resistance	Apparatus under pressure, air or water reactive chemicals
Heavy chemical resistant gloves	Butyl gloves 	High permeation resistance to most chemicals	Large volumes of organic solvents, small to large volumes of dangerous solvents, acutely toxic or hazardous materials
	Viton® II gloves 	High permeation resistance to most chemicals	Same as butyl gloves, plus hazardous material spills

## Section 11 – Handling Chemical Emergencies

This section covers important information for spill response. The Principal Investigator is responsible for reviewing this material and determining its applicability. Supplementary information is included on the following page.

### Overview

Laboratory emergencies may result from a variety of factors, including serious injuries, fires and explosions, spills and exposures, and natural disasters. All laboratory employees should be familiar with and aware of the location of their laboratory's emergency response plans and safety manuals. Before beginning any laboratory task, know what to do in the event of an emergency situation. Identify the location of safety equipment, including first aid kits, eye washes, safety showers, fire extinguishers, fire alarm pull stations, and spill kits. Plan ahead and know the location of the closest fire alarms, exits, and telephones in your laboratory, and list them in your LSPS. The Lab Emergency Poster (*Appendix Q*) provides an overview of emergency response procedures for laboratories. It should be posted in each laboratory.

**For all incidents requiring emergency response, call UCPD at 9-911 from a campus phone.**

### Accidents

PIs/Laboratory Supervisors are responsible for ensuring that their employees receive appropriate medical attention in the event of an occupational injury or illness. All accidents and near misses must be reported within 8 hours to EH&S. If unavailable, report to CAT-COPS (209 228-2677).

EH&S will conduct an accident investigation and develop recommendations and corrective actions to prevent future accidents.

At a minimum, each laboratory must have the following preparations in place:

- Fully stocked first aid kit (minimum contents in Section 1)
- Posting of emergency telephone numbers and locations of emergency treatment facilities, including OHF
- Training of adequate number of staff in basic CPR and first aid
- Training of staff to accompany injured personnel to medical treatment site and to provide medical personnel with copies of SDS(s) for the chemical(s) involved in the incident

Accident Prevention Methods	
DO	DON'T
<ul style="list-style-type: none"> <li>• Always wear appropriate eye protection</li> <li>• Always wear appropriate laboratory coat</li> <li>• Always wear appropriate gloves</li> <li>• Always wear closed-toe shoes and long pants</li> <li>• Always confine long hair and loose clothing</li> <li>• Always use the appropriate safety controls (e.g., certified fume hoods)</li> <li>• Always label and store chemicals properly</li> <li>• Always keep the work area clean and uncluttered</li> </ul>	<ul style="list-style-type: none"> <li>• Never enter the laboratory wearing inappropriate clothing (e.g., open-toe shoes and shorts)</li> <li>• Never work alone on procedures involving hazardous chemicals, biological agents, or other physical hazards</li> <li>• Never eat, drink, chew gum or tobacco, smoke, or apply cosmetics in the laboratory</li> <li>• Never use damaged glassware or other equipment</li> </ul>



If an employee has a severe or life threatening injury, call for emergency response. Employees with minor injuries should be treated with first aid kits as appropriate, and sent to the Occupational Health Facility for further evaluation and treatment. After normal business hours, treatment can be obtained at designated medical centers and emergency rooms.

**Serious occupational injuries, illnesses, and exposures to hazardous substances must be reported your health and safety officer within 8 hours.** EH&S will report the event to Cal/OSHA, investigate the accident, and complete exposure monitoring if necessary. Serious injuries include those that result in permanent impairment or disfigurement, or require hospitalization. Examples include amputations, lacerations with severe bleeding, burns, concussions, fractures and crush injuries. As soon as PIs/Laboratory Supervisors are aware of a potentially serious incident, they must contact EH&S. For after-hours emergencies, call cat-cops.

### Fire-Related Emergencies

If you encounter a fire, or a fire-related emergency (e.g., abnormal heating, smoke, burning odor), immediately:

1. Pull the fire alarm pull station **and call 9-911 from a campus phone or 911** from an off-campus or cell phone to notify the Fire Department;
2. Evacuate and isolate the area
3. Use portable fire extinguishers to facilitate evacuation and/or control a small fire (i.e., size of a small trash can), if safe to do so
4. If possible, shut off equipment before leaving
5. Close doors;
6. Remain safely outside the affected area to provide details to emergency responders; and
7. Evacuate the building when the alarm sounds. It is against state law to remain in the building when the alarm is sounding. If the alarm sounds due to a false alarm or drill, you will be allowed to re-enter the building as soon as the Fire Department determines that it is safe to do so. Do not go back in the building until the alarm stops and you are cleared to reenter.

**If your clothing catches on fire, go to the nearest emergency shower immediately. If a shower is not immediately available, then stop, drop, and roll.** A fire extinguisher may be used to extinguish a fire on someone. Report any burn injuries to the supervisor immediately and seek medical treatment. Report to your health and safety officer within 8 hours every time a fire extinguisher is discharged.



## Chemical Spills

Follow UC Merced chemical storage guidelines (Section 8) to prevent/minimize spills, review emergency preparedness measures, (Section 2) and make sure everyone understands laboratory spill procedures.

Chemical spills can result in chemical exposures and contaminations. Chemical spills become emergencies when:

- The spill results in a release to the environment (e.g., sink or floor drain)
- The material or its hazards are unknown
- Laboratory staff cannot safely manage the hazard because the material is too hazardous or the quantity is too large

Effective emergency response to these situations is imperative to mitigate or minimize adverse reactions when chemical incidents occur. After emergency procedures are completed, all personnel involved in the incident should follow UC chemical exposure procedures as appropriate.

### **If someone has been splashed:**

- Use nearest eyewash/douse showers for eyewashes or hand washes.
- Begin flushing immediately; continue for 15 minutes. (2 min for HF)

Seek medical attention if necessary. Call 9-911 and request an ambulance if needed.

The first response for all chemical spills (except HF) is to rinse the affected area with fresh water for at least 15 minutes (the exposed person will need assistance with this).

If a shower is not available, wash hoses on many laboratory sinks can be used as a temporary substitute.

In the event of a significant chemical exposure or contamination, immediately try to remove or isolate the chemical if safe to do so. When skin or eye exposures occur, remove contaminated clothing and flush the affected area using an eye wash or shower for at least 15 minutes. If a chemical is ingested, drink plenty of water. Obtain medical assistance as indicated. Remember to wear appropriate PPE before helping others. Pls/ Laboratory Supervisors must review all exposure situations, make sure affected employees receive appropriate medical treatment and/or assessment, and arrange for containment and clean-up of the chemical as appropriate.

Prior to responding to any spill, laboratory personnel should be thoroughly familiar with the hazards involved. This information should be included in the laboratory procedures or as a safety SOP. Laboratory employees should only handle small, incidental spills and should never handle a spill without understanding the risks to themselves and others.

### Factors to Consider Before Spill Clean Up

1. Size of spill area
2. Quantity of chemical
3. Toxicity
4. Volatility
5. Clean up materials available.

**The location of Spill Kit(s) and emergency eyewash and safety showers should be included in the LSPS.**

## Small Chemical Spill

(<1 liter, not highly toxic, not significant fire or environmental hazard, not in public area)

- Evacuate all non-essential persons from the spill area
- If needed, call for medical assistance by dialing 9-911 from a campus phone or 911 from an off-campus or cell phone
- Help anyone who may have been contaminated. Use emergency eyewashes/showers by flushing the skin or eyes for at least 15 minutes
- Post someone just outside the spill area to keep people from entering. Avoid walking through contaminated areas
- You must have the proper protective equipment and clean-up materials to clean-up spills. Check the chemical's Safety Data Sheet (SDS) in your laboratory or online (<https://ehs.ucop.edu/sds/#/>) for spill clean-up procedures, or call your health and safety officer for advice
- Turn off sources of flames, electrical heaters, and other electrical apparatus, and close valves on gas cylinders if the chemical is flammable
- Confine the spill to a small area. Do not let it spread.
- Avoid breathing vapors from the spill. If the spill is in a non-ventilated area, do not attempt to clean it up.
- Call for emergency personnel to respond and clean up the spill
- Wear personal protective equipment, including safety goggles, gloves, and a laboratory coat or other protective garment to clean-up the spill
- Work with another person to clean-up the spill. Do not clean-up a spill alone
- DO NOT ADD WATER TO THE SPILL
- Use an appropriate kit to neutralize and absorb inorganic acids and bases. For other chemicals, use the appropriate kit or absorb the spill with sorbent pads, paper towels, vermiculite, dry sand, or diatomaceous earth. For mercury spills and specific procedures for all other spills see Appendix P.
- Collect the residue and place it in a clear plastic bag. Double bag the waste and label the bag with the contents.
- Create a WASTE tag, and request pickup. (Section12)



Large Chemical Spill (>1 Liter, Spills of any quantity of highly toxic chemicals, or chemicals in public areas or adjacent to drains.)

**Large chemical spills require emergency response. Call 9-911 from a campus phone or 911 from an off-campus or cell phone. If the spill presents a situation that is immediately dangerous to life or health (IDLH) or presents a significant fire risk, activate a fire alarm, evacuate the area and wait for emergency response to arrive.**

- Remove the injured and/or contaminated person(s) and provide first aid
- Call for emergency medical response
- As you evacuate the laboratory, close the door behind you, and:
- Post someone safely outside and away from the spill area to keep people from entering
- Confine the spill area if possible and safe to do so
- Leave on or establish exhaust ventilation
- If possible, turn off all sources of flames, electrical heaters, and other electrical equipment if the spilled material is flammable
- Avoid walking through contaminated areas or breathing vapors of the spilled material
- Any employee with known contact with a particularly hazardous chemical must shower, including washing of the hair as soon as possible unless contraindicated by physical injuries

#### **Highly Toxic Chemical Spills**

***Do not try to clean up spills of any size that involve these materials. All spills require emergency response:***

- |                    |                   |
|--------------------|-------------------|
| • Aromatic amines  | • Hydrazine       |
| • Bromines         | • Nitriles        |
| • Carbon disulfide | • Nitro-compounds |
| • Cyanides         | • Organic halides |
| • Ethers           |                   |

#### **All laboratory personnel should know:**

- Where fire extinguishers are kept and how to use them - Section 3.
- The location, uses and limitations of the laboratory spill kit(s).
- The location of first aid supplies and how to respond to an injury - Section 1.
- Emergency procedures, including Eyewash/Douse shower locations.

#### **Eyewash/Facewash/Douse Showers**

An emergency eyewash/facewash/douse shower should be available within 55 feet without going through a door wherever toxics and corrosives are used. These may be freestanding units or eyewash units installed near laboratory sinks. Units are tested by EH&S. Maintain access to emergency eyewash/douse showers at all times – do not store anything around them that could impede access.

**The location of emergency eyewash/douse showers should be included in the LSPS.**

### **Laboratory Scale Chemical Spill Kits**

Spills can occur wherever chemicals are used. Laboratory personnel can clean up small, incidental spills of hazardous chemicals if they feel comfortable doing so, and if they have the proper equipment and supplies located in the laboratory.

***Prior to responding to any spill, laboratory personnel should be thoroughly familiar with the hazards involved. This information should be included in the laboratory procedures or as a safety SOP. Laboratory employees should only handle small, incidental spills and should never handle a spill without understanding the risks to themselves and others.***

**Laboratory personnel should never clean up:**

- Spills that present an immediate hazard (fire, explosion, chemical exposure, etc.)
- Any spill of highly dangerous chemicals
- A moderate or large-scale chemical spill

To respond to a small-scale laboratory spill, laboratories should have a simple spill kit (see sample below). Employees who choose to clean up a spill must wear the proper personal protective equipment (PPE) and wastes must be disposed according to UC Merced Guidelines (Section 12). Spill kits are provided by EH&S.

**Kits must include**  
(at a minimum):

- A storage container with the SPILL KIT LABEL
- PPE – Laboratory workers are responsible for providing appropriate protective equipment, including goggles and gloves.
- Absorbent materials appropriate for chemicals used, bags to contain the waste and UC Merced Hazardous Waste tags.
- Other materials as needed for chemicals used in laboratory.

Gloves and other PPE should be appropriate for laboratory needs, see Section 10 or call EH&S for more information.

Kits should be tailored to laboratory activities, including materials for biological and radiation spills. Consult the individual Laboratory Safety Plan Supplement for more specific information.

## Section 12 – Disposing of Chemical Wastes

This section described the minimum requirements for managing hazardous waste in laboratories.

### Hazardous Waste Program

The EH&S Hazardous Materials Program manages the shipment and disposal of all hazardous waste generated on campus. Each laboratory employee must comply with the campus Hazardous Waste Management Program requirements and all applicable regulations. A regular pick-up service is provided to most research buildings equipped with wet labs, and a pick-up is available upon request to other locations where hazardous waste is generated.

Laboratory personnel are responsible for identifying waste, labeling it, storing it properly in the laboratory, and transporting waste to their designated pick-up location within regulatory time limits. Laboratory clean-outs and disposal of high-hazard compounds must be scheduled in advance, and fees for these services are sometimes applied.

The PI/Laboratory Supervisor is responsible for coordinating the disposal of all chemicals from his/her laboratories prior to closing down laboratory operations. A *Hazardous Waste Management Safety* video can be viewed at:

<https://www.youtube.com/watch?v=0tLJFb3YrWA>



### Regulation of Hazardous Waste

In California, hazardous waste is regulated by the Department of Toxic Substance Control (DTSC), a division within the California Environmental Protection Agency (Cal/EPA). Federal EPA regulations also govern certain aspects of hazardous waste management, since most of our waste is treated and disposed out of state. These hazardous waste regulations are part of the Resource Conservation and Recovery Act, or RCRA. Local enforcement authority is administered by the Merced County CUPA.

### DEFINITION OF HAZARDOUS WASTE

EPA regulations define hazardous waste as substances having one of the following hazardous characteristics:

- Corrosive: pH < 2 or >12.5<sup>1</sup>
- Ignitable: liquids with flash point below 60° C or 140° F [e.g. methanol, acetone]
- Reactive: unstable, explosive or reacts violently with air or water, or produces a toxic gas when combined with water [e.g. Sodium metal]
- Toxic: Determined by toxicity testing [e.g. mercury] or waste designation calculations.

The EPA definition of hazardous waste also extends to the following items:

- Abandoned chemicals
- Unused or unwanted chemicals
- Chemicals in deteriorating containers
- Empty containers that have visible residues
- Containers with conflicting labels
- Unlabeled or unknown chemicals

---

<sup>1</sup> There are additional restrictions on the disposal of substances with a non-neutral pH; see the section on Drain Disposal, below.

Chemicals not in frequent use must be carefully managed to prevent them from being considered a hazardous waste. This is especially true for certain compounds that degrade and destabilize over time and require careful management to not become a safety hazard (see the section below titled “Wastes that Require Special Handling”).

## EXTREMELY HAZARDOUS WASTE

Certain compounds meet an additional definition known as “extremely hazardous waste”. This list of compounds includes carcinogens, pesticides, and reactive compounds, among others (e.g., formaldehyde, chloroform, and hydrofluoric acid). The Federal EPA refers to this waste as “acutely hazardous waste” located at <https://www.epa.gov/sites/production/files/2013-09/documents/epcrafrnotice4-22-1987.pdf> (start on p. 20), but Cal/EPA has published a more detailed list of extremely hazardous waste at <https://www.dir.ca.gov/title8/339.html>.

## TRAINING

All personnel who are responsible for handling, managing or disposing of hazardous waste must attend training prior to working with these materials. Hazardous Chemical Waste training covers the hazardous waste program requirements and includes training on the container labeling program, or WASTE. Training schedule and course descriptions are located at the EH&S website (<http://ehs.ucmerced.edu/general-safety/safety-training>).

## WASTE IDENTIFICATION

All the chemical constituents in each hazardous waste stream must be accurately identified by knowledgeable laboratory personnel. This is a critical safety issue for both laboratory employees and the waste technicians that handle the waste once it is turned over to EH&S. Mixing of incompatible waste streams has the potential to create violent reactions and is a common cause of laboratory accidents. If there is uncertainty about the composition of a waste stream resulting from an experimental process, laboratory workers must consult the PI/Laboratory Supervisor, the Chemical Hygiene Officer or the Hazardous Materials Manager. In most cases, careful documentation and review of all chemical products used in the experimental protocol will result in accurate waste stream characterization.

The manufacturer’s SDS provides detailed information on each hazardous ingredient in laboratory reagents and other chemical products, and also the chemical, physical, and toxicological properties of that ingredient. The UC SDS library (<http://www.ucmsds.com>) provides an extensive library of research chemicals. Waste streams that have a large percentage of ingredients listed as proprietary information should be discussed with the Hazardous Materials Program Manager.

## LABELING

UC utilizes a system-wide Waste Accumulation Storage Tracking (WASTE) program. Information on how to use WASTE is included in the Waste Management for Labs and Laboratory Safety Fundamentals course and online <https://ehs.ucmerced.edu/researchers-labs/chemical-safety/hazardous-waste/storage-and-accumulation>

### WASTE (ehs.ucop.edu/WASTE)

#### How to Create an Account

WASTE accounts are maintained under the PI. If you have been added to the lab in Profile (ehs.ucop.edu/profile) you have access to WASTE.

#### How to Use WASTE

- Once an account has been established, employees can print labels from their laboratory's printer, then affix the tag to the waste container by sliding it into the plastic envelope provided by EH&S.
- Each label must be completed accurately, and the tag must be updated as the contents of the waste container change. Product names or abbreviations for waste container ingredients should not be used. WASTE tags cannot be photocopied, as each tag has a unique bar code that is used to track that individual container. Reprinted tags should only be used for updates, missing or damaged tags, NOT for new containers. Employees may save a profile in the program for waste streams that are frequently generated.
- Request pickup by checking the box to the left of the entry and clicking the down arrow button.
- When waste containers approach the maximum allowable storage period in the laboratory accumulation area, all the contacts for that WASTE account are emailed a reminder to request a pick-up from EH&S. When EH&S collects the waste, the tags are scanned and the containers are entered into the inventory for the campus waste accumulation area and removed from the laboratory inventory.

## STORAGE

The hazardous waste storage area in each laboratory is considered a Satellite Accumulation Area (SAA) by the EPA. According to EPA requirements, this area must remain under the control of the persons producing the waste. This means that it should be located in an area that is supervised and is not accessible to the public. Other SAA requirements include:

- Hazardous waste containers must be labeled with a WASTE tag at all times
- Waste must be collected and stored at or near the point of generation
- According to State law, the maximum amount of waste that can be stored in a SAA is 55 gallons of a hazardous waste or 1 quart of extremely hazardous waste. If you reach these volumes for a specific waste stream, you must dispose of the waste within 3 days
- The maximum amount of flammable solvents allowed to be stored in a laboratory is 60 gallons; this figure also includes waste solvents
- All hazardous waste containers in the laboratory must be kept closed when not in use
- Hazardous waste streams must have compatible constituents, and must be compatible with the containers



In which they are stored

- Hazardous waste containers must be stored in secondary containment at all times.
- Containers must be in good condition with leak proof lids
- Containers must be less than 90% full
- Dry wastes must be double-bagged in clear, 3-mil plastic bags
- All containers must be labeled with a WASTE tag when the first drop is added.

## SEGREGATION

All hazardous materials must be managed in a manner that prevents spills and uncontrolled reactions. Stored chemicals and waste should be segregated by hazard class. Examples of proper segregation are:

- Segregate acids from bases
- Segregate oxidizers from organics
- Segregate cyanides from acids

Segregation of waste streams should be conducted in a similar manner to segregation of chemical products. Refer to *Appendix N* for chemical segregation guidelines.

## INCOMPATIBLE WASTE STREAMS

Mixing incompatible waste streams, or selecting a container that is not compatible with its contents, is a common cause of accidents in laboratories and waste storage facilities. Reactive mixtures can rupture containers and explode, resulting in serious injury and property damage. All chemical constituents and their waste byproducts must be compatible for each waste container generated. Waste tags must be immediately updated when a new constituent is added to a mixed waste container, so that others in the laboratory will be aware and manage it accordingly.

Some common incompatible waste streams include:

- Oxidizers added to any fuel can create an exothermic reaction and explode. The most frequent is acids oxidizing flammable liquids. For this reason, all flammable liquids are pH tested before they are consolidated.
- Piranha etch solution is a specific waste stream that contains sulfuric acid and hydrogen peroxide, which form a reactive mixture that is often still fuming during disposal. For this waste stream, and other reactive mixtures like it, vented caps are mandatory.

## WASTES THAT REQUIRE SPECIAL HANDLING

### Unknowns

Unlabeled chemical containers and unknown/unlabeled wastes are considered unknowns, and additional fees must be paid to have these materials analyzed and identified. These containers must be labeled with the word “unknown”. If a large number of unknowns is created out of negligence or mismanagement of the lab, analysis will be recharged to that lab, or if not available, to the school.

### Peroxide Forming Chemicals

Peroxide forming chemicals, or PFCs, include a number of substances that can react with air, moisture or product impurities, and undergo a change in their chemical composition during normal storage. The peroxides that form are highly reactive and can explode upon shock, heating, or friction. Peroxides are not particularly volatile and thus tend to precipitate out of liquid solutions. It is particularly dangerous to allow a container of these materials to evaporate to dryness, leaving the crystals of peroxide on the surfaces of the container.

Each container of peroxide forming chemicals should be dated with the date received and the date first opened. There are three classes of peroxide forming chemicals, with each class having different management guidelines. A guide to managing some PFCs commonly found in research labs is provided in *Appendix I*. Since this Appendix does not provide an exhaustive list of PFCs, review the safety information provided by the manufacturer for any chemicals you purchase.

Ensure containers of PFCs are kept tightly sealed to avoid unnecessary evaporation, as this maintains the stabilizers that are sometimes added. Visually inspect containers periodically to ensure that they are free of exterior contamination or crystallization. PFC containers must be disposed of prior to expiration date. If old containers of peroxide forming chemicals are discovered in the laboratory, (greater than two years past the expiration date or if the date of the container is unknown), or if crystallization is present in or on the exterior of a container, do not handle the container. Secure it and contact your health and safety officer for pick-up and disposal. The laboratory assumes all costs associated with improper management of peroxide forming chemicals. If a lab has been abandoned, the school shall assume all associated costs.

### Dry Picric Acid and Dinitrophenyl Hydrazine

Picric acid (also known as trinitrophenol) and dinitrophenyl hydrazine must be kept hydrated at all times, as it becomes increasingly unstable as it loses water content. When dehydrated, it is not only explosive but also sensitive to shock, heat and friction. Picric acid is highly reactive with a wide variety of compounds (including many metals) and is extremely susceptible to the formation of picrate salts. Be sure to label all containers that contain either of these substances with the date received, and then monitor the water content every 6 months. Add distilled water as needed to maintain a consistent liquid volume.

If old or previously unaccounted for bottles of picric acid or dinitrophenyl hydrazine are discovered, do not touch the container. Depending on how long the bottle has been abandoned and the state of the product inside, even a minor disturbance could be dangerous. Visually inspect the contents of the bottle without moving it to evaluate its water content and look for signs of crystallization inside the bottle and around the lid. If there is even the slightest indication of crystallization, signs of evaporation, or the formation of solids in the bottle, do not handle the container and contact your health and safety officer immediately. Secure the area and restrict access to the container until it can be evaluated by EH&S personnel.

### Explosives and Compounds with Shipping Restrictions

A variety of other compounds that are classified as explosives or are water or air reactive are used in research laboratories. These compounds often have shipping restrictions and special packaging requirements. When disposing of these compounds, employees must ensure that they are stored appropriately for transport. Flammable metals must be completely submerged in oil before they are brought to a waste pick-up. Many pyrophoric and reactive compounds can be stabilized using a quenching procedure prior to disposal. Chemicals classified by the Department of Transportation (DOT) as explosive (e.g., many nitro- and azo-compounds) will require special packaging and shipping, and may require stabilization prior to disposal. Consult with the Chemical Hygiene Officer for disposal considerations of these compounds.



### MANAGING EMPTY CONTAINERS

Empty containers that held Extremely Hazardous waste must be managed as hazardous waste, and picked up through WASTE. Do not rinse or reuse these containers.

All other hazardous waste containers, if they are less than 5 gallons in size, should either be reused for hazardous waste collection, or should be cleaned and discarded or recycled. Proper cleaning involves triple rinsing the container, with the first rinse collected as hazardous waste. Then the labels should be completely defaced (remove it or mark it out completely). Dispose or recycle rinsed plastic or glass containers as regular trash or in a campus recycling bin. To request a recycling bin, contact Facilities Management. Clean bottles can be left in the room next to 257 for other labs to use to collect waste. The labels must be removed and put a date on the bottle.

Empty containers 5 gallons in size or more should be turned in to EH&S or brought to a hazardous waste pick-up. If completely empty and only contained solvent, 5 gal cans can be recycled.

### TRANSPORTATION

It is a violation of DOT regulations to transport hazardous waste in personal vehicles, or to carry hazardous waste across campus streets that are open to the public. As a result, EH&S provides pick-up services for all hazardous waste generators. Special pick-ups and laboratory clean-outs are available upon request for large volumes (more than 20 containers or 20 gallons).

Inspect all containers to make sure that they are safe to transport. Verify that each container has an accurate waste tag, and the containers are clean and free of residue and do not show any signs of bulging, fuming, or bubbling. Containers should be segregated by hazard with secondary containment. As a best practice, employees should wear eye protection, lab coat, long pants, and closed toe shoes (and carry gloves with them) when transporting waste.

### DISPOSAL

Frequent disposal will ensure that waste accumulation areas in labs are managed properly, and that maximum storage volumes are not exceeded. Federal regulation states that hazardous chemical waste can be stored in a laboratory for up to 180 days. Once a waste container is 90% full or it is near the 180-day time limit, it should be disposed on the next designated pick-up. Once an experiment or process is completed, all partially filled containers should be disposed on the next scheduled pick-up.

## Acceptable Wastes for a Routine Pick Up

EH&S accepts the following materials at a routine pick-up:

- 20 containers or less of research generated waste
- Liquid waste in suitable containers that are clean, free of contamination, and have a leak proof cap
- Dry waste that is double bagged in clear 3-mil plastic
- Chemical contaminated sharps (with no infectious or biohazardous contamination) in a rigid sharps container
- Treated infectious waste streams or deactivated biological agents that are mixed with chemical wastes

Wastes that will not be accepted at a routine pick-up location include:

- Biohazardous waste (medical waste, infectious materials or biohazardous agents) - dispose of these in SE1, biowaste room on the loading dock, S&E2 cage on first floor by freight elevator, SRE basement, or Castle building 1201, room 1313.
- Radioactive Wastes - contact your health and safety officer
- Controlled Substances - contact your health and safety officer
- Reactive waste streams without a properly vented cap, or containers that are bulging, fuming or bubbling. This includes non-vented piranha acid and no-chromix
- Leaking, overflowing, or contaminated containers, or containers that are compromised
- Bags that have protruding glass or other sharps, or bags that are ripped or punctured
- Wastes that require special handling procedures or have shipping restrictions
- Waste streams in incompatible containers
- Unknowns and expired peroxide forming chemicals without a FAU for recharge
- Wastes that are improperly labeled (i.e. molecular formulas, one constituent listed when others obviously present).

Information about hazardous waste pick-ups is provided in *Appendix O*. Waste is picked up once per week.

## Hazardous Waste Minimization

In order to meet our permit obligations and our sustainability mission, EH&S has developed a Hazardous Waste Minimization Program, in an effort to minimize the costs, health hazards, and environmental impacts associated with the disposal of hazardous waste. Before ordering, check [ehs.ucop.edu/chemicals](http://ehs.ucop.edu/chemicals) and select the "Chemical Redistribution" list. Contact EHS if you can use a chemical on this list.

## ADMINISTRATIVE CONTROLS

In order to reduce the amount of chemicals that become waste, administrative and operational waste minimization controls can be implemented. Usage of chemicals in the laboratory areas should be reviewed to identify practices which can be modified to reduce the amount of hazardous waste generated.

### Purchasing Control:

Check the "shared chemicals" list on the chemical inventory program before new products are ordered. When ordering chemicals, be aware of any properties that may preclude long term storage, and order only

minimum volumes to be used. Using suppliers who can provide quick delivery of small quantities can assist with reducing surplus chemical inventory. Consider establishing a centralized purchasing program to monitor chemical purchases and avoid duplicate orders.

**Inventory Control:** Rotate chemical stock to keep chemicals from becoming outdated. Locate surplus/unused chemicals and attempt to redistribute these to other users, or investigate returning unused chemicals to the vendor. Note only EH&S can ship hazardous materials.

**Operational Controls:** Review your experimental protocol to ensure that chemical usage is minimized. Reduce total volumes used in experiments; employ small scale procedures when possible. Instead of wet chemical techniques, use instrumental methods, as these generally require smaller quantities of chemicals. Evaluate the costs and benefits of off-site analytical services. Avoid mixing hazardous and non-hazardous waste streams. Distill and reuse solvents if possible. Spent solvents can also be used for initial cleaning, using fresh solvent only for final rinse. Use less hazardous or non-hazardous substitutes when feasible. Some examples include:

- Specialty detergents can be substituted for sulfuric acid/chromic acid cleaning solutions
  - Gel Green and Gel Red are recommended in place of ethidium bromide

## DRAIN DISPOSAL

UC does not permit drain disposal of chemical wastes, unless a specific dilution and/or neutralization method for a consistent waste stream has been reviewed and approved by EH&S. This applies to weak acid and base solutions. As indicated in previous sections, EPA hazardous waste definitions specify that materials with a pH between 2.5 and 12.5 are not hazardous wastes. However, drain disposal of these materials is still not permitted, because local industrial waste water discharge requirements have more restrictive pH thresholds. In addition, acid and base neutralization is considered waste treatment, a process that is strictly regulated by the EPA (see "Bench Top Treatment" below). Contact EH&S for specific questions about drain disposal variances.

Drain disposal of properly disinfected infectious or biohazardous liquids is acceptable, if disinfection is conducted as specified by the EH&S Biosafety Program, and the liquids disposed contain no other hazardous constituents.

## BENCH TOP TREATMENT

EPA regulations allow some limited bench top treatment of certain chemical waste streams in laboratories provided that specific procedures are followed. Due to the stringent nature of these requirements, any treatment of hazardous waste in labs must be reviewed and approved by EH&S. The EPA requirements for treating hazardous waste in laboratories generally follow the "Prudent Practices in the Laboratory 1995" (p. 160-171), National Research Council procedures, or other peer-reviewed scientific publications. The quantity of waste treated in one batch cannot exceed 5 gallons of liquid or 18 kilograms of solid/semi-solid waste. As treatment may result in residuals which may have to be managed as hazardous waste, all residual hazardous waste must be handled according to UC's Hazardous Waste Program requirements.

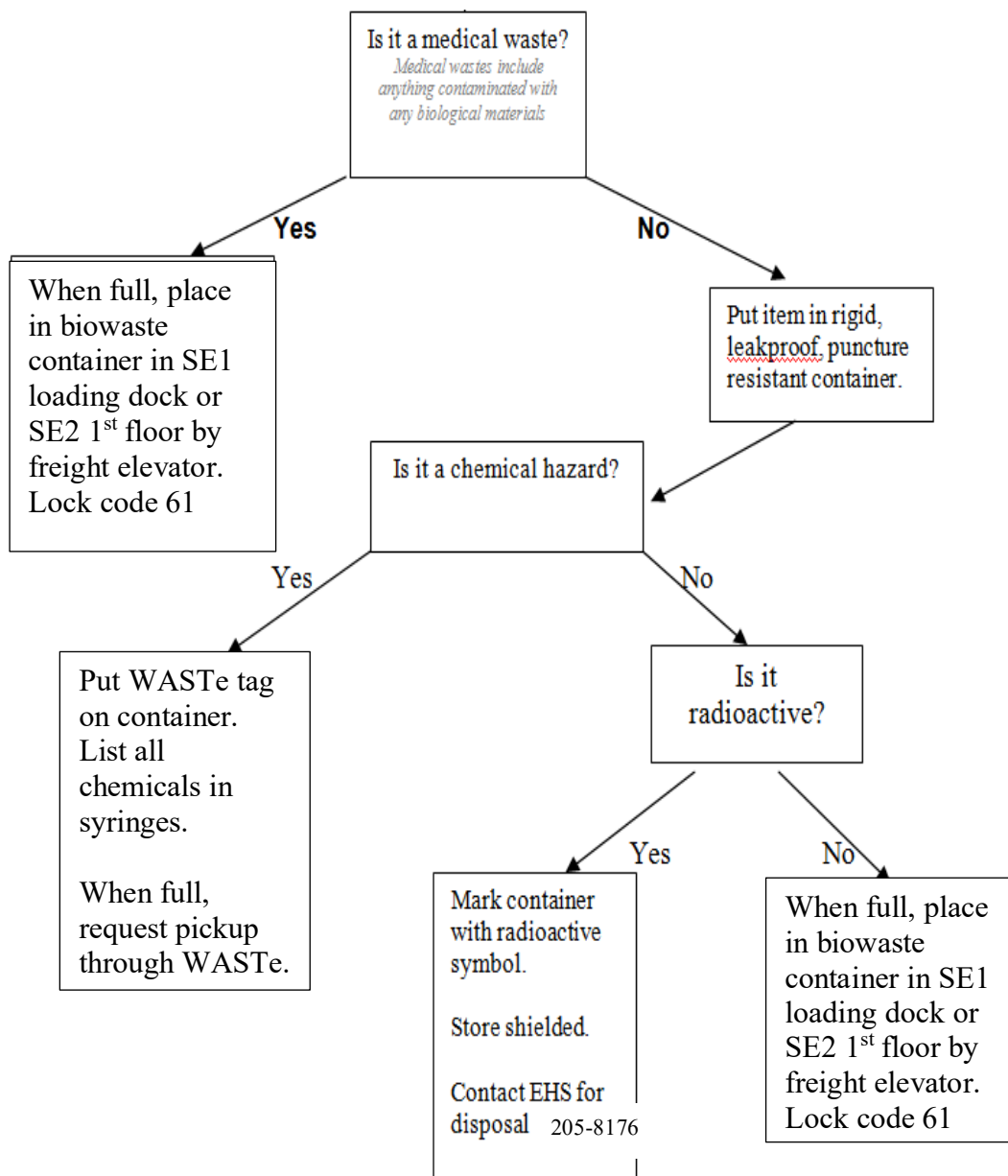
**Laboratory specific procedures** for hazardous waste should be listed in your LSPS (Section 7, Chemical Safety).

Call EH&S at 209 205-8176 for further information on chemical and radioactive wastes disposal from your laboratory.

## Sharps Decision Tree

Use this guide to help decide how to handle sharps and piercing objects

Sharps and piercing objects can puncture regular waste bags, posing both a physical and a contamination hazard. State and local regulations have become more stringent to protect waste processors, resulting in the increased complexity of treatment, packaging, labeling, and disposal of waste. To make it easy, EH&S has prepared a Sharps and Piercing Objects Decision tree--a flowchart that will guide you to the correct disposal method for your sharps and piercing objects waste. Please note Eppendorf tips and serological pipets are considered sharps in addition to broken glass and syringes.





## Section 13 – Handling Carcinogens and Reproductive Toxins

This section describes important issues and legal requirements for working with carcinogens.

The surest way to prevent toxic chemicals from causing harm is to minimize exposure. The following sources should be used to help identify and characterize carcinogens and reprotoxins:

- SDS sheets – available at <https://ehs.ucop.edu/sds/#/>
- NTP – National Toxicology Program [reports on carcinogens](#)
- IARC – [International Agency for Registration of Carcinogens](#)
- ACGIH – American Conference of Governmental Industrial Hygienists
- Prop 65 list – List of carcinogens and reproductive toxins from California [Proposition 65](#)

Information about carcinogens should be used to develop protective measures, including engineering controls, work practices and PPE plus emergency practices and waste management. PPE procedures should include procedures to prevent spread of contamination, including removing any contaminated equipment (such as gloves) before leaving the designated area.

- These measures should be included as separate safety SOPs in the laboratory-specific LSPS (Section 7).
- Maintain an inventory of all carcinogens and reproductive toxins, and all chemicals should be kept in a secure storage area.

**A Carcinogen Inventory and List of Storage Areas for all laboratories should be included in Section 13 of the LSPS. You may insert the completed form in appendix E in lieu of filling out section 13**

- Storage and work areas where carcinogens are used must be designated with the “Carcinogen” sticker.
- Carcinogens and reproductive toxins should only be used in designated areas that are known to laboratory workers. Access to these areas should be controlled and all work surfaces should be decontaminated after use. Chemical techniques, disposable “bench coat” or other means can be used for decontamination.

**Designated Areas and Decontamination Techniques for carcinogen use are listed in the LSPS.**

As with all chemicals, workers have a right to medical attention if they are exposed – see Section 7. Report all exposures immediately for medical evaluation (Section 1).

### Carcinogen Reporting

UC Merced is required to make an annual report of use of certain carcinogens. Users of Cal-OSHA Carcinogens must complete a registration form (Appendix E) and return it to EH&S, and list these materials on their chemical inventory at [ehs.ucop.edu/chemicals](https://ehs.ucop.edu/chemicals)



## Section 14 – Controlled Substances

This section provides information concerning purchasing and using substances listed by the United States Drug Enforcement Agency.

The use of psychotropic drugs, such as narcotics for research purposes, is regulated by the federal government. Narcotics are classified as Schedule I, II, III, IV, V, or as a “Listed Chemical.” Schedule I narcotics have the highest potential for abuse, and no legitimate medical uses. Schedule V narcotics have limited potential for abuse and Listed Chemicals are generally for drug precursors. Lists of controlled substances are available electronically, as well as the Drug Abuse Prevention and Control Act itself.

Laboratories wishing to use controlled substances, listed chemicals, or tax-free ethanol (200 proof) for research purposes must fill out a Controlled Substances Use Authorization. These substances can only be used if specifically authorized by the Department Chair, if an appropriate storage location is available in the laboratory, and if an accurate inventory is maintained at all times. Orders must be made through the purchasing department, not by laboratory personnel on low value orders or through Departmental Buyers.

### Storage Requirements

Laboratories are required to have a proper drug storage location for controlled substances:

- The cabinet should be equipped with a keyed lock.
- If a padlock is used, the hasp should be installed so that there is no access to the mounting screws or bolts when the door is closed and the lock is fastened.
- Hinges should be installed in such a manner as to prevent access to mounting screws or bolts or to the hinge pins when the door is closed.
- The key should at all times remain in the physical custody of the individual authorized by the Department Chair to maintain a storage cabinet for controlled substances.

### Restricted Access

Access to controlled substances must be restricted to specific personnel who will be using these materials. Controlled substances cannot be stored in a cabinet with other, general use chemicals, even if the cabinet locks.

### Inventory and Disposal

Laboratories must maintain an accurate inventory of all controlled substances, listed chemicals and tax-free ethanol (200 proof); forms can be requested from EH&S. Contact EH&S at 209 205-8176 for instructions on how to dispose of controlled substances.

The controlled substances policy, inventory forms, and use authorization request forms can be found at <http://ehs.ucmerced.edu/researchers-labs/chemical-safety/controlled-substances>

## Section 15 - Hazardous Drug Guidelines

This section contains information about using cytotoxic drugs.

Hazardous Drugs (HDs) include: antineoplastic agents; drugs for which the manufacturer suggests the use of special isolation techniques; drugs known or suspected to be human or animal mutagens, carcinogens, teratogens or reproductive toxicants; (drugs known to be mutagenic in multiple bacterial systems or animals should also be considered hazardous); drugs known to be acutely toxic to an organ system; and Investigational New Drugs.

Damage from many of these agents may be cumulative and related to dose and duration of exposure; therefore, it is essential to use good work practices and proper controls.

1. Appropriate personal protective equipment, including gloves and protective clothing should be worn – see Section 10. A biosafety cabinet (BSC) or chemical fume hood should be used when working with these chemicals – see Section 9.
2. Restrict hazardous drug use to specific areas. All areas where hazardous drugs are stored, prepared or administered should be clearly labeled. In addition, any BSCs used for HD work should be labeled.
3. HD work areas should be covered with disposable plastic-backed bench liner, appropriately labeled sharps containers should be available, and written decontamination/spill control procedures should be posted - see Section 11.
4. Generation of aerosols should be minimized, large bore needles should be used, and as many operations as possible should be conducted in a BSC or chemical fume hood.
5. Materials and equipment in contact with HDs should be labeled, and all waste associated with hazardous drug use should be handled as hazardous waste according to UC Merced procedures, including sharps.
6. All personnel working with hazardous drugs, including technicians, animal handlers, etc. should be informed of the hazards of these materials and the measures necessary to protect themselves. In cases where significant exposures are likely, such as the handling of a large number of treated animals, a program of medical surveillance should be discussed with EH&S.
7. Write Standard Operating Procedures for HDs at [ehs.ucop.edu/chemicals](https://ehs.ucop.edu/chemicals). A list of HD's is located at <https://www.cdc.gov/niosh/docs/2016-161/pdfs/2016-161.pdf?id=10.26616/NIOSH PUB2016161>, start on p. 9.

### Issues to be addressed include:

- A description of the procedure and chemicals
- Personal Protective Equipment (PPE) – Section 9
- Waste disposal procedures – Section 12
- Any approvals necessary, specific decontamination procedures or any specific designated areas.
- Engineering controls – Section 9
- Spill and emergency procedures –

## Section 16 – Acutely Hazardous Materials

This section contains information about using acutely hazardous materials.

All substances can be toxic, depending on the dose. Special consideration should be given to work with materials that are toxic at very low doses. The table below gives an idea of how to view materials, depending on different measures of toxicity. As with all materials, the basic chemical safety guidelines in Section 7 should be followed and the laboratory should develop an SOP or write the procedure directly into the appropriate LSPS. For acutely hazardous materials special consideration should be given to the establishment of a “Designated Area,” containment devices such as hoods and glove boxes, and decontamination procedures. All waste should be handled according to UC Merced procedures outlined in Section 12.

**Toxicity Levels**, adapted from *Prudent Practices in the Laboratory*, 1995

<b>Toxicity Rating</b>	<b>Oral LD<sub>50</sub> – Rat</b>	<b>Skin LD<sub>50</sub> – Rabbit</b>	<b>Inhalation LC<sub>50</sub> – 1 hr., Rat</b>	<b>Inhalation LC<sub>50</sub> – 1 hr., Rat</b>
<b>Highly Toxic</b>	<50 mg/kg	<200 mg/kg	<200 ppm	<2,000 mg/m <sup>3</sup>
<b>Moderately Toxic</b>	50 – 500 mg/kg	200 mg – 1 g/kg	200 – 2,000 ppm	2,000 – 20,000 mg/m <sup>3</sup>
<b>Slightly Toxic</b>	500mg – 5 g/kg	1 – 5 g/kg	2,000 – 20,000 ppm	20,000 – 200,000 mg/m <sup>3</sup>

There are also State and Federal lists of materials considered extremely hazardous. Section 3 of Prudent Practices also has a great deal of useful information for evaluating potential hazards.

Use information from hazard assessment resources to develop safe work practices. These should include engineering controls, such as fume hoods, glove boxes or biosafety cabinets; and personal protective equipment, such as protective clothing, gloves and eye protection. All procedures should be included in written laboratory procedures or as separate safety SOPs.

**Guidelines for work with substances of high acute toxicity should include:**

- Prior approval or training before beginning work
- Specific areas where work should be performed.
- Storage and labeling practices, including secondary containment.
- Use of engineering controls such as a fume hood or a glove box. As a general rule, materials with a TLV of less than 50 ppm should be used in a hood
- How to respond to small spills and how to evacuate in case of large ones
- How to handle wastes

## Section 17 - Select Agents

This section contains information about the use of “Select Agents” as identified by the Center for Disease Control.

The threat of illegitimate use of some toxic and infectious agents has attracted increasing interest. In view of these concerns, the “Anti-Terrorism and Effective Death Penalty Act of 1996” (42 CFR Part 72) established new provisions to regulate the transfer of select agents.

### **Approval to Work with Select Agents**

Individual researchers who wish to use these agents, including botulinum toxin, tetrodotoxin, certain other toxins as well as some hazardous biological agents, must be approved by the EH&S office. These researchers will be asked to document:

1. The individual agents and the type of work being done
2. Where the work will be done, including floor plans showing relevant equipment (fume hoods, biosafety cabinets, incubators, etc.).
3. Safety procedures appropriate for work with acutely hazardous materials, including access control, training and proficiency evaluation along with completed Laboratory Safety Plan Supplement and LSP Training Sheets
4. Agent disposal requirements

The Principal Investigator is responsible for filling out a select agent registration package in order to procure any one of the select agents. Registration forms are available through EH&S.

### ***Purchasing and Sending Select Agents***

Please contact the Purchasing Department to place any orders.

## Section 18 – Compressed and Hazardous Gases

This section includes guidance for the safe use of compressed gases. Basic requirements apply to all gases; more stringent precautions are needed for toxic gases.

Compressed gases are classified as Class I, II, III or IV, in order of decreasing hazard. The requirements below apply to all gases. Additional requirements for hazardous gases (Class I, II and III) are listed on the Hazardous Gas Requirements sheet.

A list of compressed gases used in your laboratory should be included in Section 18 of the LSPS.

### For all gas cylinders:

- Store cylinders in an upright position and in a well-ventilated area. Cap when not in use.
- Secure cylinders and dewars with upper and lower restraints, separate from incompatible gas classes (Oxygen must be separated from flammables by 20'). No more than two cylinders per chain.
- Laboratory cylinders less than 18" tall may be secured by stands or wall brackets.
- Do not store cylinders in exits or egress routes.
- Cylinders and gas lines must be labeled. Do not depend on color codes.
- Do not roll, drag, slide containers, or lift cylinders by cylinder caps. Instead, use a hand truck or other suitable device.
- Always transport cylinders with cylinder caps in place.
- Do not attempt to repair a cylinder, valve or regulator.
- If a cylinder leak cannot be stopped by tightening the valve gland or packing nut, close the leaking valve, replace the valve cap and move the cylinder to a well-ventilated area (i.e., outdoors). Notify EH&S (209 205-8176 or 9-911) as soon as possible.
- Always use the correct regulator and never use adapters.
- Cylinders of flammable gases, such as oxy-acetylene torch units, should have flashback protectors installed.
- Plumbing should be copper or braided metal hose. Tygon tubing can whip around if pressurized and is disconnected from its outlet.
- Compressed gas cylinders can corrode or degrade over time and should be returned to the manufacturer if they are no longer being used. This will remove any potential hazard and save the demurrage charge, which can exceed the cost of the gas over time.
- Do not use lecture bottles if other cylinders are available. Lecture bottles are very difficult to dispose of and they use universal threads and valves (some of which are interchangeable). If lecture bottles are used, label all associated equipment with the gas name to prevent unintentional mixing of incompatible materials.
- Receiving locations are for temporary storage only. If cylinders stay more than 6 months, they will be returned to the supplier.
- EH&S will review orders of compressed gases and approve within 1 business day.
- Praxair will write the name of the PI on the cylinder upon delivery.
- Cylinders are delivered on Monday and Thursday each week, to the same building as the PI's lab if space allows.
- Within one day of receipt, cylinders will receive a barcode tag by EH&S.
- Within one week of receipt, the cylinder will be added to UC Chemicals by EH&S or the lab.
- When a cylinder is moved to the lab, the location will be updated by the lab in UC Chemicals

### Hazardous Gas Requirements

Gases are classified as Class I, Class II, Class III or Class IV based on LC<sub>50</sub> (rat)

(LC<sub>50</sub> (rat) = lethal concentration for 50% of test rats)

- **Class I** – LC<sub>50</sub> (rat) < 200 ppm
- **Class II** – 201 ppm < LC<sub>50</sub> (rat) < 3000 ppm
- **Class III** – 3001 < LC<sub>50</sub> (rat) < 5000 ppm
- **Class IV** – LC<sub>50</sub> (rat) > 5001 ppm

Requirements	Class IV	Laboratory Exempt	Class III	Class II	Class I
Basic Gas Safety Requirements	X	X	X	X	X
Exhausted Enclosures (gas cabinets or hoods)		X	X	X	X
Discharge Treatment to ½ IDLH at release		X	X	X	X
Leak Check Procedures for cylinders and manifolds		X	X	X	X
E/R Plan, Team and drills		X	X	X	X
Restrictive Orifice or Flow Limiting device		X	X	X	X
Used in Sprinklered Spaces		X	X	X	X
Documented Annual Maintenance			X	X	X
Compatible Piping			X	X	X
UFC 79-3 (NFPA 704) and No Smoking Signs			X	X	X
Purge Systems			X	X	X
Detector Systems		X (Class 1)		X	X
Emergency Alarms (and explanatory signs)		X (Class 1)		X	X
Welded Connections				X	X
Local Shut-Off				X	X
Excess Flow Triggered Shut-Off				X	X
Seismic Shut-Off				X	X
Emergency Power (alarm, detector, vent)		X (Class 1)		X	X
Monitored secondary containment					X
Auto shutoff (manual or detector triggered)					X
Emergency Control Station					X
Exhaust Flow Alarm		X (Class 1)			X

Section 1.01 Requirements are relaxed for small quantity, short term usage:

Class II and III gases, < 340 SCF (standard cubic feet), used for less than 30 consecutive days require:

- Leak check procedures for cylinders and manifolds.
- Cylinders must have a restrictive orifice, must be in an exhausted enclosure, and must be used in a sprinklered space. No lecture bottles.
- Class I, < 20 SCF, used for less than 30 consecutive days require above items, plus
- Gas and exhaust system flow detector systems, connected to an alarm system (not the building fire alarm system).
- Emergency power for detectors and alarms
- Requirements may be relaxed for quantities less than 2 pounds, no single cylinder > 1 pound (1/4 pound for Class 1).
- Quantities over threshold levels raise the level of classification.

## Section 19 – Cryogenic Liquids

This section provides guidance for working with cryogenic liquids.

Cryogenic liquids, liquefied gases with temperatures below  $-73^{\circ}\text{C}$ , and their boil-off vapors rapidly freeze human tissue and cause embrittlement of many common materials. Cryogenic liquids also produce large volumes of gas when they vaporize (at ratios of 600:1 to 1440:1, gas: liquid) and may create oxygen-deficient conditions.

### Precautions for working with cryogenic liquids:

- Use appropriate personal protective equipment (PPE) including insulated gloves and eye protection (face shield with safety glasses or goggles underneath) during any transfer of cryogenic liquid.
- Minimize boiling and splashing of cryogenic fluid during transfers to open cryogenic containers, such as dewars.
- Avoid clothing that can trap spilled liquid. If skin contact with a cryogenic liquid occurs, do not rub skin.  
Instead, place the affected part of the body in a warm (not hot) water bath.
- Be alert for the condensation of oxygen from air.
- Use high quality dewars with protective covers, not standard “thermos” bottles.
- Excessive ice buildup could result in the discharge of excessively cold gas or structural damage to the cryogenic container or surroundings.
- All cryogenic systems (including piping) must be equipped with pressure relief devices that are directed to a safe location.
- Hot air, steam, or hot water should be used to thaw frozen equipment. DO NOT USE water to thaw liquid helium equipment.
- Do not store cryogenics in cold rooms.

Cryogenic liquids used in laboratories should be listed in Section 19 of their LSPS.



## Section 20—Operational Hazards

This section provides information on operating certain types of equipment safely.

Many common pieces of laboratory equipment can cause severe accidents or damage if not used properly. Below is a list of the most common pieces of equipment.

- **Centrifuging**
- **Ultra-Sonation**
- **Distillation**
- **Water cooled equipment**
- **Vacuum Pumps and systems**
- **Rotary Evaporator use and trapping**
- **Glassware**
- **Photographic Hazards**

Many laboratory chemicals have severe or unique hazards, such as:

- **Hydrofluoric Acid (HF)**
- **Picric Acid**
- **Perchloric Acid**
- **Ethidium Bromide**
- **Peroxide forming chemicals**
- **Silane**

What else should be added to this list? Please help us improve this guide by sending your comments and suggestions to EH&S or 209 205-8176.

## Section 21 – Biosafety

This section contains information concerning the safe handling of biological materials.

The biosafety program covers work with all organisms (bacteria, chlamydia, fungi, parasites, prions, rickettsias, viruses, etc.), toxins, and allergens that can cause disease in humans, or cause significant environmental or agricultural impact. The program also covers work with human or primate tissues, human or non-human embryonic stem cells, recombinant DNA (rDNA), transgenic plants or animals, human gene therapy, releases of rDNA to the environment, and work with animals known to be reservoirs of zoonotic diseases. Bear in mind that a large number of organisms that would ordinarily be innocuous can be infective in immuno-compromised persons. Please contact the Biosafety Officer at EH&S, (209) 288-4639 to discuss your work if your laboratory currently works with or intends to begin working with biological materials. The Biosafety Officer will assist you in determining whether institutional authorization is required in order to perform this work.



### **Please use the following guide to assist you:**

Principal Investigators may need an approved *Biological Use Authorization (BUA)* prior to working with biological materials. To apply for a BUA, go to

<https://ehs.ucop.edu/biosafety/template/5efb5ecf29ff423dc72a7d5c>

- It is also important to note that before any one begins working with biologicals, he or she must attend the EH&S *Biosafety or Bloodborne Pathogens Safety class*, depending upon the risk assessment conducted by the Biosafety Officer and/or the Institutional Biosafety Committee (IBC).
- Each Principal Investigator who is authorized to use biological material (either exempt from requiring a BUA or requiring a BUA) is required to follow procedures outlined in the UC Merced Biosafety Manual. This manual is available on the UC Merced EH&S website, on the Biosafety page, and is updated annually, or as regulations change. The Biosafety Manual is written to comply with NIH guidelines, the handbook of "Biosafety in Microbiological and Biomedical Laboratories", 6th edition, state & federal regulations, and UC-wide best practices.

## Section 22 – Radiation Safety

This section is intended to provide basic information about UC Merced's Radiation Safety Program. Contact EH&S for more information.

The Radiation Safety Program at UC Merced is designed to protect researchers when working with ionizing radiation and radiation producing machines. For any questions regarding radioactive materials (RAM) or devices capable of producing ionizing or non-ionizing radiation x-ray machines, lasers, etc.) contact EH&S.



**Please use the following guide to assist you:**

- Principal Investigators need a *Radioisotope Use Authorization (RUA)* prior to working with RAM or radiation producing machines. To apply for an RUA go to [ehs.ucop.edu/radiation](http://ehs.ucop.edu/radiation)
- It is also important to note that before any one begins working with ionizing radiation, he or she must attend the EH&S *Radiation Safety class*.
- For laboratory relocations, decommissioning or clearances, contact EH&S at 209 205-8176.
- Each Principal Investigator who is authorized to use radioactive material will be assigned a copy of the UC Merced Radiation Safety Manual at the time an application for an RUA is approved. This should be kept in the main facility where radioactive materials or radiation-producing machines are used. All persons using radioactive materials or ionizing-radiation-producing devices are required to be familiar with, and comply with, all provisions of this publication. For any further inquiries contact EH&S.

**Manuals and forms are located at <http://ehs.ucmerced.edu/researchers-labs/radiation-safety>**

## Section 23 – Physical Hazards\*

### Explosions

When there is a reasonable risk that a reaction or system could explode, blast shields will be used and projects must be approved by EH&S. This includes use of tube furnaces, pressure reactors, and energetic materials.

### Crushing

Equipment will be left in a zero-mechanical state. Equipment should be guarded to prevent persons from entering crush zones.

### Pinching

Equipment with pinch or nip points will be guarded to prevent access to the operator's hands.

### Pressure and Vacuum systems – including regulators, dewars, manifolds, and pressure reactors.

- Goggles or safety glasses will be used at all times.
- Damaged pressure systems will be removed from service immediately. Safety relief valves will not be defeated.
- Blast shields will be used or glassware / pressure vessels taped, coated with plastic, or wrapped in plastic mesh.
- Manifold systems will be designed for the intended operating pressures.
- Braided metal, copper or stainless steel tubing are recommended for plumbing gases under pressure. Do not use flexible hose such as tygon or latex tubing.

## Important UC Merced Safety Telephone Numbers

Useful telephone numbers for UC Merced researchers. Always 9-911 in an emergency

Department	Contact	Phone	Cell Phone
<b>ENVIRONMENTAL HEALTH &amp; SAFETY</b>	Director, Mal Donohue	209 201-9820	
	Karen Smith (chem, rad)	209 205-8176	
	Gerry Kefalinos (chem, rad technician)	209 761-9414	
	Aparupa Sengupta (bio)	209 382-4535	
	Saumik Panja (bio)	209 285-8593	
	Tracy Staiger (fire)	209 746-9542	
<b>FACILITIES MANAGEMENT</b>	HELP DESK	209 228-2986	217-7251
	Mark Lutz (SE1 & Castle)	209 228-7819	
	Tyler Grise (SE2)	209 203-8900	
	Neil Svendsen (SRE)	209 349-1321	
	Eddie Dabbs Vilciauskas (BSP)	209 217-4246	

Poison Control 1-800-222-2222

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## Appendix A: General Rules for Laboratory Work with Chemicals

### PRUDENT LABORATORY PRACTICES

It is prudent to minimize all chemical exposures. Few laboratory chemicals are without hazards, and general precautions for handling all laboratory chemicals should be adopted, in addition to specific guidelines for particular chemicals. Exposure should be minimized even for substances of no known significant hazard, and special precautions should be taken for work with substances that present special hazards. One should assume that any mixture will be more toxic than its most toxic component and that all substances of unknown toxicity are toxic.

Avoid inadvertent exposures to hazardous chemicals by developing and encouraging safe habits and thereby promoting a strong safety culture.

#### Safe Laboratory Habits

##### Personal Protective Equipment:

- Wear closed-toe shoes and full-length pants, or equivalent, at all times when in the laboratory
- Utilize appropriate PPE while in the laboratory and while performing procedures that involve the use of hazardous chemicals or materials. These items may include laboratory coats, gloves, and safety glasses or goggles. (See UC PPE Policy in *Appendix R*)
- Confine long hair and loose clothing
- Wear appropriate gloves when the potential for contact with toxic materials exists; inspect the gloves before each use, and replace them often
- Remove laboratory coats or gloves immediately on significant contamination, as well as before leaving the laboratory
- Avoid use of contact lenses in the laboratory unless necessary; if they are used, inform supervisor so special precautions can be taken
- Ensure that appropriate PPE is worn by all persons, including visitors, where chemicals are stored or handled
- Use appropriate respiratory equipment when air contaminant concentrations are not sufficiently restricted by engineering controls, inspecting the respirator before use. Use of respirators requires successful completion of the EH&S Respirator Training and Fit Test course and medical evaluation through the OHSS program (<https://ehs.ucop.edu/ohss/protected/home.htm>.) Use any other protective and emergency apparel and equipment as appropriate. Be aware of the locations of first aid kits and emergency eyewash and shower stations.

##### Chemical Handling:

- Use only those chemicals for which the quality of the available ventilation system is appropriate
- Vent apparatus which may discharge toxic chemicals (vacuum pumps, distillation columns, etc.) into local exhaust devices
- Properly label and store all chemicals. Use secondary containment at all times
- Deposit chemical waste in appropriately labeled receptacles and follow all other waste disposal procedures of the Chemical Hygiene Plan



- In the case of an accident or spill, refer to the emergency response procedures for the specific material.

These procedures should be readily available to all personnel. Information on minor chemical spill mitigation may also be referenced in *Appendix P*. For general guidance, the following situations should be addressed:

Eye Contact: Promptly flush eyes with water for a prolonged period (15 minutes) and seek medical attention

- Skin Contact: Promptly flush the affected area with water and remove any contaminated clothing. If symptoms persist after washing, seek medical attention
- Clean-up: Promptly clean up spills, using appropriate protective apparel and equipment, and proper disposal.

### **Equipment Storage and Handling:**

- Use equipment only for its designed purpose
- Store laboratory glassware with care to avoid damage. Use extra care with Dewar flasks and other evacuated glass apparatus; shield or wrap them to contain chemicals and fragments should implosion occur
- Use certified fume hoods, glove boxes, or other ventilation devices for operations which might result in release of toxic chemical vapors or dust. Preventing the escape of these types of materials into the working atmosphere is one of the best ways to prevent exposure
- Keep hood closed at all times, except when adjustments within the hood are being made
- Leave the fume hood "on" even when it is not in active use if toxic substances are in the fume hood or if it is uncertain whether adequate general laboratory ventilation will be maintained when it is "off"

### **Laboratory Operations:**

- Keep the work area clean and uncluttered
- Seek information and advice about hazards, plan appropriate protective procedures, and plan positioning of equipment before beginning any new operation
- If unattended operations are unavoidable, and have been approved by the PI/Laboratory Supervisor, place an appropriate sign on the door, leave lights on, and provide for containment of toxic substances in the event of failure of a utility service (such as cooling water)
- Be alert to unsafe conditions and ensure that they are corrected when detected

### **Personal Protective Equipment:**

Do not enter the laboratory without wearing appropriate clothing, including closed-toe shoes and full-length pants, or equivalent. The area of skin between the shoe and ankle should not be exposed. (See UC PPE Policy in *Appendix R*)

Do not wear laboratory coats or gloves outside of the laboratory area

### **Chemical Handling:**

Do not smell or taste chemicals.

Do not allow release of toxic substances or fumes into cold or warm rooms, as these types of areas typically involve re-circulated atmospheres

Never use mouth suction for pipetting or starting a siphon

Do not dispose of any hazardous chemicals through the sewer system. These substances might interfere with the biological activity of waste water treatment plants, create fire or explosion hazards, cause structural damage or obstruct flow.

**Equipment Storage and Handling:**

Do not use damaged glassware or other equipment, under any circumstances. The use of damaged glassware increases the risks of implosion, explosion, spills, and other accidents

Do not use uncertified fume hoods or glove boxes for hazardous chemical handling

Avoid storing materials in hoods and do not allow them to block vents or air flow

**Laboratory Operations:**

Never work alone on procedures involving hazardous chemicals, biological agents, or other physical hazards.

Avoid unattended operations, if at all possible. Unattended operations require prior approval from the PI/Laboratory Supervisor

Do not engage in distracting behavior such as practical joke playing in the laboratory. This type of conduct may confuse, startle, or distract another worker

**Food/Drink:**


Do not eat, drink, smoke, chew gum, or apply cosmetics in areas where laboratory chemicals are present; wash hands before conducting these activities

Do not store, handle, or consume food or beverages in storage areas, or use refrigerators, glassware or utensils which are also used for laboratory operations

Wash areas of exposed skin well before leaving the laboratory.

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## Appendix B: Sample Safety Data Sheet (SDS)


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### SAFETY DATA SHEET

Version 6.7  
Revision Date 03/06/2020  
Print Date 11/19/2020

---

**SECTION 1: Identification of the substance/mixture and of the company/undertaking**

**1.1 Product identifiers**

Product name : Formaldehyde solution

Product Number : 252549

Brand : Sigma-Aldrich

**1.2 Relevant identified uses of the substance or mixture and uses advised against**

Identified uses : Laboratory chemicals, Synthesis of substances

**1.3 Details of the supplier of the safety data sheet**

Company : Sigma-Aldrich Inc.  
3050 Spruce Street  
ST. LOUIS MO 63103  
UNITED STATES

Telephone : +1 314 771-5765

Fax : +1 800 325-5052

**1.4 Emergency telephone number**

Emergency Phone # : 800-424-9300 CHEMTREC (USA) +1-703-527-3887 CHEMTREC (International) 24 Hours/day; 7 Days/week

---

**SECTION 2: Hazards identification**

**2.1 Classification of the substance or mixture**

**GHS Classification in accordance with 29 CFR 1910 (OSHA HCS)**

Flammable liquids (Category 3), H226  
Acute toxicity, Oral (Category 3), H301  
Acute toxicity, Inhalation (Category 3), H331  
Acute toxicity, Dermal (Category 3), H311  
Skin corrosion (Category 1B), H314  
Serious eye damage (Category 1), H318  
Skin sensitisation (Category 1), H317  
Germ cell mutagenicity (Category 2), H341  
Carcinogenicity (Category 1B), H350  
Specific target organ toxicity - single exposure (Category 1), Eyes, H370  
Short-term (acute) aquatic hazard (Category 2), H401

For the full text of the H-Statements mentioned in this Section, see Section 16.

**2.2 GHS Label elements, including precautionary statements**

Pictogram



Signal word

Danger

Hazard statement(s)

H226 Flammable liquid and vapour.  
H301 + H311 + H331 Toxic if swallowed, in contact with skin or if inhaled.  
H314 Causes severe skin burns and eye damage.  
H317 May cause an allergic skin reaction.  
H341 Suspected of causing genetic defects.  
H350 May cause cancer.  
H370 Causes damage to organs (Eyes).  
H401 Toxic to aquatic life.

Precautionary statement(s)

P201 Obtain special instructions before use.  
P202 Do not handle until all safety precautions have been read and understood.  
P210 Keep away from heat/sparks/open flames/hot surfaces. No smoking.  
P233 Keep container tightly closed.  
P240 Ground/bond container and receiving equipment.  
P241 Use explosion-proof electrical/ ventilating/ lighting equipment.  
P242 Use only non-sparking tools.  
P243 Take precautionary measures against static discharge.  
P260 Do not breathe dust/ fume/ gas/ mist/ vapours/ spray.  
P264 Wash skin thoroughly after handling.  
P270 Do not eat, drink or smoke when using this product.  
P271 Use only outdoors or in a well-ventilated area.  
P272 Contaminated work clothing must not be allowed out of the workplace.  
P273 Avoid release to the environment.  
P280 Wear protective gloves/ protective clothing/ eye protection/ face protection.  
P301 + P310 + P330 IF SWALLOWED: Immediately call a POISON CENTER/doctor. Rinse mouth.  
P301 + P330 + P331 IF SWALLOWED: Rinse mouth. Do NOT induce vomiting.  
P303 + P361 + P353 IF ON SKIN (or hair): Take off immediately all contaminated clothing. Rinse skin with water/shower.  
P304 + P340 + P310 IF INHALED: Remove person to fresh air and keep comfortable for breathing. Immediately call a POISON CENTER/doctor.  
P305 + P351 + P338 + P310 IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing. Immediately call a POISON CENTER/doctor.  
P307 + P311 IF exposed: Call a POISON CENTER or doctor/ physician.  
P333 + P313 If skin irritation or rash occurs: Get medical advice/ attention.  
P362 Take off contaminated clothing and wash before reuse.  
P370 + P378 In case of fire: Use dry sand, dry chemical or alcohol-resistant foam to extinguish.  
P403 + P233 Store in a well-ventilated place. Keep container tightly closed.  
P403 + P235 Store in a well-ventilated place. Keep cool.  
P405 Store locked up.  
P501 Dispose of contents/ container to an approved waste disposal plant.

## 2.3 Hazards not otherwise classified (HNOC) or not covered by GHS - none

### SECTION 3: Composition/information on ingredients

#### 3.2 Mixtures

Synonyms : Formalin  
Formula : CH<sub>2</sub>O  
Molecular weight : 30.03 g/mol

Component		Classification	Concentration
<b>Formaldehyde</b>			
CAS-No.	50-00-0	Flam. Liq. 4; Acute Tox. 2; Acute Tox. 3; Skin Corr. 1B; Eye Dam. 1; Skin Sens. 1; Muta. 2; Carc. 1B; Aquatic Acute 2; H227, H300, H331, H311, H314, H318, H317, H341, H350, H401	>= 30 - < 50 %
EC-No.	200-001-8		
Index-No.	605-001-00-5		
Registration number	01-2119488953-20-XXXX		
<b>Methanol</b>			
CAS-No.	67-56-1	Flam. Liq. 2; Acute Tox. 3; STOT SE 1; H225, H301, H331, H311, H370	>= 10 - < 20 %
EC-No.	200-659-6		
Index-No.	603-001-00-X		
Registration number	01-2119433307-44-XXXX		

For the full text of the H-Statements mentioned in this Section, see Section 16.

### SECTION 4: First aid measures

#### 4.1 Description of first aid measures

##### General advice

Consult a physician. Show this safety data sheet to the doctor in attendance. Move out of dangerous area.

##### If inhaled

If breathed in, move person into fresh air. If not breathing, give artificial respiration. Consult a physician.

##### In case of skin contact

Take off contaminated clothing and shoes immediately. Wash off with soap and plenty of water. Take victim immediately to hospital. Consult a physician.

##### In case of eye contact

Rinse thoroughly with plenty of water for at least 15 minutes and consult a physician. Continue rinsing eyes during transport to hospital.

##### If swallowed

Do NOT induce vomiting. Never give anything by mouth to an unconscious person. Rinse mouth with water. Consult a physician.



**4.2 Most important symptoms and effects, both acute and delayed**

The most important known symptoms and effects are described in the labelling (see section 2.2) and/or in section 11

**4.3 Indication of any immediate medical attention and special treatment needed**

No data available

---

**SECTION 5: Firefighting measures**

**5.1 Extinguishing media**

**Suitable extinguishing media**

Dry powder Dry sand

**Unsuitable extinguishing media**

Do NOT use water jet.

**5.2 Special hazards arising from the substance or mixture**

Carbon oxides

Carbon oxides

**5.3 Advice for firefighters**

Wear self-contained breathing apparatus for firefighting if necessary.

**5.4 Further information**

Use water spray to cool unopened containers.

---

**SECTION 6: Accidental release measures**

**6.1 Personal precautions, protective equipment and emergency procedures**

Wear respiratory protection. Avoid breathing vapours, mist or gas. Ensure adequate ventilation. Remove all sources of ignition. Evacuate personnel to safe areas. Beware of vapours accumulating to form explosive concentrations. Vapours can accumulate in low areas.

For personal protection see section 8.

**6.2 Environmental precautions**

Prevent further leakage or spillage if safe to do so. Do not let product enter drains.

Discharge into the environment must be avoided.

**6.3 Methods and materials for containment and cleaning up**

Contain spillage, and then collect with non-combustible absorbent material, (e.g. sand, earth, diatomaceous earth, vermiculite) and place in container for disposal according to local / national regulations (see section 13).

**6.4 Reference to other sections**

For disposal see section 13.

---

**SECTION 7: Handling and storage**

**7.1 Precautions for safe handling**

Avoid contact with skin and eyes. Avoid inhalation of vapour or mist.

Keep away from sources of ignition - No smoking. Take measures to prevent the build up of electrostatic charge.

For precautions see section 2.2.



## 7.2 Conditions for safe storage, including any incompatibilities

Keep container tightly closed in a dry and well-ventilated place. Containers which are opened must be carefully resealed and kept upright to prevent leakage.

Storage class (TRGS 510): 3: Flammable liquids

## 7.3 Specific end use(s)

Apart from the uses mentioned in section 1.2 no other specific uses are stipulated

# SECTION 8: Exposure controls/personal protection

## 8.1 Control parameters

### Components with workplace control parameters

Component	CAS-No.	Value	Control parameters	Basis
Formaldehyde	50-00-0	TWA	0.1 ppm	USA. ACGIH Threshold Limit Values (TLV)
	Remarks	Dermal Sensitization Respiratory sensitization Upper Respiratory Tract irritation Eye irritation Upper Respiratory Tract cancer Confirmed human carcinogen		
		STEL	0.3 ppm	USA. ACGIH Threshold Limit Values (TLV)
		Dermal Sensitization Respiratory sensitization Upper Respiratory Tract irritation Eye irritation Upper Respiratory Tract cancer Confirmed human carcinogen		
		TWA	0.016 ppm	USA. NIOSH Recommended Exposure Limits
		Potential Occupational Carcinogen See Appendix A		
		C	0.1 ppm	USA. NIOSH Recommended Exposure Limits
		Potential Occupational Carcinogen See Appendix A 15 minute ceiling value		
		PEL	0.75 ppm	OSHA Specifically Regulated Chemicals/Carcinogens
		1910.1048 This standard applies to all occupational exposures to formaldehyde, i.e. from formaldehyde gas, its solutions, and materials that release formaldehyde OSHA specifically regulated carcinogen		
		STEL	2 ppm	OSHA Specifically Regulated Chemicals/Carcinogens
		1910.1048 This standard applies to all occupational exposures to formaldehyde, i.e. from formaldehyde gas, its solutions, and materials that release formaldehyde		

		OSHA specifically regulated carcinogen		
		Substance listed; for more information see OSHA document 1910.1048		
		Substance listed; for more information see OSHA document 1910.1048		
		PEL	0.75 ppm	California permissible exposure limits for chemical contaminants (Title 8, Article 107)
		see Section 5217		
		STEL	2 ppm	California permissible exposure limits for chemical contaminants (Title 8, Article 107)
		see Section 5217		
		TWA	0.016 ppm	USA. NIOSH Recommended Exposure Limits
		Potential Occupational Carcinogen Formalin is an aqueous solution that is 37% formaldehyde by weight; inhibited solutions usually contain 6-12% methyl alcohol. Also see specific listings for Formaldehyde and Methyl alcohol. See Appendix A		
		C	0.1 ppm	USA. NIOSH Recommended Exposure Limits
		Potential Occupational Carcinogen Formalin is an aqueous solution that is 37% formaldehyde by weight; inhibited solutions usually contain 6-12% methyl alcohol. Also see specific listings for Formaldehyde and Methyl alcohol. See Appendix A 15 minute ceiling value		
Methanol	67-56-1	TWA	200 ppm	USA. ACGIH Threshold Limit Values (TLV)
		Headache Nausea Dizziness Eye damage Substances for which there is a Biological Exposure Index or Indices (see BEI® section) Danger of cutaneous absorption		
		STEL	250 ppm	USA. ACGIH Threshold Limit Values (TLV)
		Headache Nausea Dizziness Eye damage Substances for which there is a Biological Exposure Index or Indices (see BEI® section) Danger of cutaneous absorption		
		TWA	200 ppm 260 mg/m3	USA. NIOSH Recommended Exposure Limits
		Potential for dermal absorption		

		ST	250 ppm 325 mg/m3	USA. NIOSH Recommended Exposure Limits
		Potential for dermal absorption		
		TWA	200 ppm 260 mg/m3	USA. Occupational Exposure Limits (OSHA) - Table Z-1 Limits for Air Contaminants
		The value in mg/m3 is approximate.		
		C	1,000 ppm	California permissible exposure limits for chemical contaminants (Title 8, Article 107)
		Skin		
		PEL	200 ppm 260 mg/m3	California permissible exposure limits for chemical contaminants (Title 8, Article 107)
		Skin		
		STEL	250 ppm 325 mg/m3	California permissible exposure limits for chemical contaminants (Title 8, Article 107)
		Skin		

**Biological occupational exposure limits**

Component	CAS-No.	Parameters	Value	Biological specimen	Basis
Methanol	67-56-1	Methanol	15 mg/l	Urine	ACGIH - Biological Exposure Indices (BEI)
	Remarks	End of shift (As soon as possible after exposure ceases)			

**8.2 Exposure controls**

**Appropriate engineering controls**

Avoid contact with skin, eyes and clothing. Wash hands before breaks and immediately after handling the product.

**Personal protective equipment**

**Eye/face protection**

Tightly fitting safety goggles. Faceshield (8-inch minimum). Use equipment for eye protection tested and approved under appropriate government standards such as NIOSH (US) or EN 166(EU).

**Skin protection**

Handle with gloves. Gloves must be inspected prior to use. Use proper glove removal technique (without touching glove's outer surface) to avoid skin contact with this product. Dispose of contaminated gloves after use in accordance with applicable laws and good laboratory practices. Wash and dry hands.

Full contact

Material: Nitrile rubber

Minimum layer thickness: 0.4 mm

Break through time: 480 min

Material tested: Camatril® (KCL 730 / Aldrich Z677442, Size M)

Splash contact

operates as HimporeSigma in the US and Canada

**SIGMA**

Minimum layer thickness: 0.2 mm

Break through time: 60 min

Material tested: Dermatrill® P (KCL 743 / Aldrich Z677388, Size M)

data source: KCL GmbH, D-36124 Eichenzell, phone +49 (0)6659 87300, e-mail sales@kcl.de, test method: EN374

If used in solution, or mixed with other substances, and under conditions which differ from EN 374, contact the supplier of the CE approved gloves. This recommendation is advisory only and must be evaluated by an industrial hygienist and safety officer familiar with the specific situation of anticipated use by our customers. It should not be construed as offering an approval for any specific use scenario.

## Body Protection

Complete suit protecting against chemicals, Flame retardant antistatic protective clothing., The type of protective equipment must be selected according to the concentration and amount of the dangerous substance at the specific workplace.

## Respiratory protection

Where risk assessment shows air-purifying respirators are appropriate use a full-face respirator with multi-purpose combination (US) or type ABEK (EN 14387) respirator cartridges as a backup to engineering controls. If the respirator is the sole means of protection, use a full-face supplied air respirator. Use respirators and components tested and approved under appropriate government standards such as NIOSH (US) or CEN (EU).

## Control of environmental exposure

Prevent further leakage or spillage if safe to do so. Do not let product enter drains. Discharge into the environment must be avoided.

## SECTION 9: Physical and chemical properties

### 9.1 Information on basic physical and chemical properties

- |   |   |
|---|---|
| a) Appearance                                   | Form: liquid, clear<br>Colour: colourless                       |
| b) Odour  | pungent   |
| c) Odour Threshold                              | No data available   |
| d) pH   | No data available   |
| e) Melting point/freezing point                 | No data available   |
| f) Initial boiling point and boiling range      | 100 °C 212 °F   |
| g) Flash point                                  | 56 °C (133 °F) - closed cup                                     |
| h) Evaporation rate                             | 1   |
| i) Flammability (solid, gas)                    | No data available   |
| j) Upper/lower flammability or explosive limits | Upper explosion limit: 70 %(V)<br>Lower explosion limit: 7 %(V) |
| k) Vapour pressure                              | 53 hPa at 39 °C (102 °F)  |





- |   |   |
|---|---|
| l) Vapour density                         | 1.04 - (Air = 1.0)                      |
| m) Relative density                       | 1.09 g/cm <sup>3</sup> at 25 °C (77 °F) |
| n) Water solubility                       | completely soluble                      |
| o) Partition coefficient: n-octanol/water | log Pow: 0.35                           |
| p) Auto-ignition temperature              | No data available                       |
| q) Decomposition temperature              | No data available                       |
| r) Viscosity                              | No data available                       |
| s) Explosive properties                   | No data available                       |
| t) Oxidizing properties                   | No data available                       |

## 9.2 Other safety information

Relative vapour density 1.04 - (Air = 1.0)

---

## SECTION 10: Stability and reactivity

### 10.1 Reactivity

No data available

### 10.2 Chemical stability

Stable under recommended storage conditions.  
Contains the following stabiliser(s):  
Methanol (>=10 - <15 %)

### 10.3 Possibility of hazardous reactions

No data available

### 10.4 Conditions to avoid

Heat, flames and sparks.

### 10.5 Incompatible materials

Strong oxidizing agents, Aniline, Phenol, Isocyanates, Acid anhydrides, Strong acids, Strong bases, Amines, Peroxides, Acid chlorides, Alkali metals, Reducing agents

### 10.6 Hazardous decomposition products

Hazardous decomposition products formed under fire conditions. - Carbon oxides  
Other decomposition products - No data available  
Hazardous decomposition products formed under fire conditions. - Carbon oxides  
In the event of fire: see section 5

---

## SECTION 11: Toxicological information

### 11.1 Information on toxicological effects

#### Acute toxicity

No data available

Inhalation: No data available



No data available

**Skin corrosion/irritation**

No data available

**Serious eye damage/eye irritation**

No data available

**Respiratory or skin sensitisation**

May cause sensitisation by skin contact.

**Germ cell mutagenicity**

No data available

**Carcinogenicity**

IARC: 1 - Group 1: Carcinogenic to humans (Formaldehyde)

NTP: No component of this product present at levels greater than or equal to 0.1% is identified as a known or anticipated carcinogen by NTP.

OSHA: No component of this product present at levels greater than or equal to 0.1% is on OSHA's list of regulated carcinogens.

**Reproductive toxicity**

No data available

No data available

**Specific target organ toxicity - single exposure**

No data available

**Specific target organ toxicity - repeated exposure**

No data available

**Aspiration hazard**

No data available

**Additional Information**

RTECS: Not available

Warning: contains methanol. May be fatal or cause blindness if swallowed. Cannot be made nonpoisonous., To the best of our knowledge, the chemical, physical, and toxicological properties have not been thoroughly investigated.

Liver - Irregularities - Based on Human Evidence

Stomach - Irregularities - Based on Human Evidence

---

**SECTION 12: Ecological information**

**12.1 Toxicity**

No data available

**12.2 Persistence and degradability**

No data available

**12.3 Bioaccumulative potential**

No data available

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The life science business of Merck KGaA, Darmstadt, Germany  
operates as MilliporeSigma in the US and Canada

**Millipore  
SIGMA**

#### 12.4 Mobility in soil

No data available

#### 12.5 Results of PBT and vPvB assessment

PBT/vPvB assessment not available as chemical safety assessment not required/not conducted

#### 12.6 Other adverse effects

An environmental hazard cannot be excluded in the event of unprofessional handling or disposal.

Toxic to aquatic life.

---

### SECTION 13: Disposal considerations

#### 13.1 Waste treatment methods

##### Product

Burn in a chemical incinerator equipped with an afterburner and scrubber but exert extra care in igniting as this material is highly flammable. Offer surplus and non-recyclable solutions to a licensed disposal company. Contact a licensed professional waste disposal service to dispose of this material.

##### Contaminated packaging

Dispose of as unused product.

---

### SECTION 14: Transport information

#### DOT (US)

UN number: 1198 Class: 3 (8) Packing group: III  
Proper shipping name: Formaldehyde solutions, flammable  
Reportable Quantity (RQ): 270 lbs  
Poison Inhalation Hazard: No

#### IMDG

UN number: 1198 Class: 3 (8) Packing group: III EMS-No: F-E, S-C  
Proper shipping name: FORMALDEHYDE SOLUTION, FLAMMABLE

#### IATA

UN number: 1198 Class: 3 (8) Packing group: III  
Proper shipping name: Formaldehyde solution, flammable

---

### SECTION 15: Regulatory information

#### SARA 302 Components

Formaldehyde	CAS-No. 50-00-0	Revision Date 2008-11-03
--------------	--------------------	-----------------------------

#### SARA 313 Components

The following components are subject to reporting levels established by SARA Title III, Section 313:

Formaldehyde	CAS-No. 50-00-0	Revision Date 2008-11-03
--------------	--------------------	-----------------------------

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Methanol

**SARA 311/312 Hazards**

Fire Hazard, Acute Health Hazard, Chronic Health Hazard

**Massachusetts Right To Know Components**

No components are subject to the Massachusetts Right to Know Act.

**SECTION 16: Other information**

**Further information**

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**SAFETY NOTICE:** In order to provide our customers with the highest quality material and maintain our high standards of safety, the surface temperature of the bubbler may be monitored during the transportation of our products using a tempilabel. Tempilabel is a temperature-monitoring strip which will indicate the temperature during shipment. The strip will turn black at one of the four ratings shown if the temperature is reached (normally a silver centre). If the temperature monitor is changed, please notify an SAFC Hitech representative immediately and we will assist you in the proper measures to be taken. We ask for your co-operation in our efforts of quality assurance and safety. If you have any questions or comments, please contact an SAFC Hitech representative. We thank you for your co-operation. Your assistance is greatly appreciated.

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Other International Countries: (703) 527 3887 (CHEMTREC)

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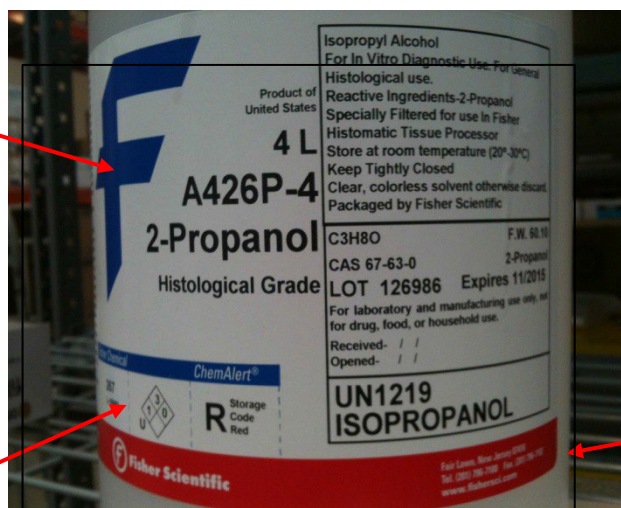
## Appendix C: Container Labeling

Chemical container labels are a good resource for information on chemical hazards. All containers of hazardous chemicals must have labels attached. Figure C.1 displays the label requirements.

Figure C.1. – Container Labeling Requirements

The common name

The  
appropriate  
hazard  
warnings



The name,  
address, and  
phone # of the  
company  
responsible for  
the product

The warning may be a single word (e.g. Danger, Caution, Warning) or may identify the primary hazards, including both physical (e.g. water reactive, flammable, or explosive) and health (e.g. carcinogen, corrosive or irritant), such as what is found on an NFPA diamond, GHS pictograms and hazard warnings from the label or SDS.

<p><b>Health Hazard</b></p>  <ul style="list-style-type: none"> <li>• Carcinogen</li> <li>• Mutagenicity</li> <li>• Reproductive Toxicity</li> <li>• Respiratory Sensitizer</li> <li>• Target Organ Toxicity</li> <li>• Aspiration Toxicity</li> </ul>	<p><b>Flame</b></p>  <ul style="list-style-type: none"> <li>• Flammables</li> <li>• Pyrophorics</li> <li>• Self-Heating</li> <li>• Emits Flammable Gas</li> <li>• Self-Reactives</li> <li>• Organic Peroxides</li> </ul>	<p><b>Exclamation Mark</b></p>  <ul style="list-style-type: none"> <li>• Irritant (skin and eye)</li> <li>• Skin Sensitizer</li> <li>• Acute Toxicity</li> <li>• Narcotic Effects</li> <li>• Respiratory Tract Irritant</li> <li>• Hazardous to Ozone Layer (Non-Mandatory)</li> </ul>
<p><b>Gas Cylinder</b></p>  <ul style="list-style-type: none"> <li>• Gases Under Pressure</li> </ul>	<p><b>Corrosion</b></p>  <ul style="list-style-type: none"> <li>• Skin Corrosion/Burns</li> <li>• Eye Damage</li> <li>• Corrosive to Metals</li> </ul>	<p><b>Exploding Bomb</b></p>  <ul style="list-style-type: none"> <li>• Explosives</li> <li>• Self-Reactives</li> <li>• Organic Peroxides</li> </ul>
<p><b>Flame Over Circle</b></p>  <ul style="list-style-type: none"> <li>• Oxidizers</li> </ul>	<p><b>Environment (Non-Mandatory)</b></p>  <ul style="list-style-type: none"> <li>• Aquatic Toxicity</li> </ul>	<p><b>Skull and Crossbones</b></p>  <ul style="list-style-type: none"> <li>• Acute Toxicity (fatal or toxic)</li> </ul>

Most labels provide additional safety information to help workers protect themselves from the substance. This information may include protective measures and/or protective clothing to be used, first aid instructions, storage information and emergency procedures.



**Chemical Labeling – What are Laboratory Personnel Responsible for?**

- Inspecting incoming containers to be sure that labels are attached and are in good condition and contain the information outlined above
- Reading the container label each time a newly purchased chemical is used. It is possible that the manufacturer may have added new hazard information or reformulated the product since the last purchase
- Ensuring that chemical container labels are not removed or defaced, except when containers are empty
- Labeling any secondary containers used in the laboratory, to prevent unknown chemicals or inadvertent reaction
- Verifying that chemical waste containers have complete and accurate chemical waste labels

Labeling is important for the safe management of chemicals, preventing accidental misuse, inadvertent mixing of incompatible chemicals, and facilitating proper chemical storage. Proper labeling helps ensure quick response in the event of an accident, such as a chemical spill or chemical exposure incident. Finally, proper labeling prevents the high costs associated with disposal of “unknown” chemicals.

With the exception of transient containers that will contain chemicals for immediate use, all containers of chemicals being used or generated in UC research laboratories must be labeled sufficiently to indicate the contents of the container. On original containers, the label must not be removed or defaced in any way until the container is emptied of its original contents. Incoming containers must be inspected to make sure the label is in good condition. It is also advisable to put a date on new chemicals when they are received in the laboratory, and to put a date on containers of chemicals generated in the laboratory, as well as the initials of the responsible person.

Abbreviations or other acronyms may be used to label containers of chemicals generated in the laboratory as long as all personnel working in the laboratory understand the meaning of the label, or know the location of information, such as a laboratory notebook or log sheet that contains the code associated with content information. In addition, small containers, such as vials and test tubes, can be labeled as a group by labeling the outer container (e.g., rack or box). Alternatively, a placard can be used to label the storage location for small containers (e.g., shelf, refrigerator, etc.). This information must be provided to janitorial and maintenance staff as part of their hazard communication training.

Containers of practically non-toxic and relatively harmless chemicals must also be labeled with content information, *including containers such as squirt bottles containing water and soap.*

With respect to chemical labeling, all potentially hazardous chemicals transferred from their original container to a second container must be labeled with the chemical name and the principal hazards found on the primary container label or SDS. For more information on labeling, see Chapter 6: Labeling, Storage, Inventory and Transport.



## Appendix D: SOP Instructions and Template

### INSTRUCTIONS FOR COMPLETING STANDARD OPERATING PROCEDURES

To be in compliance with the Cal/OSHA Laboratory Standard, laboratory-specific Standard Operating Procedures (SOPs) are required to be included in your Laboratory Safety Plan. This manual does not provide specific SOPs for the hazardous chemical or hazardous substance use operations or procedures in your particular laboratory. If your laboratory research involves the use of hazardous substances or chemicals, you must develop laboratory-specific SOPs to supplement the information found in the Laboratory Safety Plan. You may work with your departmental safety committee and/or EH&S, as required. Below are instructions for completing the laboratory-specific SOPs, which will be reviewed by EH&S during the annual audit. Write all SOPs in UC Chemicals at ehs.ucop.edu/chemicals. UC Chemicals will complete all safety information found on safety data sheets; PIs just need to add lab specific procedures.

#### 1. Type of SOP

You can write a SOP for one chemical, a process, or an entire hazard class

Process: the SOP will be for a process such as distillation, synthesis, etc.

Hazardous chemical: the SOP will be for an individual chemical such as arsenic, formaldehyde, nitric acid, etc.

Hazard class: the SOP will be for a hazard class of chemicals such as oxidizer, flammable, corrosive, etc.

#### 2. Answer the process & procedure screening questions.

#### 3. Detailed Procedure Descriptions

Procedures should be detailed enough for an organic lab student to follow and include quantities of material. Include the maximum acceptable quantities or concentrations to be used if specific quantities cannot be listed.

All questions must be answered in this section to submit the SOP.

- **Process**: Briefly describe the process and name all the hazardous chemicals or substances used in the process
- **Hazardous chemical**: Provide the name of the chemical. Include the full name, common name, and any abbreviations used for the chemical
- **Hazard class**: Name the hazard class and list the name of the chemicals in this hazard class used or stored in your laboratory

#### 2. Risk

Describe all the potential hazards for each process, hazardous chemical, or hazard class. Describe the potential for both physical and health hazards. Health hazards include carcinogens, toxic or highly toxic agents, reproductive toxins, irritants, corrosives, sensitizers, hepatotoxins, nephrotoxins, neurotoxins, agents which act on the hematopoietic systems, and agents which damage the lungs, skin, eyes, or mucous membranes. State the potential for chronic and/or acute health hazard effects of the chemical(s).

Physical hazards include radioactivity, cryogen, high temperature, electrical, compressed gas or other pressure systems, UV light, laser, flammable or combustible, corrosive, water-reactive, unstable, oxidizer, pyrophoric, explosive, or peroxide formers.

### 3. Controls

Discuss the circumstances under which this particular process, hazardous chemical or hazard class will require prior approval (if any) from the PI/Laboratory Supervisor or Chemical Hygiene Officer. The circumstances may be based on such criteria as: the inherent hazards of the material(s) used, the hazards of the experimental process, the experience level of the worker, the scale of the reaction, etc. Some examples of circumstances that may require prior approval include unattended or overnight operations, use of explosives or pyrophorics, use of highly toxic gas in any amount, use of large quantities of toxic or corrosive gases or use of carcinogens. Describe or list engineering controls that will be used to prevent or reduce employee exposure to hazards. Examples of engineering controls are fume hoods, glove boxes, interlocks on equipment, and shielding of various kinds.

### 4. Special Handling and Storage Requirements

Describe the storage requirements for hazardous substances, including special containment devices, special temperature requirements, special storage areas or cabinets, chemical compatibility storage requirements, etc. State the policy regarding access to the substance(s). Provide the exact storage location in the laboratory. Describe any special procedures, such as dating peroxide forming chemicals on receipt, opening and disposal, or testing after an appropriate amount of time has passed. Describe safe methods of transport, such as in a secondary container using a low, stable cart, or using two hands to carry the chemical container.

### 5. Spill and Accident Procedures

Spills and accidents are automatically addressed in the program. You can add additional information if needed.

### 6. Decontamination Procedures

Describe specific decontamination procedures for equipment, glassware or work areas.

### 7. Waste Disposal Procedures

Describe the anticipated waste products as well as how waste will be collected and disposed.

### 8. Designated Area

Indicate the designated area established for experiments using particularly hazardous substances (PHS). A portion of a laboratory bench, a piece of equipment, the fume hood, or the entire laboratory may be considered as a designated area for experiments using PHS.

### 9. Personal Protective Equipment (PPE)

Identify the required PPE for the process, hazardous chemical, or hazard class. PPE includes, but is not limited to:

gloves, aprons, laboratory coats, safety glasses, goggles, masks, respirators, or face shields.

### 10. Safety Data Sheet (SDS) Location

Limited information from SDSs is linked to the SOP automatically once chemicals are selected.

**11. Risk assessment**

Low – very small quantities of materials at low concentrations with no to little chance of harming the worker.

Medium – Materials may be heated, are medium concentration (i.e. 6M HCl). Failure to use PPE could result in injury.

High- failure to follow procedures will lead to severe, permanent injury or death. Materials are under high pressure, react vigorously, are of high concentration, very toxic, pyrophoric.

**12. Signatures**

The PI and Chemical Hygiene Officer must review the SOP. Any students using the material must sign the bottom of the document electronically.

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## Appendix E: UC Particularly Hazardous Substance Policy

\*These are UC Merced procedures based on UCLA Policy #907, but have not been formerly adopted as an official UCM policy.

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<b>UCM Policy:</b>	<b>Safe Handling of Particularly Hazardous Substances</b>
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Issuing Officer:	Vice Chancellor for Research
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Responsible Dept.:	Environment, Health & Safety
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Effective Date:	
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Supersedes:	
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I.	<b>REFERENCES</b>
II.	<b>PURPOSE</b>
III.	<b>STATEMENT</b>
IV.	<b>RESPONSIBILITIES</b>
V.	<b>LABORATORY SAFETY REQUIREMENTS &amp; PROCEDURES</b>
VI.	<b>ATTACHMENTS</b>

### REFERENCES

Title 8, California Code of Regulations (CCR), Section 5191 (Occupational Exposures to Hazardous Chemicals in Laboratories; Article 110 (Regulated Carcinogens); Section 5209 (Listed Carcinogens); Section 5203 (Report of Use Requirements); Section 5154.1 (Ventilation Requirements for Laboratory-Type Hood Operations);

UC Policy 905, Research Laboratory Personal Safety and Protective Equipment;

### PURPOSE

This Policy provides general guidance on how to work safely with chemicals that have been designated as “particularly hazardous” by Cal/OSHA. It describes the minimum requirements for the safe storage, use, handling, and disposal of particularly hazardous substances, including spill and accident response procedures. Particularly hazardous substances are defined by Cal/OSHA as: reproductive toxins, acutely toxic substances and select carcinogens, which include regulated carcinogens. Refer to Attachment A, Particularly Hazardous Substances Definitions, for specific definitions.

## STATEMENT

This Policy is applicable to, and must be adhered to by, all UC laboratory workers (i.e., Principal Investigators, laboratory personnel, students, visiting researchers, etc.) who use or work with particularly hazardous substances. Careful handling and stringent controls of these chemicals are essential to protect workers and the environment, and to comply with Cal/OSHA regulations.

Additional safety requirements may apply, depending on the specific chemical. For example, carcinogens that are also highly flammable require both particularly hazardous substance controls as well as fire safety controls. Contact your health and safety officer for guidance on use of chemicals that may require further controls. Information and guidance on handling of particularly hazardous substances can also be found in UC's Chemical Hygiene Plan.

## RESPONSIBILITIES

Preventing workplace injuries, exposures, and illnesses is the responsibility of every member of the campus community. Specific responsibilities are assigned to more senior members of the research and teaching community in order to implement, and ensure compliance with this Policy by their subordinate personnel.

The Chancellor has overall responsibility for compliance with health and safety requirements at all facilities and programs under campus control.

The Vice Chancellor for Research is responsible for the implementation of this Policy in all applicable research and teaching laboratories within his or her jurisdiction.

The UC Laboratory Safety Committee (LSC) has a broad oversight role in overseeing research activities and is responsible for promoting a safe working environment in all research and teaching laboratories on campus, and for developing, updating and maintaining policies applicable to the health and safety of laboratory work.

Department Chairpersons are responsible for communicating, promoting and enforcing this Policy in their respective research and teaching areas.

Principal Investigators and laboratory management staff are responsible for complying with this Policy and ensuring their laboratory personnel receive appropriate training and comply with this Policy as it relates to their research and teaching activities.

All Laboratory Personnel working in laboratory areas are responsible for following laboratory safety requirements, including how to work safely with substances designated as particularly hazardous.

The UC Office of Environment, Health & Safety (EH&S) is responsible for inspection of

laboratories and for campus compliance with this Policy. In cases where laboratory activities pose an immediate danger to life or health, designated EH&S staff have the responsibility and authority to order

the temporary cessation of the activity until the hazardous condition is abated.

The UC Chemical Hygiene Officer (CHO), also referred to as the Chemical Safety Officer, is responsible for facilitating necessary reviews of procedures that involve the use of hazardous chemicals. The reviews of procedures should primarily be provided by subject experts as part of a departmental safety committee. The CHO, with the support of other EH&S Research Safety Experts, will support, and assist in the organization of, and provide annual oversight for this process.

## LABORATORY SAFETY REQUIREMENTS & PROCEDURES

### Laboratory Specific Standard Operating Procedures

Individual laboratory groups must prepare and maintain laboratory-specific standard operating procedures (SOP) for identifying hazards and handling methods to avoid exposure to particularly hazardous substances in UC Chemicals. The procedures must indicate the designated use areas, limitations on the quantities and procedures used, information on containments, and on hazards involved. These procedures may be specific to particular substances or generalized over a group of chemicals with similar hazardous properties and use limitations. Chemical-specific procedures must be developed for each Cal/OSHA regulated carcinogen and procedures should be developed for reproductive toxins, acutely toxic materials, and select carcinogens. EH&S can provide additional guidance for specific chemical hazards.

A copy of the particularly hazardous substances procedures, including laboratory specific information, and the Safety data sheets (SDS) for the chemical(s) used must be readily accessible in the lab.

EH&S must be notified immediately if members of the laboratory become ill or exhibit signs or symptoms associated with exposure to hazardous chemicals used in the laboratory. Affected employees must be provided immediate first aid and medical surveillance within 24-hours of the event.

Principal Investigators must identify what classes of particularly hazardous substances are in use in their labs on their PPE Assessment Tool which must be completed as conditions change in the laboratory,

### Training and Documentation

All laboratory personnel who work with or may be exposed to particularly hazardous substances must be provided laboratory-specific training and information by the Principal Investigator or their designee prior to beginning their initial assignment. Laboratory-specific training should cover specific policies and procedures, etc. and is in addition to the basics covered in the Laboratory Safety Fundamentals training. Records of laboratory-specific training must be maintained in the laboratory and should include an outline of the topics covered. A form is available at the end of the Laboratory Safety Plan Supplement (LSPS) Training shall include:

- The hazards/toxicological effects associated with the chemicals being used.
- Routine procedures and decontamination methods.
- Emergency response practices and procedures.
- Methods and observations for detecting the presence or release of hazardous chemicals.
- Available protection measures, including appropriate work practices and personal protective equipment (PPE).
- A review of written SOP and SDSs and the Chemical Hygiene Plan (CHP).
- A review of this Policy.



- All laboratory personnel are responsible for knowing and complying with all safety guidelines, regulations, and procedures required for the task assigned and for reporting unsafe conditions, accidents or near misses to the Principal Investigator, immediate laboratory management staff or EH&S.

Continuing training shall be conducted as needed to maintain a working knowledge of hazards and the safety requirements for all laboratory personnel who work with particularly hazardous substances, including an annual refresher for particularly hazardous substances. Written records must be maintained for each training session that list name of training, name of person, date, location, and time of training.

### Use in Designated Areas

Designated area(s) for use of particularly hazardous substances must be formally established by developing SOPs and posting appropriate signage. This designated area(s) may be an entire laboratory, a specific work bench, or a chemical fume hood. When particularly hazardous substances are in use, access to the designated area shall be limited to personnel following appropriate procedures and who are trained in working with these chemicals.

Access to areas where particularly hazardous substances are used or stored must be controlled by trained employees. Working quantities of particularly hazardous substances should be kept as small as practical and their use should be physically contained as much as possible, usually within a laboratory fume hood or glove box. It is the responsibility of each Principal Investigator, or their designee, to train and authorize their staff for these operations and to maintain documentation of this training and authorization.

Signage is required for all containers, designated work areas and storage locations. Sign wording must state the following as appropriate for the specific chemical hazard:

“DANGER, CANCER HAZARD – SUSPECT AGENT”

“DANGER, CANCER HAZARD – REGULATED CARCINOGEN” “DANGER, REPRODUCTIVE TOXIN”

“DANGER, ACUTE TOXIN”

Entrances to designated work areas and storage locations must include signage, “AUTHORIZED PERSONNEL ONLY”, in addition to the above specific hazard warning wording.

Work surfaces should be stainless steel, plastic trays, dry absorbent plastic backed paper, chemically resistant epoxy surfaces, or other chemically impervious material.

Protocols, procedures, and experiments must be designed and performed in a manner to safely maintain control of the particularly hazardous substances. Laboratory personnel must specifically consult with their Principal Investigators if a special hazard is involved (e.g., material under pressure) or if they are uncertain of the potential hazards.

### Personal Protective Equipment (PPE)

PPE must be sufficient to protect eyes and skin from contact with the hazardous agents. At minimum, safety glasses, lab coat, long pants, closed toe shoes, and gloves are required when working with particularly hazardous substances. See UC Policy 905, Research Laboratory Personal Safety and Protective Equipment for more information. Goggles may be required for processes in which a splash or spray hazard may exist and flame-resistant lab coats may be required if the chemicals being used are flammable.

Refer to the specific chemical's SDS and SOP for specific information on additional PPE and glove selection.

Contaminated PPE and clothing must be disposed of or decontaminated prior to removal from the designated work area. While small spots of contamination may be cleaned in the lab, grossly contaminated lab coats may need to be disposed of as dry hazardous waste. Refer to UC Policy 905

and the Lab Safety Plan for guidance on handling contaminated protective apparel and other PPE.

### Engineering Controls

Bench top work with particularly hazardous substances should be avoided whenever practical in favor of contained systems (such as fume hoods or glove boxes) and is not permitted if there is a reasonable likelihood of workers exceeding regulatory exposure limits. For questions regarding exposure limits and for assistance in conducting a hazard assessment for uncontained procedures, contact your health and safety officer.

Laboratories and rooms where particularly hazardous substances are used outside of containment systems must have general room ventilation that is maintained at negative pressure with respect to public areas. Air from these ventilation systems must be vented externally; recirculation is not permitted. Doors providing access from public areas must be kept closed.

### Special Handling & Storage Requirements

Particularly hazardous substances must be stored in a designated area and used in a manner that will minimize the risk of accidental release (e.g., capped tightly, use of chemical resistant secondary containment, whenever possible). Laboratory personnel should remove chemicals from storage only as needed and return them to storage as soon as practical.

Chemicals should be segregated from incompatible materials, as described in this Lab Safety Plan. The use of particularly hazardous substances must be confined to an established designated area (see C. Use in Designated Areas, above).

Additional requirements for the safe storage of a specific chemical may be found in the manufacturer's instructions or in the SDS.

When transporting chemicals beyond the immediate laboratory environment, containers should be protected from breakage by using a bottle carrier or other effective containment.

Contact your health and safety officer for guidance on the planned use of chemicals that may require further controls.

### Spill & Accident Procedures

Immediate measures must be available to prevent the possible spread of contamination in the event of a small spill of a particularly hazardous substance. Absorbent materials and clean up materials should be available in all laboratories sufficient to contain and decontaminate individuals and equipment and areas. Any known spills must be contained and decontaminated as soon as possible.

- In the event of a large spill that is beyond a laboratory group's immediate response capabilities, the following procedures should be followed:
- Evacuate the area immediately.
- Restrict access to the affected areas to emergency responders and post signage and barriers as needed to prevent unauthorized entry.
- Call 9-911 from a UC campus phone or 911 from a cell phone (to UCPD) as needed.

In the event of direct skin contact with a particularly hazardous substance, the affected person must shower or flush the affected areas for a minimum of 15 minutes. Whenever personal contamination occurs, the event must be reported to your health and safety officer and an incident report will be completed and maintained by EH&S.

If the spill involves acutely toxic materials, the spill should be treated as a large spill if there is any doubt about the group's ability to safely mitigate the spill.

If the spill involves regulated carcinogens, a Report of Use may need to be filed (see Regulated Carcinogens and Report of Use Requirements, below).

### Routine Decontamination Procedures

To limit the spread of contamination, laboratory work surfaces should be decontaminated at the conclusion of each procedure and at the end of each day on which particularly hazardous substances are used.

All equipment should be decontaminated before removing it from the designated area; this decontamination should be carried out in a glove box or fume hood where practical.

Contaminated PPE must not be removed from the designated area until properly decontaminated; refer to the PPE policy (appendix R) and the Lab Safety Plan for guidance on the cleaning of protective apparel and other PPE. After working with these chemicals, gloves must immediately be removed and disposed of as hazardous waste and hands and arms washed with soap and water.

### Waste Disposal Procedures

Disposal of waste materials that include particularly hazardous substances must comply with the hazardous chemical waste disposal procedures found in the Laboratory Safety Manual.

In addition to general hazardous waste labeling requirements, waste containers containing particularly hazardous substances must also be labeled as appropriate for the specific chemical hazard:

“DANGER, CANCER HAZARD – SUSPECT AGENT”

“DANGER, CANCER HAZARD – REGULATED CARCINOGEN” “DANGER, REPRODUCTIVE TOXIN”

“DANGER, ACUTE TOXIN”

All non-radioactive chemical waste must be disposed of through the UC Hazardous Chemical Waste Program. Mixed wastes of hazardous chemicals and radioactive material are disposed of through the Radiation Safety Department. Due to regulatory restrictions and the high cost of disposal, the Radiation Safety Department should be contacted prior to producing mixed wastes.

### Regulated Carcinogens and Report of Use Requirements

Regulated carcinogens are a specific subset of select carcinogens which have special additional requirements associated with their use under certain circumstances. See Attachment B for the specific list. EH&S maintains an air sampling program to monitor individuals to determine if they are, or may reasonably be expected to, exceed short or long term exposure limits. Every effort should be made to keep exposure levels below these limits by using fume hoods, limiting the quantities used, and following SOP designed to reduce exposure. If levels cannot be kept below these levels, additional requirements may include:

- Required medical evaluations.
- Additional documented training.
- Use of respirators with required initial and ongoing training, medical evaluations, and maintenance documentation.
- Additional documented hazard evaluations.

Listed carcinogens are a further subset of regulated carcinogens. See Attachment C for the specific list. The use of these materials must be registered with EH&S through the PPE Assessment Tool or other equivalent EH&S approved process. An evaluation will be completed to assess safety requirements for

groups that use these materials.

Report of Use Requirements must be met for each group when they:

- Begin the use of, or make significant changes to existing use of any listed carcinogen.
- Use regulated carcinogens such that there is a reasonable expectation that exposure limits may be exceeded.
- In the event of an emergency in which employees have been exposed to any regulated carcinogen.

## ATTACHMENTS

Particularly Hazardous Substances Definitions

Regulated Carcinogens

Listed Carcinogens

Issuing Officer

Vice Chancellor for Research

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**Questions concerning this policy or procedure should be referred to the Responsible Department listed at the top of this document**

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## ATTACHMENT A

**Particularly Hazardous Substances Definitions**

Particularly hazardous substances fall into the following three major categories: acute toxins, reproductive toxins, and carcinogens. Acute Toxins Substances that have a high degree of acute toxicity are substances that may be fatal or cause damage to target organs as the result of a single exposure or exposures of short duration. They can be defined as:

A chemical with a median lethal dose (LD50) of 50 mg or less per kg of body weight when administered orally to albino rats weighing between 200 and 300 gm. each;

A chemical with a median lethal dose (LD50) of 200 mg or less per kg 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 2 and 3 Kg each; and

A chemical that has a median lethal concentration (LC50) in air of 5000 ppm by volume or less of gas or vapor, or 50 mg per liter or less of mist, fume, or dust, when administered by continuous inhalation for 1 hour (or less if death occurs within 1 hour) to albino rats weighing between 200 and 300 gm. each.

**Reproductive Toxins**

Reproductive toxins include any chemical that may affect the reproductive capabilities including chromosomal damage (mutations) and effects on fetuses (teratogenesis). A list of reproductive toxins is maintained online at [http://www.oehha.ca.gov/prop65/prop65\\_list/Newlist.html#files](http://www.oehha.ca.gov/prop65/prop65_list/Newlist.html#files).

**Carcinogens**

Carcinogens are chemical or physical agents that cause cancer. Generally, they are chronically toxic substances; that is, they cause damage after repeated or long-duration exposure, and their effects may only become evident after a long latency period.

The term “regulated carcinogen” means a recognized cancer causing substance, compound, mixture, or product regulated by Cal/OSHA sections 1529, 1532, 1532.2, 1535, 8358, 8359 or Article 110, sections 5200-5220. See *Attachment B for the specific list of Regulated Carcinogens*.

The term “Listed Carcinogen” refers to a specific list of 13 chemicals regulated by Cal/OSHA and Federal OSHA and has specific use and handling requirements. See *Attachment C for the specific list of Listed Carcinogens*.

The term “select carcinogen” refers to a category of chemicals where the available evidence strongly indicates that the substances cause human carcinogenicity. A select carcinogen meets one of the following criteria:

- It is regulated by Cal/OSHA as a carcinogen; or
- It is listed under the category “known to be carcinogens” in the annual report by the National Toxicology Program (NTP); or
- It is listed under Group 1 – “carcinogenic to humans” – by the International Agency for Research on Cancer (IARC); or
- It is listed in either Group 2A or Group 2B by the IARC or under the category “reasonably anticipated to be carcinogens” by the NTP, and causes statistically significant tumor incidence in experimental animals in accordance with any of the following criteria:

- After inhalation exposure of 6-7 hours per day, 5 days per week, for a significant portion of a lifetime
- to dosages of less than 10 mg/m<sup>3</sup>;
- After repeated skin application of less than 300 mg/kg of body weight per week; or
- After oral dosages of less than 50 mg/kg of body weight per day.

**Regulated Carcinogens**

**ATTACHMENT B**

The term “regulated carcinogen” means a recognized cancer causing substance, compound, mixture, or product regulated by Cal/OSHA sections 1529, 1532, 1532.2, 1535, 8358, 8359 or Article 110, sections 5200-5220. For more information, see UC Policy 907.

Acrylonitrile  
 Arsenic metal and inorganic arsenic compounds  
 Asbestos  
 Benzene  
 1,3-butadiene  
 Cadmium metal and cadmium compounds  
 Chromium(VI) compounds  
 Coke Oven Emissions  
 1,2-Dibromo-3-chloropropane (DBCP)  
 Ethylene Dibromide (EDB)  
 Ethylene Oxide (EtO)  
 Formaldehyde gas and formaldehyde solutions  
 Lead metal and inorganic lead compounds  
 Methylene Chloride  
 4,4'-Methylene bis(2-chloroaniline) (MBOCA)  
 Methylenedianiline (MDA)  
 Vinyl Chloride  
 2-Acetylaminofluorene  
 bis-Chloromethyl ether  
 Methyl chloromethyl ether  
 Ethyleneimine  
 4-Aminodiphenyl  
 Benzidine (and its salts)  
 3,3'-Dichlorobenzidine (and its salts)  
 4-Dimethylaminoazobenzene  
 alpha-Naphthylamine  
 beta-Naphthylamine  
 4-Nitrobiphenyl  
 N-Nitrosodimethylamine  
 beta-Propiolactone  
 bis-Chloromethyl ether  
 Methyl chloromethyl ether  
 Ethyleneimine



## ATTACHMENT C

### **Listed Carcinogens**

The term “listed carcinogen” refers to a specific list of 13 chemicals regulated by Cal/OSHA and Federal OSHA and has specific use and handling requirements. For more information, see UC Policy 907.

2-Acetylaminofluorene  
4-Aminodiphenyl  
Benzidine (and its salts)  
3,3'-Dichlorobenzidine(and its salts)  
4-Dimethylaminoazobenzene  
alpha-Naphthylamine  
beta-Naphthylamine  
4-Nitrobiphenyl  
N-Nitrosodimethylamine  
beta-Propiolactone  
bis-Chloromethyl ether  
Methyl chloromethyl ether  
Ethyleneimine

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## Appendix F: Particularly Hazardous Substance<sup>2</sup> (PHS) Use Approval Form

Before using any particularly hazardous substance (PHS), please complete this form and have it approved by the Principal Investigator, and EH&S. See p.4 for more complete definitions of a PHS and instructions for completing this form. The SDS will generally list the information needed to determine whether a chemical meets the PHS definition. If you have any questions, contact EH&S for assistance. Creating a SOP at [ehs.ucop.edu/chemicals](http://ehs.ucop.edu/chemicals) fulfills this requirement.

Applicant Name \_\_\_\_\_

Supervisor \_\_\_\_\_

Division: \_\_\_\_\_

Bldg. /Office # \_\_\_\_\_

Phone: \_\_\_\_\_

Date: \_\_\_\_\_

### Substance Information

A. Chemical name \_\_\_\_\_ CAS number \_\_\_\_\_ Physical State \_\_\_\_\_

B. Carcinogen      Reproductive Toxin      High Acute Toxicity      (circle all that apply)

C. Estimated Rate of Use (e.g., grams/month) \_\_\_\_\_ Maximum Quantity to be kept on hand \_\_\_\_\_

D. SDS reviewed and readily available      Yes      No

E. Duration of Project \_\_\_\_\_

### 2. Additional Hazards Associated with this PHS (circle all that apply)

#### Physical Hazards

A. Flammable      Yes      No      B. Corrosive      Yes      No

C. Reactive      Yes      No      D. Temperature      Yes      No

E. Stability (e.g., decomposes, forms peroxides, polymerizes, shelf-life concerns)      Stable      Unstable

F. Known incompatibilities \_\_\_\_\_

#### Health Hazards

#### G. Significant Route(s) of Exposure

Inhalation Hazard      Yes      No

Skin Absorption      Yes      No

H. Sensitizer      Yes      No

I. Medical Consultation  
Needed      Yes      No

<sup>2</sup> See ([http://safety.dri.edu/LabSafety/PARTICULARLY\\_HAZARDOUS\\_SUBSTANCES.pdf](http://safety.dri.edu/LabSafety/PARTICULARLY_HAZARDOUS_SUBSTANCES.pdf)) for a partial list of PHSs

**Procedure**

A. **Briefly describe how the material will be used and list all personnel** who will be involved in the use of this chemical

B. Vacuum system used Yes No

If yes, describe method for trapping effluents \_\_\_\_\_

**Exposure Controls** (circle all that apply)

A. Ventilation/Isolation

1. Hood required? Yes No (See hood sticker for the following information) If yes, hood currently operates at 95 - 125 feet per minute face velocity? Yes No Hood ID \_\_\_\_\_
2. Glove box required? Yes No
3. Vented gas cabinet required? Yes No

B. Personal Protective Equipment (PPE) Required (**circle all applicable**)

Safety glasses Chemical splash goggles Face  
 shield Gloves (type \_\_\_\_\_) Lab coat Apron  
 Respirator (*Respirators require EH&S approval*)  
 Other, please describe \_\_\_\_\_

**Location of Proposed Use/Designated Area**

A. Building(s)/Room(s) \_\_\_\_\_

B. Describe below the area where substance(s) will be used and the method of posting as a designated area.

C. Location where substances will be stored \_\_\_\_\_

D. Storage Method/Precautions (circle all that

apply) refrigerator/freezer hood

double containment vented cabinet

flammable liquid storage cabinet other, describe \_\_\_\_\_

**Spills and Decontamination**

- A. Spill control materials readily available      Yes      No
- B. Special personal protective equipment needed      Yes      No      Describe \_\_\_\_\_
- C. Decontamination method \_\_\_\_\_

**Waste Disposal** (circle all that apply)

- A. Bench top neutralization      Yes      No
- B. Deactivation      Yes      No
- C. Dispose as hazardous waste      Yes      No

**8. Authorization**

This individual has demonstrated an understanding of the hazards of the listed substance and plans to handle the substance in a manner that minimizes risk to health and property. S/he is authorized to use the substance in the manner described.

\_\_\_\_\_  
Principal Investigator/Supervisor/ Date

\_\_\_\_\_  
Division Chair or Dean/Date

\_\_\_\_\_  
Environmental Health and Safety/Date

Much of the information needed to complete this form can be found in the chemical's SDS.  
March 19, 2007, rev. 1

A particularly hazardous substance (PHS) includes known or suspected human carcinogens, reproductive toxins, and substances with acute toxicity above certain thresholds.

Each individual planning to use a PHS must complete this form and have it approved by their Principal Investigator (PI) or supervisor, Division Director and EH&S prior to ordering (or if the chemical is already in inventory prior to initial use).

Responsibility for determining whether a chemical is a PHS and completing this form rests jointly with the PI/supervisor and the individual seeking use approval.

Review the substance SDS or other appropriate literature for help in determining whether a substance meets the PHS criteria. Contact EH&S for assistance.

## 1. Substance Information

- A. Enter name and CAS (Chemical Abstract Service) number and physical state (gas, liquid, solid) for the PHS.
- B. *Carcinogen*: if on IARC, OSHA or NTP list  
*Reproductive toxin*: mutagens, teratogens, embryotoxins  
*High Acute Toxicity*: oral  $LD_{50} \leq 50$  mg/kg, I. skin  $LD_{50} \leq 200$  mg, air  $LC_{50} \leq 200$  ppm or  $\leq 2$  mg/l.
- C. Self-explanatory
- D. SDS may be available in hard copy or via the internet.

## 2. Hazards Identification

- A. *Flammable liquid*: flashpoint  $\leq 100^{\circ}$  F. *Flammable solid*: likely to cause fire through friction, absorption of moisture, spontaneous chemical change, or which can be ignited readily and when ignited burns vigorously.
- B. *Corrosive*: Causes visible destruction of, or irreversible alterations in, living tissue by chemical action at the site of contact.

C. *Reactive*: May become unstable or contact with water produces flammable or toxic gas.

D. *Temperature Sensitive*: Must be kept within a certain temperature range to ensure stability.

E. *Unstable*: substance will vigorously polymerize, decompose, condense, or will become self-reactive under conditions of shock, or high or elevated pressure or temperature. Also includes time-sensitive materials, particularly those that produce peroxides over time.

F. List chemicals or materials that might cause instability or adverse conditions if mixed with the particularly hazardous substance(s).

G. *Inhalation*: inhalation of the substance may cause adverse health effects. *Skin exposure*: substance is readily absorbed through the skin or can cause significant damage to skin upon contact.

H. Certain chemicals are known to affect the immune system, causing a person to experience allergic reactions, up to and including anaphylactic shock, upon exposure to the chemical, after the initial sensitization.

I. Some chemicals can accumulate in body tissues and may require initial or periodic medical surveillance. Contact EH&S for more information.

## 3. Procedure

- A. Briefly describe the laboratory procedure that involves the substance, with particular attention to how the chemical will be manipulated.
- B. Vacuum systems include central vacuum systems and vacuum pumps within the lab. Describe what will be done to ensure that the substance is not accidentally drawn into the vacuum system. Cold traps or filters are some examples of such measures.

#### 4. Exposure Controls

A chemical hood should be used for chemicals that may produce vapors, mists, or fumes, or if the procedure may cause generation of aerosols.

The hood must have an average face velocity of between 95 and 125 feet per minute. This measurement is noted on the hood survey sticker. If the hood has not been inspected within the past year, contact Facilities via the work request process for re-inspection before using the hood.

The hood number is noted on the bottom of the hood survey sticker.

A glove box should be used if protection from atmospheric moisture or oxygen is needed or when a chemical hood may not provide adequate protection from exposure to the substance; e.g., a protection factor of 10,000 or more is needed.

Highly toxic gases must be used and stored in a vented gas cabinet connected to a laboratory exhaust system. Gas feed lines operating above atmospheric pressure must use coaxial tubing.

**Safety glasses with side shields** protect from flying particles and minor chemical splashes, for instance, from opening a centrifuge tube.

Chemical splash goggles should be worn when there is a possibility of a significant chemical splash. Most chemical manipulations, particularly where pressure is involved, warrant chemical splash goggles.

Face shield, worn with splash goggles, provides full face protection when working with large volumes of chemicals. The use of a face shield is especially important when dispensing corrosive chemicals.

Gloves should be worn when working with any particularly hazardous substance. Since not all gloves offer significant protection from every chemical, it is important to choose the glove that offers the best resistance. See the SDS or glove manufacturer compatibility charts for more information.

Lab coats should be worn when working with hazardous substances. The coat should not be worn outside the laboratory and should be laundered separately from other clothing.

Aprons offer chemical resistance and protection from splashes and can be used in conjunction with a lab coat.

Respirators offer protection from inhalation of substances when engineering controls are not sufficient. Use of respirators must be approved by EH&S. Prior to approving a respirator, a medical clearance may be required. Contact EH&S for more information.

#### 5. Location/Designated Area

- Building(s) and room number(s) where the substance will be used.
- Describe where in the room(s) the substance will be used. For example, in a hood, on a specific bench top, in several areas of the laboratory, etc. This room or area must be posted as a *Designated Use Area*.
- Describe where the substance will be stored. Be specific, e.g., on a shelf, in a refrigerator, in a hood, etc.
- Self-explanatory. *Double containment* means that the container will be placed inside another container that is capable of holding the contents in the event of a leak and provides a protective outer covering in the event of contamination of the primary container.

#### 6. Spills and Decontamination



A and B. Self-explanatory.

C. Describe how the work area will be decontaminated after use, in the event of a spill, or upon completion of the work and before removal of the designated area signage.

#### 7. Waste Disposal

Some corrosive chemicals may be bench top neutralized then drain disposed.

Some materials, such as ethidium bromide, can be chemically deactivated before disposal.

See the EH&S web page for more information about the hazardous waste program. No hazardous chemicals may be poured down the drain without first consulting EH&S.

## Appendix G: Regulated Carcinogens

Cal/OSHA Regulated Carcinogens fall into a higher hazard class and have extensive additional requirements associated with them. The use of these agents may require personal exposure sampling based on usage. The following is the list of Cal/OSHA Regulated Carcinogens.

Cal/OSHA Regulated Carcinogens		
Acrylonitrile	Arsenic (Inorganic)	Ethylene Oxide (EtO)
(MBOCA)	Asbestos	Ethyleneimine
1,2-Dibromo-3-chloropropane (DBCP)	Benzene	Formaldehyde
1,3-butadiene	Benzidine (and its salts)	Lead
2-Acetylaminofluorene	Beta-Naphthylamine	Methyl chloromethyl ether
3,3'-Dichlorobenzidine (and its salts)	Beta-Propiolactone	Methylene Chloride
4,4'-Methylene bis(2-chloroaniline)	Bis-Chloromethyl ether	Methylenedianiline (MDA)
4-Aminodiphenyl	Cadmium	N-Nitrosodimethylamine
4-Dimethylaminoazobenzene	Chromium (VI)	Non Asbestiform Tremolite, Anthophyllite, and Actinolite
4-Nitrobiphenyl	Coke Oven Emissions	Vinyl Chloride
Alpha-Naphthylamine	Ethylene Dibromide (EDB)	

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## Appendix H: Respiratory Hazard Assessment Form

This form is designed to assist in the proper selection of respiratory equipment. Complete the information below and review it with your supervisor. Submit completed form via email using the button on the bottom of the form and print a copy for your records. **if a field is not applicable, please enter "N/A."**

First Name:  Last Name:

Employee ID #:  Email:

PI Last Name:  PI Employee ID #:

Department:  Building and Room #:

The Reason I'm Requesting/Need Respiratory Protection Is:

Description of Activity Requiring A Respirator:

Chemical Name:  Quantity of Usage

Duration (hrs):  Frequency  CAL-OSHA Permissible Exposure Limit:

I have reviewed the MSDS for this chemical ☐ Yes ☐ N/A

Health Hazard Information:

Controls Typically in Place (Check all that apply)

- |  |   |   |
|--|---|---|
| <input type="checkbox"/> Chemical Fume Hood        | <input type="checkbox"/> Goggles/Face Shield      | <input type="checkbox"/> Benchwork        |
| <input type="checkbox"/> Biological Safety Cabinet | <input type="checkbox"/> Lab Coat/Body Protection | <input type="checkbox"/> Clean Room       |
| <input type="checkbox"/> Glovebox                  | <input type="checkbox"/> Gloves                   | <input type="checkbox"/> Outdoor Activity |

By submitting, I attest that my supervisor/PI has reviewed and approved this Respiratory Hazard Assessment Form and to the best of my knowledge it is accurate and complete ☐ Yes

Today's Date

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## Appendix I: Peroxide Forming Chemicals (PFCs) Common to Research

### Class 1 PFCs

Class 1 chemicals form peroxides after prolonged storage. The chemicals listed below should be tested for the formation of peroxides on a periodic basis. Several methods are available to check for peroxides; the two most common are the use of peroxide test strips or the potassium iodide test.

Class 1 PFCs		
Isopropyl ether	Potassium amide	Vinylidene chloride
Divinyl acetylene	Potassium metal	
Divinyl ether	Sodium amide	

### Class 2 PFCs

This group of chemicals will readily form peroxides when they become concentrated (e.g., via evaporation or distillation). The concentration process defeats the action of most auto-oxidation inhibitors. As a result, these chemicals should be disposed of within 12 months of receiving.

Class 2 PFCs		
Acetal	Diethyl ether	Methyl isobutyl ketone
Cumene	Dioxane	Tetrahydrofuran
Cyclohexene	Ethylene glycol dimethyl ether	Tetrahydronaphthalene
Cyclopentene	Furan	Vinyl ethers
Diacetylene	Methylacetylene	
Dicyclopentadiene	Methylcyclopentane	

### Class 3 PFCs

This group of chemicals forms peroxides due to initiation of polymerization. When stored in a liquid state, the peroxide forming potential dramatically increases. These chemicals should be disposed of if they become degraded or are no longer needed.

Class 3 PFCs		
Acrylic acid	Chlorotrifluoroethylene	Vinyl acetate
Acrylonitrile	Methyl methacrylate	Vinyl acetylene Vinyl chloride
Butadiene	Styrene	Vinyl pyridine
Chlorobutadiene	Tetrafluoroethylene	Vinylidene chloride

## Appendix J: EH&S Safety Training Matrix for Laboratory Personnel

Everyone working in a lab must take the following modules every 3 years: Laboratory safety fundamentals\* (Required before beginning work) Hazmat spill response with DOT awareness \*, Fire Safety – labs

Exceptions are labs that are strictly computational that are not housed in the same room as labs using chemicals, lasers, or radiation.

Use the guide below to see if other classes are needed.

\*= classes available online

**Are you UCM faculty, staff, student, or volunteer who...**

**If yes, take...**

Will handle animal carcasses, animal tissue, or will have access to a vivarium?	Medical History Questionnaire and Risk Assessment Form annually, through OHSS online tool.
Will have direct contact with <u>live</u> vertebrate animals?	Medical History Questionnaire and Risk Assessment Form annually, through OHSS online tool, AND contact IACUC office 228-4613
Is a PI, faculty sponsor, or personnel listed on an approved IACUC protocol, (even if you don't handle animals)?	Contact IACUC office 228-4613
Will use a respirator?	Respirator Training and Fit testing (medical clearance also required) annually through EH&S/ OHF
Will use shop equipment?	Shop Safety Training, one time as long as continuously affiliated with UCM. Contact Brian Zimmerman.
Work with nanomaterials?	Nanomaterials every 3 years, through EH&S.
Will work with human or primate materials (blood, specimens, tissue or cells)?	Bloodborne pathogens annually, through EH&S. May need vaccinations. Contact EH&S.
Will use biohazardous materials (including bacteria, viruses, toxins)?	Biosafety every 3 years, through EH&S. May need vaccinations. Contact EH&S.
Will work in BSL-3?	Air Transmissible Diseases (ATD) annually.
Will ship materials?	Shipping with Dry Ice* every 2 years through EH&S.
Will handle radioactive materials?	Radiation Safety* every 2 years through EH&S.
Will work with lasers?	Laser Safety* every 3 years through EH&S
Will work with x-ray equipment or radiation producing machines?	Radiation Safety-Machines* every 2 years through EH&S



Will perform a survival surgery procedure or a procedure requiring aseptic technique?	Medical History Questionnaire and Risk Assessment Form annually, through OHSS online tool.
Will have access to or enter an animal barrier facility?	Medical History Questionnaire and Risk Assessment Form annually, through OHSS online tool.
Will enter or have access to an animal biocontainment facility?	Medical History Questionnaire and Risk Assessment Form annually, through OHSS online tool.
Will receive hazardous materials?	Hazmat spills with DOT Awareness* every 3 years through EH&S.
Work with compressed gases?	Compressed Gases* every 3 years through EH&S
Work with controlled substances (scheduled drugs) or drug precursors?	Controlled Substances* every 3 years through EH&S
Generate chemical waste?	Waste management* in the lab every 3 years through EH&S.
Work off site or at field stations?	Field Safety every 3 years through EH&S, and fill out field safety plan.
Work with recombinant DNA?	rDNA training



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## Appendix M: Laboratory Inspection Checklist

Animals are housed in the lab overnight. (Minor)

Biosafety cabinet has not been certified within the last year if BSL2 or above. (Minor)

Access to designated carcinogen work and storage areas is not properly marked or controlled. (Minor)

California-regulated carcinogen inventory is not reported to EH&S. (Minor)

Standard operating procedure(s), specific to the carcinogen(s) in use are not being followed or are not available. (Minor)

Chemicals stored above eye level. (Minor)

Common abbreviations used on container labels are not identified in a prominent place in the lab. (Minor)

Containers of hazardous chemicals are stored on the floor. (Minor)

Flammable liquid storage in the lab exceeds allowable quantities as determined by the campus Fire Marshal. (Major)

Flammable liquid storage outside of the flammable storage cabinet exceeds 10 gallons. (Major)

Flammables are used in close proximity to ignition sources. (Minor)

Flammables stored in large containers. (Minor)

Flammables stored in non-"laboratory safe" refrigerator/freezer. (Minor)

Incompatible chemicals are stored together. (Minor)

Storage cabinets are not clearly labeled as to contents. (Minor)

Time sensitive chemicals/peroxide formers stored inappropriately. (Minor)

Chemical containers not clearly labeled with contents and primary hazard(s). (Minor)

Appropriate hazard communication signage is not posted at laboratory entrance(s). (Minor)

All group members are not listed in the LHAT (Minor)

Chemical hygiene plan is not available or not reviewed within past 12 months. (Minor)

Chemical inventory has not been completed or updated within past 12 months. (Minor)

Current emergency contacts and PI/supervisor contact are not posted at the laboratory entrance. (Minor)

Emergency Action Plan unavailable. (Minor)

Lab Hazard Assessment Tool (LHAT) is incomplete. (Minor)

Laboratory Safety Plan Supplement is not complete (Minor)

No documented laboratory self-inspection. (Minor)

Prudent Practices book is not in lab. (Minor)

Safety Data Sheets are not available. (Minor)

Self-inspections are not accomplished and documented on a regular basis. (Minor)

Staff is unaware of how to report concerns or exposures to materials that should have medical consult. (Minor)

Staff is unaware of how to report incidents and near misses. (Minor)

Standard Operating Procedures unavailable. (Minor)

A minimum clearance of thirty-six inches in front of electric panel/breaker box is not being maintained. (Minor)

Electrical cords pose trip hazard. (Minor)

Equipment has damaged cord; plug or other condition that constitutes an electrical hazard (Minor)

Extension cords are being used as semi-permanent wiring. (Minor)



Extension cords or power strip not plugged directly into outlet. (Minor)

---

GFCI protection not installed with receptacles that are within 6 feet of the sink. (Minor)

---

High voltage equipment not clearly labeled. (Minor)

---

High voltage equipment not properly guarded. (Minor)

---

Major appliances/equipment not plugged directly into outlet. (Minor)

---

Personnel, working on hard-wired equipment are not trained to the Energy Isolation – Lock Out/Tag Out program. (M

---

Power strips near liquids lack surge protection. (Minor)

---

3-Prong plugs have been modified to plug into 2-prong receptacle. (Minor)

---

Appropriate safety information not posted on equipment. (Minor)

---

Centrifuges are not properly maintained to ensure safe operation. (Minor)

---

Moving parts of equipment not properly guarded. (Minor)

---

No secondary containment for vacuum pump. (Minor)

---

Oil filled vacuum pumps do not have oil mist filters. (Minor)

---

Aisles, exits and/or hallways are obstructed. (Minor)

---

Clearance not maintained 18" to ceiling (Minor)

---

Fire alarm bells, horns and/or strobes are obstructed and could hamper proper operation or reduce the sound. (Mino

---

Fire extinguisher is not properly mounted. (Minor)

---

Fire extinguisher maintenance tag is missing or not up-to-date. (Minor)

---

Fire extinguishers not available as required. (Minor)

---

Fire extinguishers not fully charged, pin and/or security seal is missing. (Minor)

Fire-rated doors blocked open. (Minor)

Flammable cabinets are not marked "FLAMMABLE- KEEP FIRE AWAY" (Minor)

Flammable cabinets aren't self-closing (Minor)

Audible/visual alarm is non-functional or visual airflow indicator is not working. (Minor)

Chemical work occurring less than 6" from front of hood. (Minor)

Fume hood has not been certified within the past year. (Minor)

Fume hood illumination is non-functional. (Minor)

Fume hood is cluttered or used for storage. (Minor)

Fume hood users don't know how to check their airflow monitor to verify that the hood airflow is functioning properly.

Users don't know how to check the certification sticker for annual testing. (Minor)

Fume hood users have not completed specific fume hood training. (Minor)

Proper sash height not indicated or sash position exceeds approved working height, or improper horizontal placement, and is left open when not in use.(Minor)

Compressed gas cylinders are not adequately secured. (Minor)

Compressed gas cylinders are not labeled with contents and hazards. (Minor)

Oxygen and combustible cylinders stored together. (Minor)

Toxic gases are not properly stored in a ventilated cabinet/fume hood. (Minor)

Valves of gas cylinders are not capped when not in use. (Minor)

Ceiling tiles/panels are missing or not in good condition. (Minor)

Ergonomic evaluations have not been completed for laboratory employees who use a computer for four or more hours

Evidence of eating or drinking in the laboratory where hazardous materials are being used or stored. Food stored with

Evidence of mouth pipetting. (Minor)

Evidence suggests spills not promptly or properly cleaned. (Minor)

Floor is in need of repair to preclude slipping, tripping or falling. (Minor)

Furnishings used in laboratory are covered with a material that is not easily decontaminated. (Minor)

General housekeeping in laboratory needs improvement. (Minor)

Hand wash sink is not available with soap and paper towels. (Minor)

Laboratory sinks, delivering non-potable water, are not labeled "Industrial Water - Do Not Drink" (Minor)

Laboratory ventilation pressure is positive with respect to corridors and offices. (Minor)

Refrigerators/freezers are not labeled appropriately for the use of the refrigerator/freezer. (Minor)

Repetitive lab activities for extended periods of time have not been evaluated for the risk of long-term injury. (Minor)

Vacuum systems (both house systems and stand-alone vacuum pumps) are not fitted with traps and/or protection (HEPA/hydrophobic) filter, if required.(Minor)

A current laser use authorization is not on file. (Minor)

Laser safety glasses are not available or not appropriate for the laser's operating parameters. (Minor)

Appropriate gloves are not available for use with hazardous activities conducted within this lab. (Minor)

Face shields not worn as appropriate. (Minor)

Gloves are not worn for laboratory procedures where skin contact with hazards may occur. (Minor)

Lab coats, appropriate to the activity, are not worn. (Minor)

Lab coats, properly fitted, are not available. (Minor)

Lab workers were observed wearing gloves while accessing common items, door knobs, elevator buttons, etc. (Minor)

Long pants (legs covered) and closed-toe/heel shoes are not worn in the lab. (Minor)

PPE contaminated with hazardous materials disposed in regular trash. (Minor)

Respirator use has not been evaluated by EH&S and users are not included in the campus respiratory protection program. (Minor)

Safety glasses or chemical splash goggles are not worn in the laboratory. (Minor)

A plumbed emergency eyewash/safety shower or emergency eyewash is not available within 10 seconds. (Minor)

Access to emergency eyewash/shower is obstructed. (Minor)

Annual test of emergency eyewash/shower or emergency eyewashes has not been completed or documented.

Monthly activation of eyewash/shower is not documented. (Minor)

Appropriate chemical spill kit is not available. (Minor)

Calcium gluconate paste for HF exposure first aid is not available. Calcium gluconate paste has expired.

Training on HF first aid is not documented. (Minor)

Fall protection equipment is not available (Minor)

Heavy items and precariously situated items are stored overhead. (Minor)

Large equipment is not seismically anchored. (Minor)

Shelves are missing restraints to prevent items from falling. (Minor)

---

Nobody in the lab has taken training on waste management. (Minor)

Specialized training for lab-specific hazards has not been documented. (Minor)

---

Spill response training is not documented. (Minor)

---

The following individuals need to take biosafety training: (Minor)

The following individuals need to take bloodborne pathogens training: (Minor)

---

The following individuals need to take fire safety training: (Minor)

---

The following individuals need to take hazmat spill response: (Minor)

The following individuals need to take lab safety fundamentals training: (Major)

---

The following individuals need to take radiation safety training: (Minor)

---

Training on laboratory specific Standard Operating Procedures (SOP) is not documented. (Minor)

Training on the Chemical Hygiene Plan is not documented. (Minor)

Training on the Illness and Injury Prevent Plan (IIPP) is not documented. (Minor)

---

Training to manage or handle hazardous waste is not documented. (Minor)

---

Biomedical waste in red bags improperly disposed. (Minor)

Biomedical waste secondary containment is not used. (Minor)

---

Biowaste container not closed. (Minor)

Biowaste improperly labeled (Minor)

---

Biowaste not in red bags. (Minor)

Hazardous waste container opened when not in use. (Minor)

---

Hazardous waste found being improperly disposed. (Minor)

---

Hazardous waste not properly labeled. (Minor)

---

Hazardous wastes accumulated beyond regulatory time limits. (Minor)

---

Sharps containers are not properly labeled, as to contents, hazard, etc. (Minor)

---

Sharps found disposed improperly in regular trash. Appropriate sharps container not available. (Minor)

---

Tight fitting lid not in place. (Minor)

---

Waste not stored in secondary containment (Minor)

---

Does your lab engage in any outside fieldwork?. (Minor)

---

Any unusual hazards associated with this research or lab?

---

Do you have any plastic waterbaths?(Minor)

## Appendix N: Segregation of Incompatible Chemicals

Table N.1 contains a list of incompatible chemicals. The following chemicals, listed in the left column, should not be used with chemicals listed in the right column, except under specially controlled conditions. Chemicals in the left column should not be stored in the immediate area with chemicals in the right column. Incompatible chemicals should always be handled, stored or packed so that they cannot accidentally come into contact with one another. This list is representative of chemical incompatibilities and is not complete, nor are all incompatibilities shown.

**Table N.1 – Incompatible Chemicals**

Chemical	Keep Out of Contact with:
Alkaline metals, such as powdered aluminum, magnesium, sodium, potassium, etc.	Carbon tetrachloride or other chlorinated hydrocarbons, carbon dioxide and water
Acetic Acid	Chromic acid, nitric acid, hydroxyl compounds, ethylene glycol, perchloric acid, peroxides and permanganates
Acetylene	Chlorine, bromine, copper, fluorine, silver and mercury
Ammonia	Mercury, chlorine, calcium hypochlorite, iodine, bromine and hydrofluoric acid
Ammonium nitrate	Acids, metal powders, flammable liquids, chlorates, nitrites, sulfur, finely divided organic or combustible materials
Carbon, activated	Calcium hypochlorite
Copper	Acetylene and hydrogen peroxide
Chromic acid	Acetic acid, naphthalene, camphor, glycerin, turpentine, alcohol and flammable liquids
Chlorine	Ammonia, acetylene, butadiene, butane, methane, propane, hydrogen, sodium carbide, turpentine, benzene and finely divided metals
Cyanides	Acids - organic or inorganic
Hydrogen peroxide	Copper, chromium, iron, most metals, alcohols, acetone, organic materials, aniline, nitromethane, flammable liquids and combustible materials
Hydrogen sulfide	Fuming nitric acid and oxidizing gases
Hydrocarbons (butane, propane, benzene, gasoline, turpentine etc.)	Fluorine, chlorine, bromine, chromic acid and sodium peroxide
Iodine	Acetylene, ammonia and hydrogen



Nitric acid	Acetic acid, aniline, chromic acid, hydrocyanic acid, hydrogen sulfide, flammable liquids, flammable gases, copper, brass and any heavy metals
Perchloric acid	Acetic anhydride, bismuth and its alloys, alcohol, paper, wood, ether, oils and grease
Phosphorous	Oxidizing agents, oxygen, strong bases
Potassium chlorate	Sulfuric and other acids
Potassium permanganate	Glycerin, ethylene glycol, benzaldehyde and sulfuric acid
Sodium	Carbon tetrachloride, carbon dioxide and water
Sodium nitrite	Ammonium nitrate and other ammonium salts
Sodium peroxide	Ethyl or methyl alcohol, glacial acetic acid, acetic anhydride, benzaldehyde carbon disulfide, glycerin, ethylene glycol, ethyl acetate, methyl acetate and furfural
Sulfides, inorganic	Acids - Sulfuric acid, potassium chlorate, potassium perchlorate and potassium permanganate

### Special Segregation of Incompatible Chemicals

In addition to the segregation noted in Table N.1, dangerously incompatible substances, even in small quantities, should not be stored next to each other on shelves or in such a position that accidental rupture of containers may allow mixing. Table N.2 contains examples of dangerously incompatible substances. Table N.3 contains examples of incompatible oxidizing agents and reducing agents.

**Table N.2 – Dangerously Incompatible Substances**

Chemical	Keep out of contact with:
Chlorine	Acetylene
Chromic acid	Ethyl alcohol
Oxygen (compressed, liquefied)	Propane
Sodium	Chloroform and aqueous solutions
Nitrocellulose (wet, dry)	Phosphorous
Potassium permanganate	Sulfuric acid
Perchloric acid	Acetic acid
Sodium chlorate	Sulfur in bulk

**Table N.3 – Incompatible Oxidizing Agents and Reducing Agents**

Oxidizing Agents	Reducing Agents
Chlorates	Ammonia
Chromates	Carbon
Dichromates	Metals
Chromium trioxide	Metal hydrides
Halogens	Nitrates
Halogenating agents	Organic Compounds
Hydrogen peroxide	Phosphorus
Nitric acid	Silicon
Nitrates	Sulfur
Perchlorates	
Peroxides	
Permanganates	
Persulfates	

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## Appendix O: Hazardous Waste Pick-Up

Waste is picked up by EH&S once per week. For laboratory clean-outs, large, or special pick-ups, call your health and safety officer for instructions. Label all hazardous chemical waste using an Online Hazardous Waste Tag. Materials should be segregated according to hazard classification for transportation. Each hazard class should have a separate secondary container. Do not transport materials on public streets. Hazardous waste can never be left unattended in any public area.

Wear appropriate personal protective equipment such as safety glasses, laboratory coats and closed-toed shoes.

### Waste Disposal Information

All waste must be labeled with a tag from WASTE [ehs.ucop.edu/waste](https://ehs.ucop.edu/waste) when the first drop of waste is added.

### Container Requirements

#### Liquid Waste:

Containers must be free of exterior contamination

Containers must be chemically compatible and the size should be suitable for the material stored

Containers must be in good condition with screw tops or sealed lids

Containers MUST NOT be leaking, rusting or have any other defects

Containers MUST NOT be filled to the top. (Leave 10% air space)

Wastes must not be generating gases.

Dry Waste must be double-bagged in transparent, sturdy bags and cannot have sharp or protruding edges

**Unknown chemicals** The cost of identifying an unknown for disposal may be recharged to the lab.

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## Appendix P: Spill Clean-up Procedures

Laboratory personnel can clean up small spills if trained and competent to do so. Small spills include chemical spills that are up to 1 liter in size and of limited toxicity, flammability and volatility, and mercury spills from broken thermometers (about 1.5 grams). If respiratory protection is needed for spill cleanup, the spill is too large to be handled by laboratory personnel – dial 9-911 or your health and safety officer. Commercial chemical and mercury spill kits are available, which include protective equipment such as goggles and gloves, neutralizing and absorbing materials, bags, and scoops. You can also make your own spill kits to include the materials described below.

### Chemical Spills:

- Sodium Bicarbonate
- Citric Acid
- Vermiculite or other diking material
- pH paper
- 1 pair neoprene or nitrile gloves
- 1 pair goggles
- 1 scoop
- Spill pillows, sorbent pads
- Disposable shoe covers (plastic bags may work)

### Mercury Spills:

- Disposable gloves
- Disposable shoe covers (plastic bags will work)
- Index card or rubber squeegee
- Disposable syringe or a vacuum trap flask fitted with tubing or Pasteur pipette
- Inactivating solutions and/or powders

### Weak Inorganic Acid or Base Spill Clean Up Procedure

1. Wear gloves, goggles, laboratory coat and shoe covers.
2. To clean-up a spill of weak inorganic acid or base, neutralize the spilled liquid to pH 5 to 8 using a Neutralizing Agent such as:
  - Sodium bicarbonate
  - Soda ash
  - Sodium bisulfate
  - Citric acid
3. Absorb the neutralized liquid with an Absorbent such as:
  - Sorbent pads
  - Diatomaceous earth
  - Dry sand
  - Sponges
  - Paper towels
  - Vermiculite

4. Rinse the absorbent pads or sponges in a sink with water. Scoop or place the other absorbent materials into a clear plastic bag. Double bag and tag the bag with a chemical waste tag.

#### Solvent Spill Clean Up Procedure

1. Absorb the spill with a non-reactive material such as:

- Vermiculite
- Dry sand
- Paper towels
- Sponges

2. Package as described above. Do not rinse or dispose of any chemicals down the sink or into any drain.

#### Broken Thermometer Clean Up Procedure

1. Clean up the spill immediately after it has occurred.
2. Prevent the spread of the spilled mercury. Do not allow people to walk through spill area.
3. Wear disposable gloves and shoe covers or place plastic bags over your shoes during the clean-up.
4. Push the mercury droplets together into a bead using an index card or rubber squeegee.
5. Aspirate the beaded mercury into a disposable syringe, or use a disposable Pasteur Pipette attached with tubing to a vacuum flask to aspirate the mercury into the flask. The flask should contain water. Always have a second vacuum flask between the mercury flask and the house vacuum.
6. Chemically inactivate any residual mercury. There are several methods to inactivate the residual mercury including:

Use a commercial inactivating powder following its directions for use

Sprinkle zinc powder over the spill area. Then moisten the zinc with a 5 to 10 percent sulfuric acid solution until a paste is formed. Scour the contaminated surface and allow the paste to dry. Sweep up the dried paste.

Wash the contaminated area with a detergent solution. Rinse and then swab the area with a calcium polysulfide solution containing two to four tablespoons of calcium polysulfide per gallon of water.

7. Place the collected mercury and materials used in the clean-up into a clear plastic bag. Double bag and label the waste. Take it to the chemical waste pick-up for your building.





**If a large spill occurs, call 9-911 from a campus phone or 911 from an off-campus or cell phone or your health and safety officer (228-2EHS or 209 205-8176).**





## Appendix Q: Lab Emergency Poster

### LAB EMERGENCY

Call 9-911 from a campus phone, 911 from a cell phone

<p>Medical Emergency Dial <b>911</b></p> 	<p>LIFE THREATENING EMERGENCY, AFTER HOURS, WEEKENDS AND HOLIDAYS: Dial 9-911 from a campus phone or 911 from a cell phone. <i>Note: all serious injuries must be reported to EHS at 209 201-9820 within 8 hours.</i></p> <p><b>NON-LIFE THREATENING EMERGENCY:</b> Go to Olivewood Meadows Occupational Health Facility at 374 Olive Ave. Hours: M-F 8am-5pm. All other times report to Merced Medical Center emergency room at 333 Mercy Ave. <i>Note: all serious injuries must be reported to EHS at 209 201-9820 within 8 hours.</i></p> <p>Needle stick/puncture exposure: Wash the affected area with antiseptic soap and warm water for 15 minutes. Seek medical Attention listed under “non-life threatening emergency”. Note: All needlesticks must be reported to EHS at <b>209 201-9820</b> within 8 hours.</p>
<p>Fire Dial <b>911</b></p> 	<p><b>SMALL FIRE</b> (trash can size)- If you have been trained, you may put out the fire using a fire extinguisher. Report the fire by calling <b>911</b>. Notify EHS at 209 201-9820 and Facilities Management 209 228-2956 anytime a fire extinguisher is used or discharged.</p> <p><b>LARGE FIRE</b> (requiring more than 1 fire extinguisher) – Evacuate the area. Close all doors and windows as you leave. Close the fume hood sash if the fire is in the hood. Activate the nearest alarm. Call <b>911</b>. Evacuate using the stairwells. Do not use the elevator.</p> <p><b>CLOTHES ON FIRE</b> – Use the nearest safety shower. If none immediately available, STOP-DROP-ROLL to quickly smother the fire. Seek medical attention. <i>Notify supervisor and EHS at 209 201-9820 immediately.</i></p>
<p>Chemical Spill Dial <b>911</b> and 209 205-8176</p> 	<p><b>SPILL</b> – Help contaminated or injured persons. Evacuate the spill area. Avoid breathing vapors. Eliminate ignition sources if spill is flammable. If possible, confine the spill to a small area using a spill kit or absorbent material. Keep others from entering contaminated area (e.g. use caution tape, barriers, etc.)</p> <p><b>SMALL (&lt;1L)</b> – If you have training, you may assist in the clean-up effort. Use appropriate personal protective equipment and clean-up material for chemical spilled. Double bag spill waste in clear plastic bags. Label and take to the next chemical waste pickup.</p> <p><b>LARGE (&gt;1L)</b> – Dial 911 and EH&amp;S at 209 205-8176 for assistance.</p> <p><b>CHEMICAL SPILL ON BODY OR CLOTHES</b> – Remove clothing and rinse body thoroughly in emergency shower for at least 15 minutes. Seek medical attention. <i>Notify supervisor and EHS at 209 205-8176 immediately.</i></p> <p><b>CHEMICAL SPLASH INTO EYES</b> – Immediately rinse eyeball and inner surface of eyelid with water for 15 minutes by forcibly holding the eye open. Seek medical attention. <i>Notify supervisor and EHS at immediately.</i></p>
<p>Biohazard Spill Dial <b>911</b> and 209 382-4535</p> 	<p><b>CONCENTRATED, &gt;100ML OF BSL-2 OR SPILL IN PUBLIC AREA</b> - Do not attempt to clean it up. Keep people from entering. Dial <b>911</b> and EHS at 209 382-4535 for assistance.</p> <p><b>BIOHAZARDOUS SPILL ON BODY OR CLOTHES</b> – Immediately remove contaminated clothing and place in a red biohazard bag. Wash with antiseptic soap and water for at least 15 minutes. Seek medical attention. <i>Notify supervisor and EHS at 209 382-4535 immediately.</i></p> <p><b>GENERAL BIOHAZARD SPILL CLEAN-UP</b>- Use clean personal protective equipment appropriate for the lab’s Biosafety Level. Place absorbent pads over area. Use appropriate disinfectant and carefully pour disinfectant starting from the outside to the inside of material (do not spray the disinfectant to minimize aerosol). Allow a minimum 20 minutes of contact time. Remove any sharps using forceps and discard in a sharps container. Dispose clean-up materials as biohazardous waste for proper waste disposal. Repeat clean-up process as necessary. Remove protective clothing and segregate for disposal or laundering. Wash hands with soap and water. <i>Notify supervisor and EHS at 209 382-4535 immediately.</i></p> <p><b>UNCONTROLLED SPILLS (e.g. unknown biohazard, outside of a biosafety cabinet, unsure of the clean-up)</b> – Notify room occupants of the spill. Immediately exit the room if you are not wearing the appropriate</p>

	personal protection. Mark-off the area using tape and warning signs. Everyone should wash their hands and face or shower using a disinfecting soap. Wait at least 30 minutes for aerosol to settle. Dial <b>911</b> and EHS at <b>209 382-4535</b> for assistance.
<p>Radioactive Spill Dial <b>911</b> and 209 382-4935</p> 	<p><b>SMALL</b> (&lt;1mCi contained in labs, not public areas, and not-alpha emitters). Cover spill with absorbent material. Notify others in the area of the spill. If comfortable, continue clean-up of the area with absorbent materials. Use disposable gloves and change frequently. Place all contaminated materials in a radioactive waste bag. Monitor spill area and all personnel participating in decontamination efforts with appropriate survey instrument. Record incident in the laboratory survey log and call radiation safety at 209 205-8176.</p> <p><b>LARGE</b> (&lt;1mCi not contained in labs, in public area or alpha-emitters) – Cover spill with absorbent material and shield spill if necessary. Evacuate all personnel from immediate area and prevent entry of others. Personnel that are potentially contaminated should be surveyed with appropriate survey instruments. Dial <b>911</b> and EHS at 209 205-8176 for further assistance.</p> <p><b>PERSONAL CONTAMINATION</b>- Immediately remove contaminated clothing. Rinse area, especially between fingers and around fingernails with water first, then wash with a mild detergent. Dial <b>911</b> and EHS at 209 205-8176 for further assistance</p>
<p>Earthquake</p> 	<p><b>DURING EARTHQUAKE</b> – Take cover in the laboratory underneath a table or desk, or move to the hallway and brace yourself against the wall, covering your head with your arms. After the shaking has stopped:</p> <p>Remain in the building if the quake was minor.</p> <p>Evacuate the building if the quake was severe. Do not use the elevators; use the stairwells.</p> <p>After evacuation, report to your designated meeting place (main campus – quad, Castle back parking lot).</p>

Note: All serious injuries must be reported within 8 hours to EHS at 209 201-9820 or CAT-COPS. All fires, large spills and exposures must be reported as soon as possible.

Revised 4/2021

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## Appendix R: UC Personal Protective Equipment Policy

<b>Responsible Officer:</b>	Chief Risk Officer
<b>Responsible Office:</b>	RK - Risk / EH&S
<b>Issuance Date:</b>	[Issuance Date]
<b>Effective Date:</b>	3/1/2013
<b>Scope:</b>	<p>This policy and regulatory standards require the supervisor to select Personal Protective Equipment (PPE) for workers under their supervision based on an assessment of hazards in the workplace which those workers are likely to encounter. Supervisors are required to inform such workers of the selection decisions, and to have their workers follow those decisions when obtaining PPE. PPE will be provided to workers at no cost.</p> <p>This policy applies to students enrolled in academic courses in which PPE is required by the instructor and/or indicated in the course syllabus.</p>

<b>Contact</b> : <b>Email:</b> <b>Phone</b> #:	Erike Young eyoung@ucop.edu (510) 987-0170
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## I. POLICY SUMMARY

The University of California is committed to providing a healthy and safe working environment for all members of the campus community. This Personal Protective Equipment (PPE) policy is designed to prevent workplace injuries and illnesses for all academic appointees, staff, students, and visitors.

## II. DEFINITIONS

**Hazardous Materials:** Hazardous materials, for the purposes of this policy, are chemical or biological agents that have been identified as a health or physical hazard. Unsealed radioactive materials are also included as “hazardous materials.” Additional guidance is included in Appendix A.

**Laboratory/Technical Areas:** A laboratory/technical area is a location where the laboratory use or storage of hazardous materials occurs or where laboratory equipment may present a physical hazard. It includes, but is not limited to:

Research laboratories	Cold rooms
Teaching laboratories	Machine and other
QA/QC and analytical	Vivaria
Stock rooms	Surgery/Operating rooms
Storage rooms	Visual/performing arts studios and shops
Waste accumulation	

**Personal Protective Equipment (PPE):** Personal protective equipment is worn to minimize exposure to a variety of hazards. Examples of PPE include such items as lab coats, gloves, foot protection (steel-toed shoes), eye protection (safety glasses or goggles), protective hearing devices (earplugs, muffs), hard hats, respirators, fall protection harnesses, etc.

**Physical Hazards:** Physical hazards are identified as substances, equipment, or activities that can threaten physical safety. Physical hazards can include but are not limited to: impact (falling objects), fall hazards, extreme pressures, temperature extremes (heat/cold), radiation (ionizing and non-ionizing), noise, vibration, electrical, light (optical), welding, cutting, brazing.

**Student:** An individual enrolled in an academic class.

**Supervisor:** An employee who may have authority to hire personnel, evaluate performance, direct work assignments, apply progressive discipline, direct resources to correct identified safety issues. This includes a Principal Investigator, area manager, unit manager, project manager, superintendent, and foreman/person. Unless specified in writing, the default “supervisor” in laboratory/technical areas is the Principal Investigator.

**Use or Storage:** For the purposes of this Policy, “use or storage” includes those operations where workers are directly manipulating hazardous materials, adjacent to or in proximity to a hazard or in areas where there is a reasonable risk of exposure. Reasonable risk of exposure includes all activities identified in the hazard assessment that pose an exposure risk to the worker.

**Worker:** For purposes of this policy, a worker is an individual who actively performs work functions with hazardous materials or equipment in a laboratory/technical area. A “worker” may be faculty, staff, student volunteer assisting in a non-academic class, or visitor/visiting scholar. For the purpose of this definition, “worker” excludes individuals who only passively participate in tours, lectures, conferences, etc.

### III. POLICY TEXT

Hazards exist in every University workplace and can take many different forms: sharp edges, falling objects, flying sparks, chemicals, noise, and a myriad of other potentially dangerous situations. This policy requires that the University protect its workers from workplace hazards that can cause injury.

Controlling a hazard at its source is the best way to protect employees. Depending on the hazard or workplace conditions, the preferred solution is the use of engineering or work practice (administrative) controls to manage or eliminate hazards to the greatest extent possible. When engineering or administrative (work practice) controls are not feasible or do not provide sufficient protection, supervisors must provide personal protective equipment (PPE) to their workers and ensure its use.

Failure/refusal to wear required PPE is a basis for discipline, in accordance with locally established procedures. A student not wearing course required PPE in a laboratory/technical area may not participate in lab activities until such PPE is worn.

This policy sets minimum systemwide requirements; each campus may develop policies and procedures which meet or exceed this policy standard.

#### A. General Program Requirements

##### 1. For workers:

##### a. Perform Hazard Assessment

Each supervisor shall assess the workplace to determine if hazards are present, or are likely

to be present, which necessitate the use of personal protective equipment (PPE). This assessment must evaluate both the hazards to the individuals performing the work and assess the hazards to individuals who occupy the room or space where the work is being performed. Each supervisor shall verify that the required workplace hazard assessment has been performed through a written certification that identifies the workplace evaluated; the person certifying that the evaluation has been performed; the date(s) of the hazard assessment and identifies the document as being a certification of hazard assessment. Hazard assessments that indicate less than the minimum PPE for a laboratory/technical area as stated in section B require review and approval from campus Environment(al) Health and Safety (EH&S) in accordance with local procedures (See section B3).

A completed standard operating procedure, job hazard analysis, or other similar document which includes a workplace hazard assessment can be used to satisfy this requirement.

**b. Identify Required PPE**

Each supervisor, based upon the hazard assessment, shall ensure that the appropriate personal protective equipment has been identified and is provided for each user. The PPE must be the proper fit and design for the user and not interfere with the ability of the worker to work safely. The PPE will be provided to the worker at no cost.

**c. Training**

Each supervisor will assure workers know how to properly wear, adjust and maintain assigned PPE. Workers will demonstrate understanding of the proper use of assigned PPE. The training must cover these elements: When PPE is necessary; What PPE is necessary; How to properly don, doff, adjust, and wear PPE; The limitations of the PPE, and; The proper care, maintenance, useful life and disposal of the PPE. Training will be documented.

**d. Maintenance and Replacement**

Each worker is responsible for properly wearing required PPE. Each worker is responsible for informing their supervisor when worn or damaged PPE needs to be replaced.

**e. Evaluating the Appropriateness of Identified PPE**

Each supervisor is responsible for periodically re-evaluating the selection and use of PPE in work areas under their control. The hazard assessment should be repeated when new hazards are identified or introduced into the workplace or at least every three (3) years.

**2. For students:**

Academic courses which include laboratory, shop or field work are required to indicate PPE requirements (including specifications of the type of PPE) as part of the course syllabus. These PPE items shall be the responsibility of the student to obtain and wear as part of the class. Common communal PPE such as thermal protective, welding aprons, face shields, etc., will be provided by the sponsoring department. The instructor of record for a course, or designee, is responsible for ensuring that students are familiar with and properly using required protective devices

**B. Minimum Attire and Personal Protective Equipment Requirements for Laboratories/Technical Areas**

The following minimum attire and PPE requirements pertain to all laboratories/technical areas where use or storage of hazardous materials occurs or a physical hazard exists. This section should be used as the basis for developing the required PPE elements to include in the course syllabus for laboratory classes. The wearing of required PPE may only be modified as determined by a standard operating procedure or the laboratory hazard assessment. (See section III.A.1.a).

**1. Attire when occupying a Laboratory/Technical Area**

- a. Full length pants (or equivalent) and closed toe/heel shoe attire must be worn at all times

by all workers who are occupying or entering a laboratory/technical area. The area of skin between the pants and shoe should not be exposed.

## **2. PPE when working with, or adjacent to, hazardous material use areas within a Laboratory/Technical Area**

a) Laboratory coats (or equivalent protective garments) and protective eyewear are required to be worn by all workers working with hazardous materials. In addition, laboratory personnel occupying the adjacent area, who have the potential to be exposed to chemical splashes or other hazards as determined by SOP requirements and/or the laboratory hazard assessment, are required to wear laboratory coats (or equivalent protective garments) and protective eyewear.

- i. Laboratory coats must be appropriately sized (and if necessary fitted) for the worker. Coats must be buttoned/snapped to their full length. Laboratory coat sleeves must be of a sufficient length to prevent direct skin exposure while wearing gloves.
- ii. Flame Resistant (FR-rated) laboratory coats must be worn when working with any amount of pyrophoric materials. FR-rated lab coats are also required when working with flammable liquids in laboratories using open flames or other potential ignition sources; or as determined by the hazard assessment.
- iii. Laboratory coats shall not be laundered at private residences or public laundry facilities. Any protective clothing that becomes contaminated with hazardous materials must be decontaminated prior to being laundered or appropriately discarded. Campuses are responsible for providing suitable laundry services to maintain required laboratory coats.
- iv. All protective eyewear must meet American National Standards Institute (ANSI) standards and be appropriate for the work being done. Typical prescription spectacles are not suitable eye protection. Prescription safety glasses/goggles are available through individual campus procurement offices. Protective eyewear may be removed when using optical microscopes or similar instruments, requiring close contact between the eyes and the eyepieces.

b) Protective gloves must be worn while using any hazardous materials, hot or cold liquids (including cryogenics), objects that pose a risk of thermal burns, items having physical hazards, or equipment that may cause hand injury. These gloves must be appropriate for the material or process being used and must not interfere with the ability of the worker to work safely. The Safety Data Sheet (SDS) for the material and the manufacturer-specific glove selection guide should be referenced to determine appropriate glove type.

c) Some operations and procedures may warrant additional PPE, as indicated by the Safety Data Sheet (SDS), the Standard Operating Procedures (SOP), facility policies, regulatory requirements, or the hazard assessment. These might include face shields, aprons, respiratory protection, hearing protection, etc.

## **3. Exceptions**

a) The minimum personal protective equipment requirements for Laboratories/Technical Areas (sections III.B.1-2) will not apply to:



- i. Laboratories/technical areas which have been designated and posted as free of physical or chemical hazards. Examples: Laboratories/technical areas that house only operations with no inherent physical or chemical hazards during normal, reasonably foreseeable upset (unexpected occurrence), or routine maintenance activities. Examples include some electron microscope rooms, precision measurement rooms, etc.
- b) Exceptions that require written approval from their campus Environment(al) Health and Safety (EH&S) Department or EH&S approved department designees. EH&S has the final authority for determining this risk assessment.
  - i. The establishment of a level of personal protective equipment below the minimum specified in sections III.B.1-2 to a laboratory/technical area that uses hazardous materials or includes a physical hazard.
  - ii. The establishment of non-PPE required corridors that may be delineated within technical areas provided that the corridor does not pass near any potential exposure hazard.
  - iii. Non-hazardous work areas (e.g., offices, work stations) that are within laboratory/technical areas but are clearly delineated by distance or physical barrier (e.g., walls, doors, or cubicle dividers). It must be clear that the area is intended to be a self-contained, dedicated area. Readily movable furniture does not constitute a physical barrier as envisioned here.
    - 1. Exceptions for individual desks or work spaces within a Technical Area are discouraged.
- c) This policy does not apply to College of American Pathologists (CAP) accredited laboratories, which meet equivalent safety standards through CAP accreditation requirements.

#### **IV. COMPLIANCE / RESPONSIBILITIES**

The Chancellor has overall responsibility for compliance with health and safety requirements at all facilities and programs under her/his control.

Vice Chancellors/Directors/Deans/Departments Chairs are responsible for communicating, promoting and enforcing the Policy in areas under their control.

The Campus or School Laboratory and/or Chemical Safety Committee is responsible for promoting a safe working environment in all research and teaching laboratories on campus.

Supervisors are responsible for complying with this policy and ensuring their staff complies with this policy. Supervisors are also responsible for ensuring their staff receives both the required PPE identified in the hazard assessment, and documents their training on the proper use of their PPE. Noncompliance with the policy is handled in accordance with Personnel Policies for Staff Members (PPSM) policies 62-65 pertaining to disciplinary actions and Academic Personnel Manual (APM) policies 015- 016 pertaining to the Faculty Code of Conduct and administration of discipline; and APM 140 and 150 pertaining to Non-Senate Academic Appointees.

Workers are responsible for knowing the PPE requirements for areas in which they work or enter, and for properly wearing PPE as established in this policy and in the hazard assessment. All workers are

responsible for completing training, for knowing how to use PPE, for knowing how to properly put on and take off required PPE, and for knowing how to care for and maintain PPE. They are responsible for informing others in the area of these requirements and reporting unsafe conditions to their supervisor, or EH&S. Workers are NOT responsible for purchasing their own PPE. As applicable, a staff employee may address issues of noncompliance with this Policy through the complaint resolution processes described in PPSM 70 and II-70 (Complaint Resolution) and PPSM 71 and II-70 (Resolution of Concerns) or Collective Bargaining Agreement.

Students are responsible for obtaining course required PPE as noted in the course syllabus and wearing as directed by the instructor.

The Office of Environment(al), Health & Safety (EH&S) is responsible for providing interpretation and clarification regarding this Policy. EH&S will also provide consultation and tools to assist supervisors in performing the hazard assessment and with developing training. In cases where work activities pose an immediate danger to life or health, designated EH&S staff have the responsibility and authority to order the temporary cessation of the activity until the hazardous condition is abated. The Academic Personnel or Staff Human Resources Offices are responsible for all employee and labor relations issues, including interpretation and clarification of Personnel Policies and Collective Bargaining Agreements related to this Policy.

## **V. PROCEDURES**

Not applicable

## **VI. RELATED INFORMATION**

Appendix A – Hazardous Materials

Appendix B – Laboratory Hazard Assessment Tool (LHAT) 8 CCR 3380 Personal Protective Devices:

(<http://www.dir.ca.gov/title8/3380.html>) 8 CCR 5191 Laboratory Standard:

(<http://www.dir.ca.gov/title8/5191.html>) 8 CCR 5194 Hazard Communication:

(<http://www.dir.ca.gov/title8/5194.html>) 8 CCR 3203 IIPP: (<http://www.dir.ca.gov/title8/3203.html>) 8 CCR

5209: Listed Carcinogens (<http://www.dir.ca.gov/title8/5209.html>) VII. FREQUENTLY ASKED QUESTIONS

Not applicable.

## **VIII. REVISION HISTORY**

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This is the first version of this policy.

## Appendix A – of PPE Policy

### Hazardous Materials

Hazardous materials may be described using the following characteristics or regulatory definitions. This list is to be used as a guideline and allows for some laboratory/ technical areas to be classified as non-hazardous materials areas. It does not supersede Cal/OSHA regulations or accepted safe work practices for specific materials. The container label and the Safety Data Sheet for the material should be consulted to determine the hazard classification(s) of a particular substance.

- a) Corrosives are any chemical that causes visible destruction of, or irreversible alterations in, living tissue at the site of contact. *Examples: hydrochloric acid, sulfuric acid, sodium hydroxides, potassium hydroxides.*
- b) Materials recognized as readily absorbed through the skin. *Examples: phenol, THF, DMSO, benzene, carbon disulfide, toluene.*
- c) Skin or eye irritants are chemicals which are not corrosive, but which cause a reversible inflammatory effect on living tissue by chemical action at the site of contact. *Examples: xylenes, formamide, many amines like triethanolamine, carbon tetrachloride, perchloroethylene, many inorganic salts like cobalt and nickel sulfate*
- d) Flammable liquids having a flash point not more than 93°C. *Examples: organic solvents, ethers, alcohols, toluene, pentane, acetone*
- e) Violently air-reactive or water-reactive chemicals, including pyrophorics (substances that spontaneously ignite in air). *Examples: sodium or potassium metal, diethyl zinc, lithium aluminum hydride, t-butyl lithium, aluminum alkyls, calcium carbide, phosphine*
- f) Carcinogens or Mutagens *Examples: formaldehyde, dichloromethane, benzene, chloroform,*
- g) Reproductive Hazards. *Examples: acrylamide, Cd, Pb, Hg, Cr(VI), carbon disulfide, toluene, chloroform, ethylene glycol ethers*
- h) Toxic or Highly Toxic Chemicals – a materials likely to be fatal or toxic if inhaled, ingested or if contacted by skin.
- i) Oxidizing agents – a material that, generally by yielding oxygen, causes or contributed to the combustion of other material. *Examples: nitric and perchloric acids, chromates, nitrates, nitrites, hydrogen peroxide, chlorates*
- j) Any unsealed radioactive material.
- k) Biological materials classified as Risk Group 2, or greater.
- l) Centers for Disease Control Select Agent Toxins

## Appendix S: Glossary

**ACGIH** - The American Conference of Governmental Industrial Hygienists is a voluntary membership organization of professional industrial hygiene personnel in governmental or educational institutions. The ACGIH develops and publishes recommended occupational exposure limits each year called Threshold Limit Values (TLVs) for hundreds of chemicals, physical agents, and biological exposure indices.

**ACTION LEVEL** - A concentration designated in Title 8, California Code of Regulations for a specific substance, calculated as an eight (8)-hour time weighted average, which initiates certain required activities such as exposure monitoring and medical surveillance.

**AEROSOL** - Liquid droplets or solid particles dispersed in air that are of fine enough size (less than 100 micrometers) to remain dispersed for a period of time.

**ASPHYXIAN** - A chemical (gas or vapor) that can cause death or unconsciousness by suffocation. Simple asphyxiants, such as nitrogen, either use up or displace oxygen in the air. They become especially dangerous in confined or enclosed spaces. Chemical asphyxiants, such as carbon monoxide and hydrogen sulfide, interfere with the body's ability to absorb or transport oxygen to the tissues.

**"C" OR CEILING** - A description usually seen in connection with a published exposure limit. It refers to the concentration that should not be exceeded, even for an instant. It may be written as TLV-C or Threshold Limit Value - Ceiling. (See also Threshold Limit Value).

**CARCINOGEN** - A cancer-producing substance or physical agent in animals or humans. A chemical is considered a carcinogen or potential carcinogen if it is so identified in any of the following:

- National Toxicology Program, "Annual Report of Carcinogens" (latest edition)
- International Agency for Research on Cancer, "Monographs" (latest edition)
- OSHA, 29 CFR 1910, Subpart Z, Toxic and Hazardous Substances

**CHEMICAL HYGIENE OFFICER** - An employee who is designated by the employer and who is qualified by training or experience to provide technical guidance in the development and implementation of the provisions of the Chemical Hygiene Plan.

**CHEMICAL HYGIENE PLAN** - A written program developed and implemented by the employer which sets forth procedures, equipment, personal protective equipment, and work practices that (1) are capable of protecting employees from the health hazards presented by hazardous chemicals used in that particular workplace and (2) meets the requirements of OSHA regulation 29 CFR 1910.1450.

**COMBUSTIBLE LIQUID** - Any liquid having a flashpoint at or above 100°F (37.8°C) but below 200°F (93.3°C) except any mixture having components with flashpoints of 200°F or higher, the total volume of which make up 99% or more of the total volume of the mixture.

**COMPRESSED GAS** - A gas or mixture of gases having, in a container, an absolute pressure exceeding 40 psi at 70°F (21.1°C), or; a gas or mixture of gases having, in a container, an absolute pressure exceeding 104 psi at 130°F (54.4°C) regardless of the pressure at 70°F (21.1°C), or; a liquid having a vapor pressure exceeding 40 psi at 100°F (37.8°C) as determined by ASTM D-323-72.

**CORROSIVE** - A substance that, according to the DOT, causes visible destruction or permanent changes in human skin tissue at the site of contact or is highly corrosive to steel.

**DESIGNATED AREA** - An area which has been established and posted with signage for work involving hazards (e.g., "select carcinogens," reproductive toxins, or substances which have a high degree of acute toxicity). A designated area may be the entire laboratory, an area of a laboratory, or a device such as a laboratory hood.

**EMERGENCY** - Any potential occurrence, such as, but not limited to, equipment failure, rupture of containers, or failure of control equipment which could result in an uncontrolled release of a hazardous chemical into the workplace.

**EXPLOSIVE** - A chemical that causes a sudden, almost instantaneous release of pressure, gas, and heat when subjected to a sudden shock, pressure, or high temperature.

**FLAMMABLE** - A chemical that falls into one of the following categories:

1. Flammable aerosol - 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. Flammable gas - a gas that, at ambient temperature and pressure, forms a flammable mixture with air at a concentration of 13% by volume or less; or a gas that, at ambient temperature and pressure, forms a range of flammable mixtures with air wider than 12% by volume, regardless of the lower limit;
3. Flammable liquid - any liquid having a flashpoint below 100°F (37.8°C), except any mixture having components with flashpoints of 100°F (37.8°C) or higher, the total of which make up 99% or more of the total volume of the mixture; or
4. Flammable solid - 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 greater than one-tenth of an inch per second along its major axis.

**FLASHPOINT** - The minimum temperature at which a liquid gives off a vapor in sufficient concentration to ignite in the presence of an ignition source or when tested as follows:

1. Tagliabue Closed Tester (See American National Standard Method of Test for Flashpoint by Tag Closed Tested, Z11.24-1979 (ASTM D-56-79) for liquids with a viscosity of less than 45 Saybolt Universal Seconds (SUS) at 100°F (37.8°C) or that contain suspended solids and do not have a tendency to form a surface film under test;
2. Pensky-Martens Closed Tester (See American National Standard Method of Test for Flashpoint by

Pensky-Martens Closed Tester, Z11.7-1979 (ASTM D-73-79) for liquids with a viscosity equal to or greater than 45 SUS at 100°F (37.8°C), or that contain suspended solids, or that have a tendency to form a surface film under test; or,

3. Setaflash Closed Tester (See American National Standard Method of Test for Flashpoint of Setaflash Closed Tester (ASTM D-3278-78)). Organic peroxides, which undergo auto accelerating thermal decomposition, are excluded from any flashpoint determination methods specified above.

**GENERAL VENTILATION** - Also known as general exhaust ventilation, this is a system of ventilation consisting of either natural or mechanically induced fresh air movements to mix with and dilute contaminants in the workroom air. This is not the recommended type of ventilation to control contaminants that are highly toxic, when there may be corrosion problems from the contaminant, when the worker is close to where the contaminant is being generated, and where fire or explosion hazards are generated close to sources of ignition. (See Local Exhaust Ventilation)

**GHS** – (Globally Harmonized System for classifying and labeling chemicals) – Designed to uniformly define and communicate health, physical and environmental hazards of chemicals on a global scale.

**HAZARD ASSESSMENT** - A formal procedure undertaken by the supervisor in which occupational hazards for all employees are described per procedure or task, and by affected body part(s) or organ(s), and which is documented and posted in the workplace with all personal protective equipment requirements.

**HAZARD WARNING** - Any words, pictures, symbols or combination thereof appearing on a label or other appropriate form of warning which convey the hazards of the chemical(s) in the container(s).

**HAZARDOUS MATERIAL** - Any material which is a potential/actual physical or health hazard to humans.

**HAZARDOUS MATERIAL (DOT)** - A substance or material capable of posing an unreasonable risk to health, safety, and property when transported including, but not limited to, compressed gas, combustible liquid, corrosive material, cryogenic liquid, flammable solid, irritating material, material poisonous by inhalation, magnetic material, organic peroxide, oxidizer, poisonous material, pyrophoric liquid, radioactive material, spontaneously combustible material, an water-reactive material.

**HAZARDOUS CHEMICAL** - A chemical for which there is statistically significant evidence based on at least one study conducted in accordance with established scientific principles that acute or chronic health effects may occur in exposed employees. The term "health hazard" includes chemicals which are carcinogens, toxic or highly toxic agents, reproductive toxins, irritants, corrosives, sensitizers, hepatotoxins, nephrotoxins, neurotoxins, agents which act on the hematopoietic system, and agents which damage the lungs, skin, eyes or mucous membranes. A chemical is also considered hazardous if it is listed in any of the following:

1. OSHA, 29 CFR 1910, Subpart Z, Toxic and Hazardous Substances;
2. "Threshold Limit Values for Chemical Substances and Physical Agents in the Work Environment," ACGIH (latest edition);
3. "The Registry of Toxic Effects of Chemical Substances," NIOSH (latest edition); or
4. Director's List.



**HIGHLY TOXIC** - A substance falling within any of the following categories:

1. A substance that has a median lethal dose (LD50) of 50 milligrams or less per kilogram of body weight when administered orally to albino rats weighing between 200 and 300 grams each;
2. A substance that has a median lethal dose (LD50) of 200 milligrams or less 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; or
3. A substance that has a median lethal concentration (LC50) in air of 200 parts per million by volume or less of gas or vapor, or 2 milligrams per liter or less 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.

**IGNITABLE** - A solid, liquid or compressed gas waste that has a flashpoint of less than 140°F. Ignitable material may be regulated by the EPA as a hazardous waste as well.

**INCOMPATIBLE** - The term applies to two substances to indicate that one material cannot be mixed with the other without the possibility of a dangerous reaction.

**IRRITANT** - A substance which, by contact in sufficient concentration for a sufficient period of time, will cause an inflammatory response or reaction of the eye, skin, nose or respiratory system. The contact may be a single exposure or multiple exposures. Some primary irritants: chromic acid, nitric acid, sodium hydroxide, calcium chloride, amines, metallic salts, chlorinated hydrocarbons, ketones and alcohols.

**LABEL** - Any written, printed or graphic material displayed on or affixed to containers of chemicals, both hazardous and non-hazardous.

**LABORATORY TYPE HOOD** - A device located in a laboratory, enclosed on five sides with a movable sash or fixed partial enclosure on the remaining side; constructed and maintained to draw air from the laboratory and to prevent or minimize the escape of air contaminants into the laboratory; and allows chemical manipulations to be conducted in the enclosure without insertion of any portion of the employee's body other than hands and arms.

**LABORATORY USE OF HAZARDOUS CHEMICALS** - Handling or use of such chemicals in which all of the following conditions are met:

1. Chemical manipulations are carried out on a "laboratory scale";
2. Multiple chemical procedures or chemicals are used;
3. The procedures involved are not part of a production process nor in any way simulate a production process; and
4. "Protective laboratory practices and equipment" are available and in common use to minimize the potential for employee exposure to hazardous chemicals.

**LHAT (Lab Hazard Assessment Tool)** – An online tool that allows a PI and EH&S to track the lab roster, list required PPE for the space, document PPE training and issuance.

**LOCAL EXHAUST VENTILATION** (Also known as exhaust ventilation) – A ventilation system that captures and removes the contaminants at the point they are being produced before they escape into the workroom air. The system consists of hoods, ductwork, a fan, and possibly an air-cleaning device. Advantages of local exhaust ventilation over general ventilation include: it removes the contaminant rather than dilutes it, requires less airflow and, thus, is more economical over the long term; and the system can be used to conserve or reclaim valuable materials; however, the system must be properly designed with the correctly shaped and placed hoods, and correctly sized fans and ductwork.

**SAFETY DATA SHEET (SDS)** - Written or printed material concerning a hazardous chemical which is prepared in accordance with paragraph (g) of 29 CFR 1910.1200. Formerly known as Material Safety Data Sheet (MSDS)

**MEDICAL CONSULTATION** - A consultation which takes place between an employee and a licensed physician for the purpose of determining what medical examinations or procedures, if any, are appropriate in cases where a significant exposure to a hazardous chemical may have taken place.

**MIXTURE** - Any combination of two or more chemicals if the combination is not, in whole or in part, the result of a chemical reaction.

**MUTAGEN** - Anything that can cause a change (or mutation) in the genetic material of a living cell.

**NFPA** - The National Fire Protection Association; a voluntary membership organization whose aims are to promote and improve fire protection and prevention. NFPA has published 16 volumes of codes known as the National Fire Codes. Within these codes is Standard No. 705, "Identification of the Fire Hazards of Materials". This is a system that rates the hazard of a material during a fire. These hazards are divided into health, flammability, and reactivity hazards and appear in a well-known diamond system using from zero through four to indicate severity of the hazard. Zero indicates no special hazard and four indicates severe hazard.

**NIOSH** - The National Institute for Occupational Safety and Health; a federal agency that among its various responsibilities trains occupational health and safety professionals, conducts research on health and safety concerns, and tests and certifies respirators for workplace use.

**OHF** – Occupational Health Facility. Contact information for Patients First is in section 1.

**ODOR THRESHOLD** - The minimum concentration of a substance at which a majority of test subjects can detect and identify the substance's characteristic odor.

**OXIDIZER** - a substance that gives up oxygen easily to stimulate combustion of organic material.

**PERMISSIBLE EXPOSURE LIMIT (PEL)** - An exposure, inhalation or dermal permissible exposure limit specified in 8 CCR 5155. PELs may be either a time-weighted average (TWA) exposure limit (8-hour), a 15-minute short-term limit (STEL), or a ceiling (C).

**PERSONAL PROTECTIVE EQUIPMENT** - Any devices or clothing worn by the worker to protect against hazards in the environment. Examples are respirators, gloves, and chemical splash goggles.



**PHYSICAL HAZARD** - A chemical for which there is scientifically valid evidence that it is a combustible liquid, a compressed gas, explosive, flammable, an organic peroxide, an oxidizer, pyrophoric, unstable (reactive), or water-reactive.

**PYROPHORIC** - A chemical that will spontaneously ignite in the air at a temperature of 130oF (54.4oC) or below.

**REACTIVITY** - A substance's susceptibility to undergoing a chemical reaction or change that may result in dangerous side effects, such as explosion, burning, and corrosive or toxic emissions. The conditions that cause the reaction, such as heat, other chemicals, and dropping, will usually be specified as "Conditions to Avoid" when a chemical's reactivity is discussed on an SDS.

**REPRODUCTIVE TOXINS** - Chemicals which affect the reproductive capabilities including chromosomal damage (mutations) and effects on fetuses (teratogenesis).

**RESPIRATOR** - A device which is designed to protect the wearer from inhaling harmful contaminants.

**RESPIRATORY HAZARD** - A particular concentration of an airborne contaminant that, when it enters the body by way of the respiratory system or by being breathed into the lungs, results in some body function impairment.

**SELECT CARCINOGENS** - Any substance which meets one of the following:

1. It is regulated by OSHA as a carcinogen; or
2. It is listed under the category, "known to be carcinogens," in the Annual Report on Carcinogens published by the National Toxicology Program (NTP) (latest edition); or
3. It is listed under Group 1 ("carcinogen to humans") by the International Agency for Research on Cancer Monographs (IARC) (latest editions); or
4. It is listed in either Group 2A or 2B by IARC or under the category, "reasonably anticipated to be carcinogens" by NTP.

**SENSITIZER** - A substance that may cause no reaction in a person during initial exposures, but afterwards, further exposures will cause an allergic response to the substance.

**SHORT-TERM EXPOSURE LIMIT** - Represented as STEL or TLV-STEL, this is the maximum concentration to which workers can be exposed for a short period of time (15 minutes) for only four times throughout the day with at least one hour between exposures. The daily TLV-TWA must not be exceeded.

**SOLVENT** - A substance, commonly water, but in industry often an organic compound, which dissolves another substance.

**THRESHOLD LIMIT VALUE (TLV)** - Airborne concentration of substances devised by the ACGIH that represents conditions under which it is believed that nearly all workers may be exposed day after day with no adverse effect. TLVs are advisory exposure guidelines, not legal standards, that are based on evidence from industrial experience, animal studies, or human studies when they exist. There are three different types of TLVs: Time-Weighted Average (TLV-TWA), Short-Term Exposure Limit (TLV-STEL), and Ceiling (TLV-C). (See also PEL).

**TOXICITY** - A relative property of a material to exert a poisonous effect on humans or animals and a description of the effect and the conditions or concentration under which the effect takes place.

**VAPOR** - The gaseous form of substances which are normally in the liquid or solid state (at normal room temperature and pressure). Vapors evaporate into the air from liquids such as solvents. Solvents with lower boiling points will evaporate faster.

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## Appendix T: Procedures for Safe Use of Pyrophoric Liquid Reagents

Researchers should not use pyrophoric reagents until they have read and fully understood these safe operating procedures. However, reading these procedures does not substitute for hands-on training. New users of pyrophoric reagents must work under the close supervision of an experienced user.

### I. Scope

A variety of liquid reagents are pyrophoric (spontaneously ignite in air) including (but not necessarily limited to):

- Alkylolithium reagents (Typically in hydrocarbon solvents) (Tert-butyllithium is VERY pyrophoric)
- Alkenyllithium and Aryllithium reagents (Typically in hydrocarbon solvents)
- Alkynyllithium reagents (Typically in hydrocarbon solvents)
- Grignard Reagents (RMgX) (Typically in hydrocarbon solvents)
- Alkylaluminum reagents (Neat or in hydrocarbon solvents) (Neat reagents are VERY pyrophoric)
- Alkylzinc reagents (Neat reagents are pyrophoric)
- Boranes (Neat reagents are pyrophoric)

### II. Hazards

In general these materials are pyrophoric; they ignite spontaneously when exposed to air. They also tend to be associated with flammable solvents. Other common hazards include corrosivity, water reactivity, peroxide formation, toxicity, and damage to the liver, kidneys, and central nervous system.

### III. Controlling the Hazards

BEFORE working with pyrophoric reagents, read the relevant Safety data sheets (SDS) and understand the hazards. The SDS must be reviewed before using an unfamiliar chemical and periodically as a reminder.

Set up your work in a laboratory fume hood or glove box and ALWAYS wear the appropriate PPE

#### ***Personal Protective Equipment (PPE)***

##### **Eye Protection**

- Chemical Splash goggles or safety glasses that meet the ANSI Z.87.1 1989 standard must be worn whenever handling pyrophoric chemicals. Ordinary prescription glasses will NOT provide adequate protection unless they also meet this standard. When there is the potential for splashes, goggles must be worn, and when appropriate, a face shield added.
- A face shield is required any time there is a risk of explosion, large splash hazard or a highly exothermic reaction. All manipulations of pyrophoric chemicals which pose this risk should occur in a fume hood with the sash in the lowest feasible position. Portable shields, which provide protection to all laboratory occupants, are acceptable.

##### **Skin Protection**

- Flame resistant gloves must be worn when handling pyrophoric chemicals. Use adequate protection to prevent skin exposures. Heavy gloves are required for work with large quantities.

- A fire resistant lab coat must be worn.
- A chemical-resistant apron worn over the lab coat is required for working with large quantities.
- No open toe shoes are allowed.

## IV. Designated Work Area

### Eyewash

- Suitable facilities for quick drenching or flushing of the eyes should be within 10 seconds travel time for immediate emergency use. Bottle type eyewash stations are not acceptable.

### Safety Shower

- A safety or drench shower should be available within 10 seconds travel time where pyrophoric chemicals are used.

### Fume Hood

- Many pyrophoric chemicals release noxious or flammable gases and should be handled in a laboratory hood. In addition, some pyrophoric materials are stored under kerosene (or other flammable solvent), therefore the use of a fume hood (or glove box) is required to prevent the release of flammable vapors into the laboratory.

### Fire Extinguisher

- A Class C dry chemical fire extinguisher must be available within 10 seconds travel time from where pyrophoric chemicals are used.
- Know the location of the nearest Class D fire extinguisher.
- A container of powdered lime (calcium oxide, CaO) should be kept within arm's length when working with a pyrophoric material.

### Glove (dry) box

- Glove boxes are an excellent device to control pyrophoric chemicals when inert or dry atmospheres are required.

## V. Protocols

### Handling pyrophoric Reagents

By using proper needle and syringe techniques, these reagents can be handled safely in the laboratory.

#### The Aldrich1 Sure/Seal™ Packaging System

The Sure/Seal packaging system (Fig. 1A) provides a convenient method for storing and dispensing air-sensitive reagents. The reagent can be dispensed using a syringe or double-tipped needle (16, 18 or 20 gauge) inserted through the hole in the metal cap. When inserting a needle through a septum, a layer of silicone or hydrocarbon grease on the septum will help. Upon withdrawal of the needle, the small hole that remains in the PTFE liner will not cause the reagent to deteriorate under normal circumstances. However, it is recommended that the plastic cap be replaced after each use and in particular for long-term storage.

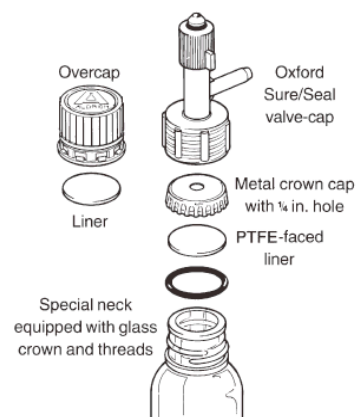
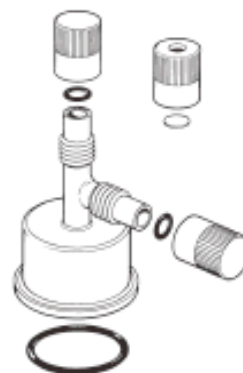


Figure 1A Sure/Seal components

For extended storage of unused reagents, use the solid plastic cap, or equip the bottle with an

Oxford Sure/Seal valve cap, or transfer the reagent to a suitable storage vessel.

The Sure/Seal septum-inlet transfer adapter (Fig. 1B) can be used when repeated dispensing is necessary. The adapter protects the contents of the bottles from air and moisture.



**Fig. 1B** Sure/Seal septum-inlet transfer adapter

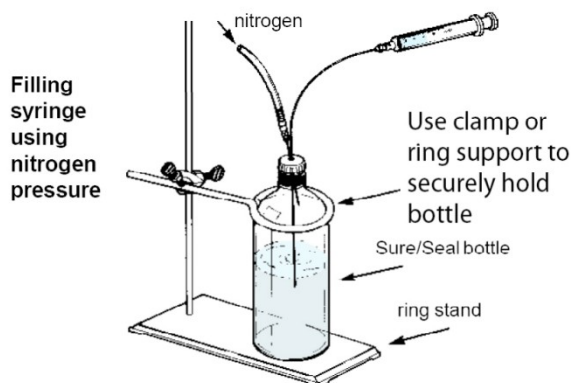


Fig. 2A Filling syringe

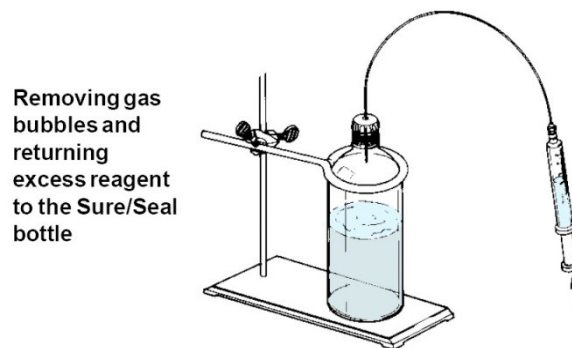
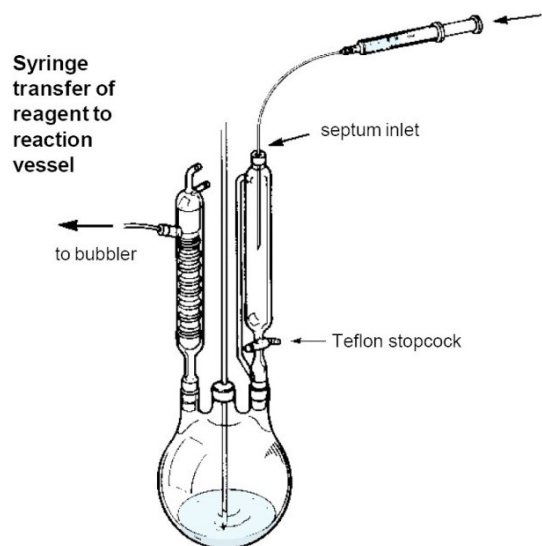


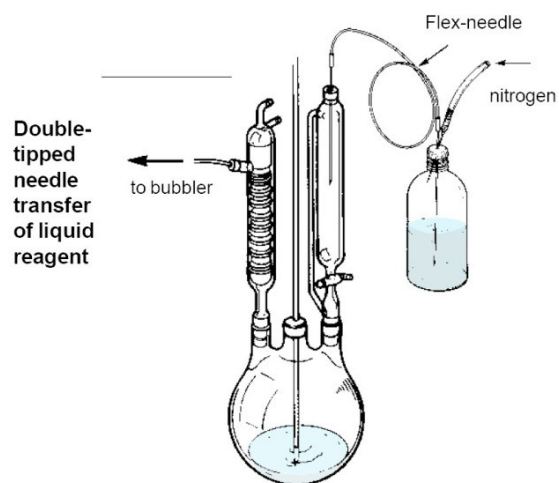
Fig. 2B Removing gas bubbles and returning excess reagent to the Sure/Seal bottle

### *Transferring Pyrophoric Reagents with Syringe*

- Clamp the reagent bottle and receiving vessel to prevent them from moving.
- Insert a needle from an inert gas source with a bubbler outlet into the bottle keeping the needle tip above the liquid level.
- NOTE: The goal of this technique is to equalize the pressure in the reagent bottle. A different technique is to use inert gas pressure to force reagent into the syringe, but that has the danger of blowing the plunger out of the syringe body and spilling out pyrophoric reagent.
- Flush dry syringe with inert gas, depress the plunger and insert the needle into the Sure/Seal bottle.
- NOTE: For large volume syringes, use a corresponding larger gauge needle.
- Gently pull the plunger to draw liquid into the syringe (Fig. 2A). Pulling too hard or too fast can cause air bubbles to enter between the plunger and syringe body.
- NOTES: Simple glass syringes are more prone to causing gas bubbles. Disposable plastic syringes have a good seal on the plunger and work well. Glass syringes with Teflon-tipped plungers (gas-tight) syringes are best. For safest work, do not fill syringe more than 60% full, up to a maximum of 10 mL of liquid. The double-tipped needle technique is safer when transferring 10 mL or more.
- Excess reagent and entrained bubbles are then forced back into the reagent bottle (Fig. 2B).
- FOR HIGHLY PYROPHORIC materials such as tert-butyllithium and trimethylaluminum, it is best to draw a plug of inert gas from the headspace into the needle after excess reagent is forced back into the bottle (Fig. 2B) and before withdrawing the needle.
- The desired volume of reagent in the syringe is quickly transferred to the reaction apparatus by puncturing a rubber septum as illustrated in Fig. 2C.



**Fig. 2C** Syringe transfer of reagent to reaction vessel reagent

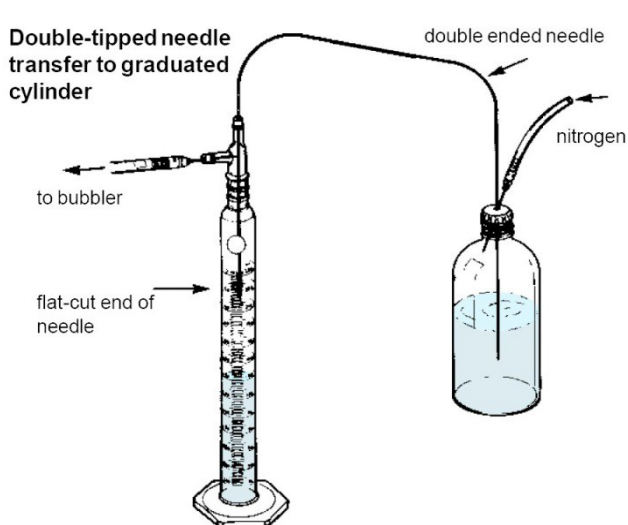


**Fig. 3A** Double-tipped needle transfer of liquid reagent

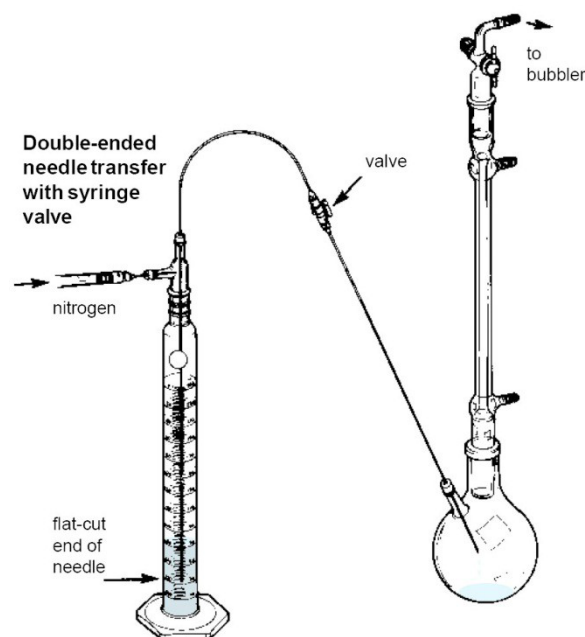


***Transferring Pyrophoric Reagents with a Double-Tipped Needle***

- The double-tipped needle technique is recommended when transferring 10 mL or more.
- Pressurize the Sure/Seal bottle with nitrogen and then insert the double-tipped needle through the septum into the headspace above the reagent. Nitrogen will pass through the needle. Insert the other end through the septum at the calibrated addition funnel on the reaction apparatus which must be equipped with a gas line to a bubbler. Push the needle into the liquid in the Sure/Seal reagent bottle and transfer the desired volume. Then withdraw the needle to above the liquid level. Allow nitrogen to flush the needle. Remove the needle first from the reaction apparatus and then from the reagent bottle. (Fig. 3A)
- Alternatively, for an exact measured transfer, convey from the Sure/Seal bottle to a dry nitrogen flushed graduated cylinder fitted with a double-inlet adapter (Fig. 3B). Transfer the desired quantity and then remove the needle from the Sure/Seal bottle and insert it through the septum on the reaction apparatus. Apply nitrogen pressure as before and the measured quantity of reagent is added to the reaction flask. Apply nitrogen pressure as before and the measured quantity of reagent is added to the reaction flask.
- To control flow rate, fit a Luer lock syringe valve between two long needles as shown in (Fig. 3C).



**Fig. 3B** Double-tipped needle transfer to graduated cylinder



**Fig. 3C** Double-ended needle transfer with syringe valve

***Cleaning Pyrophoric Reagents from Needles and Syringes***

- Needles and syringes used with pyrophoric reagents must be cleaned immediately to avoid clogging the needles and seizing the syringes.
- Draw hexane into the syringe containing small amounts of pyrophoric reagent and then discharge the diluted solution into isopropanol.
- Similarly, flush double-tipped needles with hexane and then quench hexane wash in isopropanol.

***Storage***

- Store pyrophoric chemicals under an inert atmosphere or under kerosene as appropriate.
- Avoid areas with heat/flames, oxidizers, and water sources.
- Containers carrying pyrophoric materials must be clearly labeled with the correct chemical name and hazard warning.

***Disposal of Pyrophoric Reagents***

- Small amounts of unused or unwanted pyrophoric materials must be destroyed by careful quenching of the residue. Transfer the materials to an appropriate reaction flask for hydrolysis and/or neutralization. Dilute significantly with an unreactive solvent such as heptane or toluene and place the flask in an ice water cooling bath. Slowly add isopropanol to quench pyrophoric materials. Upon completion, add methanol as a more reactive quenching agent to ensure completion. Finally, add water dropwise to make sure there are no pockets of reactive materials. Dispose of as hazardous waste.
- Alternatively, reactive substances can be quenched by slowly adding the dilute solution to dry ice, then adding a mildly reactive quenching agent such as methanol.
- AVOID low boiling diluents such as ether and pentane that tend to condense water upon evaporation.
- Do not leave containers with residues of pyrophoric materials open to the atmosphere due to uncontrolled ignition.

***Disposal of Pyrophoric Solid Reagents by Submitting to EH&S as Hazardous Waste***

- Larger quantities of pyrophoric chemicals can be disposed of as hazardous waste.
- Carefully package and label the wastes.
- Specifically alert EH&S personnel at the collection location to the hazards of any wastes containing pyrophoric chemicals.

**VI. Emergency Procedures*****Spill - Small***

- Exert extreme caution due to potential spontaneous combustion.
- Exert extreme caution due to potential ignition of flammable solvents or other materials.
- If anyone is exposed, or on fire, wash with copious amounts of water, ideally in the lab shower.
- Call for a coworker to provide backup.
- Place a fire extinguisher nearby.
- Carefully remove nearby flammable materials.
- Powdered lime (calcium oxide, CaO) or dry sand should be used to completely smother and cover any spill that occurs.

- Carefully quench by slow addition of isopropanol.
- After complete quench, double bag spill residues for hazardous waste pickup.
- Call 911 for emergency assistance if necessary.

***Spill - Large***

- Exert extreme caution due to potential spontaneous combustion.
- Exert extreme caution due to potential ignition of flammable solvents or other materials.
- If anyone is exposed, or on fire, wash with copious amounts of water, ideally in the lab shower.
- Call 911 for emergency assistance.
- Evacuate the spill area.
- Post someone or mark-off the hazardous area with tape and warning signs to keep other people from entering.
- Provide emergency personnel with technical advice on the chemicals involved.

## Appendix U: UC Merced Laboratory Emergency Contacts (Post at Lab Entrance)

In case of fire or life emergency dial 911 from any campus phone or (209) 228-2677 (CAT-COPS)

<u>Principal Investigator (PI) or Lab Manager</u>	<u>Phone</u>	<u>Email</u>

Area or Laboratory Safety Contacts (People who should be contacted in case of an after-hour emergency or other problems related to research or research equipment)

<u>Safety Contact</u>	<u>Phone</u>	<u>Email</u>
Group members:		

### Important Campus Phone Numbers

<b>Department</b>			
<b>Campus Police Dispatch</b>	911 or CAT-COPS (228-2677)		
<b>EHS Director</b>	Mal Donohue		209 201-9820
<b>Biosafety Officer</b>	Aparupa Sengupta		209 382-4535
<b>Asst. Biosafety Officer</b>	Saumik Panja		209 285-8593
<b>Chemical Hygiene Officer</b>	Karen Smith		209 205-8176
<b>Chemical Technician</b>	Gerry Kefalinos		209 761-9414
<b>Facilities</b>			
<b>Campus Building Managers</b>	Mark Lutz, S&E 1	office:	208 228-7819
		cell:	209 217-7251
	Tyler Grise, S&E2		209 203-8900
	Neil Svendsen, SRE		209 349-1321
	Eddie Vilciauskas, BSP		209 217-7246
	Central Plant	office:	209 228-4308
		cell:	209 675-8067
<b>Human Resources</b>	Main Office		209 228-8247

Other Useful Phone Numbers

California Poison Control

1-800-222-1222