

Chemical Hygiene Plan

Revised December 2025



University of California
San Francisco

Introduction

The use of chemicals is essential to the University of California San Francisco's (UCSF) research program. The Chemical Hygiene Plan (CHP) was created to support the [Chemical Safety Policy](#) by establishing provisions capable of protecting laboratory personnel from potential health hazards associated with using hazardous chemicals in the laboratory.

This CHP is designed to comply with the regulations of the California Occupational Safety and Health Administration (Cal/OSHA) codified in the California Code of Regulations, [Title 8, Section 5191](#), Occupational Exposure to Hazardous Chemicals in Laboratories. This plan applies to all UCSF laboratory personnel who handle or may be exposed to hazardous chemicals in research laboratories at UCSF. This includes clinical laboratories.

The CHP does not apply to uses of hazardous chemicals which do not meet the [definition of laboratory use](#). In these cases, personnel must reference the [Hazard Communication Program](#), even if such use occurs in a laboratory.

The CHP does not cover the use of radioactive materials or biological agents. Information on these materials can be found in the University's [Radiation Safety Manual](#) and [Biosafety Manual](#), respectively.

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Rights, Responsibilities & Regulations

Rights and Responsibilities

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

Chancellor

The Chancellor is responsible for the establishment and implementation of environmental health and safety policies at all facilities under campus control. Appropriate vice chancellors, deans, chairs, laboratory directors, department managers, principal investigators, supervisors, and EH&S personnel are jointly and cooperatively responsible for the implementation, monitoring, and enforcement of these policies.

Deans and Department Chairpersons

Deans and department chairpersons are responsible for ensuring Principal Investigators and other supervisors within their departments are providing a safe workplace for their students and employees, and following UCSF policies as well as all local, state, and federal regulations relating to chemical safety.

Principal Investigators and Other Supervisors

Principal Investigators (PIs) and other supervisors have a responsibility to provide a safe workplace to all employees, students, contractors, and visitors working in their workspaces, which includes enforcing compliance with chemical safety policies. PIs and other supervisors are responsible for ensuring appropriate training is completed by those individuals working under their supervision, and for ensuring that those individuals wear appropriate Personal Protective Equipment (PPE) and follow safe procedures. PIs and other supervisors are responsible for ensuring timely correction of identified hazards in areas under their jurisdiction, and for ensuring a current chemical inventory is reported to EH&S on an annual basis, or whenever the physical inventory changes significantly.

Office of Environment, Health, and Safety (EH&S)

EH&S is responsible for coordinating this policy's implementation, and for monitoring and enforcing the chemical safety program at UCSF. EH&S employs the UCSF Chemical Hygiene Officer, whose responsibilities are described in the next section.

In addition, EH&S Fire Inspectors and the Campus Fire Marshal enforce applicable sections of the California Fire Code, including Maximum Allowable Quantities (MAQs) for each category of hazardous material.

EH&S is responsible for performing quarterly inspections of all UCSF laboratories, recommending safe practices, reporting on findings, and assisting end users to correct unsafe conditions & practices in a timely fashion. EH&S Department Safety Advisors (DSAs) work collaboratively with PIs, lab managers, and research staff to promote a safe and healthy work environment. EH&S is also responsible for evaluating potential personnel exposures to hazardous materials, for establishing appropriate exposure controls, and for ensuring appropriate safety training is provided to persons working with hazardous chemicals.

Finally, EH&S is designated as the UCSF regulatory liaison, reporting to government agencies any required information related to hazardous materials use, environmental releases, or other incidents.

Chemical Hygiene Officer

The Chemical Hygiene Officer within EH&S is responsible for maintaining the Chemical Hygiene Plan, which must be updated at least annually. The chemical hygiene officer serves as an expert on chemical safety and, in conjunction with the CESC, recommends safe practices for the safe use of chemicals and creates and implements policies on hazardous chemical use at UCSF. The Chemical Hygiene Officer is responsible for maintaining the UCSF Chemical Hygiene Plan and related Standard Operating Procedure (SOP) templates, which detail specific procedures and guidelines that must be followed by all persons working in UCSF laboratories.

Chemical and Environmental Safety Committee (CESC)

The CESC consists of UCSF faculty and staff charged with providing expert advice on chemical safety to the chancellor. The committee arbitrates campus disagreements regarding laboratory practices and has the authority to enforce chemical safety policies.

Employees, Students, Contractors, Volunteers, and Visitors

All employees, students, contractors, volunteers, and visitors working with hazardous chemicals are required to comply with all warning labels, signs, training, Chemical Hygiene Plan requirements, Standard Operating Procedures, and the UCSF Chemical Safety Policy.

Overview of Regulatory Information

Laboratories are a highly regulated environment. While the Lab Standard is the primary Cal/OSHA regulation concerning work with chemicals in the laboratory setting, there are other regulations that directly affect laboratories. Some of these regulations are summarized below.

Occupational Exposure to Hazardous Chemicals in Laboratories, California Code of Regulations, Title 8, Section 5191

Commonly referred to as the Lab Standard, Title 8 section 5191 applies to all employers that are engaged in the laboratory use of hazardous chemicals.

The main requirement of the standard is that employers develop and implement a Chemical Hygiene Plan (CHP). This is a written program that must be capable of protecting employees from the health hazards associated with chemicals used in the laboratory. It is essential that employee exposures are maintained below the airborne permissible exposure limits adopted by Cal/OSHA.

The Lab Standard supersedes the requirements of all other health standards in Section 5190 and Article 110, except for the requirement limiting exposures to below the Permissible Exposure Limits (PELs). Where PELs are routinely exceeded, exposure monitoring and medical surveillance are required. Additionally, the prohibition of eye and skin contact specified by any Cal/OSHA health standard must be observed.

While the Lab Standard supersedes Cal/OSHA health standards, other standards not specifically addressed remain applicable, such as the General Duty Clause explained below.

General Duty Clause

The purpose of the General Duty Clause is to ensure that the workplace is free from recognized hazards that are causing or likely to cause serious physical harm to employees. The General Duty Clause must not be used in cases where a specific standard exists and may not be used to set a higher level of protection than is provided for in a standard. However, any serious hazard not covered by a specific provision of Cal/OSHA may be subject to a citation under the General Duty Clause.

The General Duty Clause can be cited when:

- employees were exposed to a hazard
- the employer failed to keep the workplace free of the hazard or should have recognized the hazard based on industry standards or national consensus standards
- the hazard is likely to cause death or serious physical harm
- a feasible method is available to correct the hazard

Emergency Planning and Community Right-to-know Act

Created to help communities plan for chemical emergencies, this Act requires UCSF to report on the storage, use, and release of hazardous substances. This Act is enforced by delegated authority to San Francisco Department of Public Health.

Hazardous Materials Storage

The California Fire Code (CFC) and the California adopted National Fire Protection Association (NFPA) standards provide regulations regarding the storage of hazardous materials, including compressed gases and cryogenic liquids. Additionally, the CFC establishes Maximum Allowable Quantities (MAQs) for chemical loading inside UCSF buildings.

Personal Protective Devices, 8 CCR § 3380

California Code of Regulations, Title 8, Section 3380 ensures that employees are provided with and have appropriate training in the use of personal protective equipment, including eye, face, and respiratory protection.

Radiation Hazards

UCSF is authorized to procure and use radioactive material in specified areas under a Broad License issued by the State of California Department of Public Health. Protection from the hazards associated with ionizing radiation, non-ionizing radiation, and radioactive materials is required by several regulations. CFR Title 10 and 21, CCR title 17, the Atomic Energy Act, the Energy Reorganization Act, and the Nuclear Regulatory Commission all establish standards of protection, exposure limits, and licensing requirements. All work with radioactive materials and equipment producing ionizing radiation (i.e., wavelengths shorter than UV wavelengths) at UCSF is regulated by the Radiation Safety Group in the Office of Environment, Health and Safety.

Bay Area Air Quality Management District (BAAQMD)

The BAAQMD was created by the California Legislature in 1955 to regulate the stationary sources of air pollution in the nine counties that surround the San Francisco Bay. The Board regulates UCSF's emissions, including what is emitted through fume hood exhaust systems.

The State Water Resources Quality Control Board

The Water Boards regulate wastewater discharges to surface water, groundwater, and storm water discharges. To prevent discharges from UCSF property from affecting California waters, the Board regulates what materials and quantities can be disposed of through the drain.

Toxic Substances Control Act

The purpose of the Toxic Substances Control Act (TSCA) is to control new or existing chemicals that may present unreasonable health risks. The part of TSCA that directly affects research laboratories is part 8c, which includes record keeping requirements for significant adverse reaction allegations.

Fire Protection and Safety

Fire protection and fire safety are addressed in Cal/OSHA Title 8, Section 3221. Cal/OSHA requires that personnel be trained in fire safety and that available firefighting equipment is maintained.

Information and Training

Information

All personnel covered by the Laboratory Standard are provided with and have access to the following information:

- the contents of Cal/OSHA Title 8, Section 5191, “Occupational Exposure to Hazardous Chemicals in Laboratories” and its appendices
- the Chemical Hygiene Plan
- the Permissible Exposure Limits for Cal/OSHA regulated substances, or, for hazardous chemicals for which there is no applicable Cal/OSHA standard, the recommended exposure limits
- the signs and symptoms associated with exposure to hazardous chemicals
- Safety Data Sheets. The University of California maintains a [safety data sheet database](#) in the [UC Safety](#) system.

The information listed shall be communicated to each employee during the training received at the employee's initial time of hire.

Training

Effective training is critical to facilitate a safe and healthy work environment and prevent laboratory accidents. All PIs/Laboratory Supervisors must participate in formal safety training and ensure that all employees have appropriate safety training before working in a laboratory. The training courses are designed so that employees are apprised of the health hazards associated with hazardous chemicals in the workplace and measures that they can take to protect themselves from these hazards. If in the course of their work assignments new exposure situations arise, the employee will receive additional training.

Types of Training

EH&S-provided Training

The [UC Learning Center](#) is a learning management system that allows personnel to:

- Complete online training
- Access and print training history reports
- View and print certificates of completion

Re-training is required for some courses at intervals decided by the relevant regulation.

The [EH&S Website](#) contains more detailed information on the available safety trainings and their requirements.

Laboratory Directed Training

PIs/Laboratory Supervisors must also provide training specific to their operations. Topics that require specific training include:

- Location and use of the Chemical Hygiene Plan, Injury and Illness Prevention Plan (IIPP), Safety Data Sheets, and other regulatory information
- Review of IIPP and Emergency Management Plan, including location of emergency equipment and exit routes
- Use of engineering controls, administrative controls, and personal protective equipment to mitigate hazards
- Specialized equipment
- Standard Operating Procedures (SOPs)
- Review of reference materials (e.g., SDS) on hazards, handling, storage, and disposal of hazardous chemicals
- Specialized procedures and protocols

Many of these topics are covered in [the site-specific orientation checklist](#). It is a University of California policy that each person working in a laboratory or technical area receives a one-time site-specific orientation.

Lab-directed training is required on a regular basis to promote a strong safety culture.

Documentation of Training

Accurate recordkeeping is a critical component of health and safety training. EH&S maintains records of all safety training that it provides. Departments or laboratories are responsible for documenting all other health and safety trainings, including safety meetings, one-on-one training, and any third-party in-person or online trainings. For lab-directed trainings, please include a sign-in sheet with sufficient details such as date, topics discussed, and instructor of the training.

EH&S provides a [safety training verification form](#) to document laboratory-directed training. Histories for EH&S-provided trainings for all laboratory employees are available to PIs/Laboratory Supervisors through either RIO or the RSS website ([instructions are available here](#)).

General Safety Procedures

Laboratory Safety Orientation for New Employees

Principal Investigators and other supervisors are responsible for ensuring that all employees receive adequate training and understand the hazards present in their work area. All employees must complete the [Laboratory Safety Orientation for New Employees](#) with their Principal Investigator or Lab Manager/Supervisor prior to initiating work of any kind.

Laboratory Hazard Assessment Tool

The Laboratory Hazard Assessment Tool (LHAT) is a web-based resource for identifying hazards present in your lab or research area. This assessment must be conducted by the Principal Investigator on an annual basis, or whenever there are significant changes to laboratory's activities. Each lab member is required to review the assessment upon starting work in the laboratory, and annually thereafter. See the [UCSF LHAT user guide](#) for further instructions.

Upon completion of the LHAT review, a Personal Protection Equipment (PPE) voucher is issued for the required PPE identified by the LHAT. Lab coats are available at no cost to UCSF researchers. For more information on obtaining & laundering lab coats, see <https://chemcentral.ucsf.edu/lab-coat-distribution>.

Campus Injury and Illness Prevention Program

The [UCSF Campus Injury and Illness Prevention Program](#) (IIPP) describes the authority and responsibilities of all UCSF campus employees with regards to general workplace safety. It addresses workplace safety, compliance, hazard identification, incident reporting and investigation, hazard mitigation, training, employee communication, program documentation and recordkeeping. The IIPP complies with the Cal/OSHA California Code of Regulations Title 8, Section 3203 to provide a safe and healthful workplace for all campus employees. The IIPP also reinforces the University of California's system-wide Policy on Health, Safety, and Environmental Protection and the UCSF Workplace Safety and Environmental Protection Policy.

UCSF Health maintains a separate IIPP that applies to all UCSF Health employees and activities, which is found [here](#).

Minors in Lab

Minors are permitted in the laboratory under the restrictions and requirements outlined in the [Minors in Laboratory Policy](#).

Food and Drink in Labs

Consumption and storage of food and/or beverages in laboratories has been associated with Laboratory-Acquired Infections (LAIs). Therefore, eating, drinking, and storing food for human consumption is not permitted in laboratory areas. This includes the use and/or presence of coffee mugs/cups, water bottles, food wrappers, etc., in any laboratory locations.

Inspections and Compliance

EH&S maintains an extensive laboratory compliance program to assist laboratories and other facilities that use, handle, or store hazardous materials to maintain a safe work environment. This program helps to ensure compliance with regulations and to fulfill UCSF's commitment to protecting the health and safety of the campus community.

As part of this program, EH&S conducts quarterly inspections of laboratories and other facilities with hazardous chemicals to ensure the laboratory is operating in a safe manner and to ensure compliance with all federal, state, and university safety requirements. The primary goal of an inspection is to identify both existing and potential accident-causing hazards, actions, and faulty operations or procedures that can be corrected before an accident occurs.

Chemical Inventory

An up-to-date inventory of hazardous chemicals and compressed gases is necessary to evaluate the hazards in a laboratory, shop, or work area. An accurate inventory is also essential to ensure the safety of first responders who may need to enter UCSF buildings in case of a fire or medical emergency. The campus can be fined if it does not provide an accurate inventory to emergency response personnel and appropriate regulatory agencies.

Anyone responsible for an area where hazardous materials are stored is required to maintain a complete chemical inventory in [UC Chemicals](#). This includes, but is not limited to, people in the following roles:

- Principal Investigators
- Supervisors
- Storeroom managers

Chemical inventory records must be comprehensively updated ("reconciled") and certified annually. In addition, they must be updated within 30 days of any significant changes to the inventory, such as a room relocation, additions of large amounts of new chemicals, or changes in the names and contact information of key contacts.

Guides and other resources can be found at <https://ehs.ucsf.edu/chemical-inventory>. For technical assistance with UC Chemicals or to request delivery of barcodes, contact chemicalinventory@ucsf.edu.

Management of Chemicals

Before a substance is received, information on the proper handling, storage, and disposal should be made known to all individuals involved, including warehouse receiving personnel and laboratory workers.

Chemical procurement

Hundreds of research chemicals are purchased through BearBuy daily, many of which pose health, security, and environmental risks if improperly handled. EH&S tracks the purchase of these hazardous materials to ensure the correct controls are in place to keep our community and environment safe.

For catalog purchases, flags are assigned to items by the catalog vendors. In the case of a non-catalog purchase, it is the responsibility of the purchaser to identify the hazards associated with all items they purchase and to select the appropriate flag.

Purchases of hazardous chemicals must **not** be made using Procurement Cards (P-Cards). All such purchases must be made through BearBuy.

Chemical Labeling, Storage, & Segregation

The [Safe Storage of Hazardous Chemicals](#) guide provides information on labeling and storage requirements for hazardous chemicals at UCSF. Additionally, the specific Safety Data Sheet (SDS) should always be consulted when doubts arise concerning chemical properties and associated hazards.

Distribution & Transport

It is important to take extra precautions when transporting hazardous materials in public hallways, which are the most dangerous places for spills. There is 6 times less ventilation in hallways than laboratories, and 1000 times less ventilation in hallways than in fume hoods. In addition, it is very difficult to isolate the spill, and building-wide evacuations are often necessary.

Transport of hazardous chemicals via public or shared transportation is prohibited. Under no circumstances may public transportation (e.g., UCSF shuttles, MUNI, private taxi, etc.) be used to transport hazardous materials. Furthermore, the use of personal vehicles to transport hazardous chemicals is also prohibited.

Transporting small quantities (<20 liters) between UCSF labs or buildings on foot

- Individual chemical containers (≤ 4 liters) can be hand delivered by employees using a rubber bucket or other equally effective means to prevent and contain spills or other releases
- Up to 20 liters can be transported on a sturdy cart within a connected building or to nearby buildings. Secure the material so it will not fall off the cart

- Ensure individual containers are labeled to accurately describe the contents. Original manufacturers' labels should be sufficient. Replace damaged or illegible labels
- Check containers and lids for damage and cracks. Replace any faulty caps or containers. Damaged containers cannot be transported
- Use sturdy moving boxes, plastic bins, or original packing boxes. Breakable containers should be avoided
- Use non-reactive packing materials
- DO NOT transport hazardous chemicals on UCSF shuttles or rental vehicles, public transportation, or personal vehicles
- Avoid public areas. Use freight elevators whenever possible
- Upon arrival at the new location, ensure that personnel check the contents for damage, remove chemicals from the packing boxes, and place the chemicals in designated storage locations

Transporting large quantities (>20 liters) of chemicals

Transport of large quantities of chemicals between buildings or across campus must be conducted by UCSF Hazardous Materials Management (HMM) or another certified hazardous material transporter.

Exception: With approval from EH&S, laboratory personnel may transport larger quantities of chemicals within connected buildings. Contact your Department Safety Advisor for more information.

1. Contact EH&S HMM at 415-476-1480 or waste@ucsf.edu to coordinate a date and time for pickup.
2. If this is part of a laboratory relocation, coordinate with your project manager to assign the cost appropriately.
3. Inspect chemical stock and dispose of old and unneeded chemicals.
4. Ensure individual containers are labeled to accurately describe the contents. Original manufacturers' labels should be sufficient. Replace damaged or illegible labels.
5. Check containers and lids for damage and cracks. Replace any faulty caps or containers. Damaged containers cannot be transported.
6. Tightly cap all bottles and stand them upright. Any beakers, bottles, and flasks closed with foil, parafilm, corks, or stoppers must be overpacked inside containers with lids that can be securely closed.
7. Disconnect gas cylinders from regulators and equipment. Cap all cylinders.
8. Contact your vendor to schedule liquid nitrogen pickup and transport, and re-connection of cylinders in new location.

HMM personnel will review the chemical lists, inspect the containers, and package the chemicals for the move. Upon arrival at the new location, laboratory personnel must check contents for damage, remove chemicals from the packing boxes, and place the chemicals in designated storage locations.

Transporting chemicals within buildings

1. All liquid chemicals transported in hallways must be in secondary containment.

- Use only break-resistant secondary containment.
- Carrying handles must be securely attached.
- Secondary containment must be large enough to hold the contents of the chemical containers in the event of breakage.
- Resealable plastic bags serve as adequate secondary containment for small samples (< 1 L).

2. Carts

- When using carts to transport chemicals, each shelf must have sides that are high enough to prevent containers from falling off the cart.
- A wide cart ($\geq 24''$ width) must be used if transporting containers larger than 4 L or more than 2 bottles of liquid chemicals.
- Cart wheels must be large enough to prevent the cart from being caught in elevator thresholds.

3. Cryogenic dewars and cylinders of compressed gas:

- Must always be transported using the elevator and never the stairs.
- Cylinders must be transported by a hand truck with the cylinder strapped in place and the valve cap screwed in place.

4. Elevators

- Use freight elevators whenever possible when transporting hazardous chemicals between floors.
- No passengers other than the person transporting may be in the elevator when transporting hazardous chemicals.
- When transporting cryogenic liquids or liquefied compressed gases using an elevator, no passengers (not even the person transporting) are allowed in the elevator. If the elevator does not have lockout controls that prevent others from calling the elevator, it is recommended to have a colleague waiting by the elevator on the destination floor.

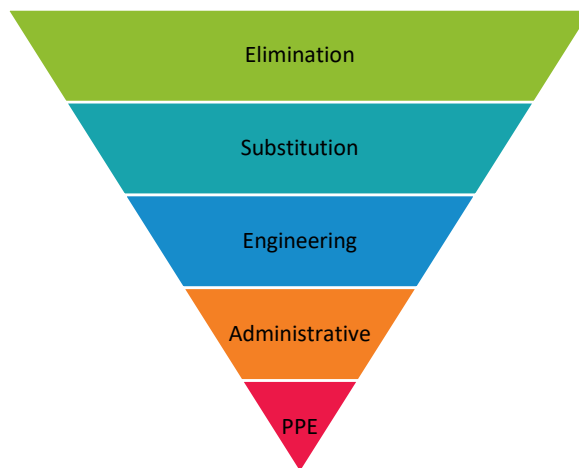
Working with Chemicals

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.

1. Inhalation
2. Absorption (through skin or eyes)
3. Ingestion
4. Injection

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.

Safety controls are divided into five main classifications and must be applied according to the hierarchy of controls (refer to the image on the right). The higher a control measure is on the hierarchy, the more effective it is at controlling hazards.



Elimination and Substitution

Whenever possible, the most effective way to avoid the hazards of a chemical is to avoid its use entirely by altering experimental procedures to eliminate the use of said hazardous material. Failing that, the next preferred method is to substitute a less hazardous material that serves the same purpose.

Such measures may not always be feasible, but are strongly encouraged.

Engineering Controls

Engineering controls include all “built in” safety systems. These controls offer the first line of protection and are highly effective in that 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 effective at containing chemical hazards and protecting users from inhalation hazards.

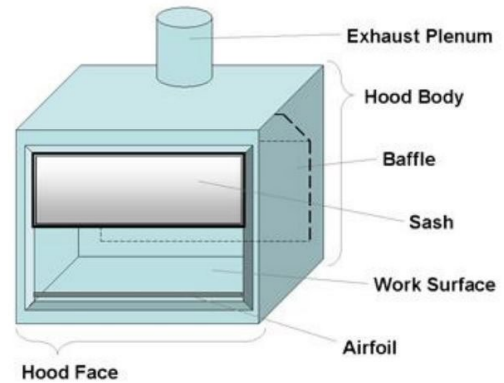
General Lab Ventilation

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 may not be part of recirculated air systems. Laboratory rooms should be kept at negative pressure compared to public areas

to prevent the spread of hazardous vapors. See the [University of California Lab Safety Design Manual](#) for additional information on laboratory ventilation.

Fume Hoods

The fume hood is the primary engineering control used to protect workers from exposure to hazardous materials in the laboratory. A fume hood is an enclosure with a movable sash that has been designed to prevent or minimize the escape of air contaminants into the laboratory. Air is drawn in from the laboratory, but the fume hood is not designed to capture air contaminants generated outside of the enclosure, only those generated within. The fume hood is constructed of material that will withstand fire for several minutes but not necessarily explosions.



General Rules for Fume Hood Use

1. Fume hoods should not be used for work involving hazardous substances unless they have a certification label that confirms certification has occurred within the last year
2. Chemicals and laboratory apparatus should be placed at least six inches behind the face of the hood.
3. **Never** put your head inside an operating fume hood. The plane of the sash is the barrier between contaminated and uncontaminated air
4. Work with the sash in the **lowest practical position**. The sash acts as a physical barrier in event of an accident.
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.

It is advisable to use a fume hood when working with all hazardous substances. In addition, a fume hood or other suitable containment device must be used:

- for all work involving particularly hazardous substances, which are defined by Cal/OSHA as select carcinogens, reproductive toxins, and chemicals with a high degree of acute toxicity
- whenever the airborne concentration of a chemical is likely to approach the action level or permissible exposure limit (PEL)
- whenever flammable vapor concentrations are likely to approach one tenth of the lower explosion limit
- whenever noxious odors are emitted

To be effective in controlling exposures to hazardous chemicals, the laboratory fume hood must be operating properly and used correctly. To ensure proper operation of fume hoods, EH&S annually measures the face velocity, and visually inspects the capture abilities using a

smoke test. The date and results of the test are recorded on a sticker, located on the fume hood.

If a hood does not pass inspection and is unsafe for use, it is labeled with a "DO NOT USE" sign and the Office of Environment, Health and Safety notifies Facilities Management, who will then determine the cause of the problem and correct the faulty conditions. During maintenance of fume hoods, the fume hood must be cleaned out and, if necessary, decontaminated.

The user must monitor fume hoods daily to ensure that air is moving into the hood and to ensure that the hood and baffles are not blocked by equipment and bottles, which may result in a decrease in the air velocity through the face. All hoods shall be equipped with a quantitative air flow indicator, and must have an audible or visible alarm to alert users to high- and low-exhaust flow. Any problems should be brought to the attention of Facilities Management.

Glove Boxes

Glove boxes are small units with multiple openings to which arm length rubber gloves are mounted, often used as containment devices.

If toxic chemicals are used, glove boxes must be operated under negative pressure, unless used for experiments in which protection from the atmosphere is desired. The gloves should always be checked for the appropriate chemical resistance and for any signs of physical damage before use. The exhaust air may require special treatment (such as chemical scrubbing and/or HEPA (high efficiency particulate air) filtration) before release into the regular exhaust system.

If highly toxic materials must be used in a positive pressure glove box, the box and gloves must be tested for leaks prior to each use. It is also desirable to have a shut off valve or pressure gauge designed into the system for monitoring purposes.

Local Exhaust Ventilation

Local exhaust ventilation (LEV) is an engineering control designed to reduce employee exposure to airborne contaminants by capturing the emission at the source and transporting it to a safe emission point or to a filter/scrubber. The two main types of LEV systems at UCSF are downdraft tables and flex-arm hoods. These systems are frequently used by UCSF personnel conducting small animal surgeries to control their exposure to hazardous chemicals such as formaldehyde or isoflurane, and allergens such as animal dander.

To ensure the LEV systems are working as designed, annual performance testing must be conducted by EH&S. To be considered compliant, air velocity measurements must have a calculated average velocity of 50-100 fpm with no single measurement points below 40 fpm or above 125 fpm.

Biological Safety Cabinets

Biological Safety Cabinets (BSCs) are enclosed, ventilated workspaces designed to provide personnel, environment, and product protection. Several different types of BSCs are available and provide different levels of protection, as summarized in the following table.

BSC Class	Face Velocity	Airflow Pattern	Non-Volatile Toxic chemicals	Volatile Toxic chemicals
I	75	Enters under sash, through HEPA to outside or to room through HEPA. No cabinet blower, uses exhaust fan outside.	Yes	Only if exhausted outdoors*
II, A1	75	Enters under sash and work surface, through work area HEPA, 70% recirculates back to work area through cabinet blower to plenum positively pressured relative to room, 30% exhaust through HEPA either into room or to outside via canopy duct	Yes, minute quantities	No
II, B1	100	Enters under sash and work surface, through HEPA to cabinet blower to work area HEPA, 30% recirculates back to work area, 70% exhausts through HEPA to outside via dedicated non-canopied duct	Yes	Yes, minute quantities*
II, B2	100	Enters through cabinet blower and under sash and work surface to blower, through HEPA, no recirculation, 100% through exhaust HEPA to dedicated non-canopied duct.	Yes	Yes, small amounts*
II, A2	100	Similar to II, A1 but has 100 fpm face velocity and plenums are negatively pressured relative to the room; can exhaust via exhaust HEPA to either room or outside via canopied duct	Yes	Yes, minute quantities*, and only if exhausted outdoors
III	N/A	Supply air is HEPA-filtered. Exhaust is through two HEPA filters to outside via non-canopied duct	Yes	yes, small amounts*

Table excerpted from [Biosafety in Microbiological and Biomedical Laboratories](#), 5th edition, page 311.

* Contact your [Department Safety Advisor](#) (DSA) before performing any work with volatile toxic chemicals in a ducted biosafety cabinet.

Administrative Controls

These controls consist of policies and procedures; they are generally not as reliable as engineering controls, in that the user must be fully trained and follow the appropriate procedures.

EH&S requires that each laboratory have safety procedures, which include instructions on safe work practices, for any work that involves hazardous materials. These safety procedures should be laboratory-specific and communicated via lab specific trainings, Standard Operating Procedures, or Job Hazard Analyses. Training on these procedures must be properly documented.

[Standard Operating Procedures \(SOPs\)](#)

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. While general guidance regarding laboratory work with chemicals is contained in this Chemical Hygiene Plan, PIs/Laboratory Supervisors are required to develop and implement laboratory-specific standard operating procedures for certain hazardous chemicals used in their laboratories. 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. To alleviate the need for hundreds or thousands of chemical-specific SOPs, UCSF encourages the use of control banded SOPs.

The process of control banding matches a control measure (i.e., ventilation, engineering control, containment, etc.) to a range or “band” of hazards and exposures. The control banding system groups chemicals in a lab’s inventory according to similar physical and chemical characteristics, how the chemical is handled or processed, and what the anticipated exposure is expected to be.

[Control banded SOP templates](#) have been prepared in collaboration with the [Chemical and Environmental Safety Committee](#).

SOPs should be written by the laboratory personnel who are most knowledgeable and involved with the experimental process. The Principal Investigator and all personnel responsible for performing the procedures detailed in the SOP shall sign the SOP to acknowledge the contents, requirements, and responsibilities. When drafting an SOP, consider the type and quantity of the chemical being used, along with the frequency of use. The Safety Data Sheet (SDS) for each hazardous chemical 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.

The SOPs shall be reviewed by qualified personnel and approved by the Principal Investigator. SOPs shall be amended when significant changes in conditions, methodologies, equipment, or the use of the chemical occurs. When an SOP is amended, it must be re-approved by the PI. For chemicals with notable hazards or that require specialized work practices, researchers must consider whether additional consultation with safety professionals and/or knowledgeable colleagues is warranted when developing an SOP.

Choosing the Right SOP Template

All chemicals are assigned GHS hazard codes based on the nature and severity of the hazards. H-codes are useful in determining which materials require a SOP as the definitions are standardized worldwide.

Each [Control banded SOP template](#) provided by EH&S correlates to a hazard class that is defined by one or more H-codes as listed below.

Acutely toxic	H300 H301 H302 H303 H310 H311 H312 H313 H330 H331 H332 H333
Carcinogens	H350 H351
Compressed gases	H280
Corrosives	H290 H314
Cryogenic liquids	H281
Explosive and Potentially Explosive Compounds	H200 H201 H202 H203 H204 H205 Other potentially explosive compounds based on chemical structure. See SOP template for more information.
Flammable gases	H220 H221
Flammable liquids	H224 H225 H226 H227
Flammable solids	H228
Peroxide Forming Chemicals	No H-codes. See SOP template for lists of common peroxide formers
Pyrophoric (liquids)	H250
Pyrophoric (solids)	H250
Reproductive Hazards	H360 H361 H362
Sensitizers	H317 H334
Strong Oxidizers	H270 H271 H272
Water Reactives	H260 H261

Pre-approval of Higher-Risk Work

Pre-approval by the laboratory manager or Principal Investigator must be obtained prior to beginning laboratory activities which do not follow standard or special operating procedures,

or which introduce significant additional hazards. These activities include off-hours work, sole occupancy of the lab, and unattended operations. The toxicity of the chemicals used, the hazards of the procedures to be done, and the knowledge and experience of the laboratory workers must be considered in deciding which work will be allowed with pre-approval.

Off-Hours Work: Laboratory personnel are not permitted to work after hours in the lab unless prior approval has been obtained from the laboratory supervisor or principal investigator.

Working Alone: Laboratory personnel are not permitted to perform laboratory work when they would be the only person in the laboratory, unless crosschecks, periodic security guard checks, or other communication measures are taken.

Unattended Operations: When laboratory operations are performed which will be unattended by laboratory personnel (continuous operations, overnight reactions, etc.), the following procedures will be employed:

- Appropriate signage will be posted that contains the name and contact information of the person to be contacted if there is an emergency, as well as the hazards associated with the reaction and recommended response actions in case of an emergency. EH&S has created a sign that can be used to communicate this information, available at [this link](#). Laminated versions are also available; contact your DSA to request them.
- The overhead lights in the laboratory will be left on
- Precautions shall be made for the interruption of utility service during the unattended operation (loss of water pressure, electricity, etc.)
- The person responsible for the operation will return to the laboratory at the conclusion of the operation to assist in the dismantling of the apparatus

Personal Protective Equipment

[PPE Policy](#)

Personal protective equipment (PPE) consists of eye protection, gloves, and apparel such as lab coats and aprons. While engineering controls are the most effective in reducing exposure to hazardous substances, the use of PPE will also minimize the risk of exposure to hazardous materials and should always be used in conjunction with engineering controls.

The University of California uses the Laboratory Hazard Assessment Tool (LHAT) to determine the appropriate PPE for tasks involving hazardous materials. LHATs can be created and viewed at <https://ehs.ucop.edu>. UCSF requires that the PI review and re-certify the LHAT at least once a year. The SDS for a given material can offer additional guidance on PPE selection.

Eye Protection

Contact with the eyes is one of the primary routes of exposure to hazardous substances. Therefore, eye protection is necessary for all work involving the use and handling of chemicals, no matter how innocuous the material may seem.

Safety glasses with side shields meeting the American National Standards Institute Standard Z87.1-1989 provide the minimum acceptable eye protection for regular use. Ordinary prescription glasses do not provide adequate protection against eye injury and should not be used as safety glasses.

Contact lenses are acceptable in the laboratory, provided that proper eye protection is worn at all times.

When the possibility of splashing or spraying chemicals exists or when there is a danger of flying particles, goggles having splash proof sides should be worn. Goggles should be worn when working with hazardous substances, when working with glassware under reduced or elevated pressures, and when using glass apparatus in high temperature operations. In addition, full face shields with throat protection should be used when working with highly hazardous or explosive materials.

For procedures involving exposure to laser, ultraviolet light, infrared light or intense visible light, specialized eye protection is required. Contact the [Laser Safety](#) Officer or your [Department Safety Advisor](#) for more information.

Pyrophoric Hand Protection

Pyrophoric chemicals are liquids, solids, or gases that **ignite spontaneously in the presence of oxygen and/or water vapor in air.**

Whenever possible, pyrophoric materials should be handled in an enclosure such as a glove box with an inert atmosphere. When handling pyrophoric materials outside of an inert glove box, fire retardant gloves must be worn. This is not only prudent, but also mandated by Cal/OSHA.

EH&S recommends Ansell Goldknit® 70-200 or Ansell Hyflex® 70-215 gloves to all UCSF laboratories using pyrophoric materials. These gloves meet flame resistance testing requirements and provides good dexterity for laboratory procedures.

Since the Kevlar® gloves can absorb hazardous liquids, a chemically resistant neoprene glove must be worn over the fire-retardant glove. Neoprene is recommended over nitrile since it is less combustible. Principal Investigators are responsible for ensuring that their SOPs for pyrophoric materials include the use of these gloves and that everyone in their laboratory is properly trained on their use and care. For questions, contact your [Department Safety Advisor](#).

Gloves

Contact with skin is one of the major routes of exposure to hazardous substances. Therefore, gloves must be worn when working with chemicals. The gloves selected should be resistant to the chemical in use, possessing the appropriate resistance to degradation and permeation upon exposure to the hazardous substance in use. Most manufactures provide glove selection guides which contain further information on the chemical resistances of various classes of gloves. UCSF EH&S also maintains a [glove selection guide](#).

Always inspect gloves before use to ensure that they do not have any cracks, tears, or small holes in them. If gloves are torn, they should be replaced immediately. Gloves should always be removed before leaving the work area and before handling objects such as telephones, doorknobs, notebooks, and writing instruments.

Protective Apparel

Protective apparel such as laboratory coats or aprons should be worn if the possibility of contaminating personal clothing with hazardous chemicals exists. The choice of apparel depends on the specific hazardous materials being used. Factors to consider in apparel choice include resistance to physical hazards, chemical and thermal resistance, ease and flexibility of movement, ease of removal, and ease of cleaning or disposal. Laboratory coats must not be worn in public spaces unless actively engaged in transport of hazardous materials.

Contaminated Clothing/PPE

In cases where spills or splashes of hazardous chemicals on clothing or PPE occur, the 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. Lightly contaminated laboratory coats should be decontaminated, and then professionally laundered by a lab coat vendor. Laboratory personnel should **never** take contaminated items home for cleaning or laundering. Refer to the following chart for decontamination procedures.

<i>Chemical</i>	<i>Radiation</i>	<i>Biological</i>
<i>Dispose of as "solid waste contaminated with..."</i>	Radioisotopes with half-life <90 days (e.g. ³²P, ³⁵S, ¹²⁵I): Store shielded for ten half-lives. When detectable counts are less than three times the background radiation, item can be sent for laundering or disposal. Radioisotopes with half-life >90 days: Dispose of as radioactive waste	Spray with 10% bleach, rinse after 30 minutes, dry, then send for laundering. If it is grossly contaminated, dispose of as biohazardous waste

Personal Protective Equipment outside of the Laboratory

Everyone plays a role in preventing the spread of contamination.

Personal protective equipment, including lab coats and gloves, must not be worn outside of the laboratory (e.g., corridors, elevators, offices). Lab coats must be removed prior to exiting the labs, and gloves must be removed prior to touching any surfaces or equipment that can result in cross-contamination (e.g., doorknobs, telephones, and computers).

If you are hand-transporting small quantities of hazardous materials, use one ungloved hand to touch common surfaces and one gloved hand to carry the hazardous items.

Scale-up of Chemical Reactions

Increasing the scale of chemical reactions introduces additional risks that must be considered when setting up the experiment and determining safe work practices. Possible complications include:

- **Insufficient cooling of exothermic reactions:** Heating & cooling of reactions is typically accomplished by immersing the reaction vessel in an appropriate material (e.g., oil bath, sand bath, ice bath). Heat transfer occurs through the surface of the vessel. Per the [square-cube law](#), when scaling up reactions, the volume of reagents (and therefore the total heat generated by the reaction) increase faster than the surface area available for heat transfer. This can cause the reaction vessel to overheat and overpressurize. Any reactions or side reactions that produce gaseous products increase the risk of overpressurization. A thermal runaway can also occur, where reaction rates accelerate exponentially due to the heat generated by the reaction.
 - Even with reactions that are heated, overheating and thermal runaways are still possible, especially if there are any exothermic side reactions. In a smaller reaction, the excess heat generated from such reactions can quickly dissipate into the heating medium, but this may not be the case when the reaction is scaled up.
- **Handling of larger amounts of hazardous chemicals:** The techniques and equipment used to handle small amounts of hazardous materials may not be safe at larger scales. For example, although syringes can be used to transfer small amounts of pyrophoric liquids, at larger scales, it is safer to use a cannula to minimize risk of spills and accidents.
- **Inadequate mixing:** Larger reaction vessels can present issues with stirring, especially with solid reagents. Inadequate stirring can lead to incomplete consumption of reagents (poses a risk during work-up), inefficient heating/cooling of the reaction mixture (as heat transfer occurs at the surface of the reaction vessel), or

unpredictable/delayed mixing of reagents (which can cause unpredictable or delayed generation of heat).

- **Work-up procedures:** The risks of scale-up do not end when the reaction is complete. Work-up steps, such as quenches or washes, can also generate excess heat or hazardous byproducts that become more hazardous at larger scales.

For these reasons, the UCSF Standard Operating Procedure templates include a section for “Approved Scale,” which describes the largest quantity of hazardous chemicals that are approved for use under the SOP. Any procedures occurring at larger scales require that the researcher consult with the PI to discuss additional safety precautions.

If a large scale-up is needed, it is recommended to gradually increase the size of the reaction over multiple iterations. If the type of reaction is one you have not scaled up before, scaling up by a factor of 3 is recommended as a starting point. For well-known reactions with a history of safe scale-up, larger increases may be permissible – consult with your PI. Monitor these reactions for signs of the issues described in this section.

Additional Protections for Work with Particularly Hazardous Substances

Cal/OSHA defines Particularly Hazardous Substances (PHS) as including “select carcinogens,” reproductive toxins, and substances which have a high degree of acute toxicity. Cal/OSHA further defines select carcinogens as any substance that meets any of the following criteria:

1. Regulated by Cal/OSHA as a carcinogen
2. Listed in the category “known to be carcinogens” in the Annual Report on Carcinogens published by the National Toxicology Program (NTP), 1985 edition
3. Listed under Group 1 (“carcinogenic to humans”) in monographs published by the International Agency for Research on Cancer (IARC)
4. Listed as either (a) Group 2A or 2B by IARC or (b) in the category “reasonably anticipated to be carcinogens” by NTP, **and** causes statistically significant tumor incidence in experimental animals under any of the following exposure criteria:
 - a. After inhalation exposure of 6-7 hours per day, 5 days per week, for a significant portion of a lifetime, to air concentrations of less than 10 mg/m³
 - b. After repeated skin application of less than 300 mg/kg of body weight per week
 - c. After oral dosages of less than 50 mg/kg of body weight per day

For any work involving PHS, Cal/OSHA requires that researchers consider the inclusion of the following provisions where appropriate:

1. Establishing a designated area for work involving PHS
2. Using containment devices such as fume hoods or glove boxes
3. Procedures for the safe handling & removal of waste contaminated with PHS
4. Decontamination procedures

At UCSF, all laboratories are considered designated areas for work involving PHS.

Carcinogens Regulated under Section 5209

In addition to the precautions for particularly hazardous chemicals, work involving certain carcinogenic chemicals is subject to the Cal/OSHA requirements listed in [8 CCR 5209](#). The carcinogens in question and the concentrations that trigger these additional requirements are listed below.

Chemical	CAS Number	% (either by volume or weight)
2-acetylaminofluorene	53-96-3	1.0
4-aminodiphenyl	92-67-1	0.1
Benzidine (and its salts)	92-87-5	0.1
3,3'-Dichlorobenzidine (and its salts)	91-94-1	1.0
4-dimethylaminoazobenzene	60-11-7	1.0
α -naphthylamine	134-32-7	1.0
β -naphthylamine	91-59-8	0.1
4-nitrobiphenyl	92-93-3	0.1
N-nitrosodimethylamine	62-75-9	1.0
β -propiolactone	57-57-8	1.0
Bis(chloromethyl) ether	542-88-1	0.1
Methyl chloromethyl ether	107-30-2	0.1
Ethyleneimine	151-56-4	1.0

For information on what additional precautions are required when working with these carcinogens, please refer to the [relevant Safety Update](#).

As the required precautions are extremely stringent and onerous, EH&S strongly encourages avoiding the purchase and use of these chemicals.

Working with Laboratory Equipment

Many types of laboratory equipment and common laboratory processes have inherent risks associated with them. For example, there is always a risk of explosion or implosion when working under conditions of elevated or reduced pressures. Highly exothermic reactions can become violent unless there is sufficient means of cooling.

Water Cooled Equipment

Using cooling water in laboratory equipment such as condensers is a common laboratory practice. The tubing used to supply the water can become disconnected, creating a flood that may seriously damage equipment. To minimize the risk of flooding:

- Be sure that all tubing is securely fastened. Water pressure in the building can vary and tends to increase after hours
- Inspect the hose material frequently, as the hoses can deteriorate and break after long-term use
- Keep sink drains free of clutter, as exit hoses tend to jump out of the sink
- Use plastic locking disconnects for easier connection of water lines, while leaving secured lines intact



Sustainability tip

Using a water circulator for equipment like reflux condensers, sublimation apparatus, or rotary evaporators can greatly reduce the amount of water used and reduce the risk of flooding. An inexpensive alternative to a temperature-controlled circulator is a simple water reservoir and a small water pump.

Cooling Baths and Cold Traps

Commonly used cooling baths include ice water & salt and ice. When it is necessary to reach lower temperatures, dry ice and an organic liquid are often used. Using cryogenic coolants must be done with caution. The following guidelines are intended to minimize the hazards associated with using cooling baths and cold traps:

- When preparing a dry ice cooling bath, add the dry ice to the liquid or the liquid to the dry ice in small increments
- Do not seal cooling baths. Pressure may build up and cause an explosion
- When handling dry ice or any other cryogenic coolant, use gloves and a face shield
- When using cold traps in a vacuum system, make sure that the trap is large enough and cold enough to collect the condensed vapors



Sustainability tip

Solvents used with dry ice can be recycled. However, used solvents will be supersaturated with CO₂, even after being warmed to room temperature. Always allow for the solvent to degas prior to sealing the solvent container. Use a vented cap to avoid pressure build up.

- Check cold traps frequently to make sure that they do not become plugged with frozen material
- If liquid nitrogen is used to cool a vacuum trap, remove the liquid nitrogen before opening the system to air. Failure to do so can lead to the condensation of liquid oxygen, which can react explosively with organic materials.
- When using a cold trap in a reduced pressure system, the trap should be taped or placed in a metal can filled with vermiculite

Laboratory Ovens

Ovens are commonly used for drying glassware and removing solvents from samples. Except for vacuum drying ovens, most ovens do not have a means of preventing volatilized material from being released into the laboratory atmosphere, which can result in potential exposure situations. In addition, it is possible that explosive mixtures can form inside the oven. Precautions that should be observed when using ovens include:

- Unvented laboratory ovens should not be used to dry samples that contain volatile and toxic chemicals.
- Glassware that has been rinsed with an organic solvent should not be dried in an oven unless it has also been rinsed with distilled water.
- If a mercury thermometer breaks inside an oven, the oven should be closed and turned off immediately.
- In case of a mercury spill, contact EH&S for cleanup and air monitoring until the mercury vapor concentration is below the PEL.

Oil and Sand Baths

Extreme care must be taken when using oil or sand baths for heating purposes. Serious injuries, such as burns, can result due to the splattering of hot material. Overheated oil can easily burst into flames. When using oil or sand baths:

- Avoid spilling water or other volatile substances into the bath
- Any hot oil spilled should be contained
- All oil baths should be labeled with the oil used and its safe working temperatures
- If oil baths must be left unattended, they must have a warning label and should be fitted with a temperature monitoring device and a timer/automatic shut-off for the heating device

Inhalation Anesthesia Systems

At UCSF, the most used anesthetic gas in animal research is isoflurane. Anesthetic gas exposure can cause acute and chronic health effects in humans. Acute effects may include headache,

dizziness, irritability, fatigue, impaired judgement, fainting, and well as nausea and vomiting. Chronic effects may include liver and kidney disease, and reproductive problems. Isoflurane users must complete both the IACUC [Rodent Isoflurane Machine](#) and EH&S [Waste Anesthetic Gas](#) courses prior to beginning animal work involving isoflurane.

The following steps should be performed before using any isoflurane vaporizer¹:

1. Verify that there is sufficient isoflurane in the vaporizer by checking the fluid level through the glass window.
2. Periodically inspect the vaporizer and system components such as tubing, flow meters, valves, scavenging system, etc., for any leaks.
3. Pressurize the system so that it delivers stable readings.
4. Turn on the vaporizer.
 - If the pressure drops slightly when the vaporizer is turned on, but stabilizes and holds steady after a short period of time, your vaporizer is most likely fine to use.
 - If the pressure drops significantly and does not hold pressure, then your vaporizer needs servicing. Check with the manufacturer/vendor.
5. As a preventive measure against leaks and other malfunctions, ensure that the anesthesia system is kept free of hair, dust, and other particulates.
6. Pay attention to signs that may indicate a problem with the vaporizer, such as discoloration (yellowish brown) in the “fill” sight glass of the vaporizer, sticking valves or knobs, animals not responding as anticipated to the level of anesthesia provided, and unusual odors.

Isoflurane vaporizer maintenance requirements:

- Preventive maintenance of the vaporizer is required annually. A sticker must be placed on the vaporizer to document the date of the maintenance.
- If the vendor is not able to perform the preventive maintenance or recalibration on time, labs may be eligible for 6-month grace period. To receive this grace period, the lab must ask the vendor for a proof document that shows when the maintenance will be performed. The proof document should include the lab’s name, the scheduled maintenance date (must be within the 6-month grace period), and the operating status of the equipment. The lab should be ready to provide a copy of the proof document to EH&S or IACUC inspectors whenever requested.
- Failure to complete annual preventative maintenance will result in the vaporizer being considered unsafe for use. All animal procedures utilizing this equipment will be prohibited until the equipment has been appropriately serviced.

¹ [WVU IACUC POLICY and GUIDELINES: Certification, Maintenance and Use of Equipment Used for Inhalation Anesthesia in Animals](#). West Virginia University IACUC. Version 5, 09/2022.

Reduced Pressure Operations

The risks of implosion and flying glass, spattering chemicals, and fires are always present when working under conditions of reduced pressure. Large pressure differences tend to develop in equipment operating at reduced pressures, which can force liquids into unwanted areas such as vacuum pumps. To work safely under reduced pressure:

- Use appropriate safety shields
- Vacuum lines should be trapped, and contain an inline HEPA filter if biologicals are used
- If there is a possibility that water, solvents, or corrosive gases can be drawn into the building vacuum system, the apparatus must be set up so there is a vapor scrubber with a solvent collection device and a trap between the aspirator and the apparatus
- When using vacuum pumps, a cold trap should be placed between the pump and the experimental apparatus, to avoid contamination of the pump
- Exhausts from vacuum pumps should be vented into a fume hood
- Use the correct type of pump for the operation. For instance, rotary evaporation is best performed with chemical-resistant diaphragm vacuum pumps
- Ensure all containers and glassware used in reduced pressure operations are built to withstand vacuum. While there is no one universal way to determine if a piece of glassware is built to withstand vacuum, look for phrases like “heavy wall” or product descriptions that explicitly indicate that the product is intended for use for vacuum filtration or use under vacuum
- Glassware should be inspected to ensure that there are no cracks, scratches, or other signs of damage prior to use
- Exercise caution when assembling custom combinations of parts. Physical compatibility of parts does not guarantee safe operation under reduced pressures

High Pressure Operations

The main risk associated with operations carried out at high pressures is that of explosion. Care must be taken in designing high pressure processes. When working at high pressures:

- Use appropriate safety shields
- Only use an apparatus designed for the particular purpose
- When selecting a vessel, it should be strong enough to withstand the operating pressures and must not react with the materials in the process. While there is no one universal way to determine if a piece of glassware is built to withstand high pressures, look for phrases like “heavy wall” or product descriptions that explicitly indicate that the product is intended for high pressure work
- Glassware should be inspected to ensure that there are no cracks, scratches, or other signs of damage prior to use

- Exercise caution when assembling custom combinations of parts. Physical compatibility of parts does not guarantee safe operation under high pressures
- Closed systems should not be used to carry out reactions unless the system has been designed for use at the operating pressures
- Pressure equipment should be inspected and tested on a regular basis
- Alert others in the area that a high pressure reaction is underway

High Pressure Hydrogenation

When performing hydrogenation reactions at pressures above 1 atmosphere, it is necessary to take additional precautions beyond those for handling gas cylinders and flammable gases. Experimental work should be designed to avoid conditions which may lead to an explosive situation. The following guidelines should be observed when performing hydrogenation reactions at high pressures. Much of this guidance can also be applied to low-pressure hydrogenations such as balloon hydrogenations.

- All safety precautions for handling gas cylinders and flammable gases should be observed
- Only use high pressure apparatus that has been designed for the intended application
- Carefully review the operating procedures for the reactor or high-pressure apparatus before use
- Equipment should be maintained in good condition and periodically tested
- Apparatus should be inspected before each use
- The chemistry of the process should be known so that any possible violent reactions may be anticipated, and appropriate precautions taken
- Remove all extraneous flammable materials from the work area. Any containers of flammable material necessary for the experiment must be closed whenever possible.
- The reaction vessel should never be filled with liquid or solids to more than 75% of the available free space
- When feasible, handle hydrogenation catalysts as wetted powders or as suspensions to minimize the risk of fire. Once the catalyst has been added to the reaction vessel, ensure it is covered with a layer of solvent. This will shield the catalyst from oxygen, prevent dispersion of catalyst powder, and dissipate heat from any unintended reactions involving the catalyst.
- Before hydrogen is added to the system, the system should be purged with inert gas to remove oxygen and avoid the possibility of producing an explosive mixture
- When feasible, hydrogen should be the last chemical added to the reaction vessel, to minimize the risk of fire.
- The equipment should only be operated within the designed pressure and temperatures limits. It is advisable to operate below 75% of the nominal pressure rating.
- Only work in a well-ventilated area. It is best to work near a hood or exhaust fan so that any released gases can be discharged safely

- There should be no open flames in the work area
- Protective shields or barricades should be used
- After completion of an experiment, the system should be purged of hydrogen before opening

Chemical Exposures

Regulatory Overview

It is University 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 permissible exposure limit.

Cal/OSHA regulates Permissible Exposure Limits (PELs) for airborne contaminants. PELs are concentrations in air 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 expressed as 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 that the daily PEL is not exceeded. Additionally, OSHA has defined ceiling limits that are not to be exceeded at any time.

Cal/OSHA has listed established PELs, STELs, and ceiling limits for certain chemical contaminants in CCR Title 8 Section 5155 (Airborne Contaminants), [Table AC-1](#). 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. These may include an Action Level (AL) that triggers medical surveillance requirements, or the imposition of a specific Excursion Limit (such as for asbestos), which is similar to a STEL, but with a different time interval.

Exposure Assessment Overview

All University employees require protection from exposure to hazardous chemicals above PELs, STELs, and ceiling limits. Cal/OSHA requires that the person supervising, directing, or evaluating the exposure 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 Manager. General questions regarding exposure assessment or the Industrial Hygiene Program can be directed to Industrial.Hygiene@ucsf.edu or 415-476-1300.

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. Exposure assessment for a particular work activity will be performed under any of the following situations:

1. EH&S determines that an exposure assessment is warranted by reviewing chemical inventories, Standard Operating Procedures (SOPs), the types of engineering controls present, laboratory inspection results, and/or the annual Laboratory Hazard Assessment Tool
2. A user of a hazardous chemical has concern or reason to believe exposure is not minimized or eliminated through the use of engineering controls or administrative practices, and the potential for exposure exists. The user should then inform their PI/Laboratory Manager, who will in turn contact the EH&S Industrial Hygiene Program, EH&S Radiation Safety Program, Department Safety Advisor (DSA), or the University's Occupational Health Services (OHS). EH&S and OHS will then determine the best course of action in assessing employee exposure, including semi-quantitative assessment, air monitoring, medical evaluation, examination, or medical surveillance
3. A regulatory requirement exists to perform an initial and (if warranted) periodic monitoring; or
4. EH&S determines that periodic monitoring is required based on past sampling data and relative exposure risk.

In event of any serious injury or exposure, including chemical splashes involving skin or eye contact, immediately call **911** from a campus phone or **415-476-6911** from an off-campus 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 their records and reports related to their 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. General protocol in conducting an exposure assessment may include any of the following:

1. Employee interviews and qualitative screening assessments
2. 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, mucous membranes, or eyes

5. Evaluation of existing engineering controls
6. Use of direct reading instrumentation
7. Collection of analytical samples of concentrations of hazardous chemicals taken from the employees' breathing zone, or personal noise dosimetry.

If exposure monitoring suggests 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 Manager to ensure that any necessary medical surveillance requirements are met. When necessary, EH&S will make recommendations regarding adjustments to 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, the Principal Investigator 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](#) 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). EH&S may use RELs, TLVs and/or other types of science-based occupational exposure limits for assessing employee risk when deemed appropriate by the industrial hygienist, even in situations where a specific Cal/OSHA standard exists. Please contact the EH&S main office at 415-476-1300 for more information regarding these chemicals.

Notification

The Industrial Hygiene Program will promptly notify the employee and their PI/Laboratory Manager of the results in writing (within 15 working days, or sooner when required by regulations) after receipt of the 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."](#)

Exposure assessments used to determine and implement controls

EH&S 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. 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
9. Medical evaluation, examination and/or surveillance findings.

Particular attention shall be given to the selection of exposure 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,"](#) 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
3. Control by respiratory protective equipment in accordance with Cal/OSHA CCR Title 8 Section 5144, shall be used as follows:
 - a. during the time period necessary to install or implement feasible engineering controls,
 - b. where engineering and administrative controls fail to achieve full compliance, and
 - c. in emergencies

Medical Evaluation

All campus employees, student workers, or laboratory personnel who work with hazardous chemicals shall have an opportunity to receive an employer-provided 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 UCSF Occupational Health Services (OHS) 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 campus employee who exhibits signs and symptoms of adverse health effects from work-related exposure to a hazardous chemical should report to OHS immediately.

Refer to the [UCSF Injury and Illness Prevention Program \(IIPP\)](#) for procedures on how to obtain medical evaluation under the above-listed circumstances.

Information to provide the clinician

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

1. Personal information such as age, weight, and University 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
8. Any additional information helpful to OHS 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. Recommendation 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
4. A statement that the employee has been informed by the physician of the results of the consultation or medical examination and any medical condition that may require further examination or treatment.

The physician's written opinion shall not reveal specific findings of diagnoses unrelated to occupational exposure.

Confidentiality & Individual's Access to Personal Medical Records

All patient medical information is protected by California and federal law and is considered strictly confidential. OHS is prohibited from disclosing any patient medical information that is not directly related to the work-related exposure under evaluation and will not reveal any diagnosis unrelated to the work-related exposure. Any patient information disclosed by OHS 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 OHS 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. OHS 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. OHS 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 Permissible Exposure Limit.

OHS 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 exposures.

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

- Asbestos
- Formaldehyde
- Noise

Individuals with questions regarding work-related medical surveillance are encouraged to contact OHS at 415-885-7580 or EH&S at 415-476-1300 for more information.

Reproductive Hazard Assessments

To receive a personalized and confidential evaluation of workplace and laboratory hazards relevant to reproductive health and/or pregnancy, please contact the UCSF Public Health Office at PublicHealthOffice@ucsf.edu or (415) 514-3531. Additional guidance is also available at <https://ehs.ucsf.edu/public-health-program/campus-medical-surveillance>.

Waste Management

Management of hazardous waste is strictly regulated and enforced at the federal, state, and local level. The Resource Conservation and Recovery Act (RCRA) gives the Federal Environmental Protection Agency (EPA) the authority to regulate hazardous waste from "cradle-to-grave." This includes the generation, transportation, treatment, storage, and disposal of hazardous waste. The California Department of Toxic Substances Control (DTSC) is authorized by the federal government to administer the RCRA hazardous waste program in California. In San Francisco, local enforcement authority is administered by the San Francisco Department of Public Health.

The EH&S Hazardous Materials Management Program is responsible for pickup and disposal of hazardous waste generated on campus. Each laboratory 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 pick-up is available upon request to other locations where hazardous waste is generated. Laboratory personnel are responsible for identifying waste, labeling it, and storing it properly in the laboratory. Laboratories at UCSF are not charged directly for routine disposal requests. However, large disposal requests from laboratory clean-outs may be subject to recharge to the laboratory or department requesting disposal. The PI/Laboratory Supervisor is responsible for coordinating the disposal of all chemicals from their laboratories prior to closing down laboratory operations.

Waste Determination

The first step to properly disposing of your waste is determining if it is hazardous. Waste generated at UCSF falls into three categories: hazardous waste, universal waste, and non-hazardous waste. The following sections will help you determine the appropriate category of our waste.

Hazardous Waste

A chemical waste is considered a hazardous waste if it is listed as a hazardous waste by state and federal regulations, or exhibits certain hazardous characteristics such as ignitability, corrosivity, reactivity, and toxicity. Hazardous waste has important labeling, storage, and disposal requirements which must always be followed. Chemicals which are considered hazardous by exhibiting a characteristic include:

Ignitable:

Ignitable wastes can create fires under certain conditions, undergo spontaneous combustion, or have a flash point less than 60°C (140°F). Solutions of primary alcohols (e.g., methanol, ethanol) in water in concentrations of 24% or less by volume are not considered ignitable.

Corrosive:

Aqueous wastes with a pH less than or equal to 2.0 or greater than or equal to 12.5 are corrosive. A liquid waste may also be corrosive if it is able to corrode metal containers, such as storage tanks, drums, and barrels or destroy living tissue.

Reactive:

Reactive wastes are unstable under normal conditions. They can cause explosions or release toxic fumes, gases, or vapors when heated, compressed, or mixed with water. Examples include lithium-sulfur batteries and unused explosives.

Toxic:

A waste is considered toxic if it has an Oral LD₅₀ less than 2,500mg/kg, Dermal LD₅₀ less than 4,300 mg/kg, 96-hour Aquatic Bioassay LC₅₀ less than 500 mg/liter, or contains ≥ 0.001% by weight of any of 16 specific carcinogens. Any material shown through experience or testing to pose a hazard to human health or the environment because of its carcinogenicity (carcinogen, mutagen, teratogen), acute toxicity, chronic toxicity, bioaccumulative properties, or persistence in the environment is also considered toxic.

“Toxic” is also the default category for materials that technically do not meet the definition of hazardous waste, but must be disposed of as hazardous waste due to prohibitions on drain disposal or disposal in trash cans.

Special note regarding Qiagen kits

Many components of Qiagen DNA purification kits must be managed as chemical waste, **not** biological waste. For further guidance, please refer to the safety update [“Qiagen: Management and Disposal of Qiagen Materials.”](#)

Labeling Waste

All hazardous waste containers must be labeled with a hazardous waste tag using [WASTE](#) as soon as the first drop of waste is added to the container. Please see the [UCSF WASTE user guide](#) for further instructions.

Pressure Vented Caps

Some materials (such as piranha solution) will naturally decompose and produce gases over time. To help prevent containers of these materials from over-pressurizing, EH&S provides vented caps.

These caps are only designed to slowly vent gases. They will not adequately release pressure from an instantaneous chemical reaction. The caps provided by EH&S fit bottles with 38-439 necks. Many 1L and 4L glass bottles used for liquid chemicals have 38-439 necks.

Laboratories can request the caps from their EH&S Department Safety Advisor. For questions about the proper usage of vented caps, please contact the Chemical Hygiene Officer at ChemHygiene@ucsf.edu.

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 waste containers should be in an area that is supervised and is not accessible to the public. Other SAA requirements include:

1. Hazardous waste containers must be labeled with a WASTE tag at all times.
2. Waste must be collected and stored at or near the point of generation and may not be moved from one SAA to another.
3. 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 liter of extremely hazardous waste. If you reach these volumes for a specific waste stream, you must dispose of the waste within 3 days.
4. All hazardous waste containers in the laboratory must be kept closed when not in use. Pressure venting caps are available for waste at risk of over pressurizing, such as CO₂ saturated solvents or piranha solution.
5. Hazardous waste streams must have compatible constituents, and must be compatible with the containers that they are stored in.
6. Hazardous liquid waste containers must be stored in secondary containment at all times.
7. Containers must be in good condition with leak-proof lids.
8. Containers must be less than 90% full.
9. Dry waste must be double-bagged in clear, 3-mil plastic bags (these do not require secondary containment).
10. The maximum accumulation time for waste containers in Satellite Accumulation Areas is 180 days. Once 180 days in storage is reached, a waste pickup must be scheduled.

Segregation

All materials, including waste, must be segregated according to their chemical family or hazard classification. Segregation of incompatibles will reduce the risk of mixing in case of accidental breakage, fire, earthquake, or response to a laboratory emergency.

Each chemical family should be separated from all other chemical families by either a non-combustible partition or a distance of 20 feet. Secondary containment, such as plastic containers for liquids, and puncture proof plastic bags for solids, provide adequate segregation.

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/or 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 common mistake is adding oxidizing acids (such as nitric or perchloric acid) to flammable liquids.
- Piranha solution is a specific waste stream that contains sulfuric acid and hydrogen peroxide, which forms a reactive mixture that is often still fuming and off-gassing during disposal. For this waste stream, and other reactive or off-gassing mixtures like it, vented caps are mandatory.
- Waste from cell extractions using Trizol (or other similar cell lysis reagents) is not biologically active and must not be treated with bleach, as bleach can react with Trizol to create hazardous fumes.

Disposal of Chemical Containers

Disposal of empty hazardous material containers is strictly regulated. The disposal method depends on the hazardous material, container size and container material.

Empty containers that held [Acutely Hazardous Materials](#) must be managed as hazardous waste, and picked up by EH&S. Do not rinse or reuse these containers. Empty containers 5 gallons in size or more should also be managed as hazardous waste.

All other chemical containers, if they are less than 5 gallons in size, should either be reused for hazardous waste collection, or discarded/recycled. In order to be considered empty:

Liquid containers

- No liquid can drain when container is tilted in any direction.
- There is no hazardous material remaining that can feasibly be removed.
- The walls of the container have no encrusted material on them. (A thin layer of dried material is acceptable).

Solid containers

- The interior container surface is scraped clean with no residual material.

Once a container is empty, the labels must be completely defaced (remove it or mark it out completely). Dispose or recycle rinsed plastic or



Sustainability tip

Empty chemical containers can be recycled for waste accumulation.

- ! Make sure container is completely empty and the label is defaced or removed
- ! Make sure waste is compatible with the former contents of the bottle

glass containers as regular trash or in a campus recycling bin.

Universal Waste

Universal waste comes primarily from consumer products containing mercury, lead, cadmium, and other substances that are hazardous to human health and the environment. These items cannot be discarded in household trash nor disposed of in landfills. Examples of universal waste include batteries, fluorescent tubes, and many electronic devices. Never dispose of this type of waste in the regular trash!

Categories of Universal Waste

- Electronic waste or E-waste includes computers, monitors, printers, copiers, phones, microwaves, lab equipment, and anything with a printed circuit board. This type of waste is disposed of through UCSF Supply Chain Management-Logistics at UCSF. Before disposing of laboratory equipment, you are required to decontaminate it of any biohazardous, chemical, and/or radioactive contamination that may be present on the equipment. Chemical decontamination can be achieved using standard household cleaners and/or soap and water. If your equipment is contaminated with ethidium bromide, consult EH&S for further information.
- Batteries have corrosive properties and contain toxic metals; therefore they need to be disposed of through EH&S. Batteries must be labeled with a Universal Waste Label (which can be created using WASTE), and should be stored in a plastic zip lock bag or leak proof hard sided container until picked up by EH&S. Alternatively, batteries can be disposed of at one of the many drop off locations throughout UCSF: <https://ehs.ucsf.edu/battery-disposal>
- Electric lamps such as fluorescent tubes and bulbs, high intensity discharge, sodium vapor, and electric lamps that contain mercury also must not be disposed of in the regular trash and must be recycled appropriately. At UCSF, Facilities Services recycles fluorescent bulbs used to light UCSF buildings. Other types of bulbs requiring recycling should be disposed of through EH&S. Universal waste lamps must also be labeled with a universal waste label and should be stored in a cardboard box or other container to prevent breakage until they can be appropriately disposed.

Disposal of non-hazardous lab waste

Drain disposal of non-hazardous liquids

Only non-hazardous chemicals explicitly approved for drain disposal by EH&S may be disposed of down the drain. All other chemical waste should be managed and disposed of as a hazardous waste, even if they do not otherwise meet any of the characteristics of hazardous waste. A list of chemicals approved for drain disposal is available on the EH&S website here: <https://ehs.ucsf.edu/chemicals-approved-drain-disposal-0>.

Please note that non-hazardous liquids with pH values lower than 6 or greater than 9.5 require additional EH&S consultation prior to drain disposal, to ensure that the building's wastewater does not exceed wastewater pH limits. Please contact the EH&S [Hazardous Waste Management group](#) before drain disposing of such liquids.

If you believe you have a non-hazardous waste stream that is not listed, please contact the EH&S Hazardous Materials Program Manager at 415-476-1480 to request a hazardous waste determination.

Broken Glass

While broken glassware is a hazard to laboratory and janitorial staff, it is not considered hazardous waste unless it is contaminated with a chemical, biological, or radioactive material. However, the following guidelines must be followed to prevent injuries to UCSF employees:

- Discard of broken glass specifically in labeled cardboard boxes
- Line boxes with provided plastic liner to ensure small pieces of glass do not fall out of the box
- Prior to disposal, tape the bottom of the box. Secure the lid with duct tape when the box is full.
- Do not overfill boxes
- The box weight should not exceed 50 lbs or 20 kg. Use smaller boxes whenever possible
- Place taped boxes in the corridor next to the entrance to the lab or adjacent to large waste bins for disposal
- Intact glass bottles and flasks must either be recycled or placed in the regular trash
- Avoid using your hands to directly handle broken glass. Use a broom, dust pan, gloves, tongs, safety glasses, and any other appropriate PPE when picking up and disposing of broken glass.
- DO NOT dispose of intact vacuum traps in broken glass boxes. They must be rinsed with a 10% bleach solution, decanted, and then discarded as biohazardous waste.
- DO NOT dispose of glassware containing any precipitates, glassware that has been visibly stained, or any chemically contaminated glassware in broken glass boxes. Place hazardous broken glass in a corrugated cardboard box lined with a plastic bag and label with an appropriate hazardous waste tag.

To dispose of biologically contaminated glassware, immerse the glassware in a 10% bleach solution for 30 minutes, rinse with tap water, and then place in a recycling bin.

Incident Response

Health-threatening Emergencies

1. Call **911** from a campus landline phone or **415-476-6911** from a cell phone.
2. Go to the closest emergency room. Bring a copy of the SDS for the chemical.
3. Notify your PI/supervisor and UCSF per the Employee Incident Protocol (available at <https://hr.ucsf.edu>, search for “Employee Incident Protocol”)
4. Notify EH&S at **415-476-1300** as soon as possible, but within 8 hours of the incident.

Non-health-threatening Incidents

1. Notify your PI/supervisor and UCSF per the Employee Incident Protocol (available at <https://hr.ucsf.edu>, search for “Employee Incident Protocol”)
2. If necessary, contact the Occupational Health Services (OHS) Clinic at **415-885-7580** to schedule an urgent care appointment. Bring a copy of the SDS for the chemical to the appointment.

Additional Instructions

The additional instructions below are to be followed for different types of chemical exposure.

Skin contact

Rinse body thoroughly using a safety shower for at least 15 minutes. If feasible, remove any contaminated or potentially contaminated clothing and/or jewelry.

Eye contact

Rinse eyes thoroughly using an eyewash station for at least 15 minutes, occasionally lifting up the upper and lower eyelids to allow rinsing of the area beneath the eyelids. Remove contact lenses if possible.

Ingestion of chemical

Do NOT induce vomiting unless directed otherwise by the SDS or by Poison Control (800-222-1222). Rinse mouth with water.

Inhalation of chemical

Move into fresh air.

Needle stick/puncture exposure

Wash the affected area with soap and water for 15 minutes. Contact Poison Control at 800-222-1222.

Fires

If a small fire occurs, you are trained in the use of fire extinguishers, and you feel safe doing so, use a fire extinguisher to put out the fire. If a single extinguisher cannot put out the fire, activate a fire alarm and evacuate the area. Wait for emergency responders to arrive so that you can provide information about the fire.

Basic fire extinguisher training is available in the “[Fire and Life Safety](#)” course in the UC Learning Center. For large groups, EH&S Fire Prevention can also provide an in-person training session.

Spill Response

- Assess the extent of the spill and the hazards. **DO NOT** enter the area if you cannot assess the conditions of the environment well enough to be sure of your own safety.
- Evacuate the spill area. Avoid breathing vapors, dusts, or aerosols from spill.
- If safe to do so, help contaminated or injured persons evacuate.
- If possible, confine the spill to a small area using a spill kit or absorbent material. Keep others from entering the contaminated area (e.g., use caution tape, barriers, etc.).

Minor Spills

If the amount and type of chemical spilled presents no potential for hazardous chemical exposure and if you are trained to do so, wear appropriate PPE and clean up the spill. Double-bag any contaminated cleaning materials and manage as hazardous chemical waste. If you are not trained and/or there is a risk of chemical exposure, report the spill to **415-476-6911**.

Major Spills

Defined as any hazardous chemical spill that:

- would result in chemical exposure during cleanup
- due to its size and/or hazards, requires capabilities beyond your training, or
- results in a release into the environment (e.g. a spill goes down a drain).

Call **911** from a campus phone or **415-476-6911** from a cell phone for assistance.