# *UCSB LABORATORY SAFETY MANUAL and CHEMICAL HYGIENE PLAN*

**Editors:**

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*Acknowledgements: thanks to the following for their assistance and expertise in compiling this manual: UCSB Laboratory Safety Division*

# MANUAL DESCRIPTION

**MANUAL PURPOSE -** this manual serves two basic purposes:

1. It is the basic laboratory safety manual for UCSB

2. Serves as the campus **Chemical Hygiene Plan (CHP***)* as required by the *California Occupational Safety and Health Administration (Cal-OSHA)*. In short, OSHA requires that a written chemical safety plan address the policies and procedures that an employer has in place to minimize the exposure of its lab employees to chemicals. Workers are required to receive documented training on their CHP. A full summary of the OSHA standard is in Sec. III.

   For **lab supervisors**, the most important portion of this manual (Section I) contains links to *Standard Operating Procedures (SOP)* templates for developing their **required Lab-specific Chemical Hygiene Plan.**

**MANUAL STRUCTURE**

- **Section I: Introduction and Lab-specific Chemical Hygiene Plan.** Forms and templates for customizing your CHP with SOPs and other local information. Links to other lab safety programs.

- **Section II: UC & UCSB policies, procedures and resources.** Summaries of key/core lab safety issues that apply to most/all laboratories. Primarily based on specific OSHA requirements.

- **Section III: Regulatory Framework.** Overview of the OSHA CHP Standard; specific University policies relative to the Lab Standard; roles and responsibilities of UCSB personnel in the program.

**OTHER UCSB RESEARCH SAFETY PROGRAMS / REGULATIONS**

Given the breadth of research at UCSB, there are other campus safety programs and regulations that can apply to a given operation. In the interests of keeping this manual shorter, more specialized programs are not directly included herein. Instead, links to these programs are provided below and affected individuals should contact these program managers for further information.

Injury and Illness Prevention Program

The "umbrella" OSHA-required worker safety program that applies to all campus workers, regardless of work activities. Elements include: designation of individuals with the authority/responsibility for program (Chairs, Directors, etc.); documented safety training and inspections; injury investigation; safety communication to workers, etc. There is significant overlap between IIPP elements and this manual as relates to lab work, particularly the training and inspection components.

Biological Safety Program: Biological Use Authorizations; Aerosol Transmittable Diseases; Bloodborne Pathogens; Medical Waste Management

Radiation Safety Program:
Oversight of radioactive materials; radiation-producing machines and lasers

Hazard Communication Standard Program
Safety Data Sheets (formerly MSDS); chemical labeling
(for labs, much of the HazCom program is superseded by the CHP program – see SDS pg. in Sec. II)

Research Diving and Boating Safety Program
Oversight of research projects involving SCUBA and small boats

Controlled Substance Program
Oversight of research activities using State/Federal regulated narcotic and non-narcotic drugs

Fire Protection Programs
Includes fire extinguisher training for lab workers, oversight and inspections of fire alarms, sprinklers and other fire protection infrastructure, plus State Fire Marshal approval of plans for lab construction.

Animal Care and Use
Oversight of care and use of animals used in campus research activities

Respiratory Protection Program (see pg. II-9)

Confined Space Program
Campus/OSHA requirements and procedures for entering Permit Required Confined Spaces

Indoor Air Quality Program
Response to concerns regarding IAQ within and around campus buildings, especially as relates to health and comfort of building occupants

Hearing Conservation Program
Personnel exposed to occupational noise levels exceeding an 8-hr time-weighted average of 85 dBA must be enrolled in this UCSB/OSHA program

Heat Illness Program
Establishes campus/OSHA requirements and procedures for individuals who perform outdoor work

Ergonomics Program
Assessments and trainings designed to analyze and evaluate an employee's workspace, equipment, body mechanics, posture, and work flow to promote a more efficient, productive worker and prevent musculoskeletal injuries.

# Directions to Customize Your Laboratory-Specific CHP

1. Develop applicable Standard Operating Procedures (SOP). This is the key step.
   - **A. Determine Which SOPs You Need.** Compare your chemical stocks and lab processes against the ***UCSB Standard Operating Procedures Library*** to see which SOPs you need. In short, per OSHA, "hazardous chemicals" require an SOP. The library is not comprehensive, but should cover the majority of SOPs needed on campus. SOPs can be based on any of the following as suits your needs:
     - a group of chemicals of similar hazard and control (e.g., acids, carcinogens)
     - a specific chemical, (e.g., formaldehyde)
     - a laboratory process involving chemicals (e.g., distillation)
     - non-chemical processes of concern due to their inherent risk (optional)

     Alternatives, if SOPs in the UCSB online library are deemed insufficient:
     - EH&S has access to more SOPs from other UCs upon request
     - Use blank SOP templates from the SOP library above to create your own SOP

     If you have materials you never use, an SOP is not necessary. Unwanted materials can be disposed of free via EH&S, except from teaching labs.

   - **B. Customize SOPs Selected from Library to your Lab.** This generally means only completing the sections in red. However, you can/should add more information, if deemed necessary to protect workers. Two of the red-marked sections are sometimes *not* applicable. However, the *Laboratory Specific Information* section is **mandatory** to generate an OSHA-compliant SOP. In many cases this can be satisfied by just a few sentences: **Examples**.

2. Add completed SOPs to the end of CHP Sec. I (this section).

3. On next page the PI/supervisor needs to certify/sign that their CHP/SOPs have been approved.

4. Assemble the above pieces, plus Secs. II and III (EH&S-provided). Store electronically and/or in the EH&S-provided binder.

5. Ensure your workers have reviewed the sections below and have ready-access to the Plan. **Document** the worker reviews on pg. I-6
   - your customized SOPs in Sec. I
   - Sec. II which covers universal/core lab safety issues (EH&S provided)

## CHEMICAL HYGIENE PLAN: CERTIFICATION PAGE

**Laboratory PI or Supervisor Name:**

**John Bowers**

**Applicable Laboratory Location(s) (Buildings /Rooms):**

ESB 2324

**Date of Last Review of *Chemical Hygiene Plan with Standard Operating Procedures*:**
(OSHA mandates Plan be updated as needed, but with minimum of **annual** review)

3/5/18

**Laboratory PI or Supervisor Signoff (required). I certify that I have reviewed and approve the attached Laboratory-specific *Chemical Hygiene Plan with Standard Operating Procedures* for my above laboratory locations.**

**Signature:_____ (see physical lab manual)**

*[This page and the next page will probably need periodic updates with signatures. Therefore, it may be preferable to maintain separate hard copies of these two pages.]*

# Laboratory Worker Training Record: Chemical Hygiene Plan

Principal Investigator/Supervisor: John Bowers

The following lab workers have reviewed and understand the following elements of the attached *Chemical Hygiene Plan* for the above PI or supervisor:

- Sec. I: Laboratory-specific Chemical Hygiene Plan with Standard Operating Procedures
- Sec. II: UC/UCSB Policies, Procedures and Resources

| Name (print) | Signature | Date |
|---|---|---|

*[This page and the previous page will probably need periodic updating with signatures. Therefore, it may be preferable to maintain separate hard copies of these two pages.]*

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**[Required: please add your customized Lab-specific Standard Operating Procedures here, per instructions on pg. I-4]**

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# SECTION I:
# FEMTO lab POLICIES, PROCEDURES AND RESOURCES

## *FUME HOOD USE*

**Rules:**

- The following solvents may be used in the fume hood:
  - Acetone
  - Ethyl alcohol
  - Isopropyl alcohol
  - Methanol
  - Methylene Chloride (dicholormethane)
  - Wafer bond remover

- None of these may be heated. Care should be taken around hot plates.

- No other chemicals may be used in the fume hood (except DI water) without permission from the lab manager and consultation with the chemical safety officer.

- Beakers left out without supervision should be labeled with the user, date, and chemical.

- Liquid waste should be disposed of in appropriately labeled waste bottles. Each bottle should have an EH&S hazardous waste label and be capped when not in use. Do not pour solvents down the drain. Request a pickup from EH&S when bottles become full or if they have been in use for more than 9 months. Acetone and isopropyl alcohol can share a waste bottle, but all other chemicals should be disposed of separately whenever possible.

- Do not block air flow by storing large objects in the fume hood. Do not lift the sash past the red arrow.

- Take appropriate (gloves, lab coat, and eyewear) safety precautions according to the chemical you are working with, as specified below.

## *NON-HALOGENATED SOLVENTS*

**Examples:** Acetone, isopropyl and ethyl alcohol, and methanol

**Hazard Properties:**

- Repeated contact can cause the skin's protective fats and oils to dissolve, resulting in reddening, itching and blistering.

- Can be readily absorbed through skin, producing systemic toxic effects.

- In addition to irritation of the respiratory tract and mucous membranes, inhalation can cause dizziness, drowsiness, headache, lack of coordination and nausea.

- Exposure over a prolonged period of time may result in damage to the liver, kidneys, lungs, blood, nervous system, and other organs. Carcinogenic, mutagenic and teratogenic effects are not uncommon

- Unlike most halogenated solvents, most non-halogenated solvents are flammable or combustible (see the subsequent section on Flammable Materials).

**Practices:**

- Use fume hoods to prevent inhalation of solvent and build-up of flammable levels of vapor. Minimize solvent vaporization by avoiding unnecessary open containers.

- Allow space for thermal expansion in containers; overfilling can cause rupture if they are filled nearly to the top with cold liquid and then stored in a warm area.

- Wear eye protection for all operations in which accidental splashing might occur.

- Substitute a less toxic solvent whenever possible.

- Avoid direct skin contact by using lab coat (only required if handling >1 liter) and solvent-resistant gloves. Appropriate gloves are kept in a marked drawer next to the fume hood. If supplies are running low, contact the lab member in charge of the fume hood.

- Dispose of solvent waste in a sealable container with an EH&S hazardous waste label. The container must be sealed when not in use.

- Store solvent bottles in the "flammable" cabinet below the fume hood. Do not store them in the fume hood, as this blocks air flow.

*Ketones and Aldehydes (Examples: acetone, methyl ethyl ketone, cyclohexanone)*

- These chemicals are generally highly flammable.
- Typical effects are those of respiratory tract irritation, anesthesia, and dermatitis.

*Aromatic Hydrocarbons (Examples: benzene, toluene, xylenes, styrene; none in lab)*

- Chronic exposure to a low concentration of benzene may damage the bone marrow, with resultant changes in blood cells. Benzene is considered carcinogenic, and has a relatively short latency period. Substitutes for benzene should be used.
- Aromatics defat the skin, and prolonged use causes drying, scaling and cracking. Readily absorbed through intact skin and may produce systemic toxic effects.
- The most commonly used aromatic solvents are flammable

*Aliphatic Hydrocarbons (Examples: hexanes, pentanes; none in lab)*

- Typically lighter aliphatics are highly volatile and flammable with low flash points.
- Although not typically very toxic, the aliphatic hydrocarbons do cause many of the common symptoms related to organic solvent overexposure.
- N-hexane is unusual among aliphatic hydrocarbons as it is particularly toxic to the peripheral nervous system.

*Ethers (Examples: ethyl ether, dioxane, glycol ethers; none in lab)*

- Many cause anesthetic effects and may be potent irritants and cause dermatitis.
- Glycol ethers may, in addition to the typical symptoms of organic solvent exposure, cause anemia (low red blood cell count) and have deleterious reproductive effects.
- The lower molecular weight ethers (e.g., diethyl ether) are highly volatile and are particularly hazardous flammable liquids.
- Can form explosive peroxides upon exposure to air

## *CHLORINATED SOLVENTS*

**Examples:** methylene chloride, chloroform, trichloroethylene, dichloroethylene

**Hazards:**

- Most of these compounds have an **anesthetic or narcotic effect**, causing people to feel intoxicated if overexposed. This can be particularly dangerous when working around machinery, as judgment and coordination can be impaired.

- Some of the chlorinated solvents are strong **systemic poisons** which damage the liver, kidneys, nervous system, and other organ systems. These symptoms most often appear gradually, with nausea, loss of appetite, vomiting, headaches, weakness, and mental confusion most common.

- All chlorinated solvents can cause **dermatitis** (chapping, drying, rashes) on repeated contact with the skin, since they remove the protective fats and oils. Gloves appropriate for a particular chlorinated solvent should be determined by consulting a **glove reference chart**. Gloves are kept in a drawer next to the fume hood.

- Many of the compounds are highly **irritating** to the membranes around the eyes, and in the nose, throat, and lungs. Examples of chlorinated solvents which have irritating properties are ethylene dichloride and chloroform.

- In studies on laboratory animals, many chlorinated hydrocarbons have been linked to the development of **cancer** in animals; examples of these compounds are: ethylene dichloride, perchloroethylene, chloroform and methylene chloride. When excessively heated, chlorinated solvents can **decompose**, forming highly toxic fumes such as phosgene, hydrochloric acid, and chlorine.

- With few exceptions, most of the chlorinated hydrocarbons are **non-flammable**.

**Work Practices:**

- As with all volatile hazardous materials, chlorinated solvents must always be used in a fume hood or with other local exhaust ventilation such as an approved snorkel. Inhalation of the vapors is not an acceptable work practice.

- Dispose of waste in a sealable container with an EH&S hazardous waste label. The container must be sealed when not in use. Chlorinated solvent waste should be kept in a separate container from non-chlorinated solvents.

- Methylene chloride should be stored in the “corrosives” cabinet below the fume hood (on the left).

## *FLAMMABLE MATERIALS*

Flammable and combustible materials are a common laboratory hazard. To minimize the risk of fire, all laboratory personnel should know the properties of the chemicals they are handling. MSDSs or other sources of information should be consulted for information such as vapor pressure, flash point, and explosive limit in air. In addition to fuel, an ignition source and an oxidizer are required for a fire to start. Users should be aware of any potential ignition sources in the immediate area including electrical equipment such as mechanical stirrers. A blanket of inert gas can be used to remove oxidizer (air) from the system. Some basic precautions for the safe handling of flammable materials include the following:

- Cap bottles and vessels when not in use. Use narrow-necked bottles and flasks for transferring to help reduce the release of flammable vapors.
- Never heat flammable substances with an open flame. Preferred heat sources include steam and water baths, oil baths, and heating mantles.
- Provide ventilation adequate enough to dilute the vapor concentration to below flammable levels rapidly. Working in a fume hood is an excellent way to achieve this.
- Use only refrigeration equipment that is certified for the storage of flammable materials.
- Metal containers and lines should be grounded to disperse static charges.
- Note that most flammable vapors are heavier than air and can travel long distances along bench tops and floors. Be aware of ALL potential ignition sources in the area, including those at a lower level than the work area.
- Know the location and proper use of laboratory fire extinguishers.

Flammable gases can rapidly produce an explosive atmosphere in the lab upon leakage or escape. Acetylene, hydrogen, ammonia, hydrogen sulfide, propane, and carbon monoxide are especially hazardous in this regard. Great care should be used when handling flammable gases. Precautions include working in a fume hood and enclosing larger cylinders in a ventilated gas cabinet. Installation of flash arresters on hydrogen cylinders is recommended. A reaction vessel should be triple flushed and purged with an inert gas prior to introduction of a flammable gas.

## *CRYOGENS*

Examples: liquid nitrogen, used with the Lakeshore cryostat and the photoluminescence setup

**Hazard Properties**

- These materials are extremely cold (-100°C to -270°C) and, upon contact, can instantly freeze other materials. Serious tissue damage may occur upon exposure.
- Evaporating liquid nitrogen will displace the air within a non-ventilated space possibly leading to **suffocation**. Generally, labs have adequate ventilation to prevent this.
- Be aware of **ice that can plug or disable pressure-relief devices**. Ensure adequate pressure relief mechanisms are functional, i.e., never use tight-fitting stoppers or closures without pressure-relief devices.

**Practices**

- Do not move an **over-pressurized container**. Evacuate and seal area, call EH&S (x3194) or dial 9-911.
- Avoid trapping cryogenic liquids between closed sections of an apparatus.
- **Dewar flasks** or other glassware devices should be taped on the outside or provided with shatterproof protection to minimize flying glass particles in case of implosion. Dewar flasks should be vented with a bored or notched stopper.
- Cool cryogenic containers slowly to reduce thermal shock and flashing of the material.
- Cryogen handlers should be protected by a **face shield or safety goggles, lab coat or apron and gloves or mitts.**
- When utilizing cold baths with solvents, use in a hood with a catch pan. Be aware of increased fire hazard. Be prepared for **vigorous solvent boiling** upon initial addition of solvent.
- Avoid **condensing oxygen** (blue in color) and/or contact with organic material when using liquid nitrogen. Flush cold traps with nitrogen or keep under vacuum to avoid condensation of oxygen from air within the trap. Condensed oxygen when contacted with organic materials can cause a powerful explosion.

Check the glassware and valves for cracks and other defects before beginning experimental work. Verify that systems assumed to be under vacuum are so, particularly when using liquid nitrogen. You should be on the lookout for the possibility of condensed air within the apparatus.

Skin contact with liquid nitrogen may least to a frostbite burn. An occasional droplet of nitrogen, such as is encountered when filling a Dewar, often does not freeze the skin because of insulting film gaseous nitrogen, which forms immediately. However skin is readily frozen if the liquid nitrogen is held on a spot by clothing which is saturated with the refrigerant, or by any other means which leads to extended contact.
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**Storage:** Storage of liquid nitrogen: use only approved low temperature containers. Make sure liquid nitrogen containers are vented to prevent pressure buildup. You must use extreme care when working with liquid nitrogen. Liquid nitrogen should not be stored in sealed containers, as tremendous pressure could result and an explosion is possible.

**Spill and accident procedures**: Flood the area (skin and eyes) immediately with large quantities of cool water, apply cold compresses. See a doctor immediately if the skin is blistered or if the liquid nitrogen came in contact with your eyes.

# *VACUUM SYSTEMS*

Vacuum systems have a variety of hazards associated with their operation. There are risks associated with implosion, as well as the release of toxic materials. The systems are typically complicated and require extensive training prior to use.

**General Safety**

- Understand the type of vacuum pumps being used and their limitations. Always check with the manufacturer for the appropriate application.
- Prepare for **power outages** whether you are present or not. Some valves close upon loss of power, some open. Understand the effects that a series of valve openings and closings will have upon the system's integrity.
- Always replace the pump **belt guard** to prevent catching fingers or clothing in the mechanism.
- Be aware of the hot surface in **oil diffusion pumps**
- If a glass vacuum line is ever used **above ambient pressure**, it should be shielded from personnel to prevent glass shards from flying if the line were to shatter.
- Glass vessels that are evacuated should be round-bottomed and/or thick-walled and designed for low-pressure work. They should be regularly checked for star cracks and scratches.
- The use of safety glasses is mandatory.

**Traps and Venting**

- Use of house vacuum systems must employ appropriate **traps** to prevent chemical, radioactive or biohazardous material from contaminating the building lines. Likewise, use of an aspirator should also employ a suitable trap to avoid contaminating the water stream.
- Mechanical vacuum pumps should be protected by **cold traps** – generally liquid nitrogen based.
- If hazardous materials are used with the vacuum system they should be located in, and **vented** to, a fume hood.
- Pump oil from vacuum system exhaust has been known to accumulate in building ductwork systems increasing the likelihood of fire spread. Pump exhaust should only be done **into the fume hood** proper, or if exhausted directly into building ductwork, an oil trap must be installed.
- Operation of low temperature traps must be thoroughly understood. Both the cooling and warming phases deserve undivided attention. For example, when using liquid nitrogen, the **condensation of air** due to an open valve may cause a serious explosion when the air vaporizes upon warming.

- **Dewar flasks are under high vacuum and are therefore subject to implosion.** They should be wrapped in tape or plastic sheathing.

**Chemical Hazards**

- Mechanical pump oil can become contaminated with hazardous materials that were being pumped on. Upon maintenance, proper protective equipment must be employed. A ventilated area should be used for changing pump oil, as harmful vapors may be released. Clean or contaminated pump oil must be disposed of as hazardous waste via EH&S.

- Mechanical pump exhaust may require suitable scrubbing for volatile highly toxic materials. This may involve a relatively simple filter or liquid bubbler.

**Practices**

Turning ON a High Vacuum System:

- Make sure all valves are closed.
- Turn on vacuum pump.
- Place Dewar around trap flask
- Submerge trap flask in liquid nitrogen. **Make sure system is under vacuum before cooling trap to avoid condensation of liquid oxygen.**

Turning OFF a High Vacuum System

- Remove all samples and experiments from vacuum line.
- Remove trap flask from Dewar. Allow to warm to room temperature
- Open vacuum system to atmosphere. **Do not do this while trap is cold to avoid condensation of liquid oxygen.**
- Turn off pump.

# *LASERS AND OPTICAL AMPLIFIERS*

High power lasers pose a threat to both eyes and skin. These guidelines are not meant to be an exhaustive reference on laser safety (UCSB has a laser safety manual and a laser safety officer for that), but rather a cheat sheet for common laser use in the FEMTO lab.

**General Safety**

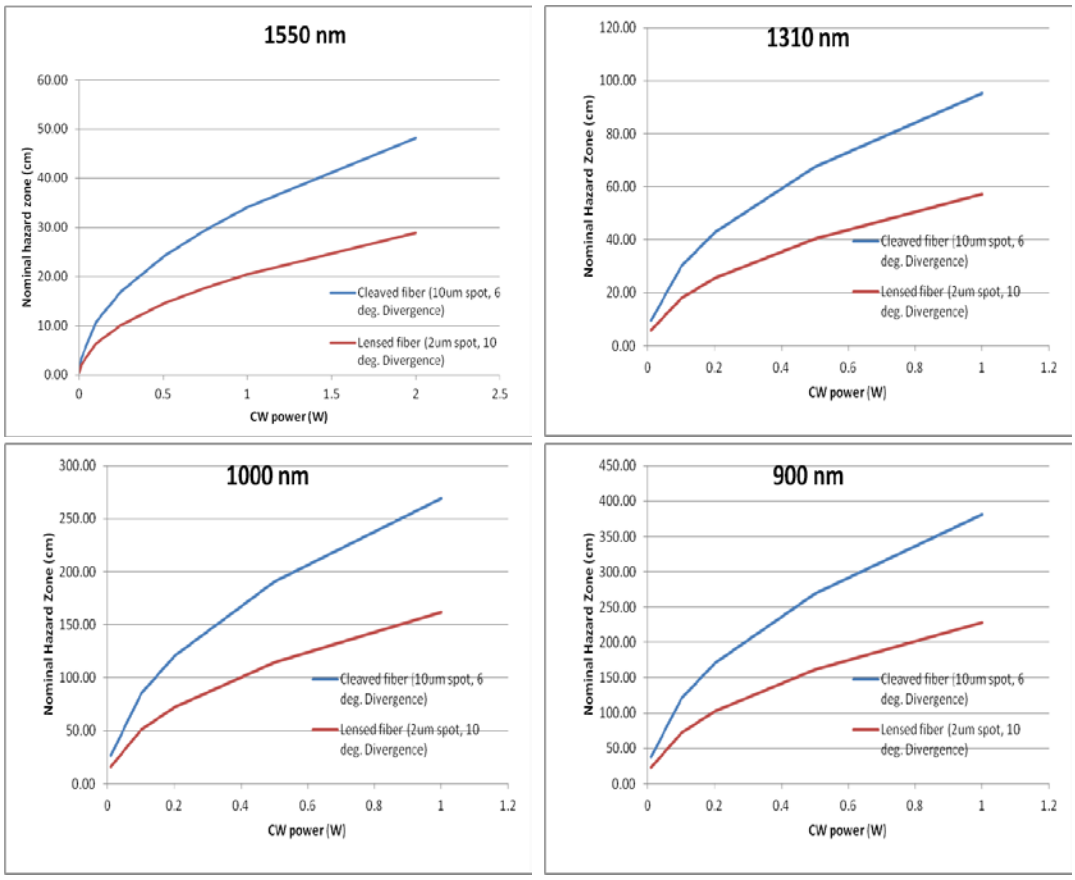
- Know where the beam goes before turning on the laser. Do not look directly into a laser beam or a fiber carrying light.
- Turn systems on from source to output: do not turn on an EDFA before a laser that pumps it.
- Know how much power comes out of the laser
- Align fibers at the lowest optical power possible

**Laser classification**

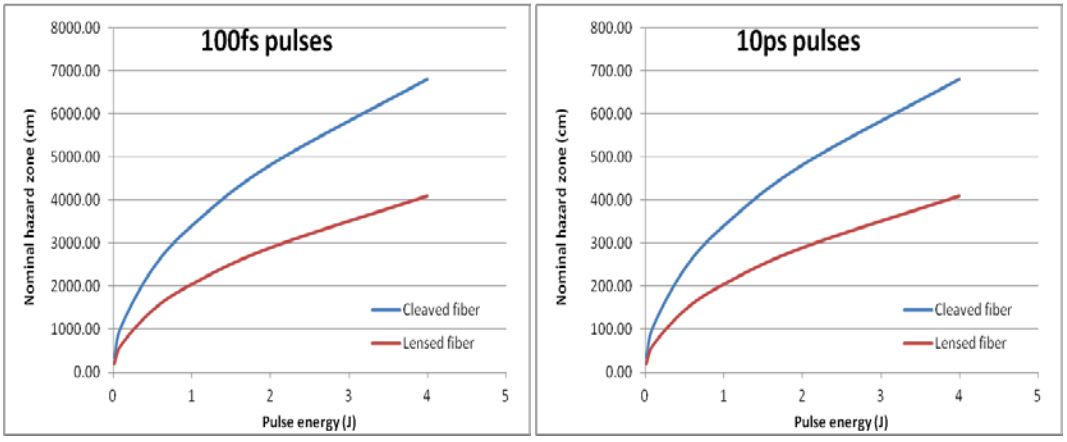
- The laser class is important and determines the safety precautions required. It is generally determined by the manufacturer and will be labeled on the laser or EDFA. As a rule of thumb, for 1550nm lasers the class is:
    - Class 4 if it is >500mW CW or >10J/cm$^2$ pulsed
    - Class 3B if it is 5-500mW CW
    - Class 3A if it is 1-5mW CW
    - Class 1 if the light is carried in a fiber.
    - There are no additional regulations on IR light below 1mW CW.

**Guidelines for commonly used laser configurations**

- Collimated beams:
    - Do not use Class 4 collimated beams in the lab. Use Class 3B only when the beam can be covered. Align below at powers Class 3B.
    - Calculate the Nominal Hazard Zone (NHZ – calculation technique below). If it is greater than a few cm, consult UCSB's laser safety officer to ensure that you are in compliance with all laser safety rules.
- Lensed and cleaved fibers:
    - In general, there is no need to worry if the power is below:
        - 200mW at 1550nm
        - 10mW at 1310nm
        - 1mW at 1000nm
    - For higher powers, find the NHZ (in cm) from the chart and follow the same guidelines as for collimated beams (consult the laser safety officer if NHZ>a few cm).
        - Only use these charts if the lensed or cleaved fiber is similar to the one for which the calculation was done. Otherwise, use the section below on how to calculate the NHZ.




- Modification for pulsed lasers
  - Calculate (or measure) the average power and calculate the NHZ using the charts above or the equation
  - Calculate the pulse energy and calculate the NHZ using the charts below or the equation
    - They are for 1550nm radiation – the NHZ will be larger for shorter wavelengths
  - Take the bigger number



**How to do Nominal Hazard Zone calculations**

- First, find:
  - The beam diameter and divergence angle
  - The beam power (or pulse energy)
- Then look up the Maximum Permissible Exposure (MPE) for the relevant exposure time, wavelength, and pulse width:
  - There are charts in UCSB's laser safety manual, which can be found on the EH&S website. These values get updated as more medically relevant data becomes available, and so are not repeated here.
- Use the equation:
  - $$NHZ = \frac{1}{\phi}\left(\frac{4\Phi}{\pi MPE} - a^2\right)^{1/2}$$
  - Where $\phi$ is the full divergence angle (not the half-angle) in radians, $\Phi$ is the flux (either W/cm$^2$ or J/cm$^2$, depending on the units of the MPE) and a is the beam diameter. The NHZ is then in cm.

## *WASTE DISPOSAL*

**Spill cleanup closets**
Cleanup closets are located in rooms 2231A and 3231A. Keys to the closets are kept on a hook near the main door of the lab. You should only clean up a spill if you feel safe doing so and have the appropriate training and equipment.

**Sharps disposal**
It is our group's responsibility to dispose of sharps containers when they become full. Sharps disposal instructions are available at: http://ehs.ucsb.edu/units/labsfty/labrsc/factsheets/factsht3sharps.pdf. Filled containers can be placed in the appropriately labeled bins in the bay between ESB and EII. These are locked, and the key is also kept on a hook near the main door of the lab.

# SECTION II:
# UC/UCSB POLICIES, PROCEDURES AND RESOURCES

## Introduction to Section II: UCSB/UC Policies, Procedures and Resources:

Section II addresses the campus policies, procedures and resources which are core/universal and apply to most labs. In order to free lab supervisors from independently having to address these issues in their Chemical Hygiene Plans (CHP), they are provided herein. In Section 1 *laboratory-specific* issues/SOPs are addressed.

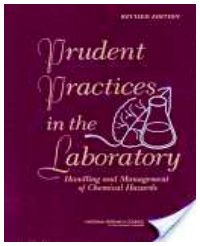
**The information here is a formal part of the *UCSB Chemical Hygiene Plan*. Therefore, all lab personnel are responsible for being familiar with this information and following the prescriptions therein as they apply to their work. Almost all of the issues addressed herein are based on current regulations and codes, from Cal-OSHA; Cal-EPA; CA Fire Code, etc.**

**Addressing Non-Chemical Hazards**

The CHP Standard requires the addressing of **chemical** safety issues, but not other lab hazards. For example, biological and radiological hazards, electricity, high/low temperature and pressure, etc. Therefore, those issues are largely *not* addressed in this CHP, but instead are referenced:

- Via the links in the *Introduction* section, e.g., *Radiation Safety Program; Biological Safety Program.* These areas have their own requirements addressed therein.

- Via links (pg. II-16) in this section to selected pages of the free reference: ***Prudent Practices in the Laboratory***, from the National Research Council. This reference is widely recognized as a definitive reference on lab safety and all researchers are strongly encouraged to bookmark its location or buy a hardcopy for their areas.




Researchers are however encouraged to address non-chemical hazards in the lab-specific of their CHP (Sec. 1) via SOPs or protocols.

**Minors in Laboratories and Shops:**

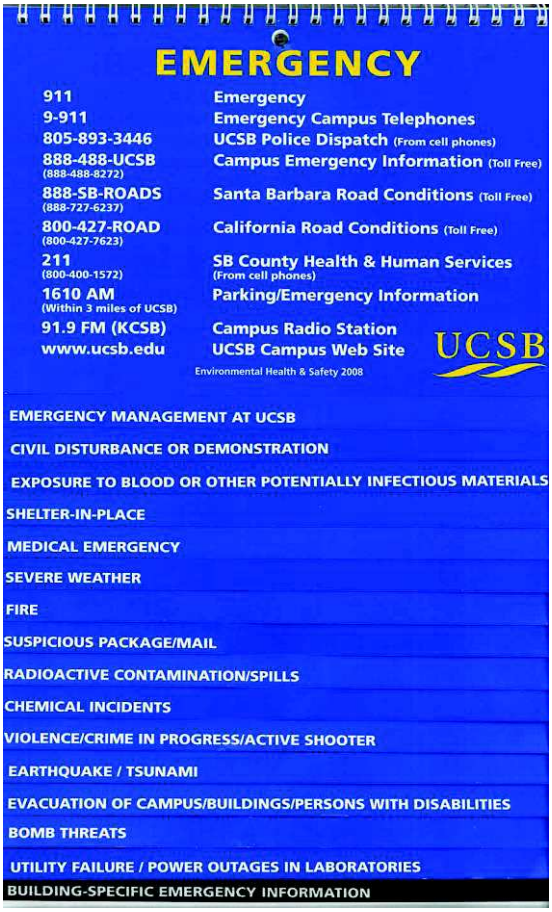
A UC policy describes the limitations on minors working in these campus areas. A summary of the policy can be found here. The lab supervisor/PI has the primary responsibility for following this policy in their areas.

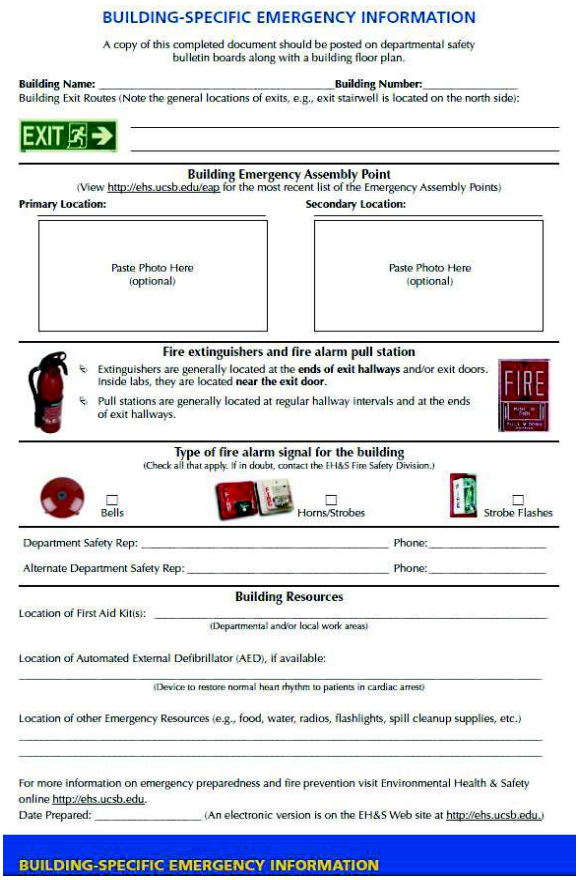
## Emergency Response Procedures

The primary informational tool for response to campus incidents is the ***UCSB Emergency Information Flipchart*** pictured below. This document **should already be posted** in, or near, every laboratory, as well as in many offices. A Spanish version of the flipchart is available.

The last page (at right) should already be customized to include your *local* building information –such as the locations of the following: your building's **Emergency Assembly Point**, fire extinguishers and fire alarm pull stations, first-aid kits, Automated External Defibrillators, etc. If it is not customized contact your local Department Safety Rep. Please familiarize yourself with the layout and general content of the flipchart. It can also be viewed online

Power outages in labs are of particular concern – preparing for them and what to do during and afterwards. A fact sheet with some basic guidelines can be found here



## Recommended Chemical Spill Cleanup Procedures

**You should NOT clean up a spill if:**

- You don't know what the spilled material is
- You lack the necessary protection or equipment to do the job safely
- The spill is too large to contain
- The spilled material is highly toxic
- You feel any symptoms of exposure

Instead contact: **x3194** EH&S (24 hr line – after-hours may have to wait up to 30 min for response to campus). OR, if immediately health-threatening call **911** (campus phone)

**Spill Response Scheme:**

*Evaluate and Notify*

- Assess the toxicity, flammability, or other properties of material (see label & MSDS)
- For flammables, remove or turn off ignition sources such as motors, pumps, fridges.
- Determine if there is an immediate health threat to you or your neighbors. If so, alert neighbors, isolate the area and call for help using the phone numbers above.
- If spill is minor, begin cleanup following steps below

*Containment/Cleanup*

- Don appropriate gloves, eye protection, lab coat, etc.
- Per SDS use absorbents* (e.g., "spill pillows" for solvents), or neutralizers appropriate for the material*, e.g. sodium bicarbonate for acids, citric for bases.
- Protect floor drains with absorbents or barriers around them
- Package and label waste. Include contaminated clothes, rags, equipment, etc.
- Store temporarily in a fume hood if material is volatile

*Followup*

- Send Hazardous Materials/ Waste Pickup Request form to EH&S
- Reorder and restock cleanup materials used
- Inform EH&S if there were any personnel exposures, or release to the environment

**Self-help spill cleanup equipment are available using graduate keys in some buildings.*

## Fire Extinguishers, First-Aid Kits and Emergency Showers/Eyewashes

**Fire Extinguishers:** Typically by the lab exit door and are the **ABC** variety (for flammable liquids/paper & wood/electrical, but *not* for flammable metals). EH&S conducts hands-on extinguisher training for most who attend the EH&S *Fundamentals of Laboratory Safety* class. There is also an online "refresher" extinguisher tutorial/video that individuals can complete who have already taken the live hands-on training. All campus individuals are strongly encouraged to view the refresher training when needed.

**Online Fire Extinguisher Usage Refresher Training:**

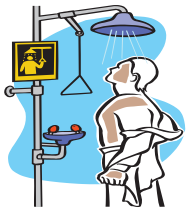
UC Learning Center

**Need "UCSB Net ID" to login. Then search on "fire extinguisher"**

**First-Aid Kits:** Individual laboratories should have their own 1st aid kit nearby in a location known to all. Supplies should be checked regularly. Departmental kits may not be accessible after-hours.

**Emergency Showers and Eyewashes**

- Know where your nearest unit is – they are typically within the lab, or in the corridor nearby. Units must be accessible always- no items should block access.
- In the case of chemical exposure to eyes or skin, flush the injury for a minimum of 15 minutes. Be sure to leave the eyes open under the water to flush them.
- Showers can also be used to extinguish a fire on an individual, or their clothing
- Consult the Safety Data Sheet (SDS) for material and show it to the doctor/nurse.
- Facilities periodically flushes emergency eyewash stations and showers. Lab personnel are urged to flush the eyewashes at least monthly as a precautionary measure. Call Facilities at x2661 if you have concerns regarding a specific unit.
- Eyewashes are plumbed with potable water - unlike the rest of the laboratory which is often on "industrial water"- and is considered safe to use on your body.
- Many eyewash/shower units are not equipped with a floor drain. This is because they are so infrequently used that they did not justify the cost of a drain when the building was constructed. Also, it is illegal to flush materials down the drain.



## UC Policy on Laboratory Personal Protective Equipment (PPE)

In 2014, UC instituted a policy on the use of PPE in labs. The policy is intended to help protect lab workers from injury, meet Cal-OSHA requirements and bring more consistency to UC PPE practices. All members of the lab community have responsibilities under the policy and the law - particularly supervisors and lab workers.

**The most important aspects of the policy are when and where individuals must wear long pants, closed-toe shoes, safety eyewear and a lab coat. This is summarized on a poster which is mounted at the main door to all labs – see next page.**

**Other Policy Aspects:**

- **Exemptions** from wearing PPE (policy requires written exemption from EH&S)
  - hazardous materials/processes-free areas
  - areas protected by adequate distance (some desk locations are problematic)
  - lab areas/desks protected by adequate physical shielding

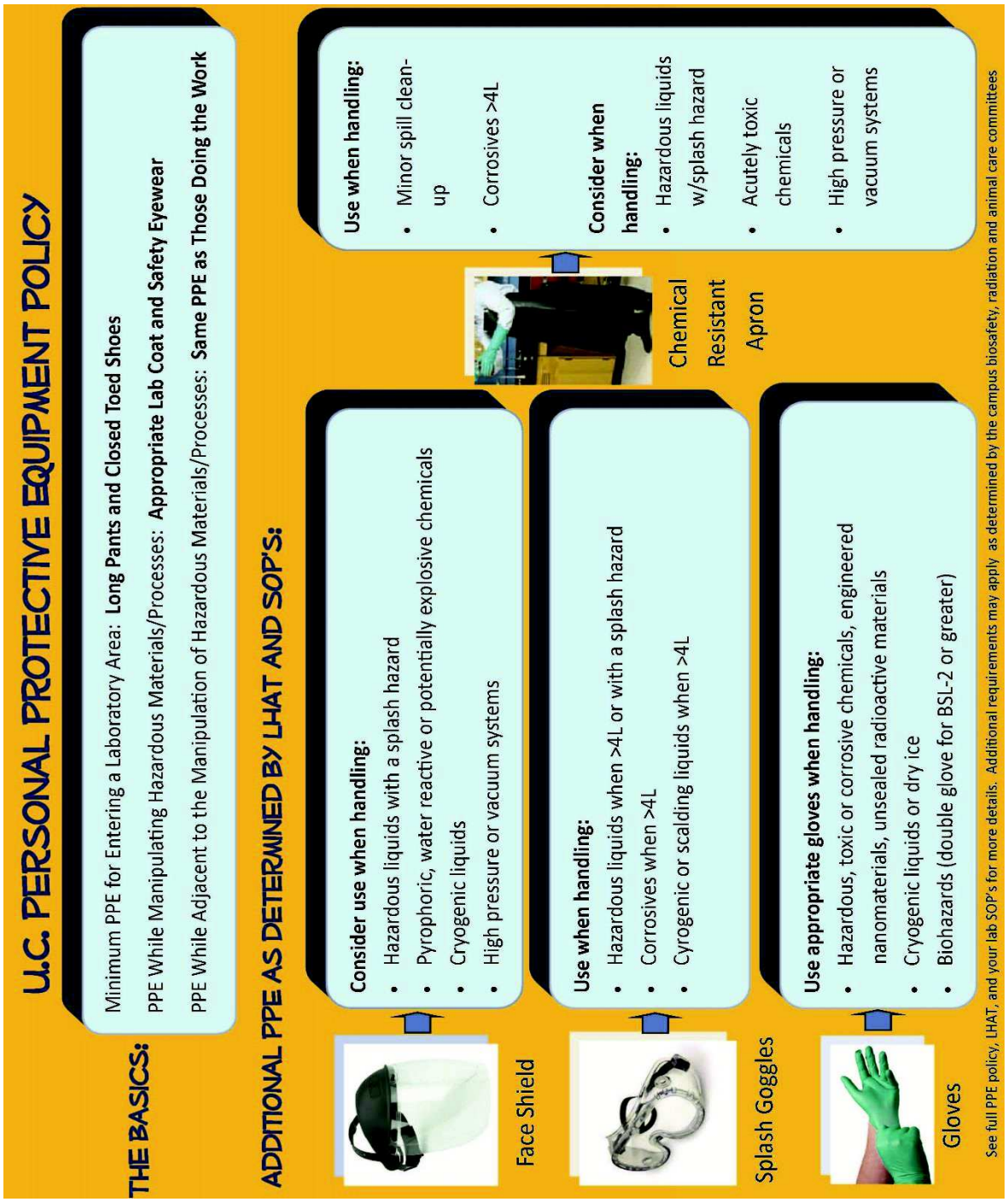
- Supervisors shall perform a **written assessment** of workplace to determine what PPE is needed – OSHA requirement. This is done via use the online *UC Laboratory Hazard Assessment Tool* ("LHAT" ). The assessment should be updated and re-certified by at least every 3 years, or more often if needed. See pg. II-8.

- Supervisor assures **workers are trained** on when PPE is needed and how to wear, adjust & maintain. Per pg. II-8, use the LHAT to receive the necessary documented training for basic lab coat and safety eyewear use.

- Laboratory coats shall not be **laundered** at private residences, or public laundry facilities. See pg. II-8 for free lab coat laundering program details.

- Safety eyewear must meet *American National Standards Institute* standards. Typical prescription spectacles do **not** meet these standards (are not shatter-proof polycarbonate) unless specifically provided by an eye care professional. Safety goggles that readily fit over glasses are provided free (see pg. II-8).

- **Teaching courses** which include lab/shop/field work are required to indicate PPE requirements in the course syllabus or manual**. The PPE requirements for teaching labs are the same as for research labs**. The instructor of record for the course, or designee, is responsible for determining the appropriate PPE and ensuring that students are familiar with and properly use PPE. However, since teaching labs do not go through the LHAT process above, the instructor is responsible for determining which type of safety eyewear are necessary – click here for guidance.




**Posted at main doorway to each campus lab**

## Obtaining Free Laboratory Personal Protective Equipment (PPE) Via the UC Laboratory Hazard Assessment Tool ("LHAT")

To facilitate the policy summarized on pg. II-6, UC provides the following resources:

1. The online ***Laboratory Hazard Assessment Tool*** ("LHAT") https://ehs.ucop.edu/lhat/ is for supervisor's to do PPE assessments for their workers. The LHAT can only be accessed via an individual's UCSB NetID and password. Per UC policy, the LHAT assessment must be re-certified/revised online at least every 3 years, or more often if changes occur. Contact EH&S for assistance.
2. For lab workers, the LHAT provides a summary of the lab's PPE needs and provides/documents training on basic lab coat and eyewear use and maintenance
3. Free laboratory coats (3 types for different hazards), safety eyewear and communal face shields and lab aprons – see below. Use & Limitations of UC-provided PPE.
4. Free lab coat laundering services – see below

**Obtaining Free PPE:** After the lab supervisor completes the LHAT process, their workers login to the LHAT to review the assessment results, watch a short training video, take a short quiz and print out a "PPE voucher". With the voucher they may pick-up two free lab coats and eyewear at the *Graduate Storeroom* in the Dept. of Chemistry & Biochemistry (Bldg. 557, room 1432). Short-time lab workers may receive a "loaner" coat they return.

For the many **short-term summer intern lab workers** each year, the procedure for obtaining their PPE is generally different – click here

**Lab Coat Laundry Service:** There are **seven sites** on campus for workers to drop off their dirty lab coats for laundering and pick-up when clean. Each coat will be marked with the coat's unique identifier number and the individual's name. Your cleaned coat will be returned to the one site that you designate – FAQs Lab coats and safety eyewear which are no longer needed should be *recycled* for reuse by placing in the separate designated bins at one of the seven sites noted above.

## Respiratory Protection

Use of respirators is highly regulated by Cal-OSHA (CCR, Title 8, 5144). Per the *UCSB Respiratory Protection Policy* (5440), all use of respiratory protection equipment (including filtering facepiece respirators (dust masks) must be reviewed and approved by EH&S. Fortunately, a respirator is typically not needed in a laboratory to reduce/eliminate exposures. Under most circumstances, safe work practices and engineering controls (e.g., fume hoods) adequately protect workers. Under certain circumstances, however, respiratory protection may be needed as determined by EH&S. These can include:

- Chemical spill outside the fume hood, or spill of biohazard outside a biosafety cabinet
- An unusual operation that can't be conducted in fume hood or biosafety cabinet
- Weighing powders outside a glove box or other protective enclosure. Disposable filtering face-piece respirators are generally recommended for nuisance dusts.
- When monitoring shows that exposures exist that cannot be otherwise controlled
- As required by a specific laboratory protocol or as defined by applicable regulations

If you believe respiratory protection equipment may be necessary, of if an individual would like to wear equipment voluntarily, please contact the *UCSB Respiratory Protection Program* (x-3743, x-8787, or rpp@ucsb.edu) for review and approval. There is a wide variety of respiratory protection equipment available, and each has specific applications, limitations and use requirements. It is extremely important that equipment is selected and used properly, to ensure that the respirator itself does not create an additional hazard.

## Selecting the Proper Gloves

The correct gloves protect against chemicals; the wrong gloves enhance chemical contact. **There is no universal glove that protects you from all chemicals. To choose the correct glove, go to a Glove Reference Chart -** links below. Chlorinated solvents are carcinogenic and are particularly challenging to find appropriate gloves for.

**All gloves are permeable**, only the permeation rate varies, depending on the chemical, the glove material and thickness, temperature, concentration gradient, etc. However, once a material begins to permeate the glove, it will continue until an equilibrium is reached. You must, therefore, decide when it is appropriate to discard dirty gloves.

**Check gloves** before use for signs of wear or penetration. Disposable gloves can be inflated to check for pinholes. When removing gloves, be careful to avoid touching the outside of the gloves with your bare hands. Always remove gloves before leaving lab.

**Disposable gloves** provide minimal protection and should be used accordingly. If using concentrated solvents, corrosives or toxics, more heavy-duty gloves should be worn. These provide more protection, but have the drawback of being more cumbersome. Note also that about 15% of the population is allergic to latex to some degree.

**Gloves for Handling Pyrophorics**: These chemicals *spontaneously ignite in air*, but are only found in a few departments. Having the proper glove is important to avoid injury from a burning/melting glove. **Per a legal Agreement between UC and Cal-OSHA, all lab workers who handle pyrophorics outside of an inert gas glove box, must use special non-combustible gloves for handling pyrophorics**. In 2016 these gloves were provided free for affected groups and they received special training from EH&S. Free gloves will be provided while funding lasts. An online training for new workers in these groups is available on the UC Learning Center (search on "Pyrophoric") and all such workers must take this training, or request live training from EH&S.

**Glove Reference Charts** ***(No guarantees are made regarding the accuracy of these charts. Recommend cross-checking at least two sites for consistency.)***

Microflex Chemical Resistance Guide

Cole-Parmer

Ansell Chemical Resistance Guide

## UC Policy on Laboratory Safety Training

Documentation of occupationally-related safety training is a legal requirement under Cal-OSHA. In 2013, UC adopted a new policy entitled: Laboratory Safety Training to satisfy OSHA and improve safety awareness. Lab supervisors/departments have clear and direct responsibilities under the policy and the law. There are two primary requirements of the policy:

1. All "lab workers" complete a ***Fundamentals of Laboratory Safety*** orientation (live or online) in order to be given access to their lab(s) by their department. Enrollment directions are given below. The trainings are generic and do not address the specific hazards/procedures for a particular lab. Supervisors/PIs are still responsible under the law for ensuring this has been provided – see #2. The fundamentals training covers the core issues common to most/all labs and addresses many specific regulatory training requirements.

**Accessing the *Fundamentals of Laboratory Safety* Orientations (mandatory per UC policy)**

- **Live Version:** 3-hour, instructor-led training is offered regularly - generally once per quarter. Enroll via the UC Learning Center using UCSB NetID*. Search on "LS01". This training is **more in-depth** than the online version below and generally **includes hands-on fire extinguisher training.**

- **Online Version:** Available via the UC Learning Center using UCSB NetID*. Search on "LS60"

**note that undergraduate UCSB NetIDs do not work directly in the UC Learning Center, but follow the instructions therein for undergraduate enrollment procedures.*

2. Lab-specific training is addressed in the second major policy mandate. The UC policy requires a **Training Needs Assessment (TNA)** pdf / Word to be performed for each lab worker. The form is electronically forwarded when the worker attends the *Fundamentals* class above. The worker is instructed to work with their supervisor, or designee, to complete the assessment and **document** completed training on the form (or elsewhere). The form categorizes training into 3 areas:
    a. "Day One" lab orientation (e.g., location of emergency equipment, issue PPE, etc.)
    b. Other EH&S formal classes, if needed (e.g., radiation safety, biosafety, etc.)
    c. Other lab-specific training (e.g., local protocols, hazards, etc.)

**The TNA is also a good tool for labs to use in "on-boarding" new workers since it lists all the basic health and safety tasks to cover with a new lab worker.**

## Exposure Limits for Laboratory Chemicals & Carcinogens

Under OSHA, there are 500+ chemicals that have airborne chemical concentration limits known as *Permissible Exposure Limits (PEL).* **Legally, you cannot be exposed above these limits**. PELs are expressed in parts per million (or $mg/m^3$) in air. PEL values can be for 15 minute or 8 hour exposure periods, or ceiling limits which should never be exceeded. A smaller table of **PEL values** for ~50 common lab chemicals is available.

Typically, if these materials are used in a fume hood and proper PPE is utilized, per this manual, then there is little reason to believe exposure levels are a concern. If you believe exposure limits may be exceeded, contact EH&S to schedule an exposure assessment. If exposure limits are exceeded, additional steps must be taken to reduce. EH&S does do occasional quantitative exposure monitoring of targeted operations to confirm acceptable exposure levels.

**Human Carcinogens**
Of the 500 materials noted above, some are carcinogens which are further/highly regulated under separate OSHA safety standards. They are separated into two classes*:*

Regulated Carcinogens fall into a higher hazard class and have extensive additional OSHA requirements associated with them. There are 30 in this category, but the common ones found in the lab are **formaldehyde, methylene chloride and benzene**. It is important to effectively apply safety controls as the regulatory requirements for laboratories that exceed threshold values for these chemicals are very extensive.

Select Carcinogens are defined under the OSHA Lab Safety Standard as follows.

- Regulated Carcinogens (see above)
- *Annual Report on Carcinogens* published by the *National Toxicology Program*: all of the substances listed as "known to be carcinogens" and some listed as "reasonably anticipated to be carcinogens"
- *International Agency for Research on Cancer*: all of Group 1 "carcinogen to humans" materials; and some in Group 2A/B.

## Safety Data Sheets (SDS, formerly known as MSDS)

**What is a Safety Data Sheet?** SDS – formerly known as Material Safety Data Sheets - are a summary of the health hazards of a chemical material and associated recommended safe work practices. SDS are required by OSHA under the *Lab Safety Standard* and *Hazard Communication Standard* to be made readily available by chemical vendors to the purchasers of their chemicals. The use and relevance of SDS are covered in the mandatory EH&S *Fundamentals of Laboratory Safety* class. If you work in a lab, then OSHA says you must:

- be aware of what an SDS is and their relevance to your health and safety
- be aware of how to access SDS for your work area
- maintain SDSs that are received with incoming chemical shipments and ensure that they are readily accessible to lab employees during each work shift when they are in their work area(s). Electronic access per below is acceptable with a printer**.**

**(M)SDS Sources:**

Google Customized SDS Search

Laboratory Chemical Safety Summaries (not SDS, but quality info aimed at labs)

Fisher Scientific

SIRI

Sigma-Aldrich SDS

Matheson's Gases

## Chemical Labelling

Under the Cal-OSHA Hazard Communication Standard (CCR, Title 8, 5194) all chemical containers must be properly labeled – unless a material is temporarily put into a new container for immediate use and is not going to be stored after that immediate use. Labeling requirements for all hazardous substances are summarized as follows:

**General requirements**

- All containers of hazardous materials must be labeled with the identity of the hazardous substance
- The label must contain all applicable hazard warning statements, e.g. flammable, carcinogen, corrosive

**For commercial materials in the original vendor's container**

- Manufacturer's product labels must remain on all containers, and not be defaced

**For materials repackaged in the laboratory**

- Labels must be legible, in English, and provide the info above under general requirements
- This includes secondary containers (such as spray bottles and acid/base baths) and must be labeled as above
- New synthesized compounds, or commercial products that are repackaged, must be labeled with the appropriate hazard warnings based on the knowledge of the chemical and physical properties of that substance.

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In 2012 Cal-OSHA adopted use of the **Globally Harmonized System (GHS)** of chemical classification and labeling which supersedes earlier systems. Employees using chemicals need to be trained on the new system. On the next page is a summary of the terms used in the system: *Hazard Statements, Hazard Classes, Signal Words and Pictograms, etc.* Campus workers should familiarize themselves with the basic aspects of this system as they will see these terms used on all containers they receive from vendors.


## Pictograms and Hazard Codes Used in the Globally Harmonized Chemical Labeling System

**Pictograms and Hazard Codes Used in the Globally-harmonized Chemical Labeling System**

All chemical containers provided by vendors will eventually use the following labeling system. Per Cal-OSHA employees need to be familiar with the labeling system and its relevance to the hazards of hazardous materials.

| Description | Pictogram | Hazard class and hazard category: |
|---|---|---|
| **Exploding Bomb GHS01** |  | Unstable explosives<br>Explosives of Divisions 1.1, 1.2, 1.3, 1.4<br>Self reactive substances and mixtures, Types A,B<br>Organic peroxides, Types A,B |
| **Flame GHS02** |  | Flammable gases, category 1<br>Flammable aerosols, categories 1,2<br>Flammable liquids, categories 1,2,3<br>Flammable solids, categories 1,2<br>Self-reactive substances and mixtures, Types B,C,D,E,F<br>Pyrophoric liquids, and solids, category 1<br>Self-heating substances and mixtures, categories 1,2<br>Substances and mixtures, which in contact with water, emit flammable gases, categories 1,2,3<br>Organic peroxides, Types B,C,D,E,F |
| **Flame Over Circle GHS03** |  | Oxidizing gases, category 1<br>Oxidizing liquids, categories 1,2,3 |
| **Gas Cylinder GHS04** |  | Gases under pressure:<br>- Compressed gases<br>- Liquefied gases<br>- Refrigerated liquefied gases<br>- Dissolved gases |
| **Corrosion GHS05** |  | Corrosive to metals, category 1<br>Skin corrosion, categories 1A,1B,1C<br>Serious eye damage, category 1 |
| **Skull and Crossbones GHS06** |  | Acute toxicity (oral, dermal, inhalation), categories 1,2,3 |
| **Exclamation Mark GHS07** |  | Acute toxicity (oral, dermal, inhalation), category 4<br>Skin and eye irritation, category 2<br>Skin sensitisation, category 1<br>Specific Target Organ Toxicity – Single exposure, category 3 |
| **Health Hazard GHS08** |  | Respiratory sensitization, category 1<br>Germ cell mutagenicity, categories 1A,1B,2<br>Carcinogenicity, categories 1A,1B,2<br>Reproductive toxicity, categories 1A,1B,2<br>Specific Target Organ Toxicity – Single exposure, categories 1,2<br>Specific Target Organ Toxicity – Repeated exposure, categories 1,2<br>Aspiration Hazard, category 1 |
| **Environment GHS09** |  | Hazardous to the aquatic environment<br>- Acute hazard, category1<br>- Chronic hazard, categories 1,2 |

## Criteria for Implementing Engineering Controls

The next few pages deal primarily with "engineering controls", i.e. fume hoods, gas cabinets, glove boxes, etc. **Engineering controls are considered the "first line of defense" in protecting workers. In contrast, PPE is generally considered the final defense.** The Lab Standard requires that the general criteria for implementing control measures be described. The appropriate engineering control is often obvious, but the general criteria are noted here for the common ones. The criteria should be followed unless equivalent protection can be realized. Specific engineering controls should also be described in a lab's SOPs.

**FUME HOODS, WET BENCHES, GAS CABINETS & OTHER EXHAUST VENTILATION**

- When using volatile substances that present a significant inhalation hazard
- When necessary to keep exposure levels below OSHA Permissible Exposure Limits
- When using toxic gases, particularly when required by the CA Fire Code
- When indicated in Standard Operating Procedures, or as indicated in SDS

**BIOSAFETY CABINETS**

- With operations involving biohazardous material as directed by NIH and CDC guidelines, or the OSHA Bloodborne Pathogens Standard
- When stipulated by the Biohazard Use Authorization
- When indicated in Standard Operating Procedures

**GLOVE BOXES**

- When indicated in Standard Operating Procedures

**APPROVED HAZARDOUS MATERIALS STORAGE CABINETS AND SAFETY CANS**

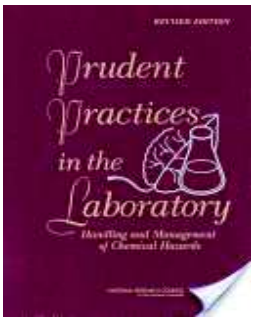
- Whenever possible, but particularly when CA fire code volume limits are exceeded
- When indicated in Standard Operating Procedures

**FLAMMABLE STORAGE REFRIGERATORS (APPROVED-TYPE)**

- When refrigerated storage of flammable materials is needed

## General Procedures for Working with Hazardous Chemicals and Operations

Within UCSB labs exists a great diversity of research and associated hazards. To address this diversity and simultaneously reduce the length of this document, we have provided links below to selected sections of ***Prudent Practices in the Laboratory*** by the National Resource Council (2011). This free text is widely considered to be the definitive publication on general lab safety. The sections selected here are those dealing with the *generic* management of hazardous materials/operations. In contrast, the other sections of this CHP are more related to issues that are UC or UCSB specific, or Cal-OSHA driven.




### *4 Evaluating Hazards and Assessing Risks in the Laboratory*

4.A Introduction
4.B Sources of Information
4.C Toxic Effects of Laboratory Chemicals
4.D Flammable, Reactive, and Explosive Hazards
4.E Physical Hazards
- Compressed Gases
- Nonflammable Cryogens
- High-Pressure Reactions
- Vacuum Work
- Ultraviolet, Visible, and Near-Infrared Radiation
- Radio Frequency and Microwave Hazards
- Electrical Hazards
- Magnetic Fields
- Sharp Edges
- Slips, Trips, and Falls
- Ergonomic Hazards in the Laboratory

4.F Nanomaterials
4.G Biohazards (see also, *UCSB Biosafety Program*)
4.H Hazards from Radioactivity (see also, *UCSB Radiation Safety Program*)

## 5 Management of Chemicals



## 6 Working with Chemicals



## 7 Working with Laboratory Equipment

## Fume Hood Usage Guide: Standard Hoods

*("Standard" hoods do not have the "VAV control box" shown on the next page)*

*Per Cal-OSHA, users of hoods must be trained on use of their hood. Attendance at the live or on-line lab safety orientations described below on the "UC Policy on Laboratory Safety Training" page satisfies that requirement. The information on this page should also be read by all hood users and is posted on campus hoods for easy reference.*

**Always work with the sash at, or below, the level of the red arrow sticker (picture on next pg.) and close it when not attended.** To adequately protect you, your hood should be producing a face velocity of about 100 ft/min. EH&S tests your hood and posts the red arrow stickers at the **proper sash level to:**

- satisfy the required air flow and protect you against airborne chemicals
- protect you better from incidents within the hood
- *All hoods on campus are equipped with an air flow monitor and/or alarm to warn you if the air velocity is too low – pictured below. **If the alarm engages, lower the sash slightly until the alarm stops.** Do **NOT** disengage or over-ride the alarm. If your alarm sounds consistently this could indicate a real problem – call EH&S.
- Always work at least 6 inches inside the hood to maximize capture efficiency and store only a minimum of equipment and chemicals in your hood because:
- Excess materials will block the air flow into the intake slots at the back of the hood. Permanent equipment should be raised on a jack to allow the air to flow smoothly.
- Most fires and explosions occur in the hood. Minimizing chemical volumes will reduce the chances of a small accident escalating into a large one.
- Keep the lab windows closed. Drafts from open windows and doors can significantly affect your hood's performance (100 ft/min is only a few miles/hr of air).

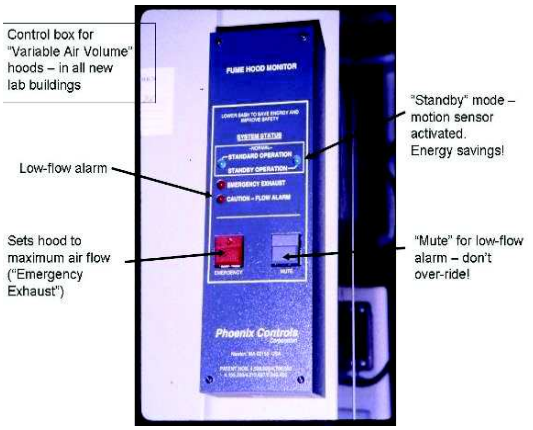

**"Magnihelic gauge" – note normal gauge position. Significant deviation may indicate low air flow.*


**Visible/audible alarm Sounds during low-flow condition of*

## Fume Hood Usage Guide: Variable Air Volume Hoods ("Phoenix" system)

*Per Cal-OSHA regulations, users of hoods must be trained on use of their fume hood. Attendance at the live or on-line lab safety orientations described below on the "UC Policy on Laboratory Safety Training" page satisfies that requirement. The information on this page should also be read by all hood users and is posted on all hoods*

- Variable Air Volume (VAV) hoods — unlike a standard hood above — automatically adjust the face velocity to stay within safe work levels (~ 100 ft./min). A VAV hood is easily distinguished by the gray control box on the hood - picture below.
- **If the low-flow alarm engages, lower the sash until the alarm stops.** DO NOT over-ride the safety alarm by permanently engaging the "Mute" or "Emergency" button (e.g., with tape). If your hood is consistently alarming call EH&S (x-4899).
- Always work with the sash at or below the level of the **red arrow sticker** (below), because, if most bldg. sashes are raised, this will generate a hood alarm, and at your neighbor's hood, due to the limited capacity of your building's ventilation.
- A lowered sash protects you against airborne chemicals and incidents better than at sash full open.
- The lower the sash, the greater the **energy savings** – lower sash when not in use
- Store only the minimum of equipment and chemicals in your hood because:
    - Excess materials block air flow into the slots at back of the hood. Permanent equipment should be raised on a stand to allow good air flow
    - Most lab fires/explosions occur in hoods. Minimizing chemical volumes will reduce the chances of a small accident escalating into a large one.
- Always work at least 6 inches inside the hood to maximize hood capture efficiency.




## Refrigerators and Freezers in Labs

Certain refrigerator/freezer units are designed specifically for the storage of flammable materials, and to prevent potentially explosions. This is critical, since flammable vapors coupled with an ignition source could result in an explosion. In other words, a normal kitchen refrigerator is not safe for the storage of chemicals. Before purchasing a new unit, or using an existing one, consider if chemicals will be stored there. Note that many lab refrigerators will be around for decades and so one cannot guarantee that a normal unit will never be used for flammables storage.

**FLAMMABLE MATERIAL STORAGE REFRIGERATORS/FREEZERS:**

These have no internal electrical components which could trigger an explosion. These must always be used for storage of volatile materials. Also known as "lab-safe" or "de-sparked" refrigerators.

All refrigerator/freezer purchases and modifications on campus **must be pre-approved** by EH&S at X8243. In addition, all approved units for storing flammable materials must be labeled with signage reading, "*Approved For Chemical Storage, No Food Storage"*. All refrigerator/freezer units not approved for storage of flammable materials must be signed as "Explosion Hazard", or equivalent. Contact EH&S for your free labels.


Examples of signage on campus lab refrigerators

UCI refrigerator which exploded when chemicals were stored in a unit which was not designed for flammables

## EH&S Laboratory Inspection and Lab Outreach Programs

EH&S inspects all lab spaces on campus at least annually. However, it is strongly recommended that labs initiate periodic self-inspections (recommend minimum of twice-a-year).

Prior to the EH&S visits a Self-Inspection Checklist is generally distributed to aid laboratories in establishing their own audits. The list does not include every possible safety issue, but are general guidelines. Most items are based on applicable regulations or UC policy. Radiation and biohazard issues are not addressed in the checklist because they are highly specialized and these labs receive targeted EH&S visits.

In 2017 EH&S instituted a "lab outreach program" in which an EH&S rep contacts each research group for an appointment to meet with a knowledgeable group rep. The sit-downs are generally less than an hour. Due to the large number of new UC lab safety policies/procedures in recent years, it is a good opportunity to review a group's understanding, answer questions and hear from researchers about their concerns.

For both the EH&S lab inspection and outreach programs, the results are summarized within an online tool known as "UC Inspect". The app allows for efficient communication and tracking of findings and corrections.



*Revised 1/2018. OSHA requires that Chemical Hygiene Plans be reviewed and updated annually. So, your copy should have a revision date of less than one year old. Latest version at: http://www.ehs.ucsb.edu/labsafety-chp*

## Chemical Waste Disposal

**REGULATIONS:** Hazardous waste regulations are stringent and penalties for violations can be severe. Santa Barbara County inspects UCSB labs for compliance on a regular basis.

**STORAGE**

- Store chemical waste in a designated area. Label as, "**HAZARDOUS WASTE STORAGE AREA**"
- Store chemicals in containers compatible with, and durable enough for, the waste.
- Liquid waste must be in screw-top containers. Do not overfill - allow for expansion.

**LABELING**

- Identify waste by proper chemical name (no abbreviations or chemical structures).
- List chemical names of hazardous components in that mixture by percent weight
- Deface existing labels when reusing containers
- Label and date container(s) when the first drop of waste is added. Hazardous waste shall be given to EH&S for disposal within ***nine months*** of start date.
- Use ***UCSB HAZARDOUS WASTE*** label on all waste containers. Available for free – see below.

**SEGREGATION:** group waste into the following categories:

-halogenated solvents
-acids with pH 2 or less
-alkali metals and other water reactives
-strong oxidizers (*e.g.,nitric acid)*
-unstable chemicals
-non-halogenated solvents
-alkaline solutions of pH 12.5 or greater
-heavy metal solutions and salts
-cyanides

**DISPOSAL**

- Chemicals may not be disposed in regular trash, sink disposed, or allowed to evaporate.
- Complete a *UCSB Waste Pick-up Request Form*. Send by campus mail or fax(X8659). Also available on the *EH&S website* for electronic submission
- EH&S cannot accept responsibility for improperly labeled, packaged, and/or segregated chemicals, and will not pick them up.
- Waste containers become the property of EH&S and will not be returned


UCSB Hazardous Waste Label

## Laboratory Sharps Disposal

"Sharps waste" means any device having acute rigid corners, edges, or protuberances capable of cutting or piercing, including, but not limited to, all of the following: hypodermic needles, syringes, razor blades and scalpel blades. Glass items contaminated with biohazards, such as pipettes, microscope slides and capillary tubes are also a "sharps waste." **Under no circumstances should "sharps waste" be disposed of in the normal trash. Sharps must be disposed of through EH&S, or a medical waste management company.**

**Sharps Contaminated with Hazardous Chemical Waste**

1. Place in a rigid, puncture-resistant container which, when sealed, is leak proof. Examples below.
2. Label the container with a hazardous waste label and include the chemical constituents.
3. Submit an online *Chemical Waste Collection Request* via the EH&S website. Please note on the request that the material is not biologically contaminated and deface any biohazard symbols, if present.

**Sharps Contaminated with Radioactive Materials**

1. Place in a rigid, puncture-resistant container which, when sealed, is leak proof. Examples below.
2. Label the container with a radioactive waste label and include the radioactive isotope.
3. Submit an online *Radioactive Waste Collection Request* via the EH&S website. Please note on the request that the material is not biologically contaminated and deface any biohazard symbols present.

**Sharps Contaminated with Medical or Biohazardous Waste**

See the EH&S website at this address: http://www.ehs.ucsb.edu/biosafety/biosafety-guide
and see the documents "Biohazards Sharps Use and Disposal" or "Medical Waste Procedures".

**Unused or Non-Contaminated Hypodermic Needles**

1. Place in an approved biohazardous sharps container that is rigid, puncture-resistant and which, when sealed, is leak proof and cannot be opened without great difficulty - examples below.
2. Deface any biohazard symbols, if present.
3. Submit an online *Chemical Waste Collection Request* via the EH&S website. Please note on the request that the material is not biologically contaminated.


**Laboratory Glass Disposal**

**Definition:** Laboratory glass is defined as equipment generally made of pyrex, borosilicate, and quartz glass used for scientific experiments. Examples of laboratory glass include, but are not limited to, the following: beakers, flasks, graduated cylinders, stirring rods, test tubes, microscope slides, glass pipettes, glass petri dishes, and glass vials. **Glass items contaminated with biohazards, such as pipettes,**

**microscope slides, and capillary tubes are considered "sharps waste". Under no circumstances should "sharps waste" be disposed of in the normal trash. Sharps must be disposed through EH&S or a certified medical waste management company.**

**Directions:**

1. Prior to utilizing the cardboard lab glass box, duct tape the bottom to ensure the container is secure.
    - Labs can use a 32gal. red lidded cart to house cardboard lab glass box for ease of transport. (*loose lab glass cannot be placed in red lidded cart)*
2. Place unwanted lab glass in the cardboard lab glass box. Non-lab glass, such as beverage containers should be placed in recycling receptacles, and not disposed along with laboratory glass waste.
3. When full, use duct tape to secure the lid to the body of the box. Be sure that the lid is securely fastened to the body of the box so the contents remain inside.
4. Bring the cardboard lab glass box down to your building's red lidded carts and place inside. Then lock the cart. If you are using the 32gal. cart to house the cardboard glass box, roll the cart down to the dumpster corral and leave for pick-up. Carts are serviced on Saturdays.

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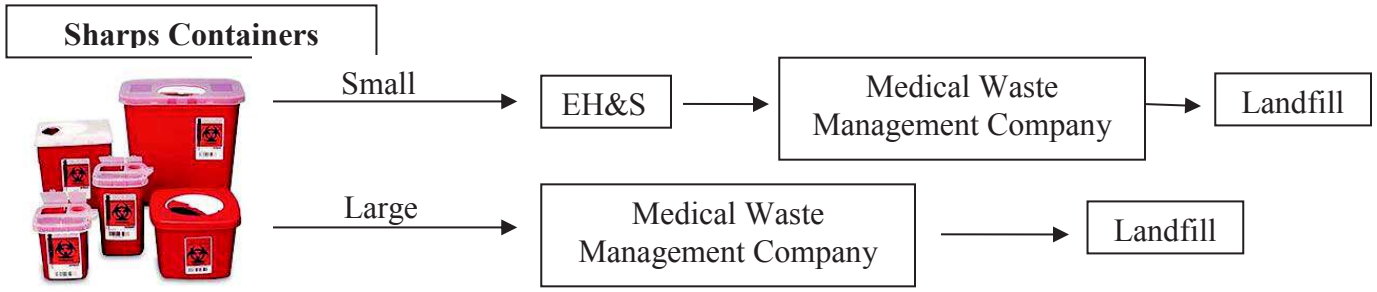
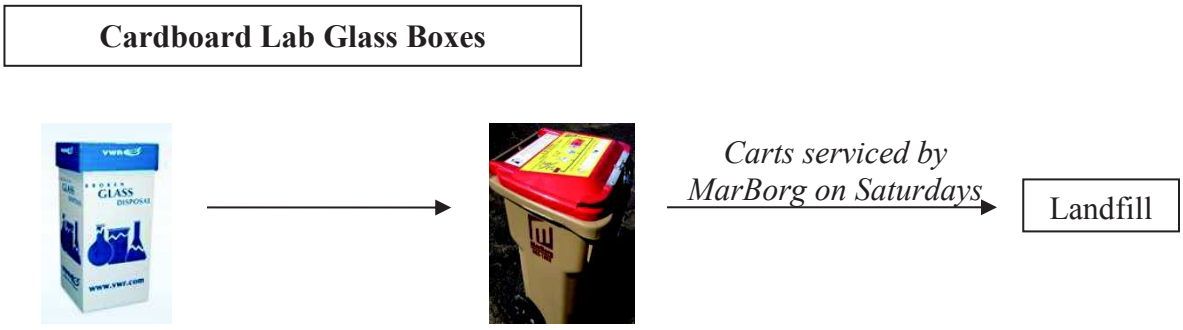
**Sharps Disposal Basic Flowchart (see above for specific types of hazmat-contaminated sharps)**



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# Section III: REGULATORY FRAMEWORK





*Revised 1/2018. OSHA requires that Chemical Hygiene Plans be reviewed and updated annually. So, your copy should have a revision date of less than one year old. Latest version at: http://www.ehs.ucsb.edu/labsafety-chp*

## A. THE CAL-OSHA LABORATORY SAFETY STANDARD

### 1. *Background*

**The Standard for *Occupational Exposure to Hazardous Chemicals in Laboratories* (commonly known as the "Laboratory Standard", or "Chemical Hygiene Plan") was adopted by the California Occupational Health & Safety Administration (Cal/OSHA) Standards Board on February 21, 1991. The Standard is summarized on the following page and the complete text is available online.**

The intent of the Laboratory Standard is to protect laboratory employees from harm due to chemicals. The design of the Laboratory Standard is based on a recognition by OSHA that laboratory work is typically different in character from industrial operations in their use and handling of chemicals. In contrast to many industrial operations, laboratory chemical work often involves a relatively large number of chemicals in small scale procedures that can change significantly over time to reflect evolving research.

### 2. *Applicability*

Labs meeting the following four criteria are subject to the Laboratory Standard:

- Chemical manipulations are on a lab scale, i.e., easily and safely manipulated by one person
- Multiple chemical procedures are used
- Procedures are not part of a production process, nor simulate a production process
- Protective laboratory practices and equipment are available and commonly used

Clearly, most research and teaching laboratories at UCSB, meet these criteria. Students in teaching laboratories are not University employees and therefore do not fall under the provisions of the Standard. However, it is the judgment of the University that, it is obligated to develop policies and course materials which attempt to provide the same level of protection for students. It should be noted that teaching assistants, faculty and staff in instructional labs are covered by the Lab Standard and therefore need to be included in a Chemical Hygiene Plan.

### 3. *Summary of the Laboratory Safety Standard*

The Laboratory Standard contains the following elements.

- **Chemical Hygiene Plan (CHP)—** A written plan (this document) must be developed to control and minimize chemical exposure in laboratories. The CHP must be readily available to affected employees, who need to be oriented to its provisions and relevance to their health and safety. A CHP is required where hazardous chemicals, as defined by OSHA, are used in the workplace. The CHP must be:

  (A) Capable of protecting employees from health hazards associated with hazardous chemicals
  (B) Capable of keeping exposures below OSHA Permissible Exposure Limits

- **Responsibilities—** Personnel responsible for implementation of the CHP must be designated, including the appointment of a Chemical Hygiene Officer. *[Sec. III.B]*

- **Employee Information and Training—** The employer shall provide employees with information and training to ensure that they are informed of the hazards in their work area and their avoidance. *[Sec. III.C.1]*

- **Standard Operating Procedures—** SOPs must be developed for incorporation into the CHP relevant to safety and health when lab work involves the use of hazardous chemicals. *[Secs. I and III.C.2]*

- **Particularly Hazardous Substances—** Provisions must be specified for additional employee protection for work with substances such as "select carcinogens", high acute toxicity substances and reproductive toxins. Provisions are generally incorporated into the SOPs *[Secs. I and III.C.3]*

- **Control Measures—** Criteria must be established that the employer will use to determine, implement and adequately maintain control measures to reduce employee exposures, including lab ventilation, personal protective equipment. Control measures generally incorporated into SOPs. *[Sec. III.C.4]*

- **Maintenance of Engineering Controls, Personal Protective Equipment and Emergency Equipment** – fume hoods must comply with Title 8 5154.1 and protective equipment function properly. *[Sec. III.C.5]*

- **Hazard Identification—** Safety Data Sheets and other reference materials need to be available. Labeling of chemicals is strictly regulated. *[Sec. III.C.6.]*

- **Prior Approval—** Circumstances must be stipulated under which a particular laboratory operation requires prior approval from the lab supervisor. Generally incorporated into SOPs *[Sec. III.C.7]*

- **Employee Exposure Determination—** As appropriate, measurements must be taken to verify that exposure limits are not exceeded. *[Sec. III.C.9]*

- **Medical Consultation and Examinations—** Workers are entitled to medical attention when a significant chemical exposure is suspected. *[Sec. III.C.8]*

## B. RESPONSIBILITIES

**a. Management**

Department heads, deans, supervisors, vice-chancellors and the chancellor are responsible for ensuring that individuals under their management have the training and authority to implement appropriate health and safety policies and practices relative to the Laboratory Standard and per campus policy #5400.

**b. Laboratory Supervisors/Principal Investigators**

The term "supervisor" at UCSB refers to anyone having direct supervisory authority, and includes staff administrators, class instructors, research assistants, managers, and faculty. The supervisor is the key individual in a successful lab safety program. Supervisors are responsible for developing and implementing the CHP for their laboratories, particularly the development of appropriate SOPs. A helpful guideline to many common specific tasks of a lab supervisor can be found online. Supervisors can delegate tasks, but cannot delegate their overall responsibility.

**c. Environmental Health & Safety (EH&S)**

Develop safety education and monitoring programs to help maintain a safe and healthy environment for all, in order to facilitate the research and teaching functions of the University. Support research and instructional activities by developing legally-mandated programs; provide technical guidance and consulting; and assist departments in program implementation. Make every effort to keep operations functioning smoothly in labs.

**d. Chemical Hygiene Officer**

The Lab Standard specifically calls for the appointment of a *Chemical Hygiene Officer*: "***An employee who is designated by the employer, and who is qualified by training or experience, to provide technical guidance in the development and implementation of the provisions of the Chemical Hygiene Plan."*** This CHO role at UCSB is now assigned as follows:

**-UCSB Departments: Chemistry & Biochemistry; Materials; Chemical Engineering, Electrical and Computer Engineering:** Alex Moretto, Chemical Laboratory Safety Officer, Physical Sciences Building North 2660, (805) 893-6630, moretto@chem.ucsb.edu

**-All Other UCSB Laboratory Departments/Units:** Currently vacant. Contact: Hector Acuna, x-8243.

***CHO Duties:*** develop and distribute the *UCSB Chemical Hygiene Plan* to laboratory supervisors. Assist and advise faculty and staff in the customization and implementation of their CHP as requested/needed. Describe the provisions of the CHP to those attending the *Fundamentals of Laboratory Safety* orientations. Monitor and evaluate the effectiveness of the CHP. As a member of the *Laboratory Safety Committee*, advise campus management on the effectiveness of CHP implementation and make recommendations for upgrades to the program. Serve as interface with Cal-OSHA regarding CHP issues.

**e. Laboratory Safety Committee**

The committee is co-Chaired by the Vice Chancellor of Research and the Associate Vice-Chancellor of Administrative Services. The LSC functions as a venue for EH&S/CHOs to receive

input from the campus laboratory community on the content and effectiveness of the CHP and other lab safety issues. Other research-related committees include: Biosafety; Radiation Safety; Institutional Animal Care and Use; Diving Control Board.

**f. Departments and Organized Research Units**

- Under the campus *Injury and Illness Prevention Program* (Cal-OSHA requirement), and the associated UCSB written program, the **department/unit Head or Chair is identified as the individual with the authority and responsibility to implement the IIPP.** The IIPP is the umbrella OSHA regulation, under which all worker safety programs exist.

- To assist the Chair/Unit Head, each department has a *Department Safety Representative (DSR)* who coordinates health and safety program elements in the department and serves as a liaison with EH&S.

- General oversight of department operations and communicating with supervisors and personnel any relevant safety issues, problem solving, and preplanning for emergencies.

- Per UC policy, depts. are responsible for ensuring that all new lab workers attend a *Fundamentals of Laboratory Safety* orientation before lab access is granted - Sec. III.C.1.

- Ensure that all operations under departmental control develop and implement lab-specific CHPs. While individual lab supervisors have the primary responsibility, department administrations need to coordinate and support these efforts.

**g. Laboratory Workers (non-supervisors)**

General responsibilities are below - a more complete list is online.

- Follow established work policies and procedures, including the UC Personal Protective Equipment policy; Laboratory Safety Training policy, CHP and authorizations from campus safety committees.
- Attend and actively participate in appropriate safety training.
- Notify the laboratory supervisor or EH&S of any unsafe or potentially unsafe condition.

Workers have rights under the law - See also the *UCSB Injury & Illness Prevention Program*

- to be informed of the hazards in their workplace
- to be properly trained on safe work practices
- to be provided appropriate personal protective equipment needed for the job at no cost
- to file a complaint with Cal-OSHA if they feel they are being exposed to unsafe conditions and no reprisals can be taken against them.

**h. Facilities Management -** see Section III.C.5

## C. PROGRAM ELEMENTS OF THE UCSB CHEMICAL HYGIENE PLAN

### 1. *Employee Information and Training*

One of the major provisions of the Laboratory Standard and the OSHA *Injury and Illness Prevention Program* is a requirement for employee information and training. The employer must convey information to the employee regarding occupational hazards identified in the workplace. In general, training is required for:

- All new employees and employees given new job assignments involving exposure situations for which training has not previously been received
- Whenever the employer is made aware of a new or previously unrecognized hazard for which training has not previously been received

**UC Laboratory Safety Training Policy**

In October 2014, UC adopted a new policy entitled UC Laboratory Safety Training Policy to reinforce and support OSHA requirements and increase safety. Lab supervisors have the primary responsibilities for implementing the policy provisions, which include:

1. Ensure all "lab workers" complete an EH&S *"Fundamentals of Laboratory Safety"* training in order to be given access to their labs. Class enrollment directions and descriptions are in Sec. II. The training covers most of the issues mandated in the Lab Standard (see below).

2. However, the fundamentals course does *not* address lab-specific training issues and it is incumbent on the lab supervisor to do so. This is done via a **Training Needs Assessment** (**pdf**; Word) to be performed for each lab worker as mandated in the UC policy. See pg. II-21.

**Safety Training Required by the Laboratory Safety Standard**

( * = topic covered/documented in the EH&S *Fundamentals of Laboratory Safety* class per UC policy)

*Worker rights & responsibilities per *Laboratory Standard* and the *Injury & Illness Prevention Program*
*Contents of the generic portions (Sec. II) of the *UCSB Chemical Hygiene Plan*
*Concept of *Permissible Exposure Limits* for OSHA-regulated substances and access to list
*Hazardous materials labeling, storage, and signage requirements
*Relevance and access to SDSs and other informational references and resources pertinent to the lab
*Spill response, waste disposal and emergency procedures

-Contents of the lab-specific *Chemical Hygiene Plan*, including any SOPs ***[Lab supervisor responsibility]***

-The hazards of hazmat including signs and symptoms of overexposure, including Particularly Hazardous Substances - Sec. III.C.3. As appropriate, training can address entire classes of materials rather than individual substances. ***[Major classes of chemical hazards are covered by EH&S*, but not lab-specific hazards. These should be addressed in a lab's SOPs - CHP Sec. I]***

-Appropriate use of control measures including engineering controls, personal protective equipment, and work practices. ***[Generic control measures covered by EH&S*]***

***2. Standard Operating Procedures***

The OSHA Laboratory Safety Standard states that a laboratory's CHP include: ***"Standard operating procedures relevant to safety and health considerations to be followed when laboratory work involves the use of hazardous chemicals",*** defined as:

- A health hazard, or simple asphyxiant
- A **health hazard** is a chemical that is classified as posing one of the following hazardous effects: Acute toxicity (any route of exposure); skin corrosion or irritation; serious eye damage or eye irritation; respiratory or skin sensitization; germ cell mutagenicity; carcinogenity; reproductive toxicity; specific target organ toxicity (single or repeated exposure); aspiration hazard.

It is incumbent on lab supervisors to develop lab-specific SOPs for operations which involve the use of a "hazardous chemical". **Specific guidance on how to prepare SOPs are given in Section I.** In short, EH&S has developed SOP templates for the common classes of hazardous chemicals (e.g., oxidizers, corrosives), or in some cases specific chemicals (e.g., formaldehyde) that labs only need to customize with some local information. In general:

- SOPs should contain information about hazards and how these hazards will be mitigated
- Special focus should be on SOPs for "Particularly Hazardous Substances" (PHS) – human carcinogens and reproductive toxins, acutely toxic materials. (see C.6). In many cases chemicals with similar hazards and safety controls can be grouped together into a single SOP ("control banding").
- SOPs should be written by lab personnel who are most knowledgeable of the experimental process and approved by the supervisor
- SOPs within a CHP must be reviewed by lab workers and be kept where workers can easily access them

***3. Particularly Hazardous Substances (PHS)***

The Laboratory Standard states that: ***"The Chemical Hygiene Plan shall include... provisions for additional employee protection for work with hazardous substances, including "select carcinogens," reproductive toxins and substances which have a high degree of acute toxicity***

**SELECT CARCINOGENS**— Includes carcinogens as listed by the following organizations: OSHA; the National Toxicology Program; the International Agency for Research on Cancer. See also Sec. II.

**REPRODUCTIVE TOXINS**— A chemical which affects human reproductive capabilities, including chromosomal damage (mutations) and effects on fetuses (teratogenesis).

**HIGH ACUTE TOXICITY SUBSTANCES**— Substances such as hydrogen cyanide or hydrogen sulfide which may be fatal or cause damage to target organs as a result of a single exposure or exposures of short duration.

It is the responsibility of individual lab supervisors to institute SOPs for using a specific Particularly Hazardous Substance in their laboratories. **See Section I for template forms and instructions**.

. The PHS section of the Lab Standard goes on to say***: " Specific consideration should be given to the following provisions which shall be incorporated where appropriate:***

1. ***"Establishment of a designated area"***
2. ***"Use of containment devices such as fume hoods or glove boxes"***
3. ***"Procedures for safe removal of contaminated waste"***
4. ***"Decontamination procedures"***

Again, directions/templates for addressing these issues is provided in section 1 of this CHP.

***4. Criteria for Determination and Implementation of Control Measures***

The Laboratory Standard states that the CHP ***"…. shall include criteria that the employer will use to determine and implement control measures to reduce employee exposure to hazardous chemicals ….."*** Hazard controls are generally classified into three broad groups: engineering controls, administrative procedures and personal protective equipment. Guidance on control measures are delineated here.

**A. General**

- Lab supervisors shall determine and implement appropriate control measures and preferably incorporate them into their lab's individual SOPs
- Environmental Health & Safety shall be responsible for assisting the above in determining these control measures upon request. EH&S may do periodic evaluations of control measures on campus as deemed necessary and notify lab supervisors of their results and recommendations.

**B. Engineering Controls—Criteria for Implementation** (see Sec. II-15)

**C. Administrative Controls—Criteria for Implementation**

The variety of possible administrative controls to reduce hazard levels in laboratories is large, e.g., training, signage, labeling, SOPs, etc. The controls instituted by a given laboratory shall be determined by the lab supervisor in consultation with EH&S, as needed. In general, measures shall be implemented:

- As indicated in Standard Operating Procedures
- As mandated by health and safety regulations, or as called for by accepted good practice

**D. Personal Protective Equipment—Criteria for Implementation**

Appropriate personal protective equipment (PPE) practices are stipulated in the UC policy titled: **Personal Protective Equipment** (March 2014). The key provisions of the policy are summarized in Sec. II, pgs. 6 to 10 of this manual.

***5. Maintenance of Engineering Controls, Personal Protective Equipment and Emergency Equipment***

Per the Laboratory Standard: ***".....a requirement that fume hoods comply with section 5154.1 (Title 8, CCR), and that all protective equipment shall function properly and that specific measures shall be taken to ensure proper and adequate performance of such equipment...."***

**General Responsibilities**:

**FACILITIES MANAGEMENT (FM):** Responsible for routine maintenance, replacement and installation of University-owned building emergency systems and environmental controls. Must inform affected departments and/or individuals in a timely way when building systems are, or will be, non-functional.

**ENVIRONMENTAL HEALTH & SAFETY:** Responsible for evaluating effectiveness of engineering control measures and emergency equipment used. Will make recommendations to FM and users on implementation of appropriate equipment and control measures as needed.

**LAB SUPERVISOR/LAB PERSONNEL:** Responsible for monitoring status and effectiveness of equipment and control measures. Responsible for reporting to appropriate campus entity if equipment is not functional. Responsible for maintaining and testing equipment they own.

**Specific Responsibilities:**

**FUME HOODS/GAS CABINETS (per CCR, Title 8, 5154.1)**

| | |
|---|---|
| Maintenance: | Facilities Management |
| Annual certification: | EH&S |

**BIOSAFETY CABINETS (per CCR, Title 8, 5154.2)**

| | |
|---|---|
| Maintenance: | Owner (generally lab supervisors) |
| Annual certification: | Generally, owner covers cost of outside vendor certification – generally TSS, Inc. via UC contract. Biosafety Committee typically requires cabinet use as part of their authorization |

**LAB-OWNED or SPECIALIZED LOCAL EXHAUST VENTILATION (e.g., laminar flow hoods)**

| | |
|---|---|
| Maintenance: | Owner responsibility. Given the specialized nature of these, FM does not have the expertise to maintain these. |
| Certification testing: | Owner responsibility. Given the specialized nature of these, FM nor EH&S have the capability to test these and should be performed by an outside testing company like TSS, Inc. under UC contract. |

**EMERGENCY SHOWERS AND EYEWASHES (per CCR, Title 8, 5162)**

| | |
|---|---|
| Maintenance & testing | Facilities shall check on a regular basis by running water through them until the water runs clear and repair as needed and keep records. |

**RESPIRATORS (per CCR, Title 8, 5144)**

| | |
|---|---|
| Administration: | EH&S has sole responsibility for approval, fit-testing and issuance. Supervisors are responsible for identifying and directing individuals to EH&S who may require respirators. |

Maintenance: Lab supervisor or designee

**OTHER PERSONAL PROTECTIVE EQUIPMENT (per CCR, Title 8, 3380-3387)**

Maintenance: Generally provided by UCSB, or the lab supervisor – maintenance & replacement are the responsibility of the supervisor and lab personnel. See Sec. II-6 to -10.

**FIRE EXTINGUISHERS, DETECTORS, ALARMS, SUPPRESSION SYSTEMS (per CA Fire Code and Building Code)**

Administration: The campus Fire Marshal's office is responsible for evaluation and approval of these systems

Maintenance: Facilities Management

**GAS DETECTION/ALARM SYSTEMS (per CA Fire Code and Building Code)**

Administration: EH&S has responsibility for evaluation and approval of code-required gas detection/alarm systems

Maintenance: Facilities Management, or Cleanroom staff

**EMERGENCY PHONES**

Maintenance: Communications Services

**HAZARDOUS MATERIALS SPILL RESPONSE EQUIPMENT (per CCR, Title 8, 5192)**

Maintenance: EH&S is responsible for equipping, maintaining and using the primary hazmat response equipment stores for the campus. Individual labs or departments may have local supplies.

### *6. Hazard Identification*

Policies and regulations on hazard identification with respect to labeling and SDS are:

- Labels on incoming containers of hazardous chemicals are not to be removed or defaced.
- The primary campus access to Safety Data Sheets is through the internet - see Sec. II-13. Individual labs are encouraged to maintain their own hardcopy files as well.
- For chemical substances developed in University laboratories, the provisions for hazard determination, training and labeling shall be those stated in the Laboratory Standard.

### *7. Prior Approval*

Another provision of the Laboratory Standard is for incorporating policies into the CHP on: ***"The circumstances under which a particular laboratory operation, procedure or activity shall require prior approval from the employer or the employer's designee before implementation."***

Given the diversity of chemical work done in campus laboratories, it is impossible to specify the operations which would require prior approval**. It is therefore the responsibility of individual lab supervisors to establish these criteria, if any, for their operations. Establishment of prior approval criteria is solely the prerogative of the lab supervisor**. These criteria should be incorporated into lab's SOPs. There is a field in the UCSB SOP templates for including.

### *8. Medical Consultation and Examination*

The Laboratory Standard states that: ***"The employer shall provide all employees who work with hazardous chemicals an opportunity to receive medical attention, including any follow-up examinations which the examining physician determines to be necessary, under the following circumstances":***

- ***When an employee develops signs or symptoms associated with a hazardous chemical to which that employee may have been exposed***
- ***Where exposure monitoring reveals an exposure level routinely above the action level or PEL for an OSHA-regulated substance***
- ***Whenever an event takes place in the work area such as a spill, leak, or explosion resulting in the likelihood of a hazardous exposure"***

The University has established the following procedures, when it is known or suspected that a worker has been exposed to a hazardous chemical(s) or is otherwise injured on campus.

- All employees suffering from chemical exposure or other work-related injury incurred at UCSB shall be evaluated/examined at University expense. Students are covered by their required medical insurance.
- If the injured/exposed person is safe to transport, escort them to either Student Health Services (undergraduate students), Goleta Valley Community Hospital, or their primary physician for evaluation. Contact EH&S at x3194, or x4440 immediately to initiate medical coverage procedures.
- In some cases a work-related chemical exposure may be suspected but not certain. For example, some low-level but chronic exposures may be difficult to identify or relate to specific symptoms. In these instances, contact the Chemical Hygiene Officer at x4899 to arrange a review of the suspected exposure.
- The Laboratory Standard includes specific provisions regarding the employer's exchange of information with the examining physician. The provisions of the Standard will be followed as stipulated therein.

### *9. Criteria for Establishing Exposure Monitoring*

The legal limits for occupational exposure to ~500 chemicals which are toxic by inhalation, or skin contact, are codified by OSHA in so-called Permissible Exposure Limit (PEL) values.

Exposure monitoring for any substance regulated by OSHA will be done if there is reason to believe that exposure levels exceed the action level, or Permissible Exposure Limit. The tasks of determining if monitoring is required and performing the monitoring shall be the sole responsibility of EH&S. For "regulated carcinogens" (See Sec. II-11) EH&S does periodic reviews of usage practices and monitoring to establish if there is reason to suspect there are exposures.