CAL STATE LA
RISK MANAGEMENT / ENVIRONMENTAL, HEALTH & SAFETY

Chemical Hygiene Plan

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California State University, Los Angeles

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1. INTRODUCTION

Policy

California State University of Los Angeles (Cal State LA) is committed to providing a healthy and safe working environment for the campus community, free from hazards recognized by the Office of the Chancellor and Cal State LA's campus policies. The Chemical Hygiene Plan (CHP) establishes a written plan for protecting all laboratory personnel against adverse health and safety hazards associated with exposure to potentially hazardous chemicals. The CHP must be available for all employees working with hazardous chemicals or those having the potential to come in contact.

To ensure compliance with regulatory standards, any materials found to not be in conformance with this plan/and or the Hazard Communication Program may be disposed of as hazardous waste at the discretion of RMEHS. In case of life safety matters or imminent danger to life or health, the Director of RMEHS or designee has the authority to order the cessation of the activity until the hazardous condition is abated. In most cases, the accident or incident will be reported to the corresponding safety committee for resolution and/or elevation to a higher authority.

Purpose

The CHP establishes a formal written program for protecting the campus community against adverse health and safety hazards associated with exposure to potentially hazardous chemicals. The CHP describes the proper use and handling practices and procedures to be followed by faculty, staff, students, visiting scholars, and all other personnel working with potentially hazardous chemicals on campus.

The CHP complies with the California Occupational Safety and Health Administration, Title 8, CCR §5191 Occupational Exposure to Hazardous Chemicals in Laboratories. This plan is based on best practices identified in, among other sources, "Prudent Practices for Handling Hazardous Chemicals in Laboratories," published by the National Research Council, and the American Chemical Society's "Safety in Academic Chemistry Laboratories."

Scope

The provisions of this CHP apply to all personnel who work in laboratory environments that use, store, or handle potentially hazardous chemicals and all personnel who work in these facilities. The information provided in the CHP applies to but is not necessarily limited to faculty/staff, principal investigators, laboratory and stockroom technicians, technical assistants, student employees, registered volunteers, graduate students, undergraduate students, building service engineers, and building trades and maintenance staff. This includes students enrolled in a laboratory class, students providing voluntary unpaid assistance to a faculty or staff member, and students in a laboratory because of a club or other co-curricular activity.

The CHP applies to all laboratories that use, store, or handle potentially hazardous chemicals and all personnel who work in these facilities. It does not apply to research involving exclusively radiological, radiation-producing machines, biological materials, or lasers, as these safety procedures and regulatory requirements are outlined in the Radiation Safety Program, Biohazardous Management Plan, and Laser Safety Manual, respectively. Research involving more than one type of hazard must comply with all applicable regulatory requirements and follow the guidance outlined in all the relevant safety programs.

This document's purpose is that laboratory use of hazardous chemicals is defined as the use of hazardous chemicals in a facility in a way that all the following conditions are met.

- Chemical manipulations are carried out on a scale in which the containers used for reactions, transfers, and another handling of substances are designed to be easily and safely manipulated by one person.
- Multiple chemical procedures or chemicals are used.
- The procedures involved are not part of a production process, or in any way simulate a production process; and
- "Protective laboratory practices and equipment" are available and in common use to minimize the potential for employee exposure to hazardous chemicals.

The use of hazardous chemicals on campus which do not meet these conditions shall be managed by Title 8, §5194, the *Hazard Communication* standard.

The information presented in the CHP is not intended to be all-inclusive. Departments, divisions, or other work units engaged in work with potentially hazardous chemicals that have unusual characteristics or are otherwise not sufficiently covered in the written CHP, must customize the document by adding additional sections addressing the hazards and how to mitigate their risks, as appropriate. Such customizations must receive prior approval from the PI/Laboratory Manager and/or the Department of Risk Management and Environmental Health and Safety (RMEHS). For information on specific chemical safety topics not covered in the CHP, please email rmehs@calstatela.edu.

Regulatory Requirements for the CHP

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

- Title 29 Code of Federal Regulations (CFR) §1910.1450, "*The Occupational Safety and Health Act (OSHA) Lab Standard*"
- Title 8, California Code of Regulations (CCR) §5191, "*Occupational Exposure to Hazardous Chemicals in Laboratories*"
- Title 8, CCR, Article 110, §5200-5220 regulated carcinogens including, but not limited to
    - §5203, "*Carcinogen Report of Use Requirements*"
    - §5209, "*Carcinogens*"
- Title 8, CCR, §5154.1, "*Ventilation Requirements for Laboratory-Type Hood Operations*"

The Department of RMEHS, with the help of the Laboratory Safety Committee (LSC), will review and evaluate this plan's effectiveness at least annually and update it, as needed.

Right and Responsibilities

All employees and other personnel who work in or maintain (i.e., custodial staff) laboratories have the right to be informed of potential chemical health hazards in their work areas and proper training requirements to work safely around or with these materials.

Those employees also have the right to file a complaint with Cal/OSHA if they feel they are being exposed to unsafe or unhealthy work conditions and cannot be discharged, suspended, or otherwise disciplined by their employer for filing a complaint or exercising these rights. In addition, any employee who maintains or works in laboratories is encouraged to report (anonymously, if preferred) any concerns about unsafe work conditions for RMEHS investigation on the RMEHS website using the "Report a Safety Concern" function.

The responsibilities of the health and safety of the campus community are shared amongst all organizational levels at Cal State LA. Both the President and Vice President at Cal State LA, have the responsibility and implementation of CSU's Environmental Health and Safety Policy in observance with the CSU Executive Order 1039 for all facilities under campus control. The Deans of the Colleges and Department Chairs are responsible for establishing and maintaining programs in their organizational areas and promoting a safe and healthy work environment.

PIs/ Laboratory Managers/responsible person(s) have the obligation of managing laboratory safety and adhering to safe laboratory practices on day-to-day operations for their control areas within their associated department. All personnel, including PIs/Laboratory Managers/responsible person(s), employees, and students, are entrusted to maintain a safe work environment. Safety is everyone's responsibility.

All laboratory personnel working with chemicals are responsible for staying informed about the chemicals in their work areas, safe work practices, and proper personal protective equipment (PPE) requirements for safe work practice while performing their job. Failure to comply may result in a temporary suspension of laboratory activities and progressive disciplinary action until corrective action is implemented.

Information regarding specific duties and responsibilities of laboratory personnel who work in areas where potentially hazardous chemicals are outlined in *General Rules for Laboratory Work*, found in *Appendix A* of this document.

Responsibilities of Deans, Directors, and Department Chairs

Deans, Directors, and Department Chairs are to work with their organization units to ensure that affected employees are trained on the provisions of the University's Chemical Hygiene Plan (CHP) and are acting to comply with its requirements.

Deans, Directors, and Department Chairs should:

1. Identify all laboratories and chemical handling areas in their organizational unit.
2. Assign responsible person(s)/party and/or lab manager for each laboratory/chemical handling area when one is currently not assigned.
3. Encourage safety guidelines for all chemical users in the organization unit.

Responsibilities of the Principal Investigator (PI), Laboratory Manager, and/or Responsible Person(s)

The PI, Laboratory Manager, and/or responsible person(s) has responsibility for the health and safety of all personnel working in his or her laboratory who handle hazardous chemicals. The PI, Laboratory Manager, and/or responsible person(s) may delegate safety duties but remains accountable for ensuring that delegated safety duties are observed. For definitions of PI, Laboratory Manager, and/or responsible person(s), please refer to the *Glossary* in *Appendix L* of this document.

The PI, Laboratory Manager, and/or responsible person(s) is responsible for:

1. Being knowledgeable of all applicable health and safety rules and regulations, training, and reporting requirements, and standard operating procedures (SOPs) associated with chemical safety for regulated substances.
2. Identify hazardous conditions or operations in the laboratory or other facility containing hazardous chemicals, and determine safe procedures, controls, and implemented enforce standard safety procedures.
3. Establish SOPs (general and protocol-specific) relevant to health and safety for laboratory-specific work.
4. Maintain an updated group roster through the Risk and Safety Solutions (RSS) profile application and conduct a formal *Hazard Assessment* to mitigate potential hazards found in their laboratory.
5. Ensure the availability of all appropriate fitting personal protective equipment (PPE) (e.g., laboratory coats, gloves, eye protection, etc.) using the *Hazard Assessment* tool (using *RSS Assessment*) as guidance for the type and use of PPE associated with hazards in their laboratory.
6. Ensure all personnel wearing PPE are trained in the selection, care, use, and proper storage and maintenance of PPE assigned.
7. Provide prior approval for hazardous chemicals in the PI/Laboratory Manager's laboratory or other facilities with them.
8. Consult with RMEHS before using higher-risk materials, such as particularly hazardous substances or conducting higher- risk experimental procedures so that special safety precautions may be considered.
9. Maintain an updated *Chemical Inventory* (using *RSS Chemicals*) for the laboratory or control area.

10. Ensure laboratory or other personnel under his/her supervision have access to and are familiar with the appropriate Safety Plan/Program(s) (i.e., Radiation Safety Program, Biohazard Management Plan, Respiratory Protection Plan, etc.) or applicable protocols.
11. Train all laboratory or other personnel he/she supervises to work safely with hazardous materials and maintain written records of such training in the "Laboratory Safety Binder" or equivalent.
    a. Training must include:
        i. The person's name and Cal State LA ID #.
        ii. Date of the training.
        iii. Information covered.
        iv. Copy of training documents given.
        v. The availability of hazard information and/or the type of information provided.
12. Promptly notify RMEHS and/or Facilities Services using the Work Order system should he/she become aware that workplace engineering controls (e.g., fume hoods) and safety equipment (e.g., emergency showers/eyewashes, fire extinguishers, etc.) become non-operational.
13. Conduct annual self-inspections, using the *RSS Inspect* module, of all responsible laboratories or facilities under their direct supervision.
14. Promptly report accidents and injuries to departmental hierarchy and RMEHS using our reporting feature on the RMEHS website. Serious injuries MUST be reported to RMEHS immediately to allow for compliance within the CAL/OSHA 8-hour reporting period. Any doubt as to whether an injury is serious should favor reporting.
15. Provide funding for medical surveillance and/or medical consultation and examination for laboratory and other personnel, as required.
16. Inform facilities personnel, other non-laboratory personnel, and any outside contractors of potential laboratory-related hazards when they are required to work in the laboratory environment by maintaining and updating their door hazard sign(s) for all their control area(s) annually.
17. Identify and minimize potential hazards to provide a safe environment for repairs and renovations.

Responsibilities of All Personnel Who Handle Hazard Chemicals

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

1. Review and follow requirements of the CHP and all appropriate Safety Plan/Program(s) (i.e., Radiation Safety Program, Biohazard Management Plan, Respiratory Protection Plan, etc.) and any applicable campus policies.
2. Follow all verbal and written laboratory safety rules, regulations, and standard operating procedures (SOPs) required for the tasks assigned.

3. Develop good personal chemical hygiene habits, including keeping the work areas safe and uncluttered.
4. Plan, review, and understand the hazards of materials and processes in their laboratory research or other work procedures before conducting any work.
5. Utilize appropriate measures to identify hazards, including consistent and proper use of engineering controls, personal protective equipment, and administrative controls.
6. Understand the capabilities and limitations of personal protective equipment (PPE) issued to them.
7. Gain prior approval from the Principal Investigator (PI), Laboratory Manager, and/or responsible person(s) for restricted chemicals and other materials.
8. Consult with PI/Laboratory Manager before using any particularly hazardous substances (PHS), pyrophoric chemicals, explosives, and other highly hazardous materials or conducting certain higher-risk experimental procedures.
9. Immediately report all accidents and unsafe conditions to the PI, Laboratory Manager, and responsible person(s). Completing all required health, safety, and environmental training, providing written documentation to either their PI, Laboratory Manager, and/or direct supervisor.
10. Participate in medical surveillance, when required.
11. Inform the PI, Laboratory Manager, and/or responsible person(s) of any work modifications ordered by a physician as a result of medical surveillance, occupational injury, or exposure; and
12. When working autonomously or performing independent research or working by
    a. Reviewing the plan or scope of work for their proposed research with the PI/Laboratory Manager.
    b. Notify in writing and consult with the PI/Laboratory Manager, in advance, if they intend to significantly deviate from the previously reviewed procedures (Note: Notable change may include, but is not limited to change in objectives, change in PI, change in duration, quantity, frequency, conditions or location, increase, or change in PPE, and reduction or elimination of engineering controls).
    c. Prepare SOPs and perform literature searches relevant to safety and health that are appropriate for their work.
    d. Provide appropriate oversight, training, and safety information for the laboratory or other personnel they supervise or direct.

Responsibilities of Delegated Department Members (DDMs)

The DDMs appointed by Department Chairs or Department Heads are responsible for ensuring compliance with regulatory guidelines and Chemical Hygiene Plan (CHP) procedures. DDMs can be Resource Managers (RMs), Instructional Support Technician(s) (ISTs), or faculty and/or staff who are qualified by knowledge and/or experience to help carry out the policies and procedures in the CHP while maintaining an accident-free environment within the area of their authority.

Responsibilities of the DDMs normally include the following.

1. Assist the Dean, Director, or Department Chair in the development and implementation of Risk Management and Environmental Health and Safety (RMEHS) Program(s) for the Department based on the regulations and procedures established by the RMEHS Department.
2. Conduct an internal safety inspection of the facilities which they service, equipment, and projects to identify unsafe practices and/or conditions.
3. Facilitating the implementation of the CHP and assisting in establishing a safe work environment by collaborating with RMEHS, faculty/staff, other researchers, and lab personnel.
4. Serve as a department representative on the Laboratory Safety Committee (LSC) by providing guidance and support.
5. Serving as a liaison between the laboratory and RMEHS in helping maintain safety and regulatory information, including Safety Data Sheets (SDS), ensuring that all markings, labeling, and identifications per regulatory requirements are in place.
6. Assist and expedite the correction of identified deficiencies as applicable.
7. Guide laboratory safety compliance and technical subjects to laboratory personnel as needed.
8. Prepare written reports and recommendations for improving compliance with RMEHS regulations.
9. Encourage compliance with the *General Rules of Laboratory Work* (*Appendix A*).

Responsibilities of the Office of Risk Management and Environmental Health and Safety (RMEHS) and the Campus Chemical Hygiene Officer (CHO)

RMEHS is responsible for administering and overseeing the institutional implementation of the Laboratory Safety Program. The campus Chemical Hygiene Officer (CHO), Rominna Valentine Ico, is designated by RMEHS and is qualified by training and experience, to provide technical guidance in the development and implementation of provisions of the Chemical Hygiene Plan (CHP). In the case of life safety matters or imminent danger to life or health, the Director of RMEHS or designee has the authority to order the cessation of the activity until the hazardous condition is abated. RMEHS provides technical guidance to personnel at all levels of responsibility on matters of laboratory use of hazardous materials.

The CHO is a member of RMEHS and, with support from other RMEHS personnel, is responsible for the following:

1. Inform PI/Laboratory Managers/RMs/ISTs/responsible person(s) of all health and safety requirements and assist with the selection of appropriate safety controls, including laboratory and other workplace practices, PPE, engineering controls, training, etc.
2. Conduct periodic inspections and immediately take steps to abate hazards that may pose a risk to life or safety upon discovery of such hazards.
3. Perform hazard assessments, upon request.
4. Help to develop and implement appropriate chemical hygiene policies and practices.

5. Have working knowledge of current health and safety rules and regulations, training, reporting requirements, and standard operating procedures associated with regulated substances. Such knowledge may be supplemented and developed through research and training materials.
6. Work with research personnel to review existing SOPs and assist with developing new SOPs for handling hazardous chemicals.
7. Provide technical guidance and investigation, as appropriate, for laboratory and other types of accidents and injuries.
8. Help determine medical surveillance requirements for potentially exposed personnel.
9. Review plans for the installation of engineering controls and new facility construction/renovation, as requested.
10. Review and evaluate the effectiveness of the CHP at least annually and update as appropriate.
11. Serve as the Co-Chair of the Laboratory Safety Committee (LSC).
12. Approve or deny chemical purchases under guidelines outlined in the Procurement of Chemicals.

Responsibilities of the Laboratory Safety Committee (LSC)

The Laboratory Safety Committee (LSC) shall function as a cooperative effort for information dissemination and ensure that the Chemical Hygiene (CHP) procedures are followed. The Committee shall include the CHO as a co-chairperson and Delegated Department Member (DDM) appointed by the executive sponsor. Members of the committee will consist of department chairs for which the CHP effects and their corresponding Resource Managers (RMs), Instructional Support Technician(s) (ISTs), or DDM (appointed by the department chair). Figure 1-1 below represents the proposed LSC structure for the campus.

The committee will support the CHP with the following responsibilities.

1. Submit and prepare agenda items to be discussed at committee meetings.
2. Develop, recommend, and review policies created by RMEHS relating to the use of hazardous chemicals and other CHP requirements.
3. Report to the appropriate manager/PI/director supervisor any unsafe conditions observed by or reported to membership and monitor the response and abatement. Refer to any unabated conditions to the next level of management, as necessary.
4. Review internal safety inspection reports conducted by RMEHS, or external reviews conducted by regulatory bodies, and offer suggestions and recommendations relative to the reports' findings and conclusions.
5. Review any investigation reports of accidents or near-misses and make recommendations related to accident prevention and hazard abatement.
6. Meet at least three times a year or as requested by the committee co-chairpersons or depending on the severity of an issue related to the health and safety of those working with chemicals.
7. Report any issues to a higher authority when no consensus can be reached.

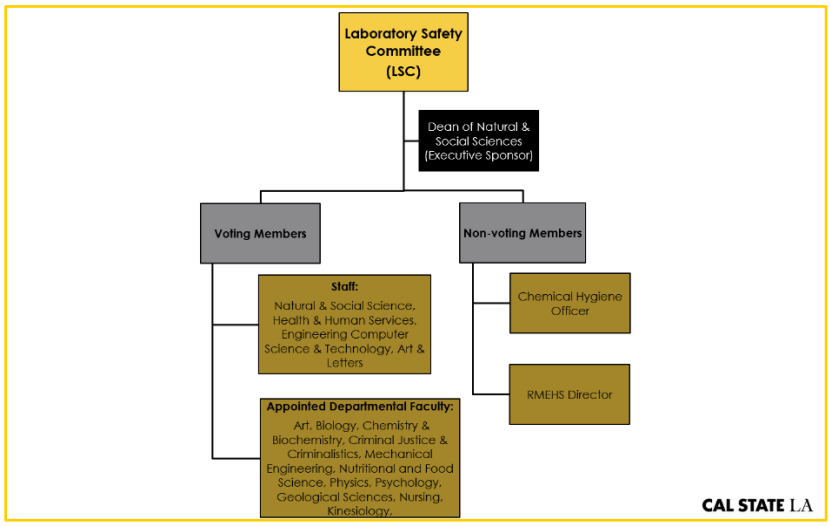


Figure 1-1: Proposed Laboratory Safety Committee Structure, 2023.

Compliance and Reoccurring Issues in Control Area(s)

Unsafe or unhealthy working conditions, practices, or procedures shall be corrected promptly based on the severity and consequence of the issue. The Risk Management and Environmental Health and Safety (RMEHS) Department is responsible for tracking and managing the recurring issues presented during safety committee meetings. Figure 1-2 shows the proposed structure of all the campus safety committees.

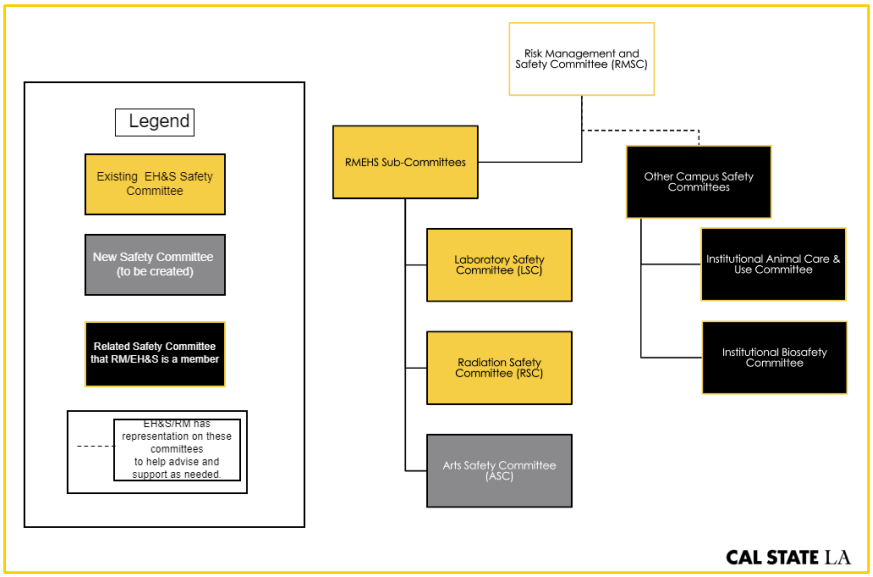


Figure 1-2: Risk Management and Safety Committee (RMSC) proposed structure, 2022.

The procedure to address recurring issues is as follows.

1. Risk Management and Safety Committee (RMSC) meeting minutes provide tracking of compliance and may serve as full or partial evidence of actions taken to resolve issues.
1. Issues regarding health and safety concerns or compliance are presented at scheduled RMSC meetings and are assigned to committee members with a 30-day period for assessment and resolution.
2. The RMSC committee members will serve as a liaison between the safety committee and the responsible party for the corrective action.
3. If the issue affects more than one responsible party, the allotted 30 days can be extended if there is a written plan or procedure to ensure resolution within a timely manner with prior acknowledgment from all parties.
4. If the 30-day period has expired or no response/update is provided by the next RMSC meeting, the committee will prioritize and evaluate the issue by reporting it to a higher authority by submitting a report to the Director of RMEHS for resolution.
5. The committee will update and document when the responsible person(s)/party has completed/will complete the date on the meeting minutes. The safety committee meeting minutes shall be updated accordingly with any relevant progress reports.

Responsibilities of Committee Chairpersons

The campus committee chairpersons provide aid to the campus community by creating a bipartisan party between RMEHS and collaborating departments. The CHO, an RMEHS specialist, and the appointed DDM, a department chair, qualified by training and experience, to provide technical guidance in the development and implementation of provisions of item topics in the LSC.

The Committee Chairpersons in turn:

1. Holds LSC Meetings when necessary or as needed to assess campus health and safety issues.
2. Has the authority to prioritize and elevate recurring issues of the LSC Meeting agenda items.
3. Helps to develop and implement appropriate chemical hygiene policies and practices.
4. Submit a written report to the Director of RMEHS who will further address any unabated issues or pending items that might require additional assistance from the campus community at the Risk Management and Safety Committee (RMSC).

2. CHEMICAL HAZARD COMMUNICATION

Regulatory Requirements

Cal State LA is responsible for providing information about the hazardous chemicals in our laboratories, the associated hazards, and the control of these hazards through a CHP. Proper hazard communication involves the active participation of the PI/Resource Manager (RM)/Laboratory Manager/DDM, the CHO, and/or the responsible person(s) who are each accountable for providing consultation and safety information to lab personnel/workers using hazardous chemicals.

List of Hazardous Substances

Each laboratory group must maintain a current chemical inventory for the chemicals and compressed gases used and stored in the lab. This list must include the quantity of the chemicals/gases and any specific information on any associated health or safety hazards, typically in the form of Safety Data Sheets (SDSs), readily available to all laboratory personnel working in the area.

Hazard Determination

PIs/Resource Managers/Laboratory Managers/responsible person(s) are responsible for verifying if any items on their chemical inventory are subject to requirements of the hazard communication regulation.

The term "hazardous substance" refers to any chemical for which there is statistically significant evidence based on at least one study conducted in accordance with established scientific principles that acute or chronic health effects may occur in exposed individuals.

Hazardous substances include those chemicals listed in the following.

1. "*The Hazardous Substance List*," prepared by the Cal/OSHA Title 8 CCR §339,
2. "*Toxic and Hazardous Substances, Air Contaminants*," Title 8 CCR §5155
3. "*Threshold Limit Values for Chemical Substances in the Work Environment*," ACGIH, 2012,
4. Most Recent "*Annual Report on Carcinogens*," NTP
5. "*Monographs*," IARC, WHO,
6. SDSs for reproductive toxins and cancer-causing substances, and
7. "*Chemicals Known to the State to Cause Cancer or Reproductive Toxicity*" (Proposition 65), Title 27 CCR 27001.

Chemical inventory items found on any of the above lists are subject to the following requirements below.

Safety Data Sheets (SDS)

An SDS (formerly known as material safety data sheets or MSDSs) must be available for each hazardous substance in the chemical inventory. SDSs are available from the manufacturer upon receipt of chemicals or through the Risk and Safety Solutions (RSS) online SDS library using the *Chemicals* module. PIs/Resource Managers/Laboratory Managers/responsible person(s) are responsible for maintaining

SDSs current and making them available to all laboratory workers throughout the workday and keeping them in a central location. Electronic copies may be kept in a file on a group drive or in a central location in the laboratory/control area if they can be accessible in an emergency or produced when requested.

New chemical substances synthesized or produced in a laboratory and used or shared outside of the laboratory suite and/or control area, require the preparation of an SDS for each synthesized substance. Please submit and reach out to RMEHS for assistance in preparing new SDSs.

Global Harmonized System (GHS)

The New Global Harmonization System (GHS) requires the standardization of SDSs. SDSs contain 16 sections that help identify, dispose of, and handle the chemical described. Below is the explanation of each section and the type of information listed below.

1. **Identification of substance or mixture and supplier**
   - GHS product identifier.
   - Other means of identification.
   - Recommended use of chemicals or restrictions on use.
   - Supplier's details (including name, address, phone number, etc.).
   - Emergency phone number.
2. **Hazard Identification**
   - GHS classification of the substance/mixture and any national or regional information.
   - GHS label elements, including precautionary statements. (Hazard symbols may be provided as a graphical reproduction of the symbols in black and white or the name of the symbol, e.g., flame, skull, and crossbones.) Symbols are required to be in a red border /red diamond.
   - Other hazards which do not result in classification (e.g., dust explosion hazard) are not covered by the GHS.
3. **Composition/ Information on Ingredients**
   - Substance
     - Chemical identity.
     - The common name, synonyms, etc.
     - CAS number, EC number, etc.
     - Impurities and stabilizing additives are classified and contribute to the substance's classification.
   - Mixture
     - The chemical identity and concentration or concentration ranges of all ingredients which are hazardous within the meaning of the GHS and are present at or above their cutoff levels.
4. **First Aid Measures**

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

5. **Firefighting Measures**
   - Suitable (and unsuitable) extinguishing media
   - Specific hazards arising from the chemical (e.g., the nature of any hazardous combustion products).
   - Special protective equipment and precautions for firefighters.
6. **Accidental Release Measures**
   - Personal precautions, protective equipment, and emergency procedures.
   - Environmental precautions.
   - Methods and materials for containment and cleaning up.
7. **Handling and Storage**
   - Precautions for safe handling.
   - Conditions for safe storage, including incompatibilities.
8. **Exposure Controls/ Personal Protection**
   - Control parameters, e.g., occupational exposure limit values or biological limit values.
   - Appropriate engineering controls.
   - Individual protection measures, such as personal protective equipment.
9. **Physical and Chemical Properties**
   - Appearance (physical state, color, etc.)
   - Odor
   - Odor threshold
   - pH
   - Melting point/freezing point
   - Initial boiling point and boiling range
   - Flashpoint
   - Evaporation rate
   - Flammability (solid, gas)
   - Upper/lower flammability or explosive limits
   - Vapor pressure
   - Vapor density
   - Relative density
   - Solubility(ies)
   - Partition coefficient: n-octanol/water
   - Auto-ignition temperature
   - Decomposition temperature

10. **Stability and Reactivity**
    - Chemical stability
    - Possibility of hazardous reactions
    - Conditions to avoid (e.g., static discharge, shock, or vibration)
    - Incompatible materials
    - Hazardous decomposition products
11. **Toxicological Information**
    - Concise but complete and comprehensible description of the various toxicological (health) effects and the available data used to identify those effects, including:
        - Information on the likely routes of exposure (inhalation, ingestion, skin, and eye contact).
        - Symptoms related to physical, chemical, and toxicological characteristics.
        - Delayed and immediate effects and chronic effects from short-and long-term exposure.
        - Numerical measures of toxicity (such as acute toxicity estimates).
12. **Ecological Information**
    - Eco-toxicity (aquatic and terrestrial, where available)
    - Persistence and degradability
    - Bio-accumulative potential
    - Mobility in soil
    - Other adverse effects
13. **Disposal Considerations**
    - Description of waste residues and information on their safe handling and methods of disposal, including the disposal of any contaminated packaging.
14. **Transport Information**
    - UN Number
    - UN Proper shipping name
    - Transport Hazard Class(es)
    - Packing group, if applicable
    - Marine pollutant (Yes/No)
    - Special precautions which a user must be aware of or comply with in connection with transport or conveyance within or outside their premises.
15. **Regulatory Information**
    - Safety, health, and environmental regulations specific to the product in question.
16. **Other Information**
    - Include information on the preparation and revision of the SDS.
    - No special precautions are included in the other sections.

Labels, Signs, and Other Forms of Warning

Labeling requirements for all hazardous substances are summarized as follows.

- All containers of purchased hazardous materials or materials intended for distribution must be labeled with the hazardous substance's identity.
- The label must contain all applicable hazard warning statements.
- The name and address of the chemical manufacturer or other responsible parties must be present.
- Manufacturers' product labels must remain on all containers and must not be defaced in any way. Appropriate hazard warning statements and Proposition 65 warning must be present if not, that information must be added.
- Labels must be legible and prominently displayed.
- Symbols and/or other languages are required for non-English speaking employees.
- Secondary containers (such as spray bottles) must be labeled with the appropriate hazard warnings based on the knowledge of the chemicals and physical properties of that substance.
- Newly synthesized compounds must be labeled with the responsible person's or parties' information and chemical name or structure if known or at a minimum a chemical identification number.
- Global Harmonization System (GHS) symbols should be used when labeling containers. Figure 2-1 explains the GHS symbols and their meaning.

Additional information on container labeling is provided in *Appendix B*.

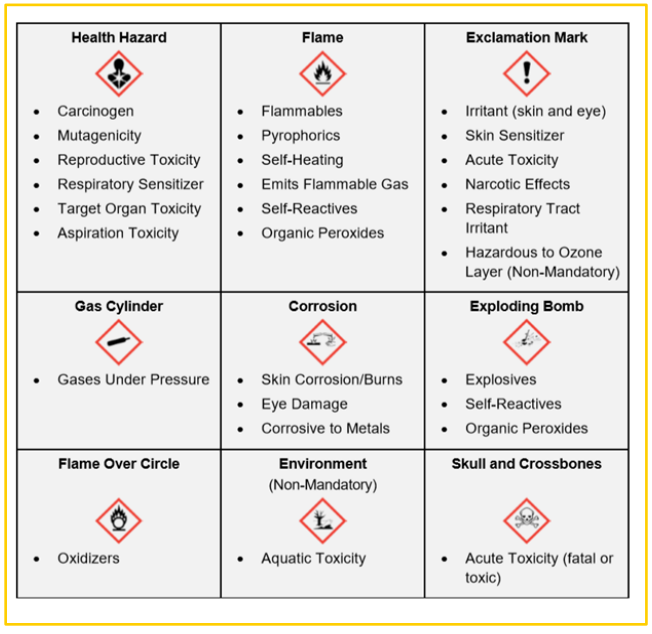


Figure 2-1: Global Harmonized System GHS, hazard communication standard pictograms and meaning.

Risk and Safety Solutions (RSS) Software for Hazard Communication

Cal State LA uses the CSU Safety Management System, also known as Risk and Safety Solutions (RSS) for chemical hazard assessments, inventory management, and safety inspections. The RSS software is located online on the RSS website. RSS was developed to broadly identify activities involving chemical and other types of hazards and is an effective method of hazard communication.

Hazard Assessment

The *Assessment* module in RSS captures information on the specific type of hazard(s), the location of hazard(s), the name of the PI/Resource Manager/Laboratory Manager/responsible person(s) who oversees the facility and helps identify the proper personal protective equipment (PPE) that should be used by laboratory workers to protect themselves against these hazards. Once the required PPE is identified, the laboratory is required to conduct and document training for all laboratory workers under their supervision, on the use of PPE. All areas working with hazardous chemicals must have an associated hazard assessment for the control area.

Additional Resources

1. "*Occupational Exposure to Hazardous Chemicals in Laboratories*." California Code of Regulations (CCR) Title 8, §5191.
2. "*Hazard Communication—Safety Data Sheets*" Title 8 §5194 section (g).
3. Standard Operating Procedures (SOPs) for handling toxic chemicals (*Appendix C*).
4. General information on the signs and symptoms associated with exposure to hazardous substances used in the laboratory or facility.
    - Identity labels, showing contents of containers (including waste receptacles) and associated hazards.
    - Label hazardous waste containers. See the RMEHS website for hazardous waste management information.
    - Warnings at areas or equipment where special or unusual hazards exist (e.g., particularly hazardous substances).
5. Procedures to follow in case of an emergency, including the posting of the "*Cal State LA Door Hazard Signs*" poster:
    - Emergency telephone numbers of emergency personnel/facilities, supervisors, and laboratory workers; and
    - Required Personal Protective Equipment (PPE), hazards, and special precautions.
6. Report injury, illness, or safety concerns online through the RMEHS website using "*Report a Safety Concern*" options.
7. Work-related injury and illness information is available online through the RMEHS website using the "*Injury Investigation Report*" option.

3. CLASSES OF HAZARDOUS CHEMICALS

Regulatory Requirements

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

- *Title 8, California Code of Regulations (CCR), § 5194, "Hazard Communication,"*
- *Title 8, CCR § 5209, "Carcinogens."*

Other applicable regulations include those promulgated by the U.S. Department of Labor including 29§ 1910.1450 "*Occupational Exposure to Hazardous Chemicals in Laboratories*" (the "*Laboratory Standard*").

Identification and Classification of Hazardous Chemicals

Chemicals can be divided into several different hazard classes. The hazard class will determine how a chemical should be stored and handled and what special equipment and procedures are needed to use it safely.

Each chemical container, whether supplied by a vendor or produced in the laboratory, must include labels that identify the hazards associated with that chemical. In addition to specific chemical labels, hazard information for specific chemicals can be found by referencing the Safety Data Sheet (SDS) for that chemical.

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

Rooms containing hazardous chemicals are labeled with a door hazard sign that gives an overview of the key chemical hazards contained within that room. The door hazard sign lists the following information:

- List the name of the PI and/or responsible person/parties and the building and room number.
- Contains emergency contact information.
- Contains personal protection and physical hazards.
- Contains specific hazards (chemical, biological, radiological).

For more information regarding door hazard signs please refer to the *Cal State LA's Door Hazard Sign* section located in Section 9 of this plan.

Flammability Hazards

Many highly flammable substances are in common use in the campus laboratories and control areas. Flammable liquids include those chemicals that have a flashpoint of less than ~200 degrees Fahrenheit. Even though the use of these materials is common in the laboratory setting, they can constitute a significant immediate threat and should be treated with particular care.

Figure 3-1: GHS Pictogram for Flammables

- These materials **must be stored in self-closing flammable storage cabinets** in aggregate quantities of 10 gallons or more per room.
- If less than 10 gallons, flammables can be stored in regular cabinets.
- Flame-resistant laboratory coats must be worn when working with large quantities (4 liters or more) of flammable materials and/or with procedures where significant fire risk is present. (e.g., when working with an open flame, etc.).
- Particular attention should be given to preventing static electricity when handling flammable liquids under Title 29 CFR §1910.106, NFPA 45 (Fire Protection for Laboratories Using Chemicals) – Chapter 9, and NFPA 77 (Recommended Practice on Static Electricity) – Chapter 11.
- Store only compatible materials inside flammable cabinets.

Reactivity Hazards

Reactive and explosive substances are materials that decompose under conditions of mechanical shock, elevated temperature, or chemical action, and release large volumes of gases and heat. Some materials such as peroxide formers, may not be explosive but may form explosive substances over time. These substances pose an immediate potential hazard and procedures which use them must be carefully reviewed. These materials must also be stored in a separate flame-resistant storage cabinet or, in many cases, in a laboratory-grade refrigerator or freezer that is designed for flammable and reactive chemicals.

Peroxide formers (*Appendix G*) can only be stored in refrigerators when unopened. Once peroxide formers are used, they must be stored in a dry environment. Pyrophoric chemicals are a special classification of reactive materials that spontaneously combust when in contact with air and require laboratory-specific training. Flame-resistant laboratory coats must always be worn when working with pyrophoric chemicals.

When using pyrophoric materials, please refer to *UCLA's Procedures for Safe Use of Pyrophoric Liquid Reagents and Procedures for Safe Use of Pyrophoric Solids*. Please notify RMEHS at 323-34**3-3531** or rmehs@calstatela.edu before initiating work with pyrophoric materials to ensure there are proper storage and safety procedures in place. Please call 911 from any campus phone or mobile device in a pyrophoric spill.

Health Hazards

Cal/OSHA uses the following definition for health hazards:

Figure 3-2: GHS Pictogram for Health Hazard

The term '*health hazard*' includes chemicals that are carcinogens, toxic or highly toxic agents, reproductive toxins, irritants, corrosives, sensitizers, neurotoxins, agents which act on the hematopoietic systems, and agents that damage the lungs, skin, eyes, or mucous membranes.

The major classes of "hazardous" and "particularly hazardous substances" and their related health and safety risks are detailed below:

Corrosive Substances

As a health hazard, corrosive substances cause destruction of, or alterations in, living tissue by chemical action at the site of contact.

Major classes of corrosive substances include:

Figure 3-3: GHS Pictogram for Corrosive

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

Symptoms of exposure through inhalation include a burning sensation, coughing, wheezing, laryngitis, shortness of breath, nausea, and vomiting. Exposure through the eye includes pain, bloodshot eyes, tearing, and blurring of vision. Skin exposure may include reddening, pain, inflammation, bleeding, blistering, and burns.

As a physical hazard, corrosive substances may corrode materials that are encountered and may be highly reactive with other substances. It is important to review information about materials they may corrode, their reactivity with other substances, and information on health effects. In most cases, these materials should be segregated from other chemicals and require secondary containment when in storage.

Irritants

Figure 3-4: GHS Pictogram for Harmful or Irritant

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

Sensitizers

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

Hazardous Substances with Toxic Effects on Specific Organs

Substances in this category include:

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

Symptoms of exposure to these materials vary. Faculty/staff/lab workers who handle these materials should review the SDS for the specific material being used and should take special note of the associated symptoms of exposure.

Particularly Hazardous Substances (PHS)

OSHA recognizes that some classes of chemical substances pose greater health and safety risk than others. To differentiate these risk characteristics, OSHA identifies two categories of hazardous chemicals:

1. **Hazardous chemicals**; and
2. **Particularly hazardous substances** (PHS).

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

- Use of containment devices such as fume hoods or glove boxes.
- Procedures for the safe removal of contaminated waste.
- Decontamination procedures.

Particularly hazardous substances are divided into three primary types:

1. Acute toxic chemicals,
2. Reproductive toxins, and
3. Carcinogens.

Acute Toxins

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

Reproductive Toxins

Reproductive toxins include any chemical that may affect reproductive capabilities, including chromosomal damage (mutations) and effects on fetuses (teratogenesis).

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

Examples of embyrotoxins include thalidomide and certain antibiotics such as tetracycline. Women of childbearing potential should note that embyrotoxins have the greatest impact during the first trimester of pregnancy. Because a woman often does not know that she is pregnant during this period of high susceptibility, special caution is advised when working with all chemicals, especially those rapidly absorbed through the skin (e.g., formamide). Pregnant women and women intending to become pregnant should consult with their laboratory PI/supervisor and RMEHS before working with substances that are suspected to be reproductive toxins.

Carcinogens

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

1. **Select Carcinogens**; and
2. **Regulated Carcinogens.**

Select carcinogens are materials that have met certain criteria established by the National Toxicology Program (NTP) or the International Agency for Research on Cancer (IARC) regarding the risk of cancer via

certain exposure routes. It is important to recognize that some substances involved in research laboratories are new compounds and have not been subjected to testing for carcinogenicity. The following references are used to determine which substances are selected carcinogens by Cal/OSHA's classification:

- OSHA's Carcinogen List.
- Annual report on Carcinogens published by the National Toxicology Program (NTP), including all the substances listed as "known to be carcinogens" and some substances listed as "reasonably anticipated to be carcinogens."
- International Agency for Research on Cancer (IARC), including:
  - All of Group 1 "carcinogen to humans" by the International Agency for Research on Cancer Monographs (IARC) (Volumes 1-48 and Supplements 1-8).
  - Some in Group 2A or 2B, are "reasonably anticipated to be carcinogens" by the National Toxicology Program (NTP), and causes statistically significant tumor incidence in experimental animals by any of the following criteria:
    - After inhalation exposure of 6-7 hours per day, 5 days per week, for a significant portion of a lifetime to dosages of less than 10mg/m3.
    - After repeated skin application of less than 300 mg/kg of body weight per week, or
    - After oral dosages of less than 50 mg/kg of body weight per day.

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

Chemicals Known to the State of California to Cause Cancer or Reproductive Toxicity

The Safe Drinking Water and Toxic Enforcement Act of 1986, also known as Proposition 65, requires the State to publish a list of chemicals known to cause cancer or reproductive toxicity. This list is updated regularly and reviewed by two committees that are a part of The Office of Environmental Health Hazard Assessment's Science Advisory Board. The two committees are the Carcinogen Identification Committee (CIC) and the Developmental and Reproductive (DART) Identification Committee.

4. HOW TO REDUCE EXPOSURES TO HAZARDOUS CHEMICALS

Regulatory Requirements for Hazardous Chemicals

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

- Title 8, California Code of Regulations (CCR), §5191, "*Occupational Exposures to Hazardous Chemicals in Laboratories*"
- Title 8, CCR, § 5209, "*Carcinogens*"
- Title 8 CCR, § 5154.1 "*Ventilation Requirements for Laboratory-Type Hood Operations*"

Other applicable regulations include those promulgated by the U.S. Department of Labor including CFR, 1910.1450 "*Occupational exposure to Hazardous Chemicals in Laboratories*" (the "*Laboratory Standard*").

Routes of Exposure

Hazardous chemicals require a carefully multi-tiered approach to ensure safety. There are four primary routes of exposure for chemicals that have associated health hazards (illustrated in Figure 4-1):

1. Inhalation.
2. Ingestion.
3. Injection (skin being punctured by a contaminated sharp object or uptake through an existing open wound).
4. Absorption (through skin or eyes).

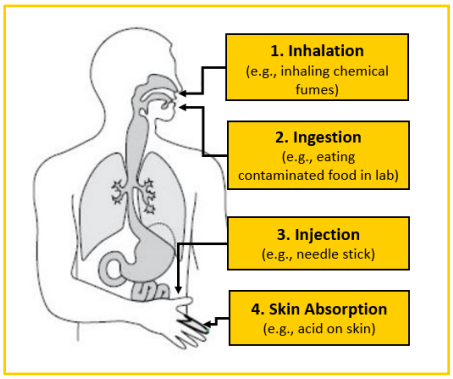


Figure 4-1: Primary chemical routes of exposure.

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

Safety Controls

Safety controls are divided into three main classifications:

1. engineering controls.
2. administrative controls.
3. protective apparel and equipment.

Elements of these three classes are used in a layered approach to create a safe working environment. Figure 4-2 displays the hierarchy of safety controls as a fundamental set of simple rules which lay out the effectiveness and reliability of methods for managing hazards in the laboratory.

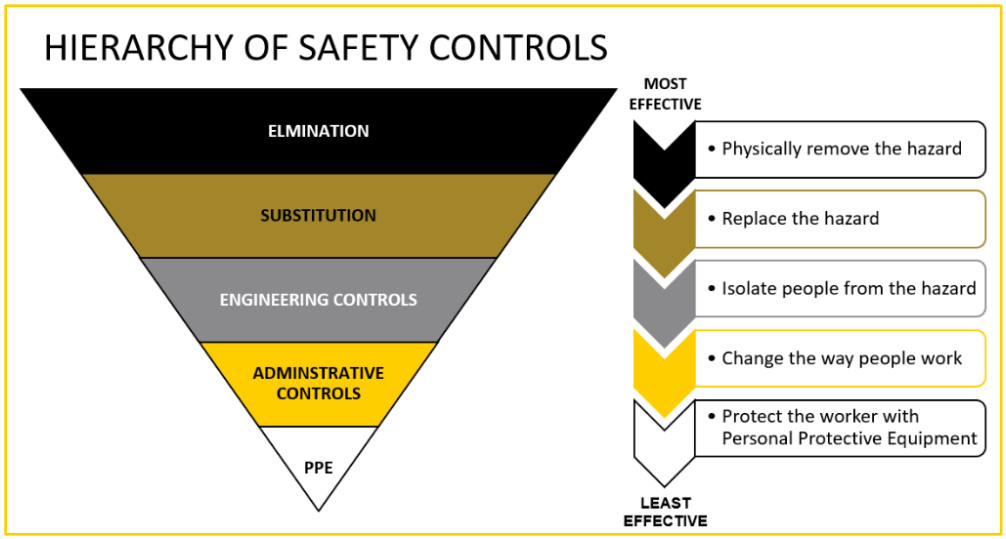


Figure 4-2: Hierarchy of Safety Controls

By understanding the hierarchy of safety controls, they can be used as a framework for planning a safe laboratory work environment. The principles for each of these elements are further detailed below.

Engineering Controls

Engineering controls include all "built-in" safety systems. These controls offer the first line of protection and are highly effective in that they require minimal special procedures or actions on the part of the user except in emergencies. Additionally, engineering controls often involve the replacement or elimination of hazards for a work environment. A fundamental and common example is the laboratory fume hood which is highly effective at containing chemical hazards and protecting users from inhalation hazards. Other examples of engineering controls include general room ventilation, flammable material storage units, and secondary containment.

General Laboratory Ventilation

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

Fume Hoods

Fume hoods are the most used local exhaust system on campus. Other methods include vented enclosures for large pieces of equipment or chemical storage and portable exhaust systems for capturing contaminants near the point of release. Some systems are equipped with air cleaning devices (HEPA filters or carbon absorbers). Exhaust from fume hoods is designed to terminate at least ten feet above the roof deck or two feet above the top of any parapet wall, whichever is higher. Figure 4-3 displays the key components of a fume hood.

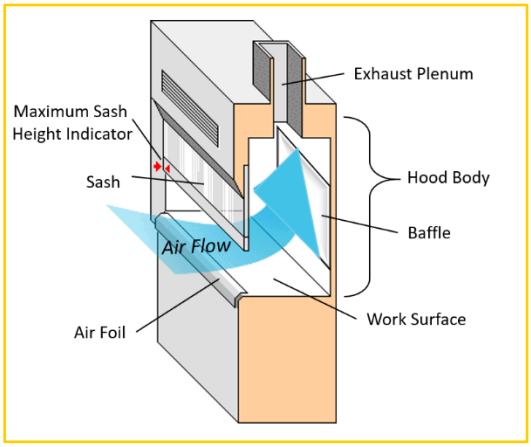


Figure 4-3: Basic Diagram of Fume Hood Components

Use a Laboratory Hood When Working with Hazardous Substances

A laboratory hood or other suitable containment device must be used for all work with "particularly hazardous substances" (PHSs). A properly operating and correctly used laboratory hood can reduce or eliminate volatile liquids, dust, and mist.

Fume hoods are evaluated for operation and certified by a contracted vendor on-site annually. These annual evaluations check the fume hood airflow velocity to ensure that the unit will contain hazardous vapors. Data on annual fume hood monitoring is maintained by Facilities Services.

In addition, each fume hood should have a current calibration sticker and a marker indicating the highest sash height to be used when working with hazardous materials. Please contact RMEHS for a hood evaluation if these labels are missing. Airflow for fume hood ventilation is measured at nine points. The average of the nine readings must be at least 100 linear feet per minute (fpm) with a minimum of 70 fpm for any measurement. The average face velocity should not exceed 160 fpm.

Each fume hood must be equipped with at least one type of continuous quantitative monitoring device designed to provide the user with current information on the operational status of the hood. Many hoods also have motion sensors to determine when they are not in active use. These sensors will reduce the fume hood's airflow as part of the campus's energy-saving effort.

When hazardous materials are in a fume hood, but it is not under active use (e.g., during an unattended reaction or equipment), the sash should be closed. **Fume hoods are not designed for the storage of hazardous materials**.

Any routine maintenance and repairs of fume hoods are conducted by Facilities Services. However, in most cases, the fume hood must be cleared by the Principal Investigator (PI), Resource Managers, and/or the Laboratory Manager before the commencement of repairs. The user may initiate the need for maintenance or repairs by submitting a Work Order Request on the Facilities Services website.

RMEHS does not initiate maintenance but will coordinate with Facilities Services to ensure its completion. An electronic notification is generated by Facilities Services after the work order is completed.

General Rules for Fume Hood Use

The following general rules should be followed when using laboratory hoods

1. Fume hoods **should not** be used for work involving hazardous substances unless they have a certification label that confirms certification has occurred within the past year. Please contact Facilities Services for a fume hood certification.
2. Always keep hazardous chemicals more than **six inches** behind the plane of the sash.
3. **Never** put your head inside an operating laboratory hood. The plane of the sash is the barrier between contaminated and uncontaminated air.
4. Work with the hood sash in the **lowest practical position**. The sash acts as a physical barrier in the event of an accident. Keep the sash closed when not conducting work in the hood.
5. **Do not use** fume hoods as storage areas for chemicals, bottles, apparatuses, or equipment. Keep it clean and clear. Only materials actively in use should be in the hood.
6. Do not make any modifications to hoods, ductwork, or the exhaust system without first contacting the Facilities Services.
7. Fume hood sashes should **remain closed** when the hood is not in use and for energy efficiency purposes.

Chemical fume hoods should be inspected upon installation, renovation, when a deficiency is reported, or a change has been made to the operating characteristics of the hood. Since fume hoods used for listed carcinogens have additional requirements, such as increase face velocity, contact the RMEHS Department for the intended use changes, or further evaluation.

Safety Ventilation Devices

There are additional ventilation devices that provide exposure control for materials used in a lab. Below are some examples of devices and their uses.

Biosafety Cabinets/Laminar Air Flow Workbenches

Laboratories that work with biological agents may be used for both biosafety cabinets (BSCs) and laminar airflow workbenches depending on the type of hazard present in the laboratory. Laboratories that require BSCs offer a ventilated enclosure that protects the lab worker from potentially hazardous microorganisms being manipulated by creating continuous airflow that is discharged into the atmosphere after filtering through a HEPA filter. BSCs are effective because they protect the lab worker from exposure to potentially hazardous microorganisms.

Laminar Air Flow Workbenches provide a clean work area enclosed and designated to create a particulate-free environment. Unlike BSCs, laminar airflow workbenches are not to be used with harmful

hazardous substances but protect the work being manipulated by the lab worker and the ambient environment.

Both are types of safety ventilation devices that prevent exposure in a laboratory environment and can be used in conjunction with other safety devices.

Glove Boxes

Some laboratories use contained glove box units for working with reactive chemicals under an inert environment, working with very toxic substances in a completely closed system, or for creating a stable, breeze-free, system for weighing hazardous or reactive materials. Glove boxes can be highly effective because the user can manipulate and perform tasks without breaking containment.

Snorkel Systems

Another ventilation device is the snorkel or elephant truck connected to an exhaust system. This device captures discharges from instruments or equipment such as gas chromatography. The intake of the snorkel must be placed close to the source to be effective. There are newer designs that are mounted on articulating arms, which make the systems more convenient to use.

Other Engineering Controls

In addition to the elements listed above, consideration must be given to providing sufficient engineering controls for the storage and handling of hazardous materials.

- **No more than 10 gallons of flammable chemicals** may be stored outside of an approved flammable storage cabinet.
- For refrigerated or frozen storage, flammable and explosive materials must be kept in explosion-proof refrigeration units specifically designed for storing these materials. These units do not have internal lights or electronic systems that spark and trigger an ignition; additionally, the cooling elements are external to the unit. These units should be labeled with a rating from Underwriters Laboratory (UL) or other certifying organizations.
- Secondary containment must be provided for corrosive and reactive chemicals and is recommended for all other hazardous chemicals. Secondary containment should be made of chemically resistant materials and should be sufficient to hold the volume of at least the largest single bottle stored in the container.
- Laboratories that use hazardous materials must contain a sink, kept clear for handwashing to remove any final residual contamination.
- Handwashing is recommended whenever laboratory personnel working with hazardous materials plan to exit the laboratory or work on a project that does not involve hazardous materials.

Administrative Controls

The next layer of safety controls is Administrative Controls. These controls consist of policies and procedures; they are not as reliable as engineering controls in that the user must carefully follow the appropriate procedures and must be fully trained and aware to do so.

Laboratory groups should review their laboratory operations to minimize the number of hazardous substances in use whenever possible or substitute them with a less hazardous alternative. Special attention should also be paid to applicable safety signs for those all materials stored and the appropriate segregation of incompatible materials.

RMEHS requires that each laboratory have safety procedures, which include safe practices, for any work that involves hazardous materials. These safety procedures should be laboratory-specific and communicate via lab-specific training, Standard Operating Procedures (SOPs), and proper documentation.

Standard Operating Procedures

Standard Operating Procedures (SOPs) (*Appendix C*) that are relevant to safety and health consideration must be developed and followed when laboratory work involves the use of hazardous chemicals (Title 8, §5191 (e)(3)(A)), especially for "particularly hazardous substances" (PHS). SOPs are written instructions that detail steps that will be performed during a given experimental procedure and include information about potential hazards and how these hazards will be mitigated.

SOPs should be written by the Primary Investigator (PI) and/or Laboratory Manager who are the most knowledgeable and involved with the experimental process. The development and implementation of SOPs is a core component of promoting a strong safety culture in the laboratory and helps ensure a safe work environment.

While general guidance regarding laboratory work with chemicals is contained in this plan, PIs/Laboratory Managers must develop and implement laboratory-specific SOPs for certain hazardous chemicals and PHS used in their laboratories. The PI and all personnel responsible for performing the procedures detailed in the SOP shall sign the SOP acknowledging the contents, requirements, and responsibilities outlined in the SOP.

The SOPs shall be reviewed by qualified personnel and shall be amended and subject to additional review and approval by the PI where changes or variations in conditions, methodologies, equipment, or use of the chemical occurs. For certain hazardous chemicals, PHS, or specialized practices, consideration must be given to whether additional consultation with RMEHS is warranted or required.

Circumstances requiring prior approval from the PI/Laboratory Manager must also be addressed in laboratory-specific SOPs. These circumstances are based on the inherent hazards of the material used, associated with the experimental process, the worker's experience level, and the scale of the experiment. Some examples of circumstances that may require prior approval include working alone in a

laboratory, unattended or overnight operations, the use of highly toxic gases of any amount, the use of large quantities of toxic or corrosive gases, the use of extremely reactive chemicals (e.g., pyrophoric, water-reactive chemicals), or the use of carcinogens.

RMEHS is available to assist with the development of SOPs. SOPs must be developed before initiating any experiments with hazardous chemicals or particularly hazardous substances and are to be reviewed, approved by PI signature, filed, and maintained in the Laboratory Safety Binder where they are accessible to all laboratory personnel.

Drafting an SOP

When drafting an SOP, consider the type and quantity of the chemical being used, along with the frequency of use. The Safety Data Sheet (SDS) for each hazardous chemical addressed in the SOP should be referenced during SOP development. The SDS lists valuable information that will need to be considered, such as exposure limits, type of toxicity, warning properties, and symptoms of exposure. If a new chemical is produced during the experiment, an SDS will not necessarily be available. In these cases, the toxicity is unknown, and it must be assumed that the substance is particularly hazardous, as a mixture of chemicals will be more toxic than its most toxic component.

Personal Protective Equipment (PPE)

Personal protective equipment (PPE) serves as a lab personnel's last line of defense against chemical exposures and is required by everyone entering a laboratory containing hazardous chemicals. Specific requirements for PPE use for chemical operations should be determined based on the manufacturer's Safety Data Sheets (SDSs) recommendations and Risk and Safety Solutions (RSS) hazard Assessment for the area.

Minimum PPE Requirements

The following minimum attire and PPE requirements pertain to all laboratories/technical areas where the use or storage of hazardous materials occurs, or a physical hazard exists. The wearing of required PPE may only be modified as determined by a standard operating procedure (SOP) or the laboratory RSS hazard assessment.

Attire when occupying a laboratory/technical control area:

- Full-length pants (or equivalent), and
- Close-toed/heel shoe attire that covers the entire foot and has rubber or equivalent soles.

PPE when working with, or adjacent to, hazardous material uses areas within a laboratory/technical control area:

- Laboratory coats (or equivalent protective garments), and
- Protective eyewear relative to the type of hazard present

The primary goal of basic PPE is to mitigate, at a minimum, the hazard associated with exposure to hazardous substances. In some cases, additional, or more protective equipment must be used. Below are some additional considerations for PPE based on the hazard associated.

- If a project involves a chemical splash hazard, chemical splash goggles with side shields are required; face shields may also be required when working with chemicals that may cause immediate skin damage.
- Safety goggles differ from safety glasses in that they form a seal with the face, which completely isolates the eyes from the hazard.
- If a significant splash hazard exists, heavy gloves, protective aprons, and sleeves may also be needed.
- Gloves should only be used under the specific condition for which they are designed, as no glove is impervious to all chemicals. It is also important to note that gloves degrade over time, so they should be replaced as necessary to ensure adequate protection.

RMEHS requires each laboratory to complete a "*Hazard Assessment*" before beginning work and to provide annual updates thereafter, of which, PPE can be selected based on this hazard assessment. Access the online hazard *Assessment* module through the RSS software can be found on the RSS website.

How to Use and Maintain PPE

Personal protective equipment should be kept clean and stored in an area where it will not become contaminated. Personal protective equipment should be inspected before use to ensure it is in good condition. It should fit and be worn properly. If it becomes contaminated or damaged, it should be cleaned or repaired when possible, or discarded and replaced.

Contaminated Clothing/PPE

In cases where spills or splashes of hazardous chemicals on clothing or PPE occur, the clothing/PPE should be removed and placed in a closed container that prevents the chemical's release. Heavily contaminated clothing/PPE resulting from an accidental spill should be disposed of as hazardous waste. Lightly contaminated laboratory coats should be cleaned and laundered as appropriate and according to the manufacturer's recommendations.

Laboratory workers should never take contaminated items home for cleaning or laundering. Persons or companies hired to clean contaminated items must be informed of potentially harmful effects of exposure to hazardous chemicals.

Respiratory Protection (in alignment with the Respiratory Protection Program)

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

circumstances, however, respiratory protection may be needed. These situations may include the following:

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

To ensure employees are issued the proper respiratory protection when existing controls are not adequate, employees are enrolled in the Respiratory Protection program. There are numerous types of respirators available, and each has specific limitations and applications. Respirator selection and use require pre-approval by RMEHS.

For the voluntary use of a respirator, the employee must fill out the Respiratory Hazard Voluntary Use Form (located in Cal State LA's Respiratory Protection Plan), review it with his/her PI/Laboratory Manager/Resource Manager. RMEHS will contact the laboratory worker to evaluate potential exposure. The review will include an evaluation of the work area and activities for the following but not necessarily limited to:

- Provision of additional ventilation controls or enclosure of airborne hazards.
- Substitution with a less hazardous substance.
- Qualitative or quantitative exposure assessment.
- Respirator usage.

Processes with potential airborne hazards that cannot be eliminated by engineering or administrative controls will not be authorized by RMEHS until affected employees can be incorporated into Cal State LA's Respiratory Protection Program.

For more information regarding Cal State LA's Respiratory Protection Program, please visit the RMEHS website. Employees must complete all components before starting work that requires respirator use.

Laboratory Safety and Emergency Response Equipment

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

Fire Extinguishers

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

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

1. it is a small fire (i.e., small trash can size fire); and
2. appropriate fire extinguisher training was received; and
3. It is safe to do so.

Per Title 29, CFR, §1910.157(e)(2), fire extinguishers in the vicinity of the assigned responsible party are subject to monthly visual inspections by any individual associated with the respective area (i.e., PI/Laboratory Manager, Resource Manager, Delegated Department Member, Faculty/Staff, Laboratory Students/Volunteers, RMEHS, etc.). The visual inspection may include the following.

1. Confirm the extinguisher is unobstructed, visible, and in its designated location.
2. Verify the tamper seal is unbroken and the locking pin is intact.
3. Examine the extinguisher for obvious corrosion, nozzle blockage, leaks, or physical damage.
4. Confirm the pressure gauge or indicator is in the operable range or position and lift the extinguisher to ensure it is still full.
5. Make sure the operating instructions on the nameplate are legible and facing outward.
6. Check the last professional service date on the tag (a licensed fire extinguisher maintenance contractor must have inspected the extinguisher within the past 12 months).
7. Initial and date the back of the tag upon concluding monthly visual inspection.

Any time a fire extinguisher is used, no matter for how brief a period, the PI/Laboratory Manager/Resource Manager, or most senior laboratory personnel present at the time of the incident, must immediately report the incident to the RMEHS Department at 323-343-3531 or rmehs@calstatela.edu. If your fire extinguisher needs service or is missing from its designated location, please submit a Facilities Services Work Order Request.

Safety Showers and Eyewash Stations

All laboratories using hazardous chemicals must have immediate access to safety showers with eyewash stations.

- Access must be available in an unlocked location **within 10 seconds or less** for a potentially injured individual and access routes must be kept clear.

  - This requirement applies to all areas where, during routine operations or emergencies, the eyes or body of a laboratory worker may encounter a substance that could cause corrosion, severe irritation, or permanent tissue damage, or is toxic by absorption.
- Safety showers must always have a **minimum clearance of 16 inches** from the centerline of the spray pattern in all directions; this means that no objects should be stored or left within this distance of the safety shower.
- During an emergency, individuals using the safety shower/eyewash station should be assisted by an uninjured person to aid in the **15-minute decontamination process** to remove all hazardous materials from the affected area.

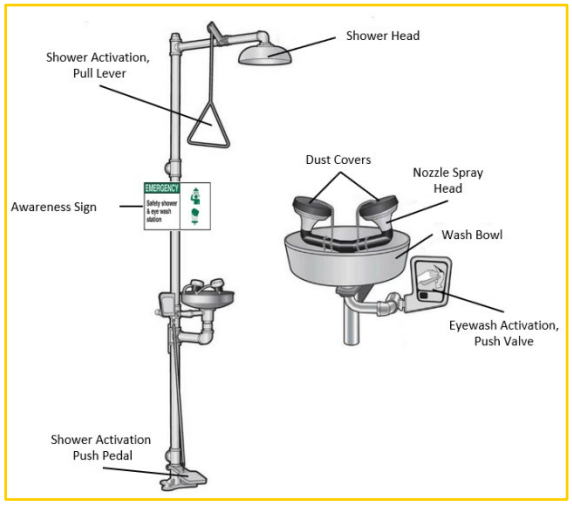


Figure 4-4: Diagram Illustrating the Basic Components of a Shower-Eyewash Safety Station.

Figure 4-4 illustrates the basic components of a compliant safety shower and eyewash station. Also, sink-based eyewash stations and drench hoses should only be used to support an existing compliant system. One-time use or keg-type shower/eyewash systems are only acceptable as a temporary solution and are not intended to replace emergency safety showers/eyewash stations.

Safety shower/eyewash stations are tested monthly by Facilities Services. Any units without a testing date within one month should be reported to Facilities Services. If an eyewash or safety shower needs repair, please submit a Facilities Services Work Order Request. Please provide the specific location of the defective equipment and a description of what is not functioning properly.

Fire Doors

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

Safe Laboratory Habits

All laboratories should have a detailed safety plan for emergencies and accidents when working in a laboratory. This safety plan should be a supplement must include layers of policies and protective equipment to allow for a safe working environment, but to achieve effectiveness, many fundamental elements must become basic working habits for the research community (Appendix A).

5. CHEMICAL EXPOSURE ASSESSMENT

Regulatory Requirements

It is the University Policy to comply with all applicable health, safety, and environmental protection laws, regulations, and requirements set forth to protect the campus community. Cal/OSHA requires that all employers "measure an employee's exposure to any substance regulated by a standard which requires monitoring if there is reason to believe that exposure levels for that substantially exceed the action level (or in the absence of an action level, the exposure limit)." Repeated monitoring may be required if initial monitoring identifies employee exposure over the action level or exposure limit.

Cal/OSHA regulates Permissible Exposure Limits (PELs) for airborne contaminants to which "nearly all workers may be exposed daily during a 40-hour workweek for a working lifetime (of 40 years) without adverse effect," and are based upon an 8-hour Time-Weighted Average (TWA) exposure. The PELs are the maximum permitted 8-hour TWA concentration of an airborne contaminant without respiratory protection. Cal/OSHA has also defined Short Term Exposure Limits (STELs) as the maximum TWA exposure during any 15 minutes, provided the daily PEL is not exceeded and ceiling (C) exposures that shall not be exceeded at any time.

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

Additionally, the Safe Drinking Water and Toxic Enforcement Act of 1986 requires Cal/EPA to publish annually a list of Proposition 65 chemicals known to the State to cause cancer or other reproductive toxicity.

Exposure Assessment Overview

All Cal State LA employees require protection from exposure to hazardous chemicals above PELs, STELs, and ceiling concentrations. The proper method of exposure assessment monitoring is conducted by an industrial hygienist, who with experience and expertise can successfully assess exposures. At Cal State LA, the person supervising, directing, or evaluating the exposure assessment monitoring to be competent in the practice of industrial hygiene and is an RMEHS specialist. For general questions regarding exposure assessment please contact RMEHS at 323-34**3-3531** or by email at rmehs@calstatela.edu.

Minimizing exposure may be accomplished using a combination of engineering controls, administrative controls, and personal protective equipment (listed in order of priority. Assessing exposure to hazardous chemicals may be accomplished through several methods performed by RMEHS, including employee

interviews, visual observation of chemical use, evaluation of engineering controls, use of direct-reading instrumentation, or the collection of analytical samples from the employee's breathing zone.

Personal exposure assessment will be performed under either of the following situations.

- Based on chemical inventories, review of Standard Operating Procedures (SOPs), types of engineering controls present, laboratory inspection results, and/or review of the annual RSS hazard Assessment tool, RMEHS determines whether an exposure assessment is warranted.

  OR

- A user of a hazardous chemical has concern or reason to believe exposure is not minimized or eliminated using engineering controls or administrative practices (such as transfer of chemical through double needle performed entirely in a fume hood) and the potential for exposure exists. The user should then inform his or her PI/Resource Manager/Laboratory Manager, who will, in turn, contact RMEHS at 323-34**3-3531** or rmehs@calstatela.edu for further instruction. RMEHS will then determine the best course of action in assessing employee exposure, including visual assessment, air monitoring, medical evaluation, examination, or medical surveillance.

In case of severe injury or exposure, including eye or dermal contact, call 911 from a campus phone or mobile device and obtain medical treatment immediately. Do not wait for an exposure assessment to be performed before seeking medical care.

Exposure Assessment Protocol

The RMEHS Department conducts exposure assessments for members of the campus community. Employees have a right to observe testing, sampling, monitoring, or measuring employee exposure. They are also allowed access to the records and reports related to the exposure assessment. Exposure assessments may be performed for hazardous chemicals, as well as for physical hazards including noise and heat stress to determine if exposures are within PELs or other appropriate exposure limits that are considered safe for routine occupational exposure.

General protocol in conducting an exposure assessment may include any of the following:

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

If exposure monitoring determines an employee's exposure to be over the action level (or the PEL) for a hazard for which OSHA has developed a specific standard (e.g., lead), the medical surveillance provisions of that standard shall be followed. It is the responsibility of the PI/Resource Manager/Laboratory Manager to ensure that any necessary medical surveillance requirements are met.

When necessary, RMEHS will make recommendations regarding adjustments to engineering controls or administrative procedures to maintain exposure below any applicable PEL. Where the use of respirators is necessary to maintain exposure below permissible exposure limits, Cal State LA will provide, at no cost to the employee, the proper respiratory equipment, and training. Respirators will be selected and used following the requirements of CCR Title 8 §5144 and the Cal State LA Respiratory Protection Program.

In assessing exposure to hazardous chemicals for which Cal/OSHA has not published a PEL, STEL, or Ceiling exposure, RMEHS defers to the Threshold Limit Values (TLVs) established by the American Conference of Governmental Industrial Hygienists (ACGIH), or the Recommended Exposure Limits (RELs) established by the National Institute of Occupational Safety & Health (NIOSH). Please contact RMEHS, 323-34**3-3531** for more information regarding these chemicals.

Notification

RMEHS will promptly notify the employee and their PI/Resource Manager/Laboratory Manager of the results in writing (within 15 working days or less if required) after the receipt of any monitoring results. RMEHS will establish and maintain an accurate record of any measurements taken to monitor exposure for each employee. Records, including monitoring provided by qualified vendors, will be managed per CCR Title 8 §3204 "*Access to Employee Exposure and Medical Records*."

Exposure Assessment Use to Determine and Implement Controls

RMEHS will use any of the following criteria to determine required control measures to reduce an employee's occupational exposure.

- Verbal information obtained from employees regarding chemical usage,
- Visual observations of chemical use or laboratory operations,
- Evaluation of existing engineering control measures or administrative practices,
- Recommendations expressed in Safety Data Sheets,
- Regulatory requirements of Cal/OSHA,
- Recommendations from professional industrial hygiene organizations,
- Direct reading instrumentation results,
- Employee exposure monitoring results, and/or
- Medical evaluation, examination, and/or surveillance findings.

Particular attention shall be given to the selection of safety control measures for chemicals that are known to be extremely hazardous. Per Cal/OSHA CCR Title 8 §5141 "*Control of Harmful Exposure to*

Employees," the control of harmful exposures shall be prevented by the implementation of control measures in the following order.

1. Engineering controls, whenever feasible,
2. Administrative controls whenever engineering controls are not feasible or do not achieve full compliance and administrative controls are practical, and
3. Personal protective equipment, including respiratory protection, during:
    a. At the time necessary to install or implement feasible engineering controls,
    b. When engineering and administrative controls fail to achieve full compliance,
    c. In emergencies, and/or
    d. As an extra precaution/option for employees.

Medical Evaluation

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

1. When an employee develops signs or symptoms associated with a hazardous chemical, they may have been exposed in a laboratory.
2. Where personal monitoring indicates exposure to a hazardous chemical is above a Cal/OSHA AL or PEL or recommended exposure levels established by the NIOSH or the ACGIH in the event Cal/OSHA has not established an AL or PEL for a particular hazardous chemical.
3. Whenever an uncontrolled event takes place in the work area such as a spill, leak, explosion, fire, etc., resulting in the likelihood of exposure to a hazardous chemical.
4. Upon reasonable request of the employee to discuss medical issues and health concerns regarding work-related exposure to hazardous chemicals.

All work-related medical evaluations and examinations will be performed by licensed physicians or staff under the direct supervision of a licensed physician. Evaluations and examinations will be provided without cost to the employee, without loss of pay, and at a reasonable time and place.

Refer to Cal State LA's Injury & Illness Prevention Program (IIPP), for procedures on how to obtain medical evaluation under the above-listed circumstances.

Information to Provide to the Clinician

At the time of the medical evaluation, the following information shall be provided to the examining physician.

1. Personal information such as age, weight, and Cal State LA ID (CID) number.
2. Common and/or IUPAC name of the hazardous chemicals to which the individual may have been exposed.

3. A description of the conditions under which the exposure occurred.
4. Quantitative exposure data, if available.
5. A description of the signs and symptoms of exposure that the employee is experiencing, if any.
6. A copy of the Safety Data Sheet (SDS) of the hazardous chemical in question.
7. History of exposure including previous employment and non-occupational (recreational) hobbies.
8. Any additional information helps assess or treat an exposure or injury such as a biological component of exposure or the existence of an antitoxin.

Physician's Written Opinion

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

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

Confidentiality and Individual's Access to Personal Medical Records

All patient medical information is protected by California and federal law and is considered confidential. The examining physician is prohibited from disclosing any patient medical information not directly related to the work-related exposure under evaluation and should not reveal any diagnosis unrelated to exposure. Any patient information disclosed by the examining physician to the employee's supervisor will be limited to information necessary in assessing an employee's return to work, including recommended restrictions in work activities if any.

Any patient information disclosed by the examining physician to RMEHS will be limited to information necessary to develop a course of exposure monitoring or perform hazard assessments and incident investigations, if appropriate. The examining physician will otherwise disclose patient medical information only as required by California and Federal law, such as for Worker's Compensation Insurance claims. Each employee has the right to access his/her own personal medical and exposure records. The examining physician will provide an employee with a copy of his/her medical records upon written request.

Medical Surveillance

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

Cal State LA regularly uses outside vendors to provide medical surveillance services. Medical surveillance is required of employees routinely exposed to certain hazards as part of their job description (such as asbestos) and may be offered to other employees based on quantifiable or measured exposure.

Examples of hazards that are monitored through the medical surveillance program may include and not limited to:

- Asbestos,
- Beryllium,
- Formaldehyde,
- Lead,
- Methylene Chloride,
- Noise (Hearing Conservation Program),
- Radioactive Chemicals (Radiation Safety Program),
- Respirator Use (Respirator Protection Program), and
- Other Particularly Hazardous Substances.

Employees with questions regarding work-related medical surveillance are encouraged to contact RMEHS at 323-34**3-3531** or rmehs@calstatela.edu. For more information regarding Occupational Health and Safety please visit the RMEHS website.

6. CHEMICAL PROCUREMENT, INVENTORY, LABELING, STORAGE, & TRANSPORTATION

Regulatory Requirements

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

- Title 8, California Code of Regulations (CCR), § 5164, "*Storage of Hazardous Materials*".
- Title 8, CCR § 5191, "*Occupational Exposures to Hazardous Chemicals in Laboratories*".
- Title 8, CCR § 5194, "*Hazard Communication*".
- Title 8, CCR § 5209, "*Carcinogens*".
- Title 8, CCR § 5154.1, "*Ventilation Requirements for Laboratory-Type Hood Operations*".
- *Assembly Bill 2286*.

Procurement and Donations

The RMEHS Department is responsible for approving equipment and materials that may result in an occupational injury and/or illness or if items purchased are regulated under an RMEHS safety program. Current lists of regulated items included: hazardous materials (biological, chemical, radiological), radiation generating equipment, lasers, and unmanned aerial vehicles (UAV and/or Drones).

Once items purchased, received, and/or donated, it is the responsibility of the PI/Laboratory Manager to ensure that the appropriate storage and/or controls are in place following Cal State LA's Chemical Hygiene Plan and any other applicable RMEHS programs. Please ensure all new materials are added to the lab's chemical inventory as applicable.

Procurement of Chemicals

Purchasers must receive pre-approval when purchasing the items listed above. Purchasers can use the Chemical and Hazardous Materials Purchase Request Form on the RMEHS website to start the approval process for the chemicals needed. RMEHS will send the purchaser an RMEHS approval via email. For the request to be processed and approved.

Requirements for Chemical Purchase Request Approval

A chemical purchase request is approved if the RMEHS requirements are met. Those requirements include but are not limited to the following:

- Update their hazard assessment on our Risk and Safety Solutions (RSS) software.
    - Ensure all lab personnel are added and acknowledge the hazard assessment.
- Update their chemical inventory in RSS and additional update once the chemicals are received and in the lab area.
    - Certify the chemicals in the area are what is being listed in RSS.

- Provide Safety Data Sheets (SDS) as precautionary for additional storage, use, or disposal requirements.
- All personnel complete the required Safety Training and any additional safety training based on the hazard assessment.

Reasons Why a Chemical Purchase Request is NOT Approved

Reasons why a chemical would not be approved may be due to additional licensing requirements or failure to provide the above-mentioned requirements.

For example,

- an X-ray device
- radiological materials
- controlled substances
- Extremely hazardous chemicals (skull and crossbones GHS label or flame GHS label)
- Extremely hazardous biological materials (Biosafety Level -BSL 2 or higher), etc.

Require additional paperwork and licensing agreements to be met per the state, federal, or county regulations. If these items are purchased without our approval, the campus will be fined by the overseeing entity. These types of fine often violate license agreements and to fix them requires a large expense to be paid.

Donations and/or Gifts in Kind

Chemical or material donations/gifts originating from an off-campus location are not permitted by the campus, without proper approval from RMEHS. Information needed from the donating/gifting party is not limited to the following information.

Special Cases

Acutely Toxic and Extremely Hazardous Chemicals

All acutely toxic and extremely hazardous chemicals require special approval from the Chemical Hygiene Officer before purchase to ensure the area that will store and use the chemicals met all necessary safety precautions and regulations. Any questions regarding acutely toxic and extremely hazardous chemicals can be directed to the Chemical Hygiene Officer. For more information on the types of acutely toxic and/or hazardous chemicals and their reporting requirements, please see the

Radionuclides

All radionuclides will be procured, handled, stored, and disposed of following Cal State LA's Radiation Safety Program and the University's radioactive materials license. All radionuclides require the notification of the Radiation Safety Officer (RSO) and Radiation Safety Committee and an approved Radiation Use Authorization before purchase. The RSO will ensure the area that will store and use the radionuclides meets all necessary regulations and precautions. Any questions regarding radionuclides can be directed to the Radiation Safety Officer.

DEA Controlled Substances and Controlled Precursors

All DEA controlled substances at Cal State LA will be procured, handled, stored, and disposed of following all federal, state, and local laws. Please contact the Office of Academic Research for more information on compliance and applicable laws.

Explosives

Before starting any work involving explosives on campus, RMEHS and Laboratory Safety Committee must be notified. Explosive materials will not be obtained until written approval is received from the College Dean, Department Chair, and RMEHS Director. Please note that the Federal Alcohol, Tobacco, and Firearms Agency, Department of Transportation, and local and state fire codes may regulate the use of some explosive materials. RMEHS will review the chemical inventory for explosive materials and verify safe storage, handling, and use, as necessary.

Lasers

There are specific requirements when working with specialized lasers, and therefore will be procured, handled, stored, disposed of following Cal State LA's Laser Safety Program. All lasers categorized as Class 3a, 3b, or 4 are not permitted for use on campus without prior notification to the Laser Safety Officer (LSO) and an approved Laser Use Registration. The LSO will ensure that the area that will use and store the laser met all applicable regulations. Any decommissioning or disposal of a laser required special disassembling before disposal/storage. More information on the use of lasers on campus can be directed to the LSO or by email.

X-Ray Producing Devices

All x-ray producing devices are to be procured, handled, stored, and disposed of following the X-Ray Producing Equipment Manual. The purchase/registrar x-ray producing equipment requires prior notification from the Radiation Safety Officer (RSO) to ensure all required regulations are met. Any questions regarding x-ray producing devices can be directed to the RSO.

Chemical Inventories

All PIs/Resource Managers/Laboratory Managers/ responsible person(s) for a control area containing chemicals must have a chemical inventory that is current, accurate, and complete for their area's hazardous materials. *Chemical Inventories* are used to ensure compliance with storage limits, homeland security threshold limits, and fire code regulations. Current chemical inventories can also be used in an emergency to identify potential hazards for emergency response operations.

Cal State LA uses the online chemical inventory system in Risk and Safety Solutions (RSS) called *Chemicals* to update and maintain an accurate chemical inventory that includes carcinogenic materials, corrosive, flammable, oxidizing, toxic, as well as any gases or liquids under pressure such as liquid

nitrogen tanks and compressed air cylinders in areas allowed or assigned to be used. Chemical inventory owners are required to reconcile their inventory at least annually or when:

- A new chemical hazard has been introduced to your area.
- Greater than or equal to 10% of your inventory has changed; or
- The inventory is moved to a new location.

An inventory update would need to be completed by the responsible party of the area to ensure proper hazard notification is in place in the event of an emergency. Information kept in the inventory includes chemical name, chemical abstracts number (CAS #), physical location, unique barcode number given when inventoried (UC#), concentration, size of the container, amount remaining, physical state, type of container, whether the chemical is pure or a mixture, and the storage temperature and pressure.

The chemical inventory list should be reviewed before ordering new chemicals and only the minimum quantities of chemicals necessary for the research should be purchased. As new chemicals are added to the inventory, each laboratory group must confirm that they have access to the Safety Data Sheet (SDS) for that chemical. Where practical, each chemical should be dated so that expired chemicals can be easily identified for disposal.

Special reporting requirements (within 60 days) to the Department of Homeland Security (DHS) are required for specific chemicals that exceed set threshold aggregate amounts. To ensure proper reporting, all personnel who have chemicals listed under the DHS Chemicals of Interest list is required to update their chemical inventories within 60 days of when the chemicals are received, consumed, and/or disposed of.

Table 6-1 below lists examples of what a chemical inventory should be included (this list, not all-inclusive some exclusions/modifications may be made depending on the operations of the laboratory).

What to include in your inventory	What not to include
All chemicals and chemical products (except those listed to the right)	Retail products are used and stored in amounts and frequencies typical to ordinary household usage.
All compressed and liquefied gases	Etiologic agents (bacteria, viruses, select agents, and toxins)
Lubricants, fuels, and oils (motor oil, gasoline, diesel, vacuum pump oil)	Biological culture media, agar, serum proteins, albumin
Aerosol lubricants	Enzyme preparations
Paints including spray paints.	Non-hazardous buffers
Pesticides and biocides	Pre-packed test kits for medical labs
Radioactive materials	

Table 6-1: The table above outlines common items that should and should not be included in a chemical inventory.

Keeping a current chemical inventory can help avoid overcrowding with materials that are no longer useful or should be replaced, have deteriorated, or show container deterioration. Unneeded and/or compromised items should be discarded as chemical hazardous waste.

Indications for disposal include.

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

Access to hazardous chemicals, including toxic and corrosive substances, should be restricted. These materials must be stored in laboratories or stockrooms kept locked when laboratory personnel are not present. Locked storage cabinets or other precautions are always recommended and may be required like in the case of acutely toxic or hazardous chemicals. Unusually toxic chemicals may include those that are an imminent danger to life or health (IDLH). For guidance on storage requirements, please contact RMEHS by either calling (323) 34**3-3531** or emailing at rmehs@calstatela.edu.

On termination or transfer of laboratory personnel, all related hazardous materials should be properly disposed of, or transferred to the laboratory manager or a designee who has the proper training.

Cal/OSHA Title 8 § 5194 (e)(1) requires that employers develop and maintain a list of the hazardous chemicals known to be present in the workplace. This is a long-standing regulatory requirement and is a vital component of our lab safety inspections. New regulation in the form of Assembly Bill 2286 mandates the development of the California Environmental Reporting System (CERS) and requires all regulated businesses to use the Internet to electronically submit chemical inventories.

To facilitate compliance with the new electronic reporting requirement, each lab group is required to maintain an up-to-date chemical inventory by using the Risk and Safety Solutions (RSS) software provided to the campus.

Chemical Labeling

All chemical containers (secondary, those with abbreviations, and/or diluted chemicals) of hazardous materials must be labeled with the full identity name of the hazardous substance and all required GHS warning statements and follow the information below for labeling.

- All containers not considered transient (being used in transfer or a reaction actively) must be labeled.
- Newly synthesized compounds must be labeled with proper hazard warnings and according to the substance's chemical and physical properties.

- Labels must be displayed clearly and legible (in English or applicable language(s) for non-English speaking employees).
- Secondary containers (i.e., spray bottles) must be labeled with the appropriate hazard warning and the identity of the substance.
- All labels must use the Globally Harmonized System of Classification and Labeling of Chemicals.
- Any peroxide forming chemicals (i.e., must be labeled with both the date of receipt and the date when the chemicals were first opened. For chemical containers without a manufacturer-supplied expiration date, only a one-year shelf life is allowed and must be disposed of as waste within a year of receipt or six months of opening. These types of chemicals should be stored and labeled with caution.
- All particularly hazardous substances (PHS) have additional labeling requirements to identify the specific hazard (carcinogen, reproductive toxin, acutely toxicant, etc.). PHS's storage area must be labeled with the type of hazard and should be segregated from less hazardous chemicals to ensure proper hazard identification and access control.

Chemical Storage and Segregation

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

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

Safe Chemical Storage Priorities

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

1. **Flammability**. When establishing a storage scheme, the number one consideration should be the flammability characteristics of the material. If the material is flammable, it should be stored in a flammable cabinet.
2. **Isolate**. If the material contributes significantly to fire (e.g., oxidizers), it should be isolated from the flammables. If there was a fire in the laboratory and a response to the fire with water would exaggerate the situation, isolate the water-reactive material away from contact with water.
3. **Corrosivity**. Next look at the corrosivity of the material, and store accordingly.
4. **Toxicity**. Finally, consider the toxicity of the material, with particular attention paid to regulated materials. In some cases, this may mean that certain chemicals will be isolated within a storage

area. For example, a material that is an extreme poison but is also flammable should be locked inside a containment area in the flammable storage cabinet to protect it against accidental release.

There will always be some chemicals that will not fit neatly in one category or another, but with careful consideration of the hazards involved, most of these cases can be handled reasonably. Please reference the Flinn Scientific Storage Pattern guidelines and Appendix F for more information.

General Recommendations for Safe Storage of Chemicals

Each chemical in the laboratory must be stored in a specific location and returned there after each use. Acceptable chemical storage locations may include corrosive cabinets, flammable cabinets, laboratory shelves, or appropriate refrigerators or freezers. Fume hoods should not be used as general storage areas for chemicals, as this will impair the ventilating capacity of the hood.

Guidelines for storing chemicals properly.

- Do not store chemicals on benchtops, floor, or in a chemical fume hood.
- Additionally, bulk quantities of chemicals (i.e., larger than one gallon) should be stored in a separate storage area, such as a stockroom, chemical cabinet, or supply room.
- Laboratory shelves should have a raised lip along the outer edge to prevent containers from falling.
- Hazardous liquids or corrosive chemicals should not be stored on shelves above eye level and chemicals that are highly toxic, or corrosive should be in unbreakable secondary containers.
- Chemicals must be stored at an appropriate temperature and humidity level and should never be stored in direct sunlight or near heat sources, such as laboratory ovens.
- Incompatible materials should be stored in separate cabinets, whenever possible. If these chemicals must be stored in one cabinet, due to space limitations, adequate segregation and secondary containment must be ensured to prevent adverse reactions.
- All stored containers and research samples must be appropriately labeled and tightly capped to prevent vapor interactions and to alleviate nuisance odors. Flasks with cork, rubber, or glass stoppers should be avoided because of the potential for leaking.

Laboratory refrigerators and freezers must be labeled appropriately with **“No Food/Drink”** and must **never be used to store food or drinks for consumables**. **Never store peroxide formers (e.g., ether) in a refrigerator not specifically designed for storage of flammable liquids**.

Flammable and Combustible Liquids

In general, flammables should not be stored alongside combustible materials like paper and packaging nylon bags. Large quantities of flammable or combustible chemicals should not be stored in the laboratory. Specific volumes of flammable materials and other classes of hazardous chemicals have Fire Code limits depending on the design and the construction of the buildings at Cal State LA.

- The maximum total quantity of class (1A, 1B, and 1C) of flammable and combustible liquids must **not exceed 60 gallons** within a flammable storage cabinet.
- The maximum quantity allowed to be kept outside a flammable storage cabinet, safety can, or approved refrigerator/freezer is **10 gallons per room**.
- Only the amounts needed for the current for a procedure or experiment should be kept in the work area.
- Always transfer flammable and combustible chemicals from glass containers to glassware or from glass containers/glassware to plastic. Transferring these types of chemicals between metal containers may lead to a fire hazard due to static electricity. The transfer of flammable liquid from 5 gallons or larger metal containers should not be done in the laboratory.
- Handle flammable and combustible substances only in areas free of ignition sources and use the chemical in a fume hood whenever practical.
- Flammable/combustible materials should be kept in flammable storage cabinets, explosion-proof refrigerators/freezers approved for storing flammable substances, or approved safety cans or drums grounded.
- **Always segregate flammable or combustible liquids from oxidizing acids and oxidizers**.
- Flammable materials must **never** be stored in domestic-type refrigerators/freezers and should not be stored in a refrigerator/freezer if the chemical has a flashpoint below the temperature of the equipment. Flammable or combustible liquids must not be stored on the floor or in any exit access.

Hazard Classification for Flammable Liquids			
Class	**Flashpoint**	**Boiling point**	**Examples**
I-A	below 73°F (23°C)	below 100°F (38°C)	diethyl ether, pentane, ligroin, petroleum ether
I-B	below 73°F (23°C)	at or above 100°F (38°C)	acetone, benzene, cyclohexane, ethanol
I-C	73-100°F (24-38°C)	__	p-xylene
Hazard Classification for Combustible Liquids			
II	101-140°F (39-60°C)	__	diesel fuel, motor oil, kerosene, cleaning solvents
III-A	141-199°F (61-93°C)	__	paints (oil-based), linseed oil, mineral oil
III-B	200°F (93°C) or above	__	paints (oil-based), Neat's foot oil

Table 6-2: Classification and Flash Points of Flammable and Combustible Liquids

Pyrophoric and Water Reactive Substances

Pyrophoric substances can spontaneously ignite on contact with air and/or water and must be handled under an inert atmosphere and in such a way that rigorously excludes air and moisture. Some

pyrophoric materials are also toxic, and many are dissolved or immersed in a flammable solvent. Other common hazards include corrosivity, teratogenicity, or peroxide formation.

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

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

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

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

- Dry any new empty containers thoroughly,
- Insert the septum into the neck in a way that prevents the atmosphere from entering the clean dry (or reagent filled) flask,
- Insert a needle to vent the flask and quickly inject inert gas through a second needle to maintain a blanket of dry inert gas above the reagent,
- Once the vessel is fully purged with inert gas, remove the vent needle then the gas line. To introduce the excess chemical, use the procedure described in the handling section, below,
- For long-term storage, the septum should be secured with copper wire,
- For extra protection, a second same-sized septum (sans holes) can be placed over the first, and
- Use "Parafilm M®" around the outer septa and remove the Parafilm M® and outer septum before accessing the reagent through the primary septum.

The UCLA documents titled, Procedures for Safe Use of Pyrophoric Liquid Reagents and Procedures for Safe Use of Pyrophoric Solids safety video (through CSULearn) provides information about the safe handling of pyrophoric chemicals. Please email RMEHS to request pyrophoric training.

Oxidizers

Oxidizers (e.g., hydrogen peroxide; ferric chloride; potassium dichromate; sodium nitrate; nitric acid and nitrate compounds; persulphuric acids; chlorite, chlorate, perchlorate, and other analogous halogen compounds; hypochlorite and other hypohalite compounds, including household bleach; hexavalent chromium compounds such as chromic and dichromic acids and chromium trioxide, pyridinium chlorochromate, and chromate/dichromate compounds; permanganate compounds; sodium perborate; nitrous oxide; silver oxide; osmium tetroxide; Tollens' reagent; 2,2'-dipyridyl disulfide; etc.) should be stored in a cool, dry place and kept away from flammable and combustible materials, such as wood, paper, Styrofoam™, majority of plastics, flammable organic chemicals, and away from reducing agents, such as zinc, alkaline metals, and formic acid.

Peroxide Forming Chemicals

Peroxide forming chemicals (like those listed in Appendix G) should be stored in airtight containers in a dark, cool, and dry place and must be segregated from other classes of chemicals that could create a serious hazard to life or property should an accident occur (e.g., acids, bases, oxidizers). The containers should be labeled with the date received and the date opened. This information, along with the chemical identity should face forward to minimize container handling during the inspection.

Carefully review all cautionary material supplied by the manufacturer before use. Avoid evaporation or distillation, as distillation defeats the stabilizer added to the solvents. Ensure that containers are tightly sealed to avoid evaporation and that they are free of exterior contamination or crystallization. **Never return unused quantities to the original container and clean all spills immediately**.

If old containers of peroxide forming chemicals are discovered in the laboratory, **do not handle the container**. If crystallization is present in or on the exterior of a container, **do not handle the container**. Secure it and contact RMEHS, (323) 34**3-3531**, or rmehs@calstatela.edu to arrange proper pick-up and disposal.

Corrosives

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

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

Special Storage Requirements

Compressed Gas Cylinders

- Compressed gas cylinders stored in the laboratory must be chained to the wall, with the safety cap in place.
- The cylinders must be restrained by two chains; one chain must be placed at one-third from the top of the cylinder, and the other placed at one-third from the bottom of the cylinder (see Figure 6-1).
- Bolted barricade rack may be to store gas cylinders close to an area of use.
- Store liquefied fuel-gas cylinders securely in the upright position.

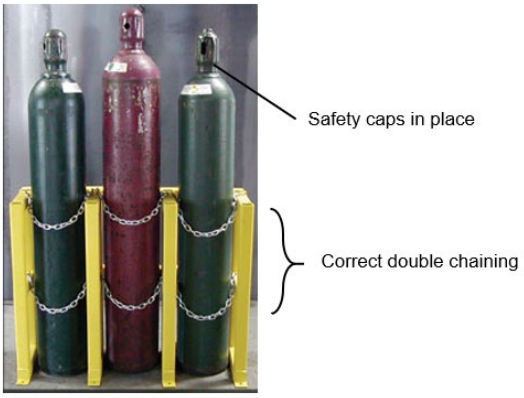


Figure 6-1:Image of gas cylinder storage using the proper two-chain method.

Cylinders are prohibited from being stored in a horizontal position. Do not expose cylinders to excessive dampness, corrosive chemicals, or fumes. Temporary clamp holders for cylinders are not meant for long term use as they do not provide the proper securing method for cylinders when in use.

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

Gas cylinder connections must be inspected frequently for deterioration and must never be used without a regulator. **Never** use a leaking, corroded, or damaged cylinder. When stopping a leak between cylinder and regulator, always close the valve before tightening the union nut. The regulator must be replaced with a safety cap when the cylinder is not in use. When moving gas cylinders, verify first that the safety cap is in place and only use carts designed for this purpose.

Liquid Nitrogen

Liquid nitrogen containers must be affixed to a permanent fixture like a wall since they are at low pressure and have protective rings mounted around the regulator. Affixing the liquid container to the wall prevents accidental rolling in an emergency.

Additional protection considerations should be addressed when storing liquid nitrogen in a laboratory.

- The primary risk to laboratory personnel from liquid nitrogen is skin or eye thermal damage caused by contact with the material.
- Nitrogen expands 696:1 when changing from a cryogenic liquid to a room temperature gas.

- The gases usually are not toxic, but if too much oxygen is displaced, asphyxiation is a possibility.
- Always use appropriate personal protective equipment (PPE) (which includes thermally insulated gloves) when handling liquid nitrogen. Face shields may be needed in cases where splashing can occur.

On-Campus Distribution of Hazardous Chemicals

Precautions must be taken when transporting hazardous substances between laboratories and between buildings within the campus.

- Chemicals must be transported between stockrooms and laboratories in break-resistant, secondary containers such as commercially available bottle carriers made of rubber, metal, or plastic, which include carrying handle(s) and which are large enough to hold the contents of the chemical container in the event of breakage.
- When transporting cylinders of compressed gases, always secure the cylinder with straps or chains onto a suitable hand truck and protect the valve with a cover cap.
- Avoid dragging, sliding, or rolling cylinders and use a freight elevator when possible. Figure 6-2 illustrates correct cylinder transport.

Figure 6-2: Proper gas cylinder transport.

Off-Campus Distribution of Hazardous Chemicals

The transportation of hazardous chemicals and compressed gases over public roads, or by air, is governed by international, federal, and state regulatory agencies, including the U.S. Department of Transportation (DOT) and the International Air Transport Association (IATA). Any person who prepares and/or ships these types of materials must ensure compliance with pertinent regulations regarding training, quantity, packaging, and labeling. **Without proper training, it is illegal to ship hazardous materials.** Those who violate the hazardous materials shipment regulations are subject to criminal investigation and penalties.

Any Cal State LA campus personnel who sign hazardous materials manifests, shipping papers, or those who handle and transport hazardous material, must be trained, certified, and approved by RMEHS.

7. SAFETY TRAINING

Regulatory Requirements

The Risk Management and Environmental Health & Safety (RMEHS) Department will follow the requirements defined in the CSU Executive Order No. 1039 for training. Implementation of the necessary work practices, procedures, and policies outlined in this chapter is required by the following:

- *Title 8, California Code of Regulations (CCR), §5191, "Occupational Exposures to Hazardous Chemicals in Laboratories"*
- *Title 8, CCR, § 5194, "Hazard Communication"*
- *Title 8, CCR, § 5209, "Carcinogens"*

Other applicable regulations include those promulgated by the U.S. Department of Labor including 29 Code of Federal Regulations (CFR) §1910.1450 "Occupational Exposure to Hazardous Chemicals in Laboratories" (also known as the "The Laboratory Standard").

Introduction

Effective training is critical to facilitate a safe and healthy work environment and prevent laboratory accidents. All PIs/Laboratory Managers must participate in formal safety training and ensure that all their laboratory personnel have appropriate safety training before working in a laboratory. RMEHS provides both classroom and online training to help meet this requirement by using the Cal State LA's MyCalStateLA CSULearn training website.

Types of Safety Training

All laboratory personnel must complete general laboratory safety training and lab-specific training:

1. before beginning work in the laboratory.
2. before new exposure situations; and/or
3. as work conditions change.

Annual refresher training is also required for all laboratory personnel. RMEHS offers resource materials and online training to assist laboratories in implementing laboratory-specific training.

Laboratory-Specific Safety Training

PIs/Laboratory Supervisors must provide laboratory-specific training to their laboratory personnel before working in the laboratory. Topics that require specific training include but are not limited to.

- Location and use of the Chemical Hygiene Plan, IIPP, SDS(s), and other regulatory information,
- Review of IIPP and Building Continuity Plan, including the location of emergency equipment and exit routes,
- Specialized equipment,
- Standard Operating Procedures (SOPs),

- Specialized procedures and protocols,
- Particularly Hazardous Substances including physical and health hazards, potential exposure, medical surveillance, and emergency procedures.
- Ensure each person working in a laboratory area receives a site-specific orientation.

Minimum Laboratory Safety Training for Employee Research Personnel

All laboratory personnel working in a research laboratory must complete the following minimum laboratory safety classes provided by RMEHS as appropriate for their employment status:

Topic	Frequency
CSU Injury Illness Prevention Program	One-time Completion
CSU Laboratory Safety Fundamentals	Annually
Globally Harmonized System	Annual
CSU Hazard Communications	Every 2 years
Principal Investigator Responsibilities*	One-time Completion
Safety Data Sheets	One-time Completion
**For PIs/ Lab Managers of a control area*	

Table 7-1: Minimum Laboratory Training for Employee Research Personnel

The type of training is also conditional to the College to which the personnel are a part of. Information for types of training by college can be viewed at the RMEHS website under '[Employee Safety Training]'

Minimum Laboratory Safety Training for Students in Laboratory Spaces

All Cal State LA students enrolled in a laboratory course must complete the minimum laboratory safety training based on the associated College. Information about the types of training based on the College can be viewed at the RMEHS website under '[Student Safety Training]'.

Additional Safety Training

Additional safety training is dependent on the Hazard Assessment for the laboratory space where the work is being conducted. Whether a PI, Responsible Person(s), or student, Additional safety training More information can be found on the RMEHS website for '[Additional Safety Training]'.

Documentation of Safety Training

Accurate recordkeeping is a critical component of health and safety training. Per OSHA regulations, departments or laboratories are responsible for documenting health and safety training, including safety meetings, one-on-one laboratory-specific training, and classroom and online training. Documentation should be maintained in the PI/Lab Manager responsible for the laboratory for all those under his/her direct supervision in a Laboratory Safety Binder.

Student training records will be maintained by the College and/or Department enrolled for an allotted time of three years or more depending on recommended by the Chancellor's Office Records Retention and Deposition schedules for the University.

Training records for laboratory employees are available to PIs/Lab Manager on request. The MyCalStateLA CSULearn website documents the training history for all courses completed online. PIs/Lab Managers must ensure that all lab personnel have completed their minimum laboratory training requirements by submitting a training certificate if the course was conducted through CSULearn. Any extra training given by the PI/Lab Manager must be documented and kept in a binder specific to the laboratory that can be easily reviewed/viewed during an inspection.

8. LABORATORY INSPECTIONS, SAFETY, AND COMPLIANCE

Regulatory Requirements

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

- Title 8, California Code of Regulations (CCR), §5191, "*Occupational Exposures to Hazardous Chemicals in Laboratories*."
- Title 8, CCR, § 5194, "*Hazard Communication*"

Other applicable regulations include those promulgated by the U.S. Department of Labor including 29 CFR, §1910.1450 "Occupational Exposure to Hazardous Chemicals in Laboratories" (the "Laboratory Standard").

Laboratory Safety Inspections

RMEHS has a comprehensive laboratory safety evaluation program to assist laboratories and other facilities that use, handle, or store hazardous chemicals to maintain a safe work environment. This program helps to ensure compliance with regulations and to fulfill Cal State LA's commitment to protecting the health and safety of the campus community.

As part of this laboratory safety program, RMEHS conducts annual inspections of laboratories and other facilities with hazardous chemicals to ensure the laboratory is operating safely and to ensure compliance with all federal, state, and university safety requirements. The inspection's main goal is to identify existing and potential accident-causing hazards, actions, faulty operations, and procedures that can be corrected before an accident occurs. RMEHS has the authority to cease and restrict any operation considered to have a significant imminent hazard to the life and safety or health and wellbeing of campus personnel or the campus community until the hazardous conditions or activity is appropriately resolved.

The laboratory safety inspection is comprehensive and investigates all key aspects of working with hazardous chemicals. While inspections are a snapshot in time and cannot identify every accident-causing mistake, they do provide valuable information on the overall operation of a particular laboratory. They can also help to identify weaknesses that may require a more systematic approach across a broader spectrum of laboratories, and strengths that should be fostered in other laboratories. Specific inspection compliance categories are included.

- Documentation and training.
- Hazard communication (including review of SOPs).
- Emergency and safety information.
- Fire safety.
- General safety.
- Use of personal protective equipment (PPE).

- Housekeeping,
- Working with biohazards,
- Chemical storage,
- Fume hoods,
- Hazardous waste segregation,
- Seismic safety,
- Mechanical and electrical safety, and
- COVID-19 safety.

Once the inspection is completed, RMEHS issues a Laboratory Inspection Report via email through the Risk and Safety Solutions (RSS) Inspect application. The report identifies incidents (or findings) in the laboratory, both critical and non-critical. Critical incidents are those that have the potential to lead to serious injuries or be of critical importance in the event of an emergency. These incidents must be immediately corrected. Non-critical incidents must be corrected within 30 days. Critical incidents requiring more than 30 days would need the approval of the Chemical Hygiene Officer and granted based on the complexity of components needed to complete the issue. Any deficiency that requires a "Facilities Services Work Order Request" for completion will be added to the Work Order database so that it can be expedited by Facilities Services.

Notification and Accountability

The laboratory safety program requires that PIs/Laboratory Managers and other responsible parties take appropriate and effective corrective action upon receipt of written notification of inspection findings. Critical deficiencies are required to be corrected within 48-hours; non-critical deficiencies must be corrected within 30 days. Failure to take corrective actions within the required period will result in an escalation of the notification to the RMEHS Director, Department Chair, Associate Dean, Dean, and Provost. The RMEHS Director, in consultation with the Department Chair, Associate Deans, Deans, and Provost and depending on the severity of the finding, may temporarily suspend research activities until the violation is resolved. In some cases, the PI may be required to provide a corrective action plan to RMEHS before recommencement of research activities.

Recordkeeping Requirements

Accurate recordkeeping demonstrates a commitment to the safety and health of the California State University community, integrity of research, and protection of the environment. RMEHS is responsible for maintaining records of inspections, accident investigations, equipment calibration, and training conducted by RMEHS staff. Per OSHA regulations, departments or laboratories must document health and safety training, including safety meetings, one-on-one training, and classroom and online training.

Also, the following records must be retained according to state and federal regulations requirements.

- Accident records (5 years).
- laboratory inspections records (5 years),

- training records (3 years),
- measurements are taken to monitor employee exposures (30 years),
- Chemical Hygiene Plan records should document that the facilities and precautions were compatible with current knowledge and regulations,
- inventory and usage records for high-risk substances should be kept,
- any medical consultation and examinations, including tests or written opinions required by CCR, Title 8, §5191 (duration of employment plus 30 years),
- Medical records must be retained according to state and federal regulations (duration of employment plus 30 years).

Laboratory Inspection Exemptions During COVID-19

When there are COVID-19 restrictions on the campus, laboratory inspections will be conducted in areas where PIs, Resource Managers, ISTs, and Responsible Persons(s) are approved to return to campus. Those approved are still expected to comply with closing out findings whether self-reported or RMEHS reported ensuring safety compliance in their responsible area(s) are not overlooked. Once return to campus is granted or full capacity is allowed that personnel who have not completed a self-inspect during their scheduled time will be expected to complete it within a week of returning.

Laboratory Safety Hierarchy and Safety Culture

All lab personnel must recognize that personal safety is dependent on accountability, teamwork, and responsibility. Safety plans, group safety meetings, annual lab safety refreshers, and internal SOPs can be used to further strengthen the laboratory's safety culture.

Laboratory Safety Organization Hierarchy

It is strongly recommended that PIs establish a formal organizational structure within their lab groups to accomplish and maintain laboratory safety compliance that enables personnel to be held accountable and help define safety responsibilities. Figure 8-1 is an example of lab hierarchy.

Two basic models for group laboratory safety hierarchy includes:

1. When there is no permanent Lab Manager, the PI or Resource Manager should appoint lab personnel to positions of defined responsibility for safety and who:

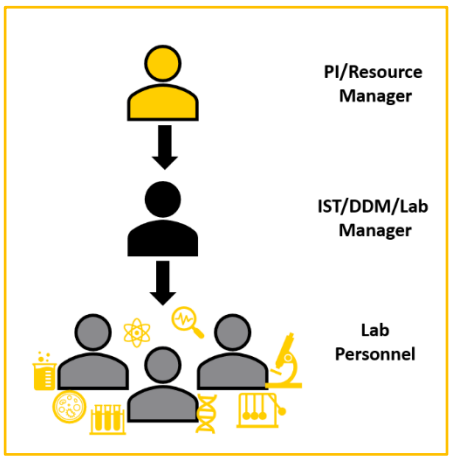


Figure 8-1:Recommended lab hierarchy. Principal Investigator (PI), Instructional Support Technician (IST), Delegated Department Member (DDM).

- Spends most of his/her time in the lab.
- Keeps an eye on the safety behavior of other personnel and holds them accountable when the safety rules are not observed.
- Ensures the chemical inventory is maintained and updated when new chemicals are received/purchased.
- Manages and delegates all safety-related lab activities (e.g., self-inspections or open findings on an inspection report), and
- Keeps the PI informed of all safety matters.

2. When there is no Lab Manager, the PI can work with another PI or Resource Manager who shares the same control area (considered a DDM) or entrust an IST who help prep the area and who:
    - Keeps an eye on the safety and lab housekeeping, the behavior of all other personnel, and reports all safety matters to the PI.
    - Holds personnel accountable for the proper segregation, storage, and labeling of hazardous waste, and who places waste pickup requests.
    - Ensures that all hazardous materials are appropriately stored, that time-sensitive materials are properly disposed of.
    - Other delegated roles as appropriate for the lab, e.g., maintainer of a specific item of equipment, responsible for a specific area of the lab, etc.

Both models are not mutually exclusive and other related safety roles can be created to fit the need of the laboratory space/control area.

Research Laboratory Safety Rules

PIs should establish written research laboratory safety rules and expectations, and it is recommended new lab members be required to sign the rules as one of the conditions for accessing the lab. Research laboratory Safety rules can derive contents of this CHP, and RMEHS online resources. It is also recommended to have rules that incorporate laboratory security policy, which should mention not leaving the laboratory space unlocked when not occupied.

All laboratory personnel exiting research areas have a responsibility for their hazardous materials and equipment. Implementing strong group rules helps prevent safety hazards and poor laboratory housekeeping from developing in labs. Below is an example research safety rules that can be implemented:

Before leaving the laboratory, please ensure all responsible areas are addressed and meet the PI's expectations by doing the following:

- *Determine which samples and chemicals the PI will keep, inventory those samples and chemicals, and place them in safe storage,*
- *Arrange for proper waste disposal unwanted samples and chemicals,*

- *Clean, decontaminate, and put away all equipment and apparatus,*
- *Clean and decontaminate all their work areas and leave all their storage areas in good working order, and*
- *Notify PI or PI's designee if lab supplies (including those for cleaning and disinfecting) are low.*

Working Alone and/or Outside Normal Working Hours

There are several inherent hazards when working in a laboratory and the PIs must establish and enforce rules when it is or is not appropriate for researchers to work in labs alone and/or outside normal working hours.

PIs and laboratory research personnel should:

- Create a schedule that allows for maximizing work during regular business hours and minimize working during irregular hours,
- Suspend hazardous operations or use of hazardous materials when alone, and
- If working outside regular hours, set up a system in checking in and out with assigned PI, University Police Department, or Campus Public Safety.

Laboratory Security

Recently regulatory agencies have been implementing rules to ensure chemical security. While many of these rules are for large manufacturing facilities, chemicals must be secured to prevent theft from campus laboratories. Numerous federal agencies are involved in the maintenance of laboratory security, including the Drug Enforcement Agency, the Federal Bureau of Investigations, and the Department of Homeland Security. It is each laboratory's responsibility to prevent and report any theft of chemicals from their laboratory.

Consider the following when evaluating a laboratory for security:

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

- Security plans in place, and
- Training and awareness of laboratory personnel.

Laboratories can increase their security by simply keeping lab doors closed and locked when unoccupied, maintaining a current and accurate chemical inventory, training personnel on security procedures, and controlling access to keys.

LABORATORIES SHOULD REPORT ANY SUSPICIOUS ACTIVITY TO CAL STATE LA UNIVERSITY POLICE DEPARTMENT AT 323-343-3700, EXT. 3-3700 AND/OR RMEHS AT 323-343-3531, EXT. 3-3531 FROM ANY CAMPUS PHONE OR MOBILE DEVICE. FOR EMERGENCIES DIAL 911.

Ingress, Egress, and Laboratory Doors

Laboratory doors should be kept closed whether the laboratory is in use or not. This is important for laboratories that utilize fume hoods and handle hazardous materials. Closed laboratory doors ensure proper negative airflow pressure is maintained by both fume hoods and building HVAC systems. When laboratory doors remain open, airflow may be affected, decreasing the effectiveness of the fume hood.

Non-functional doors should be signed as “not an entrance” on a corridor side and “not an exit” on any side adjoining a room. If the non-functional door is between two rooms, both sides should be signed “not an exit.” Note that in most cases, blocking doors is prohibited; it is only in the rare case of exceedingly small rooms with more than one exit that it may be allowed on a case-by-case basis.

Consider the following for safe egress in a case of an emergency:

- Ensure that pathways leading to exit doors have a minimum of 36” clearance and are clutter-free.
- Doorways, corridors, and stairwells should always be free of flammables, combustibles, trip hazards, obstructions, and items that may fall and prevent exiting.

Cal State LA Door Hazard Signs

RMEHS uses the Door Hazard Signs provided by the Risk and Safety Solutions (RSS) software under the *Chemicals* platform. To access your Door Hazard Signs, please log into the RSS *Chemicals* platform, and select “Inventory Summary” from the *Chemicals* homepage. Scroll down until the “Door Hazard Signs” section is present. Please note that there should be a Door Hazard Sign for each laboratory location under RSS Hazard Assessment.

Responsible person(s) is expected to annually update or update when a new hazard is introduced to the work area to ensure the most accurate information is displayed on the Door Hazard Signs for hazard communication to the campus community and to assist first responders if an emergency were to occur. The Door Hazard Sign also ensures anyone entering the laboratory understands the area is classified as a lab and only people who have knowledge of the hazards in the area should enter.

All responsible parties have access to the Door Hazard Sign Template in RSS and can update information as often as needed and simply post the new Door Hazard Sign when updated. The sign will list PI(s) and emergency contact information and display potential hazards in space, providing directions on personal protective equipment (PPE) or other safety precautions required for entry.

9. HAZARDOUS CHEMICAL WASTE ON CAMPUS

Regulatory Requirements

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

Hazardous Waste Program

The RMEHS Hazardous Waste Program manages the shipment and disposal of all hazardous waste generated on campus. Each laboratory employee must comply with the campus Hazardous Waste Management Program requirements and all applicable regulations. Hazardous waste pick-up service is provided to all Cal State LA hazardous waste generators for research laboratories upon request. Laboratory personnel are responsible for identifying hazardous waste, segregating, labeling, and storing it properly in the laboratory. Laboratory clean-outs and disposal of high-hazard compounds must be scheduled in advance. The PI/Resource Manager/Laboratory Manager is responsible for coordinating the disposal of all chemicals from his/her laboratories before closing laboratory operations by contacting RMEHS and/or their department IST.

Definition of Hazardous Waste

Federal and State regulations define hazardous waste as a substance that poses a hazard to human health or the environment when improperly managed. Chemical waste is considered hazardous if it is either listed on one of the lists of hazardous wastes found in the Federal or State regulations or exhibits one or more of the four characteristics listed below.

1. **Ignitable** –ignitable wastes are liquids with a flashpoint below 60°C or 140°F.
2. **Corrosive** –corrosive wastes are aqueous wastes with a pH less than or equal to 2 or greater than or equal to 12.5.
3. **Reactive** –reactive wastes are those wastes that are unstable, explosive, and potentially explosive or violent reactions with water.
4. **Toxic** - a chemical that poses high health or environmental hazard.
    a. Has an acute oral LD50 of less than 2,500 mg/kg.
    b. Has an acute dermal LD50 of less than 4,300 mg/kg.
    c. Has an acute inhalation LC50 less than 10,000 ppm as a gas or vapor.
    d. Has an acute aquatic 96-hour LC50 less than 500 mg/L.
    e. Has been shown through experience or testing to pose a hazard to human health or the environment because of its ability to cause cancer or mutation (carcinogen, mutagen, teratogen), acute toxicity, chronic toxicity, bio-accumulative properties in the environment.

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

- abandoned chemicals,
- unused or unwanted chemicals,
- chemicals in deteriorating containers,
- empty containers that have visible residues,
- containers with conflicting labels, and
- unlabeled or unknown chemicals.

Infrequently used chemicals must carefully be managed to avoid them being considered hazardous waste. Certain chemical compounds require careful management so that they do not become a safety hazard as they degrade and destabilize over time.

Extremely Hazardous Waste

Certain compounds meet an additional definition known as "extremely hazardous waste." This list of compounds includes carcinogens, pesticides, and reactive compounds, among others (e.g., formaldehyde, chloroform, and hydrofluoric acid). The Federal EPA refers to this waste as "acutely hazardous waste," but Cal/EPA has published a more detailed list of extremely hazardous waste. It is important to note, while there is some overlap with the list of Particularly Hazardous Substances, the extremely hazardous waste list is specific to the hazardous waste management program.

Proper Hazardous Waste Management

Waste Identification

All the chemical constituents in each hazardous waste stream must be accurately identified by knowledgeable laboratory personnel. This is a critical safety issue for both laboratory employees and the waste technicians that handle the waste once it is turned over to RMEHS. Mixing incompatible waste streams can create violent reactions and is a common cause of laboratory accidents.

If there is uncertainty about the composition of a waste stream resulting from an experimental process, laboratory workers must consult the PI/Resource Manager/Laboratory Manager, the Chemical Hygiene Officer, and/or the Hazardous Waste Technician. In most cases, careful documentation and review of all chemical products used in the experimental protocol will result in an accurate waste stream characterization.

The manufacturer's SDS provides detailed information on each hazardous ingredient in laboratory reagents and other chemical products and includes the chemical, physical, and toxicological properties of that ingredient. Any waste streams that have a substantial percentage of ingredients listed as proprietary information should consult with the Hazardous Waste Technician via email.

If you cannot find the SDS for a particular chemical, please check your RSS Chemical Inventory as SDSs are linked to the chemical added to the laboratory's inventory. If it is a chemical that is new and you

cannot find the manufacturer SDS, please you SDS Search function in RSS to find a corresponding SDS for the chemical in question.

Labeling

Hazardous waste labels must be placed on the hazardous waste container at the start of accumulation. Labels are available by contacting your department stockroom, Resource Manager, or the Hazardous Waste Technician. Each label must be completed accurately and updated as the contents of the waste container change. Product names or abbreviations for waste container ingredients should not be used. Ensure that the label is displayed so that the risk of incompatible is lessened. Additional on-site guidance and support from RMEHS are available upon request.

Storage

The RMEHS hazardous waste storage room is considered a Satellite Accumulation Area (SAA) by the Department of Toxic Substances Control (DTSC). According to DTSC requirements, this area must remain under the control of the persons producing the waste. This means it should be in an area supervised and not accessible to the public.

Other hazardous waste requirements include.

- All waste containers must be properly labeled with all contents using RMEHS Hazardous Waste Label.
- Disposal within 90 days of being generated.
- Hazardous waste containers must always be stored in secondary containment.
- All hazardous waste containers are to be kept closed when not in use.
- The maximum amount of waste that can be stored in an SAA is 55 gallons of hazardous waste or 1 quart of acutely/extremely hazardous waste. If the volumes of acutely/extremely hazardous waste, it must be disposed of within 3 days of reaching the set volumes.
- Containers must be inspected weekly for signs of leaks, corrosion, or deterioration.
- Hazardous waste containers must be in good condition with leak-proof lids.
- Containers must be less than 80% full.
- Do not dispose of chemicals by pouring them down the drain or placing them in the trash.
- Hazardous waste streams must have compatible constituents and must be compatible with the containers that they are stored in.

Segregation

All hazardous waste must be segregated to prevent incompatible mixtures. Segregation can be by hazard class. Examples of proper segregations are.

- segregate acids from bases,
- segregate oxidizers from organic compounds, and
- segregate cyanides from acids,

For more information on specific chemical incompatibility, consult a safety data sheet (SDS) and Hazardous Waste Management Plan.

Incompatible Waste Streams

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

Some common incompatible waste streams include.

- Oxidizer added to any fuel can create an exothermic reaction and explode. The most frequent is acids oxidizing flammable liquids. For this reason, all flammable liquids are pH tested before they are consolidated.

- Piranhas etch solution is a specific waste stream containing sulfuric acid and hydrogen peroxide, which form a reactive mixture often still fuming during disposal. For this waste stream, and other reactive mixtures like it, vented caps are mandatory.

Waste That Requires Special Handling

Unknowns

Unlabeled chemical containers and unknown/unlabeled wastes are considered unknowns, and additional fees must be paid to have these materials analyzed and identified. These containers must be labeled with the word “unknown.” It is the responsibility of the PI/Laboratory Manager to determine if the container is considered “unknown” and must notify RMEHS before disposal of chemicals for proper processing. PIs/Laboratory Managers must make a final attempt to categorize materials present. RMEHS will not receive unlabeled containers and will be promptly returned to the corresponding PI/Laboratory Manager until it is labeled.

Peroxide Forming Chemicals

Peroxide forming chemicals, or PFCs, include several substances that can react with air, moisture, or product impurities, and change their chemical composition during normal storage.

- Peroxides that form are highly reactive and can explode upon shock or spark. Peroxides are not particularly volatile and thus tend to precipitate out of liquid solutions.
- It is dangerous to allow a container of these materials to evaporate to dryness, leaving peroxide crystals on the container's surfaces.
- Each container of peroxide forming chemicals should be **dated with the date received and the date first opened**.

There are three classes of peroxide forming chemicals, with each class having different management guidelines. A review of the safety information/SDS provided by the manufacturer for any chemicals you purchase.

- Ensure containers of PFCs are kept tightly sealed to avoid unnecessary evaporation, as this inhibits the stabilizers that are sometimes added.
- Visually inspect containers periodically to ensure that they are free of exterior contamination or crystallization. PFC containers must be disposed of before the expiration date.
- If old containers of peroxide forming chemicals are discovered in the laboratory, do not handle the container. Secure the area and contact RMEHS, 323-34**3-3531**.
- If crystallization is present in or on the exterior of a container, do not handle the container. Secure the area and contact RMEHS, 323-34**3-3531**.

Dry Picric Acid

Picric acid (also known as trinitrophenol) must be always hydrated with deionized water, as it becomes increasingly unstable as it loses water content. When dehydrated, it is not only explosive but also sensitive to shock, heat, and friction. Picric acid is highly reactive with a wide variety of compounds (including many metals) and is extremely susceptible to the formation of picrate salts.

- Be sure to label all containers that contain picric acid with the date received, and then monitor the water content every 6 months.
- Add distilled water as needed to maintain a consistent liquid volume.
- If old or previously unaccounted for bottles of picric acid are discovered, **do not touch the container**.
- Depending on how long the bottle has been abandoned and the state of the product inside, even a minor disturbance could be dangerous.
- Visually inspect the contents of the bottle without moving it to evaluate its water content and look for signs of crystallization inside the bottle and around the lid. If there is even the slightest indication of crystallization, signs of evaporation, or the formation of solids in the bottle, **do not handle the container and contact RMEHS**, 323-34**3-3531** immediately.
- Secure the area and restrict access to the container until it can be evaluated by RMEHS personnel.

Explosives and Compounds with Shipping Restrictions

A variety of other compounds that are classified as explosives or are water or air reactive are used in research laboratories. These compounds often have shipping restrictions and special packaging requirements.

- When disposing of these compounds, employees must ensure that they are stored appropriately for transport.
- Flammable metals must be completely submerged in oil before disposal.

- Many pyrophoric and reactive compounds can be stabilized using a quenching procedure before disposal. Chemicals classified by the Department of Transportation (DOT) as explosives (e.g., many nitro- and azo-compounds) will require special packaging and shipping and may require stabilization before disposal.

Please consult with the Chemical Hygiene Officer and the Hazardous Waste Technician for disposal considerations of these compounds.

Managing Empty Containers

Empty containers that held extremely hazardous waste must be disposed of as hazardous waste and cannot be reused or reused.

All other hazardous waste containers less than 5 gallons should be reused for hazardous waste collection, or cleaned, discarded, or recycled. Contact RMEHS for guidance on repurposing and rinsing empty containers.

- Proper rinsing of the container involves the triple-rinse method, with the first rise collected as hazardous waste.
- Container labels must be completely defaced (removed or marked out) before disposal.

Transportation

It is a violation of DOT regulations to transport hazardous waste in personal vehicles or to carry hazardous waste across campus streets that are open to the public. As a result, RMEHS provides pick-up services for all hazardous waste generators. These waste pick-ups are for routinely generated instructional and/or research wastes. Special pick-ups and laboratory clean-outs are available upon request. For information regarding waste disposal, please contact the Hazardous Waste Technician, located in the RMEHS Department, or visit the RMEHS to learn more about hazardous waste.

Accumulation and Disposal

To ensure accumulation limits are not exceeded, frequent waste disposal is encouraged to manage proper hazardous waste accumulation areas in labs. Hazardous waste needs to be requested for pick-up via email to the Hazardous Waste Technician. **Do not** dispose of chemicals by pouring them down the drain or placing them in the trash. **Do not** use fume hoods to evaporate chemicals.

Reduction in Hazardous Waste

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

10. ACCIDENTS, EMERGENCIES, AND CHEMICAL SPILLS

Overview

Laboratory emergencies may result from various factors, including serious injuries, fires and explosions, spills and exposures, and natural disasters. All laboratory employees should be familiar with and aware of the location of their laboratory's emergency response procedures and safety manuals.

Before starting any laboratory task, know what to do in an emergency. Identify the location of safety equipment, including first aid kits, eyewashes, safety showers, fire extinguishers, fire alarm pull stations, and spill kits. Plan and know the location of the closest fire alarms, exits, and telephones in your laboratory. The Cal State LA Emergency Procedures Poster, posted in each laboratory, provides an overview of emergency response procedures including "Hazardous Materials."

For all incidents requiring emergency response, call Cal State LA Police Department at 911 from any campus phone or mobile device. Additional resources are available on the Emergency Preparedness website.

First Aid Kits in Laboratory and/or Activity Areas

RMEHS recommends buying ANSI/OSHA-compliant first aid kits that are suitable for laboratory/activity areas. Please note that students should not receive any ointments or oral anesthetics, only bandages, and gauze to help stop any bleeding. Any ointments present in the first aid kits can be used by the employees themselves but cannot be administered to the student.

If a student needs more help beyond a Band-Aid, please refer them to the Cal State LA Student Health Center for treatment, by having someone walk them over and to ensure they get needed attention, or if it is an emergency and unsure the condition of the student or unsure how to handle the situation, please dial 911.

RMEHS recommends Uline for the first aid kit, class A or the Staples first aid kit Class A. Please note that both vendors have different size options and selecting the size should be equivalent to the number of people in the area working at that time. If you are unsure, please contact RMEHS for additional guidance.

Laboratory Emergency Action Plan (EAP)

EAP For Equipment

It is strongly recommended to maintain an emergency action plan in the event of a disaster (earthquake, fire, flood, power outage, etc.). The plan should include:

- Evacuation routes and gathering location outside.
- List of all critical equipment on the emergency generator.
- List of shut down equipment, compressed gas supplies, etc. and person(s) responsible for doing so.
- Lab floor plan with identified locations of the gas shut-off valves and circuit breakers (if any).

After a significant natural disaster, lab buildings should remain closed for re-entry pending inspection by RMEHS personnel.

Power Outage

Research groups should plan for the possibility of a planned power outage; this is covered in Appendix J, which should be read by all laboratory personnel. PIs are expected to have a contingency plan in case of an emergency and further remind all members of where the plan is located and be made into a topic for discussion during lab meetings regarding safety.

EAP for Department Personnel

All laboratory PI(s), responsible person(s), delegate(s), lab worker(s), technician(s), under the Department should know how to handle an emergency when working with students. Below are some emergency procedures to follow, but it must be noted that only those comfortable by knowledge, training, or experience should do so, and it the situation is more than can be handle whether before or during the mitigation, ensure stabilization of the current step and dial 911 when it is safe to do so. *Appendix K* has an example EAP for department personnel who may encounter injury to a student.

Accidents—Sharps Injury Involving Non-Infectious Materials

Injuries involving scalpel blades, needles, and glass pipettes pose a potential physical hazard due to the types of materials used. For injuries involving infectious materials and sharps, consult the Exposure Control Plan located within the Biohazard Waste Management Plan.

If a non-biohazardous sharps injury is sustained in a university control area where chemicals are present or being used

1. Notify the instructor/responsible person in charge of the area immediately. If the injured person is the location instructor/responsible person, the Department personnel must be notified. If the injured person cannot notify an accident that has occurred, then another person close to the situation must immediately notify for help.
2. To the best of the ability of the injured person and the location's instructor/responsible person, determine if the incident requires basic first aid or medical treatment. If a determination cannot

be immediately made, the immediate response is to assume the situation requires medical treatment.

3. **For all cases that require medical treatment, the instructor/responsible person or other witnesses must immediately call 911 from any campus phone or mobile device** and notify that incident has occurred that requires immediate medical attention.
4. The caller must provide exact location information (Building-Floor-Room) and indicate that there is a need for an immediate emergency medical response.
5. Instructors/responsible persons are to assist the injured person and accompany them until campus police and/or emergency medical technicians (EMTs) arrive.
6. Witnesses should remain at a safe distance until University Police have released them.
7. The location instructor/responsible person may choose to assist the injured person with first aid, using materials found in the first aid kit for minor incidents.
8. In the event a student believes additional medical observation and advice are needed after the simple first aid is rendered, he or she may choose to visit the Student Health Center.
9. If the student decides to visit the Student Health Center, the location instructor/responsible person may choose to accompany the student depending on circumstances. However, the instructor/responsible person should not transport students to the Student Health Center or any medical facility for treatment.
10. Immediately after calling for medical assistance or providing first aid, the Department Chair must be notified.
11. If any person receives medical attention beyond basic first aid or is transferred off campus for medical treatment, whether it involves chemical exposure, RMEHS must be notified as soon as possible but not more than 8 hours after the incident at 323-34**3-3531**. RMEHS will report the event to Cal-OSHA if necessary.
12. For medical treatment cases involving employees (faculty, staff, and student assistants), Worker's Compensation must be contacted as soon as possible and a Workers Compensation case initiated.

Accidents—No Chemicals Involved

If an injury or illness is sustained in a university control area where chemicals are present or being used, the incident does not involve a chemical spill or any chemical exposure.

1. Notify the instructor/responsible person in charge of the area immediately. If the injured person is the location instructor/responsible person, the Department personnel must be notified. If the injured person cannot notify an accident that has occurred, then another person close to the situation must immediately notify for help.
2. To the best of the ability of the injured person and the location's instructor/responsible person, determine if the incident requires basic first aid or medical treatment. If a determination cannot be immediately made, the immediate response is to assume the situation requires medical treatment.

3. **For all cases that require medical treatment, the instructor/responsible person or other witnesses must immediately call 911 from any campus phone or mobile device** and notify that incident has occurred that requires immediate medical attention.
4. The caller must provide exact location information (Building-Floor-Room) and indicate that there is a need for an immediate emergency medical response.
5. Instructors/responsible persons are to assist the injured person and accompany them until campus police and/or emergency medical technicians (EMTs) arrive.
6. Witnesses should remain at a safe distance until University Police and RMEHS have released them.
7. The location instructor/responsible person may choose to assist the injured person with first aid, using materials found in the first aid kit for minor incidents.
8. In the event a student believes additional medical observation and advice are needed after the simple first aid is rendered, he or she may choose to visit the Student Health Center.
9. If the student decides to visit the Student Health Center, the location instructor/responsible person may choose to accompany the student depending on circumstances. However, the instructor/responsible person should not transport students to the Student Health Center or any medical facility for treatment.
10. Immediately after calling for medical assistance or providing first aid, the Department Chair must be notified.
11. If any person receives medical attention beyond basic first aid or is transferred off campus for medical treatment, whether it involves chemical exposure, RMEHS must be notified as soon as possible but not more than 8 hours after the incident at 323-34**3-3531**. RMEHS will report the event to Cal-OSHA if necessary.
12. For medical treatment cases involving employees (faculty, staff, and student assistants), Worker's Compensation must be contacted as soon as possible and a Workers Compensation case initiated.

Accidents—Chemical Spill

If an injury or illness or chemical exposure is sustained or there is a chemical spill in a university control area where chemicals are present or being used.

1. Notify the instructor/responsible person in charge of the area immediately.
2. If the person is injured or chemically exposed is the location instructor/responsible person, the Department personnel must be notified.
3. If the person injured or chemically exposed cannot notify an accident has occurred, then another person close to the situation must immediately notify for help.
4. The location instructor/responsible person (if not injured) or the department personnel (if the instructor/responsible person is injured) must determine if the spill is simple or complex. If a determination cannot be immediately made, then the immediate response is to assume the spill is a complex spill.

5. **For all cases where a hazardous chemical exposure has occurred that require immediate medical treatment, the instructor/responsible person or other witnesses must <u>immediately call 911</u>** from any campus phone or mobile device and notify that incident has occurred that requires immediate medical attention.
6. The caller must provide exact location information (Building-Floor-Room) and indicate that there is a need for an immediate emergency medical response.
7. Instructors/responsible persons are to assist the injured person and accompany them until campus police and/or emergency medical technicians (EMTs) arrive.
8. Faculty, instructors, or other University personnel with supervisory responsibility and knowledge of the location where the incident has occurred determine whether to use the showers or eyewashes.
9. For hazardous chemical exposures, this assistance may involve immediately using the eyewash fountain or the emergency shower.
10. Eyewash fountains and showers are to be used for at least 15 minutes. Contaminated clothing and lab coats must be removed as much as possible.
11. Washing off a minor exposure from a non-hazardous chemical or using only the eyewash fountain is considered first aid, not medical treatment. Therefore, it may not require calling 911.
12. To limit contamination, it is advised not to take the exposed person outside the lab and into hallways and bathrooms, unless immediate evacuation from the location is warranted, based on significant hazards of the spilled or released chemical.
13. Faculty, staff and supervisors, and any other assisting personnel must use appropriate Personal Protective Equipment (PPE) to limit their exposure while assisting the person exposed to a hazardous chemical.
14. For first aid cases and simple spills only, the location instructor/responsible person may assist the injured person by providing first aid, or for minor or non- hazardous chemical exposure, in ensuring that the person can appropriately remove contaminated clothing or PPE and ensuring the chemically exposed body parts are washed.
15. For students who have minor or non-hazardous exposure, after washing or first aid as appropriate, the student may choose to have additional medical observation and advice. In these cases, he or she may choose to visit the Student Health Center.
16. If the student decides to visit the Student Health Center, the location instructor/responsible person may choose to accompany the student depending on circumstances. However, the instructor/responsible person should not transport students to the Student Health Center or any medical facility for treatment.
17. Immediately after medical assistance has been called or first aid rendered, the Department Chair must be notified.
18. If any person receives medical attention beyond basic first aid or is transferred off campus for medical treatment, whether it involves chemical exposure, RMEHS must be notified as soon as

possible but not more than 8 hours after the incident at 323-34**3-3531**. RMEHS will report the event to Cal-OSHA if necessary.

19. For medical treatment cases involving employees (faculty, staff, and student assistants), Worker's Compensation must be contacted as soon as possible and a Workers Compensation case initiated.

Factors to Consider Before Spill Clean-up

1. Size of the spill area
2. Quantity of chemical
3. Toxicity
4. Volatility
5. Clean-up materials available
6. Training of responders

Simple Chemical Spill

To be considered a simple chemical spill all the following conditions must be met.

- The material spilled/released is known to the faculty, employee, graduate student designee, responsible person in charge of the location where the release occurs.
- This knowledge of the chemical teaching/research material enables the faculty; employee, graduate student, designee, or responsible person to immediately determine if the volume, toxicity, flammability, or environmental effects of the material can be safely managed and cleaned up using the standard personal protective equipment (PPE) already worn in the location.
- Minimum PPE (new gloves, lab coat, goggles/glasses) are used to safely work with the chemical.
- A fume hood is not needed to work with the material.
- The spill has not occurred in a public space (ex. hallway, elevator, etc.).

Simple Chemical Spill Response

1. Determine that all conditions are met for a simple spill.
2. Immediately notify the location instructor/responsible person where the spill occurred.
3. Since it is a simple spill, personnel cleaning the spill are knowledgeable about the spilled material, are current on all required RMEHS training, and are approved to do so by the faculty, employee, graduate student, designee, or responsible person.
4. Evacuate all non-essential personnel and/or students not in the immediate area of the spill.
5. Minimize contamination of other areas by preventing anyone from walking through the spill.
6. Use appropriate cleanup techniques and the local spill response kit if needed. Call RMEHS at 323-34**3-3531 f**or guidance if necessary.
7. If a person is involved in spill cleanup, where the chemical contacted skin, eye, or mouth despite wearing PPE, that person must wash off the material as soon as possible.

8. The instructor/responsible person may help those who need the chemical washed off by directing them to the appropriate location. Simple spills are low volume, low hazard chemicals that a sink, restroom, or eyewash fountain may be all that is needed to wash the chemical off. A full-body emergency shower is not necessary for a simple spill.
9. Work with another person to clean up the spill. Never clean up a simple spill alone, in case of accidental exposure.
10. Use an appropriate chemical spill kit to neutralize and absorb inorganic acids and bases, as necessary.
11. For other chemicals, use the appropriate spill kit or absorb the chemical with sorbent pads, paper towels, vermiculite, dry sand, or diatomaceous earth.
12. Collect the clean-up materials and residue and place them in a translucent plastic bag. Double bagged the waste and labeled the bag with a proper hazardous waste label.

Complex Chemical Spills

Spills that are not considered simple spills are complex chemical spills.

1. These are spills of larger quantities than 1 gal.
2. Are known toxic substances or is a spill of an unknown chemical where minimum PPE may not be sufficient.
3. A spill of a toxic/unknown substance in a public area where people are not wearing PPE or spills into or adjacent to drains.
4. Depending on the hazard of the gas, uncontrolled leaks from compressed gas cylinders can be considered a complex spill that requires an emergency response.

Complex Chemical Spill Response

1. Complex spills require an emergency response from the RMEHS Department.
2. Instructor, responsible person(s), and students do not respond directly to a complex chemical spill.
3. Evacuate the immediate area unless you have been contaminated by the spilled materials or the instructor/responsible person(s) declared a spill emergency.
4. **Call 911** on any campus phone or mobile device and indicate the room location where a chemical spill has occurred that requires an RMEHS response.
5. If the spill presents a situation that is immediately dangerous to life, activate the fire alarm and clear the entire building.
6. Anyone who has been directly exposed to a significantly hazardous chemical should not evacuate the building unless the situation is immediately dangerous to life and health and should prioritize immediately washing the contamination off before evacuating.
7. Faculty, instructors, or other University personnel with supervisory responsibility for students at the location where the incident has occurred determine whether to use the showers, eyewashes, or restrooms for decontamination.

8. Faculty or supervisors are to assist those who have been exposed to a significantly hazardous chemical by directing them to the nearest location outside the immediate spill area that has appropriate means to wash off the chemical, such as eyewash fountains, emergency showers, or restrooms if appropriate.
9. For hazardous chemicals, washing off must be immediate and continue for at least 15 minutes, unless trained EMTs and Hazmat responders arrive on the scene.
10. Heavily contaminated clothing and lab coats must be removed to the extent possible before washing.
11. Faculty, staff and supervisors, and any other assisting personnel must use appropriate Personal Protective Equipment to limit their exposure to a hazardous chemical while assisting the person exposed, so that only those with proper PPE may assist.
12. Minimize contamination of other areas by preventing anyone from walking through the spill.
13. Be sure to notify RMEHS at 323-34**3-3531** as soon as possible after calling the police/dispatch of any complex chemical spills. RMEHS will handle further notifications to regulatory authorities as needed. RMEHS will report the event to Cal-OSHA if necessary and investigate further.
14. For medical treatment cases involving employees (faculty, staff, and student assistants), Worker's Compensation must be contacted as soon as possible and a Workers Compensation case initiated.
15. No re-entry of any evacuated space where a complex emergency chemical spill has occurred is permitted until approval is provided by the RMEHS department.

Highly Toxic Chemical Spills

All spills for these chemicals require emergency response.

Highly Toxic Chemicals	
Aromatic amines	Carbon disulfide
Hydrazine	Nitro-compounds
Bromides	Cyanides
Nitriles	Organic halides

Table 10-1: Highly Toxic Chemical that Requires Emergency Response.

1. **Call 911 on a campus phone or mobile device** and be sure to **notify RMEHS** at 323-34**3-3531** of any toxic chemical spills.
2. For medical treatment cases involving employees (faculty, staff, student assistants), Worker's Compensation must be contacted as soon as possible and a Workers Compensation case initiated.
3. No re-entry of any evacuated space where a toxic emergency chemical spill has occurred is permitted until approval is provided by the University Police, RMEHS, or the Emergency Response personnel.

Accidents—Fire

1. If a fire or smoke is detected in a laboratory or other University facility, the instructor and/or responsible person of that location must be alerted immediately.
2. Faculty, staff, or responsible person(s) in a location **are not required** to extinguish fires that occur in their work areas and should not attempt to do so **unless**
    a. It is a small fire (i.e., small trash can size fire).
    b. Appropriate fire extinguisher training has been received.
    c. The person wishes to do so and is capable.
3. The immediate location must be evacuated, and a fire alarm pulled.
4. If the clothing of an individual catches on fire, the most immediate location where water (like an eye-wash station) can be used.
5. Any time a fire occurs, or a fire extinguisher is used, no matter how brief a period, the incident must be reported to Cal State LA University Police Department **call 911** and **RMEHS** at 323-34**3-3531** (during normal business hours).

11. APPENDIXES

Appendix A: General Rules for Laboratory Work

Prudent Laboratory Practices

It is prudent to minimize all chemical exposures. Few laboratory chemicals are without hazards. General precautions for handling all laboratory chemicals and specific chemical guidelines should be adopted.

Exposure should be minimized even for substances of no known significant hazard, and special precautions should be taken for work with substances that present special hazards. One should assume that any mixture will be more toxic than its most toxic component and that all substances of unknown toxicity are toxic.

Safe Laboratory Practices

- Never work alone while working on procedures involving hazardous chemicals, biological agents, or other physical hazards.
- Wear closed-toe shoes with an enclosed heel and full-length pants, or equivalent, always when in the laboratory.
- Utilize appropriate PPE in the laboratory and while performing procedures involving hazardous chemicals or materials. These items may include laboratory coats, gloves, and safety glasses or goggles.
- Confine long hair, loose clothing, and accessories.
- Wear appropriate gloves when the potential for contact with toxic materials exists; inspect the gloves before each use and replace them often.
- Remove laboratory coats or gloves immediately on significant contamination and before leaving the laboratory.
- Wash hands thoroughly before leaving the lab or upon completion of an experiment to further remain any remaining contamination.
- Avoid the use of contact lenses in the laboratory unless necessary; if they are used, inform the supervisor so special precautions can be taken.
- Ensure that appropriate PPE is worn by all persons, including visitors, where chemicals are stored or handled.
- Inspect the respirator before use. The use of respirators requires a respirator hazard assessment, successful completion of the RMEHS respirator protection training, and a fit test. Review Cal State LA's Respiratory Protection Program for more information.
- Be aware of the locations of first aid kits, emergency eyewash and shower stations, and other emergency or first aid equipment.

Chemical Handling

- Use only those chemicals for which the quality of the available ventilation system is appropriate.

- Vent apparatus which may discharge toxic chemicals (vacuum pumps, distillation columns, etc.) into local exhaust devices.
- Properly label and store all chemicals. Always use secondary containment when possible.
- Deposit chemical waste in an appropriately labeled receptacle and follow all other waste disposal procedures of the Chemical Hygiene Plan.
- In the case of an accident or spill, refer to the emergency response procedures for the specific material. These procedures should be readily available to all personnel.
- Do not smell or taste chemicals directly.
- When working in cold rooms, do not allow the release of toxic substances or fumes as areas use re-circulated air.
- Never use a pipette or siphon by mouth.
- Do not dispose of any hazardous chemicals in the sewer system. Hazardous substances may interfere with the biological activity of wastewater treatment plants, creating fire or explosion hazards.

Information on chemical spill mitigation may also be referenced in Section 10 of the Chemical Hygiene Plan and Appendix H for general spill clean-up procedures.

Equipment Storage and Handling

- Use equipment only for its designed purpose.
- Do not use damaged glassware or other equipment, under any circumstances.
- Do not use uncertified fume hoods or glove boxes for hazardous chemical handling.
- Avoid storing materials inside fume hoods that can block vents or airflow.
- Keep the hood always closed, except when adjustments within the hood are being made or when the hood is actively being used.

Laboratory Operations

- Keep the work area clean and uncluttered.
- Seek information and advice about hazards, plan appropriate protective procedures, and plan the positioning of equipment before beginning any new operation.
- If unattended operations are unavoidable and have been approved by the PI/Laboratory Manager, place an appropriate sign on the door, leave lights on, and provide for containment of toxic substances in the event of failure of a utility service (such as cooling water).
- Be alert to unsafe conditions and ensure that they are corrected when detected.
- If minors are in laboratories be sure to follow Cal State LA's Minors On-Campus Policy.
- Receive both Lab Safety Fundamentals, all minimum laboratory training, and lab-specific training before starting work in a lab.

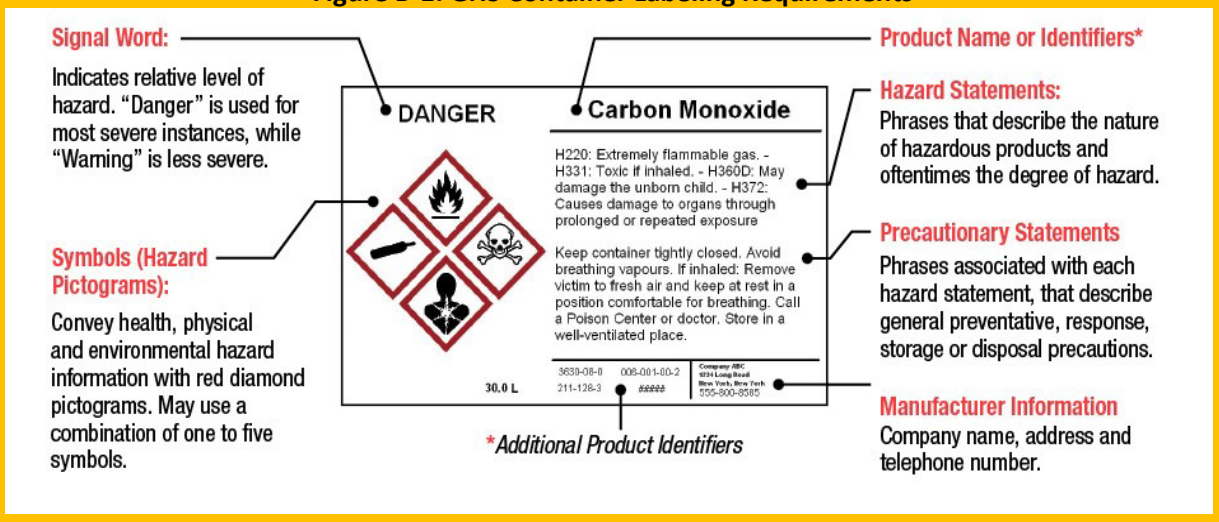
Food/Drink:

- Do not eat, drink, smoke, chew gum, or apply cosmetics (including lip balms) in areas where laboratory chemicals are present; wash hands before conducting these activities.
- Do not store, handle, or consume food or beverages in storage areas, refrigerators, glassware, or utensils that are also used for laboratory operations.
- Wash areas of exposed skin well before leaving the laboratory area.

Appendix B: Container Labeling

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

Figure B-1: GHS Container Labeling Requirements



The warning may be a single word (e.g., Danger, Caution, Warning) or may identify the primary hazards, including both physical (e.g., water-reactive, flammable, or explosive) and health (e.g., carcinogen, corrosive, or irritant), such as what is found on the hazard warnings from the label or SDS. The label will also have hazard pictograms associated with the degree of hazard.

Most labels provide additional safety information to help workers protect themselves from the substance. This information may include protective measures and/or protective clothing to be used, first aid instructions, storage information, and emergency procedures. For further information on the product, please consult the manufacturer's SDS. Table B-2 gives guidelines for laboratory personnel and proper chemical labeling use.

Table B-2: Chemical Labeling–What are Laboratory Personnel Responsible for?

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

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

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

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

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

Concerning chemical labeling, all potential chemicals transferred from their original container to a second container must be labeled with a compliant GHS chemical name and the principal hazards found on the primary container label or SDS. For more information on labeling, see *Section 6*.

Appendix C: Instruction for Creating Standard Operating Procedures (SOPs)

Cal/OSHA requires SOPs are required when working with hazardous chemicals. To determine if an SOP is needed, an updated chemical inventory is needed to identify the need for Banded SOPs and Chemical Specific SOPs. Lab-specific processes that involve hazardous materials and require SOPs should be identified by the PI/Laboratory Manager and lab personnel.

What is a Standard Operating Procedure (SOP)?

An SOP is a written document that clearly outlines the steps to be followed when carrying out a given operation or experiment so that a process can be replicated safely by any person reading it. It provides individuals with information to perform a procedure properly and facilitates consistency in the quality and integrity of the result.

Procedures and Requirements for Writing SOPs

- **Step 1**: After identifying the needed SOPs, review the Cal State LA SOP Template library for templates of bands, processes, and chemicals or for a blank SOP template to use to complete the lab's SOPs requirement.
- **Step 2**: Using a template from the SOP library or by creating your own, customize it with lab-specific information and procedures/protocols. This must be done by a delegated laboratory personnel with the most experience with the described procedure/protocol and/or chemical and who are routinely involved with the experimental process.
- **Step 3**: Once the SOP is written, it must be reviewed and signed by the PI/Laboratory Manager and all laboratory personnel responsible for performing the procedures detailed by the SOP. By acknowledging the SOP, the laboratory worker understands the contents, requirements, and responsibilities.
- **Step 4: Maintain a copy of the signed SOP in the Laboratory Safety Binder or separately designated manual available to all lab personnel to review when needed.**

SOP Requirements at Cal State LA

The Cal State LA RMEHS has created an SOP Template library which will serve as a valuable tool for researchers to fulfill a Cal/OSHA requirement for the need of SOPs when working with hazardous chemicals. An SOP is not complete until the lab completes the procedure/protocol section of the document.

There are three types of SOPs categories created to describe the type of SOP required for research operations.

1. Banded SOPs
2. Chemical Specific SOPs
3. Process SOPs

Banded SOPs are created to classify chemicals in the chemical inventory based on specific physical and chemical properties and physical and/or health hazards. Several chemicals will fall under more than one band but the primary band that is identified as important for each chemical.

Chemical Specific SOPs are created to identify regulated hazardous chemicals. All regulated carcinogens are required by Cal/OSHA to have individual SOPs. Chemicals used for animal research and included in animal protocols must also have SOPs. The lab can also choose to maintain individual chemical SOPs for all primary chemicals in the bands.

Process SOPs are created to identify specific hazardous processes performed regularly in control areas. PI/Lab Managers are responsible for identifying and creating process-specific SOPs. The template library has several process SOPs in place, but labs will have to customize accordingly. A process could include the use of specific equipment like rotary evaporators, centrifuges, etc. A process could also include specific known reactions that are regularly performed by lab personnel like Heck reaction, Suzuki reaction, etc.

Steps to follow for identifying lab SOPs needed for lab operations:

- **Step 1:** Update the lab Chemical Inventory by adding new chemicals when they arrive and removing chemicals that have been completely used and the container has been disposed of. (During an RMEHS annual inspection, the validity of the chemical inventory will be checked to cross-reference a chemical at random to RSS chemical inventory).
- **Step 2:** Identity what chemicals require individual SOPs. In addition to regulated carcinogens, any chemical included in an animal protocol must have an SOP.
- **Step 3:** PI/Laboratory Manager and/or lab personnel need to identify lab-specific processes. These could be specific, known, or regularly used reactions or procedures. These could also be commonly used equipment.

Proposed Bands

Primary Bands: Chemicals that fall under these bands pose an immediate hazard to the worker or are regulated and require chemical-specific procedures.

1. Regulated Carcinogens.
2. Strong corrosive chemicals.
3. Water-reactive chemicals.
4. Air reactive chemicals.
5. Acutely toxic chemicals (LD50 equals or lower than 50 mg/kg for rats).
6. Explosive chemicals.
7. Highly Flammable chemicals.
8. Peroxide forming chemicals.
9. Toxic gases.

Secondary Bands: Chemicals that fall under these bands can have a generic procedure that covers all chemicals under each band. These bands will have two subcategories: Solvents, non-solvents.

1. Carcinogens and reproductive toxicants.
2. Flammable chemicals.
3. Corrosive chemicals.
4. Potentially explosive chemicals and oxidizers.
5. Sensitizers, Irritants, and toxic chemicals.
6. Compressed gases.
7. Harmful and lower hazard chemicals.
8. Non-hazardous chemicals.

How to Write an SOP Protocol or Procedure

Templates from the Cal State LA RMEHS SOP Template library must be customized, by lab groups using chemicals, to include lab-specific information. In particular, the labs must complete the protocol/procedure section of the SOP detailing the use of chemicals or equipment so that it can be followed safely and consistently. This section must be written by the most experienced and knowledgeable lab personnel for the various uses of the chemicals or equipment and reviewed by the PI/Laboratory Manager. Cal/OSHA required SOPs when working with hazardous chemicals.

Steps for Writing Protocols/Procedures

- **Step 1:** Give a general range of quantities that can be used safely and consistently. If necessary, provide two procedures to cover a wider range of quantities.
- **Step 2:** Outline the conditions under which the procedure applies (temperature, pressure, concentration, etc.).
- **Step 3:** Provide a step-by-step explanation of a general experimental procedure covered within the range of quantities. Provide details on engineering controls and hazards associated with the procedure.
- **Step 4:** Include a specific example procedure describing in detail the experiment. This could be an experimental procedure from your lab notebook or a publication.
- **Step 5: If quantities or conditions significantly deviate from the SOP, get approval from the PI/Laboratory Manager, and include any changes to an updated SOP.**

Standard Operating Procedure Example for Protocol/Procedure

Quantities covered by this SOP: 0-40 g

Conditions covered by this SOP: 0°C – 50°C.

General Information: Sodium hydroxide pellets are used to make aqueous solutions that range from 0.01M to 1M and a volume of 10 ml to 1 L. The sodium hydroxide pellets are weighed and then

slowly added to a beaker of water that is cooled in an ice bath under constant stirring on a stirring plate.

Caution: The dissolution of sodium hydroxide is highly exothermic. The solution is stirred until all sodium hydroxide is dissolved. It is then allowed to reach room temperature. The final concentration is determined by titration with potassium hydrogen phthalate.

Example Procedure: Preparation of 1L of 1M sodium hydroxide solution.

40g of NaOH pellets were weighed out in a plastic weigh boat. A 2L beaker containing 1L of water and a stirring magnet was placed in an ice bath over a stirring plate. The pellets were added slowly to the water. When all pellets have completely dissolved the beaker was removed from the ice bath and allowed to reach room temperature before the solution got titrated with potassium hydrogen phthalate.

NOTE: Any deviation from this SOP requires approval from PI. All SOPs must reflect the current laboratory operations.

Appendix D: Regulated Carcinogens

The term "regulated carcinogen" means a recognized cancer-causing substance, compound, mixture, or product regulated by Cal/OSHA sections 1529, 1532, 1532.2, 1535, 8358, 8359, or Article 110, sections 5200-5220.

- Acrylonitrile
- Arsenic metal and inorganic arsenic compounds
- Asbestos
- Benzene
- 1,3-butadiene
- Cadmium metal and cadmium compounds
- Chromium (VI) compounds
- Coke Oven Emissions
- 1,2-Dibromo-3-chloropropane (DBCP)
- Ethylene Dibromide (EDB)
- Ethylene Oxide (EtO)
- Formaldehyde gas and formaldehyde solutions
- Lead metal and inorganic lead compounds
- Methylene Chloride
- 4,4'-Methylene bis(2-chloroaniline) (MBOCA)
- Methylenedianiline (MDA)
- Vinyl Chloride
- 2-Acetylaminofluorene
- 4-Aminodiphenyl
- Benzidine (and its salts)
- 3,3'-Dichlorobenzidine (and its salts)
- 4-Dimethylaminoazobenzene
- alpha-Naphthylamine
- beta-Naphthylamine
- 4-Nitrobiphenyl
- N-Nitroso dimethylamine
- beta-Propiolactone
- bis-Chloromethyl ether
- Methyl chloromethyl ether
- Ethyleneimine

Appendix E: Listed Carcinogens

The term “listed carcinogen” refers to a specific list of 13 chemicals regulated by Cal/OSHA and Federal OSHA and has specific use and handling requirements.

- 2-Acetylaminofluorene
- 4-Aminodiphenyl
- Benzidine (and its salts)
- 3,3'-Dichlorobenzidine (and its salts)
- 4-Dimethylaminoazobenzene
- alpha-Naphthylamine
- beta-Naphthylamine
- 4-Nitrobiphenyl
- N-Nitroso dimethylamine
- beta-Propiolactone
- bis-Chloromethyl ether
- Methyl chloromethyl ether
- Ethyleneimine

Appendix F: Chemical Segregation and Storage Table

The image below can be selected to view the full PDF version.

CAL STATE LA
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Chemical Segregation and Storage Table

Adapted from Prudent Practices in the Laboratory: Handling and Disposal of Chemicals, National Research Council, 1995, University of Texas/Health Science at Houston and Boston University Environmental Health and Safety.

Class of Chemical	Common Chemical Examples	Additional Concerns & Recommendations	Common Incompatible Chemical Types	Possible Reaction if Mixed/Health Concerns
Corrosive Acid-Organic 	▪ Acetic Acid ▪ Butyric Acid ▪ Formic Acid ▪ Glacial Acetic Acid ▪ Picric Acid ▪ Propionic Acid ▪ Trifluoroacetic Acid	Store in ventilated corrosives cabinet on protected shelving using secondary containment, keep away from water sources. *Do not store under the sink. *Do not store acids on metal shelving.	▪ Bases ▪ Cyanides ▪ Flammable Liquids ▪ Flammable Solids ▪ Inorganic Acids ▪ Oxidizers ▪ Poisons/Toxins ▪ Sulfides	▪ Gas Generation ▪ Heat ▪ Violent Reaction *DO NOT POUR WATER INTO ACID
Corrosive Acids-Inorganic 	▪ Chromic Acid ▪ Hydrochloric Acid ▪ Hydrofluoric Acid ▪ Nitric Acid ▪ Perchloric Acid ▪ Phosphoric Acid ▪ Sulfuric Acid	Store concentrated Nitric acid (≥68%) and Sulfuric acid (≥93%) in a secondary container. Store in a corrosive cabinet labeled "Acid" or on shelving using secondary containment. *Do not store under the sink. *Do not store acids on metal shelving. *Hydrofluoric acid should be stored in an area accessible only by authorized personnel; do not store in glass; use plastic containers and secondary containment.	▪ Bases ▪ Cyanides ▪ Flammable ▪ Flammable Solids ▪ Liquids ▪ Organic Acids ▪ Oxidizers ▪ Poisons/Toxins ▪ Sulphides	▪ Gas Generation ▪ Heat ▪ Violent Reaction *DO NOT POUR WATER INTO ACID *Perchloric acid vapor can form explosive compounds within fume hood ducts. *Hydrofluoric acid can result in severe burns to the skin and lungs
Corrosive/Bases-Organic/Caustic 	▪ Diamine ▪ Hydroxylamine ▪ Tetramethylethylamine ▪ Triethylamine	Store in a separate cabinet, preferable with ventilation, corrosive cabinet, or storage with a secondary container, away from potential water sources (DO NOT store under the sink).	▪ Acids ▪ Flammable liquids ▪ Flammable solids ▪ Inorganic Bases ▪ Poisons/Toxins	▪ Gas Generation ▪ Heat ▪ Violent Reaction
Corrosive/Bases Inorganic/Caustics 	▪ Ammonium Hydroxide ▪ Calcium Hydroxide ▪ Potassium Hydroxide ▪ Sodium Hydroxide	Store in a separate cabinet, preferably with ventilation, corrosive cabinet, or storage area with a secondary container, away from potential water sources (DO NOT store under the sink). Store solutions of inorganic hydroxides in labeled polyethylene containers.	▪ Acids ▪ Flammable liquids ▪ Flammable solids ▪ Organic Bases ▪ Poisons/Toxins	▪ Gas Generation ▪ Heat ▪ Violent Reaction
Flammable Solids 	▪ Carbon ▪ Charcoal ▪ Magnesium ▪ Paraformaldehyde ▪ Phosphorus	Keep in a dry, cool area away from oxidizers and corrosives	▪ Acids ▪ Bases ▪ Oxidizers ▪ Poisons/Toxins	▪ Fire Hazard ▪ Violent Reaction

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Appendix G: Peroxide Forming Chemicals Common to Research

Table H-1: Common Peroxide-Forming Compounds

Group A Chemicals—form explosive levels of peroxides without concentration (Safe storage time after opening - 3 months)		
Chemical Name	**CAS Number**	**Synonym(s)**
1,1-Dichloroethylene	75-35-4	Vinylidene Chloride
2-Chloro-1,3-Butadiene[1,3]	126-99-8	Chloroprene
Butadiene[1,3]	106-99-0	
Divinyl Acetylene	821-08-9	
Isopropyl Ether	108-20-3	
Tetrafluoroethylene	116-14-3	
Vinyl Ether	109-93-3	Divinyl ether
Group B Chemicals—form explosive levels of peroxides on concentration (Safe storage time after opening - 12 months)		
Chemical Name	**CAS Number**	**Synonym(s)**
2-Butanol	78-92-2	
2-Cyclohexan-1-ol	822-67-3	
2-Hexanol	626-93-7	
2-Pentanol	6032-29-7	
3-Methyl-1-Butanol	123-51-3	Isoamyl alcohol
4-Heptanol	589-55-9	
4-Methyl-2-Pentanol	108-11-2	
Acetal	105-57-7	
Acetaldehyde	75-07-0	
alpha-Methyl-Benzyl Alcohol	98-85-1	Phenyl Ethanol
Benzyl Alcohol	100-51-6	
Cyclohexanol	108-93-0	
Cyclohexene	110-83-8	
Cyclooctene	931-87-3	
Cyclopentene	42-29-0	
Decahydronaphthalene	91-17-8	
Diacetylene	460-12-8	
Dicyclopentadiene	77-73-6	
Dioxane	123-91-1	1,4 Dioxane
Ethylene Glycol Dimethyl Ether	110-71-4	Diethylene Glycol, Dimethyl Ether, and Glyme
Ethyl Ether	60-29-7	Diethyl Ether
Furan	110-71-4	
Isopropyl Benzene	98-82-8	Cumene
Methyl cyclopentane	96-37-7	

Methyl Isobutyl Ketone	108-10-1	
Penten-1-ol	821-09-0	
Propyne	74-99-7	Methyl Acetylene
Tetrahydrofuran	109-99-9	
Tetrahydronaphthalene	119-64-2	
Group C Chemicals— may auto-polymerize as a result of peroxide accumulation. (Safe storage time after opening: 12 months- inhibited chemicals; 24 hours- uninhibited chemicals) **WARNING: Do not store inhibited chemicals in this group under inert atmospheres**		
Chemical Name	**CAS Number**	**Synonym(s)**
1,1-Dichloroethylene	75-35-4	Vinylidene Chloride
2-Chloro-1,3-Butadiene[1,3]	126-99-8	Chloroprene
Acrylic Acid[2]	79-10-7	
Acrylonitrile[2]	107-13-1	
Butadiene[1,3]	106-99-0	
Buten-3-yne	689-97-4	Vinyl acetylene and Butenyne
Chlorotrifluoroethylene	79-38-9	
Methyl Methracrylate[2]	80-62-6	
Phenethyl Alcohol	60-12-8	Phenyl Ethanol
Styrene	100-42-5	
Tetrafluoroethylene	116-14-3	
Vinyl Acetate	108-05-4	
Vinyl Chloride	75-01-4	Mono chloroethylene

1. When stored as a liquid monomer.
2. Although these form peroxides, no explosions involving these monomers have been reported.
3. Also stored as a gas in gas cylinders.

Appendix H: Spill Clean-up Procedures

Laboratory personnel can clean up small spills if trained and competent to do so. Small spills include chemical spills that are up to 1 liter in size and of limited toxicity, flammability, and volatility, and mercury spills from broken thermometers (about 1.5 grams). If respiratory protection is needed for spill clean-up, the spill is too large to be handled by laboratory personnel – dial 911 or RMEHS, (323)-343-3531. Commercial chemical and mercury spill kits are available, which include protective equipment such as goggles and gloves, neutralizing and absorbing materials, bags, and scoops. You can also make your spill kits to include the materials described below.

Chemical Spills:

- Sodium Bicarbonate,
- Citric Acid,
- Vermiculite or other diking material,
- pH paper,
- 1 pair neoprene or nitrile gloves,
- 1 pair of goggles,
- 1 scoop,
- Spill pillows, sorbent pads, and
- Disposable shoe covers (plastic bags may work).

Mercury Spills:

Please contact RMEHS, before you attempt to clean up any mercury spills. There are special spill kits for this type of spill. If you are trained and have the available spill kit because you work with Mercury, please consider the following items needed before commencing any work.

- Disposable gloves,
- Disposable shoe covers (plastic bags will work),
- Index card or rubber squeegee,
- A disposable syringe or a vacuum trap flask fitted with tubing or Pasteur pipette, and
- Inactivating solutions and/or powders.

Weak Inorganic Acid or Base Spill Clean-Up Procedure

1. Wear gloves, goggles, a laboratory coat, and a shoe cover.
2. To clean-up, a spill of weak inorganic acid or base, neutralize the spilled liquid to pH 5 to 8 using a neutralizing agent such as:
    - sodium bicarbonate,
    - soda ash,
    - sodium bisulfate and
    - citric acid.

3. Absorb the neutralized liquid with an absorbent such as:
    - sorbent pads,
    - diatomaceous earth,
    - dry sand,
    - sponges,
    - paper towels, and
    - vermiculite.

Scoop or place the other absorbent materials into a transparent plastic bag. Double bag and tag the bag with a chemical waste label. Please email the Hazardous Waste Technician to request disposal.

Solvent Spill Clean Up Procedure

1. Absorb the spill with a non-reactive material such as
    - vermiculite,
    - dry sand,
    - paper towels,
    - sponges.
- The package is described above.
- Do not rinse or dispose of any chemicals down the sink or into any drain.

Broken Mercury Thermometer Clean-Up Procedure

1. Clean up the spill immediately after it has occurred.
2. Prevent the spread of the spilled mercury. Do not allow people to walk through the spill area.
3. Wear disposable gloves and shoe covers or place plastic bags over your shoes during the cleanup.
4. Push the mercury droplets together into a bead using an index card or rubber squeegee.
5. Aspirate the beaded mercury into a disposable syringe or use a disposable Pasteur Pipette attached with tubing to a vacuum flask to aspirate the mercury into the flask. The flask should contain water. Always have a second vacuum flask between the mercury flask and the house vacuum.
6. Chemically inactivates any residual mercury. There are several methods to inactivate the residual mercury including:
    a. Use a commercial inactivating powder following its directions for use.
    b. Sprinkle zinc powder over the spill area. Then moisten the zinc with a 5 to 10 percent sulfuric acid solution until a paste is formed. Scour the contaminated surface and allow the paste to dry. Sweep up the dried paste.
    c. Wash the contaminated area with a detergent solution. Rinse and then swab the area with a calcium polysulfide solution containing two to four tablespoons of calcium polysulfide per gallon of water.

Place the collected mercury and materials used in the clean-up into a transparent plastic bag. Double bag and label the waste.

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*If a large spill occurs, call 911 from a campus phone, an off-campus phone, or mobile device, and notify RMEHS, (323) 34**3-3531**.*

Appendix I: COVID-19 Face Coverings When Working in Laboratories

General Requirements Under COVID-19 Conditions:

Per University policy, face-coverings are required in classrooms and other public work or instructional environments. Face coverings are expected to be worn while working in the laboratory when other people are present. A face-covering is not required when working alone in a segregated space (private office, laboratory, studio, etc.). Face-coverings are not required if doing so is contrary to the wearer's health and safety due to an approved medical condition (contact Risk Management to determine if alternative protections can be provided). A face-covering is not a substitute for social distancing, but an additional measure to reduce the spread of COVID-19. Maintain social distancing and perform frequent hand hygiene when wearing a face-covering. For more information regarding COVID-19 at Cal State LA please visit the Health Watch website.

Laboratory areas all differ in operations, so the Principal Investigator (PI)/Lab Manager/responsible person(s) must assess the work tasks involved and the potential for chemical or biological contamination while working in the laboratory space. Laboratories with the potential for biological or chemical contamination (i.e., chemistry lab using volatile chemicals, microbiology lab, etc.) should only use disposable face-coverings (i.e., surgical type masks) and remove them, and any additional personal protective equipment (PPE), before exiting the laboratory to prevent the spread of contamination from the lab activity to outside areas. Use another clean face covering for areas outside the lab.

Laboratory procedures or tasks performed must be evaluated by the PI/Lab Manager/responsible person(s) to ensure that wearing a face-covering does not pose an additional risk. If a face covering cannot be used, then the work must be re-evaluated, modified if possible, and either substituted or ensure that social distancing is maintained when the work is conducted.

It is important to stress best lab practices are in place and ensure the use of engineering controls (i.e., fume hoods, local ventilation, biosafety cabinets) and administrative controls (i.e., proper training, protocols, SOPs, etc.) are present to prevent chemical vapors or other contaminants from escaping into the room. When best practices are followed, the potential for hazardous exposure is eliminated or reduced to a safe level. If there is a concern that the face-covering absorbing chemicals, then it is important to ask why chemicals are present in the breathing zone and adjust work practices accordingly.

The following reminders are in place to ensure the best practices are in place.

- Ensure safe chemical management. Keep all chemical containers closed when not in use.
- Work in a fume hood when handling volatile chemicals.
- Use shielding when handling reactive or highly flammable chemicals in a fume hood.
- Always work in a Biosafety Cabinet (BSC) when handling infectious agents or materials.
- Use appropriate PPE for the tasks performed or the chemicals being used.

Face Covering Recommendations for Laboratories

It is recommended to use disposable face coverings made of 2-ply material and avoid synthetics when in a lab, especially in a location where flammable solvents are used/stored. Below are some additional recommendations for face coverings.

- Ensure an adequate supply of disposable face-covering so that the face-covering can be changed if they become soiled/contaminated inside the lab.
- Always wash hands before and after removing the face-covering.
- Remove disposable face covering and replace with a clean/new disposable face covering before leaving the laboratory space and entering a public area.

Recommendation for "Eyewear Fog" When Using a Face Coverings

Face coverings are not the only form of PPE required when working in the lab. A face covering alone cannot protect against additional laboratory hazards present. The use of eyewear is required in laboratories that have splash hazards or specialized equipment.

Below are some tips to prevent the eyewear from fogging when wearing a face covering.

- Improve the fit of the covering by bending the metal nose-bridge to contour your nose and cheeks (if applicable) or adjusting the straps for a tighter fit.
- Tape the face-covering across the bridge of your nose and your cheeks (use any type of athletic or medical adhesive tape).
- Use commercial anti-fog solutions or wipe for your eyewear and prevent fog when wearing a face covering.
    - Fisher Scientific Cat# 19-047-208 or Cat# 19-041-637.

Appendix J: Laboratory Procedures for Planned Power Outages

Purpose

This document was created to provide guidance to Principal Investigators (PIs), faculty and staff, Delegated Department Members (DDMs), Resource Managers (RMs) and responsible person(s) in the event of a power outage caused by weather, rolling blackouts, infrastructure-related incidents, or equipment malfunction.

Introduction

A power outage has the potential for loss of valuable specimens, chemicals, reagents, and years of research and can result in hazardous conditions in laboratories. A blackout situation may also damage sensitive equipment, instruments, environmental rooms, and computers. Below are some procedures guided to lessen the effects of a power outage in a laboratory and how to be prepared if one occurs.

Preparation for Planned Power Outages

Ensure that the laboratory has a contingency plan in place and that all laboratory personnel are trained on the plan. The plan should include the following (*please note that this is not all-inclusive and additional planning may be required based on the hazards for the areas and/or the materials being used*)

- Verify the location of all emergency lighting (i.e., glow sticks, flashlights, etc.).
- Ensure that all experiments, equipment, machinery, or apparatus are stabilized or safe.
- A current list of all essential equipment that may be damaged by a power surge or that may have an automatic "ON" switch (that when power is restored may cause additional damage or turn on when no one is around).
- A current list of all temperature-sensitive specimens and/or materials with the location and approximate time before the temperature adversely affects such materials.
    - A separate plan for keeping temperature-sensitive specimens and/or materials safe, what to do with the temperature-sensitive materials, and how to shut down your workstation/laboratory.
    - Consider the following:
        - splitting storage,
        - identifying other freezers with backup capabilities, or
        - Store in an area that can easily be transported by obtaining dry ice in a prolonged power outage.
- Check equipment on emergency power to ensure that it is running properly.
- Unplug all equipment not deemed critical. Plug-in only critical equipment in a designated emergency power outlet, if available.
- Check on any incubators and verify that they are on emergency power or that the cell lines will be kept at the appropriate temperatures.

- If working with experimental animals, ensure any special precautions that may need to be taken to secure those areas such as emergency power, alternative ventilation, etc.
- Ensure “suspending work procedures” for work being conducted in biosafety cabinets (BSCs), fume hoods, and laminar flow desktops.

When the Power Goes Out

- Stop or stabilize all experiments immediately.
- Secure and ensure all chemicals are closed and placed into appropriate storage locations.
- Turn off all heat sources (i.e., Bunsen burners) to prevent potential fires.
- Turn off all gas cylinders at the tank valves if the gas is not used to "blanket" a reactive compound or mixture (*note: this should be part of written and posted standard operating procedure for this material or process*).
- Check all containers of cryogenic liquids to ensure that they are vented to prevent the buildup of internal pressure.
- Place “Do Not Open” signs on all applicable freezers, refrigerators, ovens to preserve any temperature-sensitive materials.
- Check all BSCs and suspend any work being done immediately. Seal, safely store all biological items, and disinfect the BSC surfaces before closing the sash.
- Do not conduct experiments or work with hazardous materials (biological, chemical, or radiological) during power outages.
- Do not use laboratory facilities during the shutdown or enter areas that have storage of material that requires mechanical ventilation.
- Close any open fume hood sashes to prevent fumes from escaping.
- Follow evacuation notices.

When the Power is Restore

Follow your contingency plan for restarting the laboratory. Below are some additional precautions to keep in mind when planning.

- Check for any unusual odors which could be a sign of leakage or spill. Contact RMEHS at (323) 343-3531 or ext. 3-3531 for cleanup if needed.
- Check equipment temperature for temperature-sensitive materials if applicable. Reset any alarms if needed.
- Reset, restart the equipment, or plug in all equipment as needed. Ensure that equipment is functioning properly.
- Check chemical fume hoods for proper operation. If chemical hoods are not functioning, do not use hazardous chemicals and contact Facilities Services on 323-343-3440 or ext. 3-3440 if your chemical hood is not operating properly. Do not use the hood until repairs/corrections have been made and verified by RMEHS.
- Check cold/environmental room(s) set points and if necessary, have the controls reset.

If you have questions or would like assistance with your laboratory contingency planning, please contact RMEHS or Emergency Preparedness.

Appendix K: Emergency Action Plan for Accidental Injury in a Laboratory or Activity Space.

Objective: To ensure the safety and well-being of all individuals in the laboratory in minor and large accidents. Note that this document is an example and should be modified to reflect the operations during an emergency.

I. Minor Accidents

Initial Response:

1. Ensure your safety first. Do not endanger yourself while helping others.
2. Advise the injured party to move away from the source of injury, if safe to do so.
3. If the injury involves chemicals, ensure that the affected individual is not in contact with the chemicals and that contaminated clothing is removed.
4. If possible, turn off any equipment or sources of danger.

Notify Lab Instructor:

1. The lab instructor should be immediately informed about the accident.
2. The lab instructor will assess the situation and provide guidance.

First Aid:

1. Lab instructors should NOT administer ointments or treatment beyond basic first aid (e.g., applying a bandage).
2. If the injury requires more than basic first aid (e.g., stitches, major wound care, etc.), the injured individual should be transported to the health center, or if unsure about the state of the individual dial 911.

Documentation:

1. Properly document the accident, including the names of the individuals involved, the nature of the injury, and any actions taken.
2. This documentation will be necessary for any potential follow-up or reporting.

II. Large Incidents

Immediate Response:

1. If the incident is large or life-threatening, the lab instructor should take immediate action to mitigate the situation if it is safe to do so.
2. If the situation is beyond the instructor's capabilities, or in cases of chemical exposure, hazardous material release, or fire, dial 911 for emergency assistance.

Evacuation:

1. In the case of a large incident, evacuate the laboratory immediately.
2. Ensure that all lab personnel and students are evacuated to a safe location.
3. If there is a fire, use the appropriate fire safety equipment, such as fire extinguishers or fire blankets, if trained to do so.

Inform Authorities:

1. Provide the 911 dispatcher with clear and concise information about the incident, the location, and any potential hazards.

Care for the Injured:

1. If there are injured individuals, ensure that they receive the necessary medical attention as soon as possible.
2. Administer basic first aid as needed to stabilize the injured until professional help arrives.

Documentation:

1. Properly document the incident, including any actions taken, injuries sustained, and individuals involved.
2. This documentation will be crucial for reporting, investigations, and insurance purposes.

III. Post-Incident Procedures:

1. After the incident is resolved, conduct a post-incident debriefing to identify what went well and areas for improvement.
2. Review and update the laboratory safety protocols and ensure that all personnel are trained in emergency procedures.

It is crucial that all individuals in the laboratory are familiar with this emergency action plan and know how to respond to both minor and large incidents. Training and regular safety drills are essential for ensuring a safe laboratory environment.

Appendix L: Glossary

A

- **ACGIH** - The American Conference of Governmental Industrial Hygienists is a voluntary membership organization of professional industrial hygiene personnel in governmental or educational institutions. The ACGIH develops and publishes recommended occupational exposure limits each year called Threshold Limit Values (TLVs) for hundreds of chemicals, physical agents, and biological exposure indices.
- **ACTION LEVEL** - A concentration designated in Title 8, California Code of Regulations for a specific substance, calculated as an eight (8)-hour time-weighted average, which initiates certain required activities such as exposure monitoring and medical surveillance.

- **AEROSOL** - liquid droplets or solid particles dispersed in the air that are of fine enough size (less than 100 micrometers) to remain dispersed for some time.
- **ASPHYXIANT** - A chemical (gas or vapor) that can cause death or unconsciousness by suffocation. Simple asphyxiants, such as nitrogen, either use up or displace oxygen in the air. They become especially dangerous in confined or enclosed spaces. Chemical asphyxiants, such as carbon monoxide and hydrogen sulfide, interfere with the body's ability to absorb or transport oxygen to the tissues.

C

- **"C" OR CEILING** - A description usually seen in connection with a published exposure limit. It refers to the concentration that should not be exceeded, even for an instant. It may be written as TLV-C or Threshold Limit Value - Ceiling. (*See also Threshold Limit Value*).
- **CARCINOGEN** - A cancer-producing substance or physical agent in animals or humans. A chemical is considered a carcinogen or potential carcinogen if it is so identified in any of the following:
    - National Toxicology Program, "Annual Report of Carcinogens" (latest edition).
    - International Agency for Research on Cancer, "Monographs" (latest edition).
    - OSHA, 29 CFR 1910, Subpart Z, Toxic and Hazardous Substances.
- **CHEMICAL HYGIENE OFFICER: An employee designated by the employer and qualified by training or experience to provide technical guidance in the development and implementation of the Chemical Hygiene Plan provisions.**
- **CHEMICAL HYGIENE PLAN** - A written program developed and implemented by the employer which sets forth procedures, equipment, personal protective equipment, and work practices that (1) can protect employees from the health hazards presented by hazardous chemicals used in that workplace and (2) meets the requirements of OSHA regulation 29 CFR. §1910.1450.
- **CONTROL AREA(S)** – A designated area behind locked doors or areas that limits access only to those trained to work with specific hazards. Control areas can include locked laboratory rooms, cabinets, drawers, refrigerators, etc. with regulated substances.
- **COMBUSTIBLE LIQUID** - Any liquid having a flashpoint at or above 100°F (37.8°C) but below 200°F (93.3°C) except any mixture having components with flashpoints of 200°F or higher, the total volume of which make up 99% or more of the total volume of the mixture.
- **COMPRESSED GAS** - A gas or mixture of gases having, in a container, an absolute pressure exceeding 40 psi at 70°F (21.1°C), or a gas or mixture of gases having, in a container, an absolute pressure exceeding 104 psi at 130°F (54.4°C) regardless of the pressure at 70°F (21.1°C), or a liquid having a vapor pressure exceeding 40 psi at 100°F (37.8°C) as determined by ASTM D-32372.
- **CORROSIVE** - A substance that, according to the DOT, causes visible destruction or permanent changes in human skin tissue at the site of contact or is highly corrosive to steel.

D

- **DELEGATED DEPARTMENT MEMBER (DDM)** -DDM's appointed by Department Chairs or Department Heads to ensure compliance with regulatory guidelines and CHP procedures. DDMs

can be Instructional Support Technician(s) (ISTs) or faculty and/or staff who are qualified by knowledge and/or experience to help carry out the policies and procedures in the CHP.

- **DESIGNATED AREA** - An area that has been established and posted with signage for work involving hazards (e.g., "select carcinogens," reproductive toxins, or substances that have a high degree of acute toxicity). A designated area may be the entire laboratory, an area of a laboratory, or a device like a laboratory hood. See also “control area.”

E

- **EMERGENCY** - Any potential occurrence, such as, but not limited to, equipment failure, rupture of containers, or failure of control equipment which could result in an uncontrolled release of a hazardous chemical into the workplace.
- **EMERGENCY ACTION PLAN: A set of procedures created in an emergency.** These procedures can be specific to the campus, department, or colleges (See also **EMERGENCY PREPAREDNESS**).
- **EMERGENCY PREPAREDNESS – Campus initiative to ensure the campus community's safety in case of a disaster, natural and/or accidental.** Please visit the campus website for Emergency Preparedness information.
- **EXPLOSIVE** - A chemical that causes a sudden, almost instantaneous release of pressure, gas, and heat when subjected to sudden shock, pressure, or high temperature.

F

- **FLAMMABLE** - A chemical that falls into one of the following categories:
    - *Flammable aerosol* - an aerosol that, when tested by the method described in 16 CFR 1500.45, yields a flame projection exceeding 18 inches at full valve opening, or a flashback (a flame extending back to the valve) at any degree of valve opening.
    - *Flammable gas* - a gas that, at ambient temperature and pressure, forms a flammable mixture with air at a concentration of 13% by volume or less; or a gas that, at ambient temperature and pressure, forms a range of flammable mixtures with air wider than 12% by volume, regardless of the lower limit. (GHS definition: A gas having a flammable range with air at 20°C and a standard pressure of 101.3kPa.
    - *Flammable liquid* - any liquid having a flashpoint below 200°F (93°C.
    - *Flammable solid* - a solid, other than a blasting agent or explosive as defined in1910.109(a), that is liable to cause fire through friction, absorption of moisture, spontaneous chemical change, or retained heat from manufacturing or processing, or which can be ignited readily and, when ignited, burns so vigorously and persistently as to create a serious hazard. A chemical shall be considered a flammable solid if, when tested by the method described in 16 CFR 1500.44, it ignites and burns with a self-sustained flame at a greater than one-tenth of an inch per second along its major axis.
- **FLASHPOINT** - The minimum temperature at which a liquid gives off a vapor in sufficient concentration to ignite in the presence of an ignition source or when tested as follows:

- *Tagliabue Closed Tester* (See American National Standard Method of Test for Flashpoint by Tag Closed Tester, Z11.24-1979 (ASTM D-56-79) for liquids with a viscosity of less than 45 Say bolt Universal Seconds (SUS) at 100°F (37.8°C) or that contain suspended solids and do not tend to form a surface film under test.
- *Pensky-Martens Closed Tester* (See American National Standard Method of Test for Flashpoint by Pensky-Martens Closed Tester, Z11.7-1979 (ASTM D-73-79) for liquids with a viscosity equal to or greater than 45 SUS at 100°F (37.8°C), or that contain suspended solids, or that tend to form a surface film under test; or,
- *Seta Flashes Closed Tester* (See American National Standard Method of Test for Flashpoint of Seta Flash Closed Tester (ASTM D-3278-78)). Organic peroxides, which undergo auto accelerating thermal decomposition, are excluded from any flashpoint determination methods specified above.

G

- **GENERAL VENTILATION** - Also known as general exhaust ventilation, this is a system of ventilation consisting of either natural or mechanically induced fresh air movements to mix with and dilute contaminants in the workroom air. This is not the recommended type of ventilation to control highly toxic contaminants, when there may be corrosion problems from the contaminant when the worker is close to where the contaminant is being generated, and where fire or explosion hazards are generated close to sources of ignition. (See Local Exhaust Ventilation)
- **GHS LABEL** - Any written, printed, or graphic material displayed on or affixed to containers of chemicals, both hazardous and non-hazardous containing signal words, descriptions, and pictograms for better clarification of the type of chemical.

H

- **HAZARD ASSESSMENT** - A formal procedure undertaken by the supervisor in which occupational hazards for all employees are described per procedure or task, and by affected body part(s) or organ(s), and which is documented and posted in the workplace with all personal protective equipment requirements.
- **HAZARD WARNING** - Any words, pictures, symbols, or a combination thereof appearing on a label or other appropriate form of warning which conveys the hazards of the chemical(s) in the container(s).
- **HAZARDOUS MATERIAL** - Any material which is a potential/actual physical or health hazard to humans.
- **HAZARDOUS MATERIAL (DOT)** - A substance or material capable of posing an unreasonable risk to health, safety, and property when transported including, but not limited to, compressed gas, combustible liquid, corrosive material, a cryogenic liquid, flammable solid, irritating material, material poisonous by inhalation, magnetic material, organic peroxide, oxidizer, poisonous material, pyrophoric liquid, radioactive material, spontaneously combustible material, a water-reactive material.

- **HAZARDOUS CHEMICAL** - A chemical for which there is statistically significant evidence based on at least one study conducted in accordance with established scientific principles that acute or chronic health effects may occur in exposed employees. The term "health hazard" includes chemicals which are carcinogens, toxic or highly toxic agents, reproductive toxins, irritants, corrosives, sensitizers, hepatotoxins, nephrotoxins, neurotoxins, agents which act on the hematopoietic system, and agents which damage the lungs, skin, eyes, or mucous membranes. A chemical is also considered hazardous if it is listed in any of the following:
    - OSHA, 29 CFR 1910, Subpart Z, Toxic and Hazardous Substances.
    - "Threshold Limit Values for Chemical Substances and Physical Agents in the Work Environment," ACGIH (latest edition).
    - "The Registry of Toxic Effects of Chemical Substances," NIOSH (latest edition); or
    - Director's List.
- **HIGHLY TOXIC** - A substance falling within any of the following categories:
    - A substance that has a median lethal dose (LD50) of 50 milligrams or less per kilogram of body weight when administered orally to albino rats weighing between 200 and 300 grams each.
    - A substance that has a median lethal dose (LD50) of 200 milligrams or less per kilogram of body weight when administered by continuous contact for 24 hours (or less if death occurs within 24 hours) with the bare skin of albino rabbits weighing between two and three kilograms each; or
    - A substance that has a median lethal concentration (LC50) in an air of 200 parts per million by volume or less of gas or vapor, or 2 milligrams per liter or less of mist, fume, or dust, when administered by continuous inhalation for one hour (or less if death occurs within one hour) to albino rats weighing between 200 and 300 grams each.

I

- **IGNITABLE** - A solid, liquid, or compressed gas waste that has a flashpoint of less than 140°F. Ignitable material may be regulated by the EPA as hazardous waste as well.
- **INCOMPATIBLE** - The term applies to two substances to indicate that one material cannot be mixed with the other without the possibility of a dangerous reaction.
- **IRRITANT** - A substance that, by contact in sufficient concentration for a sufficient time, will cause an inflammatory response or reaction of the eye, skin, nose, or respiratory system. The contact may be a single exposure or multiple exposures. Some primary irritants: chromic acid, nitric acid, sodium hydroxide, calcium chloride, amines, metallic salts, chlorinated hydrocarbons, ketones, and alcohols.

L

- **LABORATORY MANAGER** – is appointed by the principal investigator (PI) or department chair/head as the person responsible for the control area in the absence of the PI or department chair/head. A

lab manager can be an Instruction Support Technician (IST), undergraduate student, or graduate student who is trained or has the knowledge and experience of the control area.

- **LABORATORY TYPE HOOD** - A device located in a laboratory, enclosed on five sides with a movable sash or fixed partial enclosure on the remaining side; constructed and maintained to draw air from the laboratory and to prevent or minimize the escape of air contaminants into the laboratory; and allows chemical manipulations to be conducted in the enclosure without insertion of any portion of the employee's body other than hands and arms.
- **LABORATORY USE OF HAZARDOUS CHEMICALS** - Handling or use of such chemicals in which all the following conditions are met:
    - Chemical manipulations are carried out on a "laboratory scale."
    - Multiple chemical procedures or chemicals are used.
    - The procedures involved are not part of a production process nor in any way simulate a production process; and
    - "Protective laboratory practices and equipment" are available and in common use to minimize the potential for employee exposure to hazardous chemicals.
- **LOCAL EXHAUST VENTILATION** (Also known as exhaust ventilation) – A ventilation system that captures and removes the contaminants at the point they are being produced before they escape into the workroom air. The system consists of hoods, ductwork, a fan, and an air-cleaning device. Advantages of local exhaust ventilation over general ventilation include it removes the contaminant rather than dilutes it, requires less airflow and, thus, is more economical over the long term; and the system can be used to conserve or reclaim valuable materials; however, the system must be properly designed with the correctly shaped and placed hoods, and correctly sized fans and ductwork.
- **PRINCIPAL INVESTIGATOR (PI) is a faculty or staff member who is the lead investigator/researcher in a laboratory study or clinical trial.**

R

- **RESPONSIBLE PERSON(S)/PARTY** -Collective group of persons or people who are responsible/have knowledge of hazards for a control area who can either be PI, IST, adjunct faculty/staff, lab manager, and/or supervisor.
- **RESOURCE MANAGER** – is a faculty or staff associated with the college that can help provide resources for laboratory areas and consult with RMEHS to help ensure safety and adhere to state, local, and federal regulations.

S

- **SAFETY DATA SHEETS (SDS)** - Written or printed material concerning a hazardous chemical which is prepared in accordance with paragraph (g) of 29 CFR 1910.1200. Formerly known as a Material Safety Data Sheet (MSDS).

M

- **MEDICAL CONSULTATION** - A consultation that takes place between an employee and a licensed physician to determine what medical examinations or procedures, if any, are appropriate in cases where a significant exposure to a hazardous chemical may have taken place.
- **MIXTURE** - Any combination of two or more chemicals if the combination is not, in whole or in part, the result of a chemical reaction.
- **MUTAGEN** - Anything that can cause a change (or mutation) in the genetic material of a living cell.

N

- **NFPA - The National Fire Protection Association** - a voluntary membership organization whose aims are to promote and improve fire protection and prevention. NFPA has published 16 volumes of codes known as the National Fire Codes. Within these codes is Standard No. 705, "Identification of the Fire Hazards of Materials". This is a system that rates the hazard of a material during a fire. These hazards are divided into health, flammability, and reactivity hazards and appear in a well-known diamond system using from zero through four to indicate the severity of the hazard. Zero indicates no special hazard and four indicates severe hazard.
- **NIOSH - The National Institute for Occupational Safety and Health** - a federal agency that among its various responsibilities' trains occupational health and safety professionals, conducts research on health and safety concerns, and tests and certifies respirators for workplace use.

O

- **ODOR THRESHOLD** - The minimum concentration of a substance at which most test subjects can detect and identify the substance's characteristic odor.
- **OXIDIZER** - This is a substance that gives up oxygen easily to stimulate the combustion of organic material.

P

- **PERMISSIBLE EXPOSURE LIMIT (PEL)** - An exposure, inhalation, or dermal permissible exposure limit specified in 8 CCR 5155. PELs may be either a time-weighted average (TWA) exposure limit (8hour), a 15-minute short-term limit (STEL), or a ceiling (C).
- **PERSONAL PROTECTIVE EQUIPMENT (PPE)** - Any devices or clothing worn by the worker to protect against hazards in the work environment. Examples are respirators, gloves, and chemical splash goggles.
- **PHYSICAL HAZARD** - A chemical for which there is scientifically valid evidence that it is a combustible liquid, a compressed gas, explosive, flammable, an organic peroxide, an oxidizer, pyrophoric, unstable (reactive), or water-reactive.
- **PYROPHORIC** - A chemical that will spontaneously ignite in the air at a temperature of 130°F (54.4°C) or below.

R

- **REACTIVITY** - A substance's susceptibility to undergoing a chemical reaction or change that may result in dangerous side effects, such as an explosion, burning, and corrosive or toxic emissions. The conditions that cause the reaction, such as heat, other chemicals, and dropping, will usually be specified as "Conditions to Avoid" when a chemical's reactivity is discussed on an SDS.
- **REPRODUCTIVE TOXINS** - Chemicals that affect reproductive capabilities including chromosomal damage (mutations) and effects on fetuses (teratogenesis).
- **RESPIRATOR - A device designed to protect the wearer from inhaling harmful contaminants.**
- **RESPIRATORY HAZARD** - A particular concentration of an airborne contaminant that, when it enters the body by way of the respiratory system or by being breathed into the lungs, results in somebody's function impairment.

S

- **SELECT CARCINOGENS** - Any substance which meets one of the following:
    - It is regulated by OSHA as a carcinogen; or
    - It is listed under the category, "known to be carcinogens," in the Annual Report on Carcinogens published by the National Toxicology Program (NTP) (latest edition); or
    - It is listed under Group 1 ("carcinogen to humans") by the International Agency for Research on Cancer Monographs (IARC) (latest editions); or
    - It is listed in either Group 2A or 2B by IARC or under the category, "reasonably anticipated to be carcinogens" by NTP.
- **SENSITIZER** - A substance that may cause no reaction in a person during initial exposures, but afterward, further exposures will cause an allergic response to the substance.
- **SHORT-TERM EXPOSURE LIMIT** - Represented as STEL or TLV-STEL, this is the maximum concentration to which workers can be exposed for a brief time (15 minutes) only four times throughout the day with at least one hour between exposures. Also, the daily TLV-TWA must not be exceeded.
- **SOLVENT** - A substance, commonly water, but in the industry often an organic compound, which dissolves another substance.

T

- **THRESHOLD LIMIT VALUE (TLV) - Airborne concentration of substances devised by the ACGIH that represents conditions under which it is believed all workers may be exposed daily with no adverse effect.** TLVs are advisory exposure guidelines, not legal standards, which are based on evidence from industrial experience, animal studies, or human studies when they exist. There are three diverse types of TLVs: Time-Weighted Average (TLV-TWA), Short-Term Exposure Limit (TLV-STEL), and Ceiling (TLV-C). (*See also PEL*).
- **TOXICITY** - A relative property of a material to exert a poisonous effect on humans or animals and a description of the effect and the conditions or concentration under which the effect takes place.

V

- **VAPOR** - The gaseous form of substances that are normally in the liquid or solid state (at normal room temperature and pressure). Vapors evaporate into the air from liquids such as solvents. Solvents with lower boiling points will evaporate faster.