



## Botany & Plant Sciences

(includes Botanical Gardens, Institute of Genomics,  
Center for Plant Cell Biology, and Plant Transformation Facility)

# Chemical Hygiene Plan

02/18/2011

*Updates:* \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

1. Please print out and keep this plan (or copies) where everyone working in the lab has access anytime they are working.
2. Have all lab workers review the plan and sign on page iii.
3. Add information and update yearly or more often as necessary.
4. To this document include your lab's Standard Operating Procedures.
5. This is a good place to keep a record of all in-lab training sessions.

## Responsibility & Accountability


Revised February 18, 2011 (*must be updated at least annually*)

### Departmental & Campus Review

Reviewed by:

Mikeal L. Roose

Chairperson (or Director)

 3-8-11  
signature date


Alan McHughen

Laboratory Safety Officer (CHO)

 March 10/11  
signature date

Deborah A. Terao

Management Service Officer (or Administrator)

 3/10/11  
signature date

Russell Vernon

UCR EH&S Laboratory/Research Safety Specialist

 3/12/11  
signature date

### Principal Investigator Review

Reviewed by

Principal Investigator

signature

date



## TABLE OF CONTENTS

<b>Responsibility &amp; Accountability</b> .....	<b>ii</b>
<b>1. References</b> .....	<b>1</b>
<b>2. Purpose</b> .....	<b>1</b>
<b>3. Scope and Application</b> .....	<b>1</b>
<b>4. Definitions</b> .....	<b>1</b>
<b>5. Responsibilities</b> .....	<b>3</b>
<b>6. Information and Training</b> .....	<b>4</b>
<b>7. Basic or General Laboratory Safety Rules</b> .....	<b>5</b>
<b>8. Labeling</b> .....	<b>5</b>
<b>9. Chemical Procurement and Distribution</b> .....	<b>6</b>
<b>10. Storage of Chemicals in Laboratories</b> .....	<b>7</b>
<b>11. Standard Operating Procedures</b> .....	<b>7</b>
<b>12. Circumstances Under Which Prior Approval is Required</b> .....	<b>8</b>
<b>13. Criteria to Determine and Implement Control Measures</b> .....	<b>8</b>
<b>14. Provisions for Protection From Particularly Hazardous Substances</b> .....	<b>9</b>
<b>15. Housekeeping, Maintenance, Inspections, and Monitoring</b> .....	<b>10</b>
<b>16. Personal Protective Equipment (PPE)</b> .....	<b>10</b>
<b>17. Medical Consultation and Examinations</b> .....	<b>11</b>
<b>18. Spills and Accidents</b> .....	<b>11</b>
<b>19. Hazardous Waste Disposal</b> .....	<b>13</b>
<b>20. Radioactive Waste</b> .....	<b>14</b>
<b>Appendix A - General Standard Operating Procedures (SOPs)</b> .....	<b>16</b>
<b>FOLLOW THE FIVE</b> .....	<b>16</b>
<b>I. COMPRESSED GASES</b> .....	<b>17</b>
<b>II. CRYOGENIC MATERIALS</b> .....	<b>18</b>
<b>III. PEROXIDIZABLE MATERIALS</b> .....	<b>19</b>
<b>IV. PERCHLORIC ACID</b> .....	<b>20</b>
<b>V. ELECTRICAL EQUIPMENT</b> .....	<b>21</b>
<b>VI. WORKING ALONE</b> .....	<b>22</b>
<b>VII. Unattended Operations</b> .....	<b>22</b>
<b>VIII. Glassware</b> .....	<b>23</b>
<b>IX. LABORATORY (FUME) HOOD USAGE</b> .....	<b>24</b>
<b>X. AUTOCLAVES</b> .....	<b>25</b>
<b>XI. HYDROFLUORIC ACID</b> .....	<b>26</b>
<b>XII. FORMALDEHYDE AND FORMALIN</b> .....	<b>27</b>
<b>Appendix B – SAFETY &amp; HAZARD Information Sources at UCR</b> .....	<b>29</b>
<b>Appendix C Health hazard definitions and hazard assessment</b> .....	<b>30</b>
<b>HAZARD DETERMINATION (HTTP://WWW.DIR.CA.GOV/TITLE8/5194B.HTML)</b> .....	<b>32</b>
<b>Appendix D</b> .....	<b>34</b>
<b>Appendix E LAB SAFETY &amp; ENVIRONMENTAL ASSESSMENT AUDIT</b> .....	<b>35</b>

# 1. References

- California Code of Regulations (CCR) Title 8 section 5191, "Occupational Exposure to Hazardous Chemicals in Laboratories" <http://www.dir.ca.gov/Title8/5191.html>
- California Code of Regulations (CCR) Title 8, "General Industry Safety Orders" <http://www.dir.ca.gov/Title8/sub7.html>
- University of California, Riverside, Injury and Illness Prevention Program (IIPP) <http://www.ehs.ucr.edu/safety/iipp.html>
- NFPA 45 - Standard on Fire Protection for Laboratories Using Chemicals, current ed.
- Uniform Fire Code, current ed.

# 2. Purpose

The purpose of the Chemical Hygiene Plan (CHP) is to minimize exposure of laboratory personnel and students to health and physical hazards presented by hazardous chemicals used in laboratories under the auspices of the Department of Botany and Plant Sciences at the University of California, Riverside, and to comply with the requirements of California Code of Regulations, Title 8 Section 5191.

# 3. Scope and Application

The Department of Botany & Plant Sciences Chemical Hygiene Plan outlines the minimum health and safety requirements for those laboratories/operations that are engaged in the "laboratory use of hazardous chemicals" under the auspices of the Department of Botany & Plant Sciences at the University of California, Riverside ("the University").

The CHP, which is applicable only to laboratories that meet the definition of CCR Title 8, §5191, is one of the components of the UCR Injury and Illness Prevention Program (IIPP). All departments are required to comply with the IIPP. Laboratory personnel in compliance with the Chemical Hygiene Program are not required to comply with the Hazard Communication component of the IIPP.

Use of sources that produce ionizing or non-ionizing radiation and policies regarding biohazardous materials are addressed in separate documents. These documents, along with this Chemical Hygiene Plan, will be part of the IIPP for each department with laboratories.

The Department of Botany & Plant Sciences has developed and is implementing this Departmental Chemical Hygiene Plan. This plan:

- a. Meets the requirements of the UCR CHP; and
- b. Designates the following person(s), Dr. Mikeal Roose, Chair, assisted by Dr. Alan McHughen, BPS Lab Safety Officer and Deborah Terao, FAO, responsible for the implementation, oversight, and annual review of the Departmental CHP; and
- c. Designates the Principal Investigator (PI), or his/her designee as the person authorized to approve/disapprove laboratory procedures as written in section 12 of this plan, "Circumstances under which prior approval required", and
- d. Incorporates standard operating procedures in accordance with section 11 of this plan. It is encouraged that individual laboratories or small groups of laboratories under a single supervisor develop their own SOPs within their lab specific chemical hygiene plans that are referred to in this document as "individual CHPs".

# 4. Definitions

**Action level** - A concentration designated in Title 8, CCR for a specific substance, calculated as an 8-hour time weighted average, which initiates certain required activities such as exposure monitoring and medical surveillance. This is usually half of the value of the Permissible Exposure Limit.

**CCR** - The California Code of Regulations. Title 8: [www.dir.ca.gov/samples/search/query.htm](http://www.dir.ca.gov/samples/search/query.htm)

**Department Safety Coordinator (DSC)** - Liaison between the individual department and EH&S. The Department Safety Coordinator facilitates the dissemination of safety information/regulations, reporting of hazards, tracking of compliance activities, and coordination of employee training programs within the department.

**Designated area** - An area that may be used for work with particularly hazardous substances. A designated area may be the entire laboratory, an area of a laboratory, or a device such as a laboratory fume hood.

**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 personnel.

**Laboratory** - A facility where the "laboratory use of hazardous chemicals" occurs. It is a workplace where relatively small quantities of hazardous chemicals are used on a non-production basis, and can include greenhouses.

**Laboratory use of hazardous chemicals** - Handling or use of such chemicals in which all of 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 [and student] exposure to hazardous chemicals.

**Laboratory Safety Officer (LSO)** - An employee who is designated by the employer, and who is qualified by training or experience, to provide technical guidance in the development and implementation of the provisions of the Chemical Hygiene Plan. Formerly Chemical Hygiene Officer (CHO).

**Laboratory scale** - Work with substances in which the containers used for reactions, transfers, and other handling of substances are designed to be easily and safely manipulated by one person. "Laboratory scale" excludes those workplaces whose function is to produce commercial quantities of materials.

**Laboratory supervisor** - An individual that has authority and responsibility for the personnel and procedures conducted in an individual laboratory.

**Medical consultation** - Consultation which takes place between a licensed physician and an employee [or student] for the purpose of determining what medical examinations or procedures, if any, are appropriate in cases where a significant exposure to a hazardous chemical may have taken place.

**MSDS** - Material Safety Data Sheet generally available through the EH&S website <http://www.ehs.ucr.edu/services/msds.html>

**Must** - Designates a contractual or policy requirement.

**Particularly hazardous substances** - These include "select carcinogens", "reproductive toxins", and "substances with a high degree of acute toxicity".

**Permissible exposure level (PEL)** - The maximum permitted 8-hour time-weighted average concentration of an airborne contaminant. Cal/OSHA lists these limits at [www.dir.ca.gov/Title8/5155table\\_ac1.html](http://www.dir.ca.gov/Title8/5155table_ac1.html)

**Physical hazard** - A substance 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.

**Protective laboratory practices and equipment** - Those laboratory procedures, practices and equipment accepted by laboratory health and safety experts as effective, or that the employer can show to be effective, in minimizing the potential for employee exposure to hazardous chemicals.

**Regulated carcinogen** - Any of the following substances or any substance containing any of the following substances: <http://www.dir.ca.gov/Title8/sb7g16a110.html>

1,2-Dibromo-3-Chloropropane (DBCP); 1,3-Butadiene; 2-Acetylaminofluorene; 3,3'-Dichlorobenzidine (and its salts); 4,4'-Methylene bis(2-chloroaniline); 4-Aminodiphenyl; 4-Dimethylaminoazobenzene; 4-Nitrobiphenyl; Acrylonitrile; alpha-Naphthylamine; Asbestos; Benzene; Benzidine (and its salts); beta-Naphthylamine; beta-Propiolactone; bis-Chloromethyl ether; Cadmium; Coke Oven Emissions; Dibromochloropropane (DBCP); Ethylene Oxide; Ethylene Dibromide (EDB); Ethylene Oxide; Ethyleneimine; Formaldehyde; Inorganic Arsenic; Methyl Chloromethyl Ether; Methylendianiline; Methylene Chloride; N-Nitrosodimethylamine; Non Asbestiform Tremolite, Anthophyllite and Actinolite; Vinyl Chloride

**Reproductive toxins** - Chemicals that affect the reproductive capabilities including chromosomal damage (mutations) and effects on fetuses (teratogenesis).

**Select carcinogen** - Any substance that meets one of the following criteria:

- It is regulated by Cal/OSHA as a carcinogen (see regulated carcinogens listed above); or
- It is listed under the category "known to be carcinogens", in Annual Report on Carcinogens by the National Toxicology Program (NTP) (latest ed., <http://ntp.niehs.nih.gov/?objectid=72016262-BDB7-CEBA-FA60E922B18C2540>); or
- It is listed under Group 1 ("carcinogenic to humans") by the International Agency for Research on Cancer Monographs (IARC) (Vol. 1-48 and Supplements 1-8); or
- It is listed in either Group 2A or 2B by IARC (<http://monographs.iarc.fr/>) or under the category, "reasonably anticipated to be carcinogens" by NTP (<http://ntp.niehs.nih.gov/?objectid=72016262-BDB7-CEBA-FA60E922B18C2540>) and causes statistically significant tumor incidence in experimental animals in accordance with any of the following criteria:
  - a. After inhalation exposure of 6-7 hours per day, 5 days per week, for a significant portion of a lifetime to dosages of less than 10 mg/m<sup>3</sup>;
  - b. After repeated skin application of less than 300 mg/kg of body weight per week; or
  - c. After oral dosages of less than 50 mg/kg of body weight per day

**Shall** - Designates a regulatory mandate.

**Should** - Designates a recommendation contained in the regulations or a recommendation from a recognized industry standard.

**Substances which have a high degree of acute toxicity** - Substances that are "Highly Toxic" under the definitions in Appendix A of CCR Title 8 section 5194 (<http://www.dir.ca.gov/Title8/5194a.html>).

**Will** - Designates a UCR policy or standard practice.

## 5. Responsibilities

The **Chancellor** is responsible for the implementation of the University's Environmental Health and Safety policies at all facilities under campus control.

The **Vice-Chancellors, Deans, and Executive Officers** are responsible for insuring that departments/units under their authority that are engaged in the laboratory use of hazardous chemicals comply with the Chemical Hygiene Plan (CHP) applicable to each unit.

**Department chairpersons, department heads**, in areas engaged in the laboratory use of hazardous chemicals are responsible for assigning a person to be the Departmental Laboratory Safety Officer and meeting with that person at least semi-annually to discuss laboratory safety.

**Department chairpersons, department heads, unit heads, managers, principal investigators, and laboratory supervisors** in areas engaged in the laboratory use of hazardous chemicals are responsible for establishing, implementing and maintaining a CHP and ensuring compliance with that plan.

**Employees and students** engaged in the laboratory use of hazardous chemicals are responsible for complying with departmental CHPS and individual SOPs.

The **Departmental Laboratory Safety Officer** is responsible for preparation and annual review of the departmental Chemical Hygiene Plan and for providing technical assistance to laboratory workers. The Laboratory Safety Officer for the Department of Botany & Plant Sciences is Dr. Alan McHughen.

The **Environmental Health and Safety Office (EH&S)** is responsible for updating the campus CHP and assisting in the development and annual review of departmental and individual Chemical Hygiene Plans. EH&S has assigned the Laboratory / Research Safety Specialist to act as the liaison and coordinator to the departmental Laboratory Safety Officer and as the chair of the Laboratory Safety Officer Committee. The UCR, EH&S Laboratory / Research Safety Specialist provides technical guidance in the development and implementation of this Chemical Hygiene Plan. EH&S is also responsible for providing Material Safety Data Sheets and other hazard information on request (<http://www.ehs.ucr.edu/services/msds.html>), monitoring and inspecting to determine compliance with federal, state, and local health and safety regulations (<http://www.ehs.ucr.edu/safety>); and assisting with the development of safety training and education programs for CHP participants.

## 6. Information and Training

**The Department of Botany & Plant Sciences shall provide to all persons under the auspices of the department involved in the laboratory use of hazardous chemicals, information and training to apprise these persons of the hazards of the chemicals in their work area.** This training is a subset of the general safe work practices training required by the Injury and Illness Prevention Program and the Integrated Safety and Environmental Management System. Laboratory personnel who have had training under the Chemical Hygiene Plan are not required to have Hazard Communication training as long as all their work with hazardous materials falls within the scope and definition of "laboratory use".

The information and training shall be provided to the laboratory personnel or student at the time of initial assignment to the laboratory, prior to assignments involving new exposure situations, and upon changes in the procedures used and/or new hazards present in the laboratory. Annual refresher training on the CHP is required for all laboratory employees and students.

### Information provided shall include:

- The physical location and availability of "Occupational Exposure to Hazardous Chemicals in Laboratories" regulation, CCR Title 8, Article 110, Section 5191. [www.dir.ca.gov/Title8/5191.html](http://www.dir.ca.gov/Title8/5191.html)
- The location and availability of the Chemical Hygiene Plan. An electronic copy of the departmental Chemical Hygiene Plan is located on the Botany & Plant Sciences website [www.plantbiology.ucr.edu](http://www.plantbiology.ucr.edu). A paper copy is located in Batchelor Hall Room 2108 and it is available from 8:00 am – 5:00 pm Monday through Friday.
- The permissible exposure limits and recommended exposure limits for chemicals [www.dir.ca.gov/Title8/5155.html](http://www.dir.ca.gov/Title8/5155.html) and [www.dir.ca.gov/Title8/5155table\\_ac1.html](http://www.dir.ca.gov/Title8/5155table_ac1.html)
- Signs and symptoms associated with exposures to hazardous chemicals used in the laboratory; as found in the "Health Effects" section of the Material Safety Data Sheet for each chemical.
- The physical location and availability of known reference material(s) on the hazards, safe handling, storage and disposal of hazardous chemicals found in the laboratory including, but not limited to, Material Safety Data Sheets (MSDSs) received from the chemical supplier. Each laboratory shall have MSDSs for chemicals used in that laboratory readily available in a clearly marked notebook or file in the laboratory or online. Additional MSDSs are available at the EH&S office and online through the EH&S website <http://www.ehs.ucr.edu/services/msds.html>. Additional safety references are available in the Science Library and are listed in Appendix B.

### Training shall include:

- Methods and observations that may be used to detect the presence or release of a hazardous chemical;
- The physical and health hazards of chemicals in the work area;

- c. The measures that can be taken to protect oneself from these hazards, including specific procedures the University has implemented to protect persons from exposure to hazardous chemicals, such as engineering controls, appropriate safe work/lab practices, emergency procedures, and personal protective equipment to be used;
- d. The applicable details of the Chemical Hygiene Plan (in particular relevant SOPs)

Training shall be documented in accordance with the Injury and Illness Prevention Program. The Department of Botany & Plant Sciences utilizes the EH&S Core Data Management System to document required training. Each principle investigator responsible for laboratory space must keep documentation of training in their own laboratories that includes the name of the trainee, the date, and the procedures covered.

## 7. Basic or General Laboratory Safety Rules

[www.ehs.ucr.edu/laboratory/laboratorysafetyrules.pdf](http://www.ehs.ucr.edu/laboratory/laboratorysafetyrules.pdf)

- Know the location of emergency showers, eyewashes, first aid kits, emergency exits, spill kits, telephone and fire alarm pull stations. Know the location of the nearest and the next-nearest telephone, eyewash, and emergency shower. In an emergency, dial 911 from a campus phone. (From a cell phone call 951-827-5222)
- Know the location of Material Safety Data Sheets <http://www.ehs.ucr.edu/services/msds.html>. Ensure that you have been trained on this Chemical Hygiene Plan.
- No food, beverage, smokeless tobacco, or application of cosmetics is allowed in the laboratory. No smoking is allowed in any area of a laboratory. Always wash hands after working with chemicals, even when gloves have been used.
- Dress appropriately. Long hair, neckties, or loose clothing should be tied back or otherwise secured. No sandals, open-toed or perforated shoes are allowed to be worn in the laboratory. Lab coats will be worn over short skirts (above the knee), shorts, or exposed midribs.
- Appropriate eye protection (safety glasses at a minimum) will be worn at all times in laboratories; see Section 16 below and any applicable SOPs.
- Wear the appropriate personal protective equipment for the chemicals you are working with. When wearing contact lenses, be sure to wear safety goggles to protect your sight.
- Comply with warning signs and labels.
- Laboratories with special or unusual hazards shall be posted with appropriate warning signs including but not limited to: laser warning signs, radioactivity warning signs, biological hazard warning signs, etc. The EH&S Hazardous Materials Program (<http://www.ehs.ucr.edu/hazardousmaterials>) has a Placard Program to assist in the compliance with this requirement (<http://econtact.ucr.edu/>).
- Do not directly smell or taste any chemical.
- Do not pipette or siphon by mouth.
- Containers shall be kept closed when not in active use.
- When diluting strong acids, it is generally safer to add acid to water as water has a higher heat capacity and can absorb the heat generated by the dilution reaction.
- Perform only those experiments or procedures you are authorized to do by the person in charge of the lab.
- Report all injuries, fires, and accidents to your supervisor or instructor immediately. All fires and use of fire extinguishers must be reported to the Campus Fire Marshal at 951-827-6309 as soon as possible.
- If you have a question about a procedure or the hazards of a chemical, ask your supervisor or instructor before performing the procedure.



## 8. Labeling

All containers of hazardous substances shall be appropriately labeled. The manufacturer's label shall not be removed from a container as long as the material or residues of the material remain in the container. The following information is to be provided on the manufacturer's label:

1. The identity of the hazardous substance.
2. Appropriate warning words and statements.
3. Appropriate precautionary measures.
4. Name and address of manufacturer or importer.

The receiver will write the date received and the date opened on the label of chemicals that expire or can convert to a reactive material upon standing, such as diethyl ether, tetrahydrofuran, 1,4-dioxane, diisopropyl ether and other peroxide-forming substances. See Appendix A-III.

All containers into which hazardous substances are transferred or prepared shall be labeled with the following information:

- a. The identity and concentration of the hazardous substance.
- b. A description of the hazards and precautionary measures. In containers smaller than one quart, descriptions can be limited to signal words such as "FLAMMABLE, CORROSIVE, TOXIC"; consult a recent original container, the Aldrich Chemical catalog, the MSDS, or contact EH&S (951)827-5528 [www.ehs.ucr.edu](http://www.ehs.ucr.edu).
- c. It is good practice to put the date received, prepared, or transferred on the label. This is required for peroxidizable chemicals such as ethers; see Appendix A-III below.
- d. It is recommended that the responsible person's name, building, room number, and telephone number be on the container label.

All containers in which hazardous waste is collected shall be labeled with a completed hazardous waste tag. The campus uses an On-line Hazardous Waste Tag Program (<http://otp.ucop.edu>) to track waste and avoid storage and labeling violations. Guidance on how to sign up for the OTP and use it is available both through an on-line manual (<http://www.ehs.ucr.edu/forms/otpmanual.pdf>) and an on-line tutorial (<http://www.ehs.ucr.edu/training/online/otp>).

Labeling is not required for portable containers into which hazardous chemicals are transferred from labeled containers, and which are intended only for the immediate use of the individual who performs the transfer.

Where hazardous materials are transported by piping systems, above ground pipes shall be labeled:

- a. Preferably by stenciling the name of the chemical and an arrow indicating direction of flow of the material.
- b. Alternatively, by permanently marking or attaching tags of metal or other such suitable material naming the material transported on or near valves.

## 9. Chemical Procurement and Distribution

Each individual Chemical Hygiene Plan should include protocols used by the laboratory or laboratories under the Plan for procuring and distributing hazardous chemicals. The Chemical Procurement and Distribution protocol should include the following considerations:

- a. Substitute with less hazardous chemicals where possible.
- b. Limit purchases to amounts that can foreseeably be used in the next year or less.
- c. Utilize microscale techniques where feasible.
- d. Ensure that facilities and equipment are adequate for the intended use of the chemical.
- e. Ensure that equipment such as bottle carriers, carts with spill containment, or specialized containers are available for use if needed.
- f. Attempt to obtain an agreement in writing from the donor of free hazardous materials to accept the return of any unused portions.
- g. Ensure that a current MSDS is available or requested from the manufacturer for each chemical purchased. MSDSs are available through <http://www.ehs.ucr.edu/services/msds.html>.

### Surplus Chemicals

The EH&S department maintains a chemical reuse program. When disposing of reagent quality chemicals, identify them to the waste program as having the potential for re-use. Reassigned, relocated, or departing researchers are responsible for the proper disposition of their chemical and hazardous waste stocks prior to departure. The departmental Laboratory Safety Officer shall be responsible for the evaluation, redistribution,

and/or disposal of other abandoned chemicals discovered within departmental laboratories according to procedures outlined in the Chemical Hygiene Plan.

#### Hazardous Materials Inventory

California Law requires an inventory of hazardous materials. Each lab within the department is encouraged to complete an inventory online at: <http://ucriverside.ecompliance.net> If you need assistance or this is the first time the lab is completing an inventory, obtain a username and password from the Hazardous Materials Specialist at 827-5528. This inventory should be updated and kept current by making changes online through the EH&S website. Explanations of materials to be reported are also available on the website.

## 10. Storage of Chemicals in Laboratories

### General Guidelines for Storage of Chemicals in Laboratories

- Shelves used for chemical storage shall be of substantial construction and adequately braced. Shelves shall be provided with a lip or guard when used for the storage of individual containers, except when containers are stored in a hazardous materials storage cabinet or other furniture designed to prevent containers from falling off the shelf during seismic activity.
- Containers are to be arranged in such a manner as to allow all labels to be seen. When this is impossible, the shelf may be labeled with a list of contents.
- Chemicals should not be stored on the floor and should not protrude into traffic areas.
- Materials sensitive to light shall be stored in containers designed to protect the contents from light.
- Food shall not be stored or consumed in areas where toxic chemicals are used or stored. (<http://www.dir.ca.gov/title8/3368.html>) Avoid eating, drinking, gum chewing, or application of cosmetics in areas where laboratory chemicals are present; wash hands before conducting these activities. Avoid storage, handling, or consumption of food or beverages in storage areas, refrigerators, glassware or utensils that are also used for laboratory operations. (<http://www.dir.ca.gov/title8/5191a.html>). Hallways and stairways should not be used as storage areas.

#### Storage of flammable liquids in laboratories

- Storage of more than 10 gallons of flammable and combustible liquids (with a flash point less than 100° F) and 120 gallons of combustible liquids (with a flash point of less than 140 degrees F) shall be in a flammable liquid storage cabinet meeting the requirements of CCR Title 8, Section 5533. The manufacturer usually specifies that the cabinets meet the requirements of OSHA or NFPA 30 -Flammable Liquids Code.
- Flammables shall not be stored in the same cabinet as oxidizers, strong acids or water-reactive materials in a manner in which they could mix during a catastrophic event as an earthquake.

### Storage of corrosives in laboratories

- Corrosives ought not be stored under sinks or in other areas where plumbing, equipment, or shelving could be damaged by corrosive effects. Containers of hydrochloric acid, fuming acids, or other volatile corrosives should be securely capped.
- Strong acids (pH <2) and strong bases (pH >12.5) shall be stored separately in a manner precluding their mixing during a catastrophic event as an earthquake. Where amounts are small, separation can be achieved by either all the acids or all the bases being stored in separate containment such as bottle carriers, spill pans, or other secondary containment. Organic acids (e.g., acetic) should be stored with organics, not with strong inorganic acids.

## 11. Standard Operating Procedures

Each Individual Chemical Hygiene Plan shall have standard operating procedures (SOPs) that are relevant to safety and health considerations of the laboratory or laboratories covered by the specific plan and capable of preventing health hazards from exposure. These SOPs should address work practices and policies necessary to protect personnel and students from the exposure to hazardous materials in the laboratory. Sample SOPs that may be adopted or adapted for use in individual plans are available in Appendix A of this plan. Additional specific SOPs, which may be necessary to protect personnel and students in the laboratory must be developed for individual CHPs. Environmental Health & Safety can assist in locating informational resources and developing

new and specific SOPs. Any SOPs that are developed should follow the Integrated Safety & Environmental Management System process and be shared with EH&S.

## 12. Circumstances Under Which Prior Approval is Required

Each departmental or individual Chemical Hygiene Plan shall include designated persons who have authority under the plan to approve laboratory procedures and allow continuance of laboratory procedures under the conditions specified in this section. Botany and Plant Sciences has designated the faculty member, who in turn may designate one of his/her lab personnel (who must have worked in this faculty member's lab for at least three years and who hold a Ph.D.), to provide prior approval for his/her lab as needed for conditions specified in this section. The Environmental Health and Safety Office will not have final approval for research projects or laboratory procedures. EH&S is available on request to provide information or recommendations to assist designated persons in making approval decisions.

Prior approval will be obtained from the appropriate designee for the following:

1. For new laboratory procedures.
2. When it is likely that the "Action Level" or "Permissible Exposure Limit" for a chemical may be exceeded.
3. For changes in procedures that may affect reaction rates, changes in temperatures, or flammability.
4. When ingredient chemicals in a procedure are substituted, added or deleted, or the amounts of chemicals are significantly increased or decreased.
5. For operations that are to be left unattended
6. For operations to be performed by an individual working alone in a laboratory.
7. For operations involving work with "particularly hazardous substances" as outlined in section 14 of this document.

Approval to continue or proceed will be obtained from the appropriate designee:

1. When there is a failure of equipment, especially safety control measures such as fume hoods, clamp apparatus, or temperature control.
2. When the procedure produces unexpected results
3. When signs and symptoms of chemical exposure are experienced.

## 13. Criteria to Determine and Implement Control Measures

### Hazard determination

1. Labels containing substance identification and hazard information on incoming material shall not be removed or defaced as long as any material or residue remains in the container.
2. All Material Safety Data Sheets (MSDS's) received shall be retained. MSDS's are available on-line through <http://www.ehs.ucr.edu/services/msds.html> and [www.ucmsds.com](http://www.ucmsds.com). Receivers of MSDS's that are not available through these websites shall retain a copy of the MSDS and send a clean copy to the Hazardous Materials Manager (<http://www.ehs.ucr.edu/hazardousmaterials>) at Environmental Health and Safety. If hazardous chemicals are going to be used where Internet access is not readily available, such as at a field station, copies of the MSDS's shall be printed and taken with the workers.
3. Exposure levels and effects on humans will be determined using information sources suggested in Appendix B of this document and in accordance with Appendices A & B to CCR Title 8 section 5194 (Appendix C of this document). Permissible exposure limits are available on the California Occupational Safety and Health Administration web site at [http://www.dir.ca.gov/Title8/5155table\\_ac1.html](http://www.dir.ca.gov/Title8/5155table_ac1.html).
4. Physical hazards presented by chemicals will be determined using information sources suggested in Appendix B of this document.

### Implementation of control measures

5. Sufficient general ventilation, local ventilation, isolation, or respiratory protection must be used to protect against airborne contaminants.

6. Isolation, shields or barriers, and chemical protective clothing and equipment may be selected for use with chemicals that may be absorbed in injurious levels by the skin. Permeation and degradation factors of protective clothing and equipment will be considered when making selections.
7. Control measures for fire and explosion hazards may include ventilation, controls as recommended by NFPA 70 - National Electrical Code, NFPA 45 – Fire Protection for Laboratories Using Chemicals, and other recognized standards and recommendations as warranted.

## 14. Provisions for Protection From Particularly Hazardous Substances

This section will apply to laboratory use of chemicals defined as "particularly hazardous substances". These include "select carcinogens", "reproductive toxins", and "substances with a high degree of acute toxicity".

### Establishment of a designated area

1. A designated area may be the entire laboratory, an area of the laboratory, or a fume hood or glove box.
2. Storage or consumption of food, storage or use of containers of beverages, storage or application of cosmetics, smoking, storage of smoking materials, tobacco products or other products for chewing, or the chewing of such products, shall be prohibited in designated areas.
3. Use of particularly hazardous substances shall be limited to designated areas.
4. The location of the designated area shall be posted and persons working within the designated area shall be informed of the hazardous substances used there. A sample posting for designated areas is provided in Appendix D.

### Use of containment devices and methods

1. Containment devices and methods should be used to minimize exposure to persons and to prevent contamination of areas outside the designated area.
2. Use of particularly hazardous substances in a manner which may produce vapors, dusts, mists, particularly hazardous gases or other airborne particulates shall be under a laboratory hood, in a glove box, or in a closed system.
3. Laboratory fume hoods in which other substances are used shall have an average face velocity of 100 linear feet per second, with no area falling below 70 linear feet per second.
4. Mechanical pipetting aids shall be used for all pipetting procedures (no mouth pipetting).
5. Work surfaces that may become contaminated with particularly hazardous substances shall be protected from contamination.
6. When working with regulated carcinogens, laboratory vacuum systems shall be protected with a double cold trap or with disposable absolute filters. When working with beta- propiolactone, bis-chloromethyl ether, methyl chloromethyl ether, or ethyleneimine, a double cold trap shall be used.
7. Persons working in the designated area shall remove protective equipment and wash their hands and forearms before engaging in other activities or before eating, drinking, smoking, or using toilet facilities.

### Procedures for safe removal of contaminated waste

1. All waste contaminated with particularly hazardous substances should be collected in impervious containers that are compatible with the contaminant.
2. Wastes contaminated with different substances that are incompatible shall not be placed in the same container.
3. Contaminated sharps, contaminated broken glassware, etc. should be placed in a sturdy container such as a cardboard box and sealed before placing in a waste collection container. Puncture-proof containers for hazardous hypodermic needles can be obtained from EH&S.
4. All containers should be labeled with the contaminant(s), and if the contaminant is a carcinogen, the words "Cancer-suspect Agent".
5. Hazardous waste shall not be accumulated at satellite locations (e.g., laboratories) for longer than 6 months and acutely hazardous waste volumes cannot exceed 1 quart. Waste will be collected when the box associated with the accumulated container is selected and the "Checked items ready for disposal" button is clicked in the OTP system (<http://otp.ucop.edu>).

### Decontamination procedures

1. Laboratory workers should consider whether or not decontamination of designated areas is appropriate. Decontamination procedures and use of PPE will vary according to the type of substance used (consult with EH&S).
2. Small spills should be cleaned up immediately and the area decontaminated.
3. Large or particularly hazardous substance spills which require the activation of the UCR Emergency Response Plan (<http://www.ehs.ucr.edu/resources/emergencyprocedures.pdf>) will be cleaned up in accordance with that plan.

## 15. Housekeeping, Maintenance, Inspections, and Monitoring

### Housekeeping

1. Laboratories should be kept free of clutter. Working areas should be cleaned up at the end of each operation and at the end of each day.
2. Small spills of chemicals should be cleaned up immediately. Spills which require measures beyond general housekeeping by laboratory personnel to clean up should be reported to EH&S 827-5528 (after hours 827-5222) or, in case of emergency, call 9-911 from a campus phone.
3. Safety showers, eyewashes, and fire extinguishers shall be free from any obstruction that would prevent access and use. Access to emergency exits shall be kept clear at all times.
4. Circuit breaker panels shall have an unobstructed clearance of 30".
5. The floor shall be kept clean and free of slip hazards by reasonable cleaning and immediate clean up of spills.
6. Old containers, compromised containers, and chemical wastes should be disposed of promptly and not be allowed to accumulate. Hazardous waste materials should be disposed of in accordance with section 19 of this plan.

### Inspection and Maintenance of Protective Devices

1. Temperature control and over-temperature shutoff devices on heating equipment should be tested in accordance with manufacturer recommendations to ensure proper operation.
2. All automatic shutoff devices should be tested in accordance with manufacturer recommendations to ensure proper operation.
3. Records of inspection and testing of above equipment will be maintained for 3 years in the lab containing the equipment or by the Growth Chamber technician. Fume hood performance will be evaluated by EH&S. ([www.ehs.ucr.edu/safety/Fume\\_Hoods/fumehood.html](http://www.ehs.ucr.edu/safety/Fume_Hoods/fumehood.html))
4. Explosion shields and isolation devices should be visually inspected by the user for cracks or other damage before each use.
5. Safety showers and emergency eyewashes shall be inspected monthly by Physical Plant personnel.
6. ([www.pplant.ucr.edu/facilities/plumbing.htm](http://www.pplant.ucr.edu/facilities/plumbing.htm)). Tags indicating date inspected and the inspector will be attached on or near the shower or eyewash.

Laboratories shall be inspected at least annually by the department. A checklist to assist in inspections is provided in Appendix E.

**If you have problems with utilities such as water, air, building vacuum, etc., contact Physical Plant at (951) 827-4214 or [www.pplant.ucr.edu](http://www.pplant.ucr.edu).**

## 16. Personal Protective Equipment (PPE)

Respiratory protective equipment - The Office of Environmental Health and Safety will act as the sole source for purchasing, fitting and approving the use of all respiratory equipment and for training University personnel and students in its proper use and maintenance. (As required by UCR Policy and state law <http://www.ehs.ucr.edu/safety/programs.html>)

### Eye and Face Protection

1. Eye and face protection shall be required where there is a reasonable probability of injury that can be prevented by such equipment. Appropriate eye protection shall be worn at all times in laboratories. At a minimum, safety glasses with side shields shall be worn.
2. "Design, construction, testing and use of devices for eye and face protection shall be in accordance with American National Standard for Occupational and Educational Eye and Face Protection, (ANSI) Z87.1" Compliant eye or face protection is usually marked with "Z87".
3. Selection of the proper type of eye and face protection should be in accordance with ANSI Z87.1 that is available on campus at EH&S or in the Science Library.

### **Skin Protection**

1. When working with those substances that are readily absorbed by the skin or with substances that are highly corrosive to the skin, appropriate protection shall be provided to protect the laboratory worker from skin contact.
2. Skin protection may take the form of shields, isolation of the procedure, gloves, aprons, or other such protective equipment.
3. Gloves and aprons should be selected according to the chemical resistance of the protective material to the chemical to be used. This information can be obtained by the supplier of the product and is usually presented in a chemical resistance chart in the supplier's catalog. The Environmental Health and Safety Office can assist in the selection of proper personal protective equipment.

## **17. Medical Consultation and Examinations**

The University shall provide all persons involved in the laboratory use of chemicals an opportunity to receive medical attention, including any follow-up examinations that the examining physician determines to be necessary, under the following circumstances:

1. Whenever a laboratory employee or laboratory student develops signs or symptoms associated with a hazardous chemical to which the employee or student may have been exposed in the laboratory;
2. Where industrial hygiene monitoring in a laboratory reveals an exposure level routinely above the action level (or in the absence of an action level, the Permissible Exposure Limit [http://www.dir.ca.gov/Title8/5155table\\_ac1.html](http://www.dir.ca.gov/Title8/5155table_ac1.html)); or
3. Whenever an event takes place in the laboratory such as a spill, leak, explosion or other occurrence resulting in the likelihood of a hazardous exposure.

All medical examinations in accordance with section 18 of this document shall be performed by or under the direct supervision of a licensed physician and shall be provided at no cost to the exposed laboratory employee or laboratory student.

The University shall provide the following to the physician:

1. The identity of the hazardous chemical(s) to which the laboratory employee or laboratory student may have been exposed and a copy of the MSDS, if available;
2. A description of the conditions under which the exposure occurred including quantitative exposure data, if available; and
3. A description of the signs and symptoms of the exposure that the laboratory employee or laboratory student is experiencing, if any.

Exposure records shall be maintained by Environmental Health & Safety (<http://www.ehs.ucr.edu/biosafety>) and medical consultation records shall be maintained by the physician conducting any examination in accordance with CCR Title 8, section 3204. (<http://www.dir.ca.gov/Title8/3204.html>) Information about this process can be obtained from EH&S.

## **18. Spills and Accidents**

Ensure that you know the details of the departmental Emergency Action/Fire Prevention Plan applicable to your location. The campus guidance is on-line at: <http://www.ehs.ucr.edu/resources/emergencyprocedures.pdf>. Know at least two evacuation routes from your location. Know the location of emergency showers, eyewashes, first aid

kits, emergency exits, spill kits, and fire alarm pull stations. Know the location of the nearest and the next-nearest telephone, eyewash, and emergency shower. In an emergency, dial 9-911 from a campus phone.

You are expected to be familiar with the hazards of the materials in your labs.

1. Consult Materials Safety Data sheets (<http://www.ehs.ucr.edu/services/msds.html>) to obtain this information.
2. Select the appropriate response actions based upon the hazards of the materials involved.
3. Special hazards, such as hydrofluoric acid, require specific preparation and first-aid supplies. Discuss these with your Laboratory Safety Officer (<http://www.ehs.ucr.edu/services/lso.html>).

### **Fires and Chemical Spills**

- 1) Alert personnel in the immediate vicinity.
- 2) Confine the fire or chemical spill, if possible to do so without endangering personnel.
  - a) Keep yourself between the emergency and an exit while attempting to confine the emergency to avoid being trapped.
  - b) If you have been trained to put out small fires or use an extinguisher, fight the fire if you are confident that you will be able to put it out.
  - c) If emergency is inside a hood, close the sash, if possible.
  - d) Close lab doors, if possible, to prevent spread of smoke or vapors into adjoining rooms and corridors.
  - e) For flammable liquid spills, shut off ignition sources, if possible. Avoid unplugging equipment due to possible electrical arc between receptacle and plug. Turning off breaker will work.
- 3) Evacuate the emergency area. If in doubt, evacuate the building. To evacuate a building, pull the nearest fire alarm pull station on your way out.
- 4) Summon aid.
  - a) For emergencies that require response from the fire department, police department, or paramedics, dial 9-911 from a campus phone.
- 5) For other emergencies or incidents, call EH&S at 827-5528, or campus police 827-5222 after hours.

### **Clothing Fires**

1. Stop the person on fire from running; even from running to a fire blanket.
2. Drop the person to the floor or other horizontal surface to prevent flames and hot gases from rising to the face and head.
3. Roll the person to snuff out the flames. Blankets can be effective if brought to the person. Safety showers may be effective if within a travel time of one or two seconds.
4. Cool the person by removing smoldering clothing that has not adhered to the skin, and by using water and ice packs.
5. Get medical assistance. Call 911 from a cell phone or 9-911 from a campus phone.

### **Chemical splash**

1. Chemical splashes in the eyes
  - Immediately wash the eyes with potable water for at least 15 minutes.
  - Forcibly hold the eyelids open and tell the injured person to roll his/her eyes while continuously irrigating.
  - Do not use any substance other than potable water to wash the eyes.
  - Get medical assistance.
2. Chemical splashes on the skin
  - Remove chemical contact with the skin by brushing off dry and water reactive chemicals and removing contaminated clothing and protective equipment that can be removed quickly (1 second or less).
  - Flush the splashed area with large amounts of potable water. Never use anything other than water or mild soap and water to clean chemicals from exposed skin.
  - Remove protective eyewear under the emergency shower as quickly as possible when chemicals have entered the eyes. In cases where the eyewear has not been breached by the chemical, remove the protective eyewear after head and face have been thoroughly washed.
  - Wash with potable water for 15 minutes or longer. Wash any part of the skin that may have had chemical contact or contact with contaminated wash water. Remove any clothing that may have come in contact with the chemical or contaminated wash water under the emergency shower.

- Washing should give special attention to areas that may be missed such as underneath the earlobes, underneath the arms, the crotch, between the toes, the creases at the sides of the nose, a deep cleft in the chin, etc.
- Get medical assistance. Provide MSDSs for the involved chemicals to medical personnel.
- If the emergency water used for flushing is cold, the injured person should be treated for shock on completion of washing.
- If a splash causes a thermal burn as well as a chemical burn, be sure to advise the attending medical personnel of the nature of the chemical exposure.
- After washing of the victim is completed, rescuers need to wash themselves to prevent injury from diluted chemical washed off from the victim.

#### **Work-related injury or illness**

- For dire emergencies, call 911 from a campus phone (or 951-827-5222 from a cell phone) and request an ambulance.

## **Medical Treatment Facilities for Employees**

### **Parkview Occupational Medicine**

9041 Magnolia Avenue, Suite 107  
Riverside, CA 92503  
Phone: (951) 353-1021  
Hours: Weekdays: 8 a.m. to 9 p.m.; Weekends: 9 a.m. to 6 p.m.  
After hours call (951) 351-7726

### **Central Occupational Medicine Providers (COMP)**

4300 Central Avenue  
Riverside, CA 92506  
Phone: (951)222-2206  
Hours: 24 hours a day, 7 days a week.  
Transportation can be requested by calling this facility in advance.

### **IN CASE OF EMERGENCY OR LIFE-THREATENING INJURIES:**

### **Riverside Community Hospital**

4445 Magnolia Avenue  
Riverside, CA 92507  
Phone: (951)788-3000  
Hours: 24-Hour Emergency Care  
(Follow up treatment should be obtained at Central Occupational Medicine Providers or Parkview Occupational Medicine)

## **19. Hazardous Waste Disposal**

Hazardous Waste Disposal guidance is available on the Environmental Health and Safety website: [www.ehs.ucr.edu](http://www.ehs.ucr.edu). A good place to start is the Waste Management program and the summary of disposal requirements for UCR laboratories: [www.ehs.ucr.edu/waste](http://www.ehs.ucr.edu/waste) and [www.ehs.ucr.edu/services/waste.html](http://www.ehs.ucr.edu/services/waste.html)

### **Liquid Chemical Hazardous Waste Collection**

1. Hazardous wastes shall be collected in containers that are compatible with the intended contents and that are in good condition.
2. Materials placed in the same collection container shall be compatible with all other materials in the container.
3. Containers shall be labeled with the On-line Hazardous Waste Program at <http://otp.ucop.edu>.

4. All chemical reactions should be complete prior to introduction into collection containers.
5. Whenever possible, markedly different individual substances should be collected separately to increase disposal options and reduce cost.
6. Collection containers shall be kept securely closed except when adding hazardous material.
7. Containers to be submitted for disposal must not exceed 5 gallons (1 gallon for corrosives), unless prior EH&S approval has been obtained.
8. Secondary containment is required for all liquid hazardous wastes.
9. Hazardous wastes shall not be accumulated longer than six (6) months at satellite sites such as laboratories. The On-line Hazardous Waste tag Program assists with tracking and notifies EH&S when the accumulation of waste exceeds 180 days.

### **Solid Hazardous Waste Collection**

1. Solid hazardous wastes must be collected into compatible containers, kept closed except when adding waste and labeled using the On-line Hazardous Waste Tag Program (<http://otp.ucop.edu>)
2. All sharps and broken glassware contaminated with hazardous chemicals should be placed in a puncture resistant container and sealed prior to pick-up by EH&S.
3. For handling and collection of biohazardous waste, contact EH&S at 827-5529. (<http://www.ehs.ucr.edu/services/waste.html>)

### **Collection of Gases**

1. Gases will be accepted in cylinders or original shipping containers only.
2. Gas cylinders shall be equipped with a functional valve or be empty and the valve removed.
3. Whenever possible, add the name of the supplier of the compressed gas when requesting pickup through the On-line Hazardous Waste Tag. (<http://otp.ucop.edu>). This will aid in recycling efforts.
4. Containers shall be labeled in accordance with Section 8. Empty containers should also be marked with "EMPTY" or "MT".

### **Submission for disposal of collected hazardous wastes**

- a. To dispose of collected hazardous wastes, use the On-line Hazardous Waste Program at <http://otp.ucop.edu>.

## **20. Radioactive Waste**

The radioactive waste program at UCR requires your cooperation if the large amounts of waste generated are to be handled in a way that is not only safe, but cost-effective, and otherwise responsible. Our waste management program is based on regulations related to waste disposal and the resources available at the University to optimize disposal options.

### **Specific requirements related to radioactive waste management include:**

1. All radioactive waste must be transferred to EH&S for disposal. This means that NO radioactive material can be placed with the regular trash or poured down the drain.
2. For waste pick-up, contact EH&S Integrated Waste Management on the EH&S web site at [www.ehs.ucr.edu](http://www.ehs.ucr.edu)
3. Segregate waste according to half-life and in the following general categories:
  - o **Dry Solids** - All dry, solid waste must be placed in properly labeled containers provided and/or approved by EH&S. Absolutely no liquids to be included with the dry solid waste.
  - o **Sharps** - All Sharps must be placed in an approved, and properly labeled, Sharps container.
    - Sharps include needles, syringes, pipette tips, broken glass, etc.
  - o **Liquids** - Liquid waste includes the primary radioactive liquid and at least the first rinse.
    - Aqueous and organic waste must be collected separately and must be placed in properly labeled containers approved and/or provided by EH&S. All liquid waste containers must be compatible with their contents and stored in secondary containers large enough to contain five times the volume of the primary container.
  - o **Animal/Medical Waste** - All animal/medical waste must be double-bagged, labeled, and stored in a cold room or frozen if held for more than 48 hours before pickup. Any Radioactive waste mixed with Biohazardous or Medical Waste must also comply with those requirements.
  - o **Filled Scintillation Vials** - Filled vials are picked up only in flats. Segregate glass and plastic vials into separate flats.

- **Scintillation Cocktails – Use *ONLY* Biodegradable Scintillation Cocktail fluid**
- If vials are emptied, collect the scintillation cocktails, separate from other liquids, in properly labeled containers approved by EH&S.
- Miscellaneous (high specific activity, stock vials, gels, etc.) – Contact EH&S Integrated Waste Mgt. or EH&S Radiation Safety, [www.ehs.ucr.edu](http://www.ehs.ucr.edu), for specific instructions.
- Label Information must be complete while the waste is being added and before pick-up by EH&S.
- Any Radioactive waste mixed with hazardous chemicals must also comply with the Hazardous Chemical Waste requirement and use the On-line Waste Tag Program (<http://otp.ucop.edu>).
- Minimize the amount of radioactive waste generated during the course of your work. Some methods to minimize waste include:
  1. Using the smallest amounts possible.
  2. Using short-lived radioisotopes whenever possible.
  3. Dispose of only those items, or portions thereof, that are contaminated (cut out spots from coats, paper towels, etc.).
  4. A responsible individual must be present in the lab at the time of the pick-up.
  5. EH&S can supply some special containers for radioactive waste collection. contact EH&S Integrated Waste Management at [www.ehs.ucr.edu](http://www.ehs.ucr.edu)

# Appendix A

## General Standard Operating Procedures (SOPs)

### Integrating Safety & Environmental Responsibility into all Activities

[www.ehs.ucr.edu/safety/ISEM/isem.html](http://www.ehs.ucr.edu/safety/ISEM/isem.html)

### Follow the five

1. Define the scope of the activity
2. Identify and analyze the hazards
3. Develop and implement controls
4. Perform the activity within the controls
5. Provide feedback and make improvements



### List of SOP's

- I. Compressed Gases
- II. Cryogenic Materials
- III. Peroxidizable Materials
- IV. Perchloric Acid
- V. Electrical Equipment
- VI. Working Alone
- VII. Unattended Operations
- VIII. Glassware
- IX. Laboratory (Fume) Hood Usage
- X. Autoclaves
- XI. Hydrofluoric Acid
- XII. Formaldehyde

# I. Compressed Gases

1. Define the scope of the activity
  - Handling & using compressed gas
2. Identify and analyze the hazards
  - Injury to the operator and others in the room
  - Injury to others that handle the cylinder
  - Fines for refilling containers with foreign materials
3. Develop and implement controls
  - a. Engineering Controls
    - **Containers shall be stored upright and secured.** Combustible material or formed metal chains are not recommended to secure cylinders. Chains or other securing mechanisms (preferably two) should be located between one third and two thirds of the height of the container.
    - **Valves on cylinders being moved**, cylinders that are not in use, or on empty cylinders **valves shall be closed and capped.**
  - b. Work Practices & Administrative Controls
    - **Compressed gases must not be transferred from one compressed gas cylinder container to another** except by the manufacturer or distributor. In some cases it is illegal to refill empty cylinders with foreign materials. Exception - refilling SCBAs from breathable air cylinders by authorized personnel.
    - **Containers shall be legibly marked** to identify the contents and give the appropriate precautionary information. (e.g. "flammable")
    - **Oxygen and oxidizing gasses shall be stored separately** from flammable and highly combustible material. Pressure reducing regulators should be used when withdrawing contents from the cylinder.
    - **Valve outlets** and pressure relief valves should be **directed away from personnel** at all times.
    - Do not exchange regulators or other appliances used with one gas with similar equipment used with other gasses. **Oils and lubricants should not be used on fittings for oxygen** or other oxidizing gasses.
    - **Do not force connections that do not fit.**
  - c. Personal Protective Equipment
    - **Wear safety glasses** when using compressed gas, particularly when opening & closing valves and manipulating pressurized lines.
    - **Wear protective gloves**, such as leather, when moving compressed gas cylinders or attaching or detaching the valve caps
4. Perform the activity within the controls
  - **Follow this and other relevant procedures** when working with compressed gases
5. Provide feedback and make improvements
  - **Make note of problems** and better ways of doing things. Report these to your Laboratory Safety Officer so the procedures can be improved.

## II. Cryogenic Materials

The primary hazard of cryogenic materials is their extreme coldness. They, and all surfaces they cool, can cause severe burns if allowed to contact the skin.

- A. Cryogenic fluids shall be stored or handled only in containers designed for such use.
- B. When personal contact with a cryogenic fluid is possible, (as when preparing cold baths or dispensing liquid nitrogen) full face shields should be worn. Wearing of watches, rings, or other items that may trap the cryogenic material should be avoided.
- C. When gloves are worn while handling cryogenic materials, they should be dry, impervious and loose enough to be easily tossed off the hands. Potholders are preferred for handling cryogenic materials.
- D. Lab coats should be worn over shorts and short skirts while handling cryogenic materials. Open toe shoes and sandals should not be worn.
- E. Cryogenic materials should be dispensed and used in areas with good ventilation. Laboratory workers should avoid lowering their head into dry ice chests or directly over cooling baths. When transporting dry ice, or materials packaged in dry ice, the package should not be carried in the passenger compartment of the vehicle.
- F. Cryogenic material may provide an oxygen-enriched atmosphere by condensing and fractionating air. This situation may increase the fire and explosion hazard of flammable and combustible materials being cooled or materials located in the vicinity of the operation.
- G. Dry ice should be added to cooling baths (or liquid added to dry ice) in small increments, allowing the foaming to stop before each addition.

### III. Peroxidizable Materials

- A. Peroxidizable materials should be purchased in amounts that are expected to be used within six months to one year. This practice will help ensure that ethers are used up before the manufacturer's expiration date.
- B. Peroxidizables, either opened or unopened, should be disposed of or tested for peroxides upon reaching the manufacturer's expiration date, or upon one year after receipt. If positive for peroxides, the peroxides may be removed or the materials may be disposed of by submitting a "Request for Chemical Pick-up" to EH&S. Please be sure to label the date that the test for peroxides was performed and the date peroxides removed (if applicable). The new expiration date will be three months after the date tested for materials in List A, and one year after the date tested for materials in List B.
- C. Containers should be marked with the date opened and, in the absence of a manufacturer's expiration date, with the date received. Containers should also be marked with the date that the last test for peroxides was done.
- D. Ethers should be disposed of without opening if there are visible crystals around the cap, or if the container is in a grossly corroded condition. Crystals visible in the container should be brought to the attention of the instructor, principal investigator or staff research assistant.
- E. Leave at least 10% bottoms when distilling peroxidizables. The flask can be rinsed with equal amounts of a solvent such as ethanol and considered as waste.
- F. Test for peroxides before distilling (even previously unopened ethers), and upon three months after opening List A and after one year of opening List B materials.

#### List A Peroxide hazard on storage

##### ***Test or dispose in 3 months***

Isopropyl ether;  
 Divinyl acetylene;  
 Vinylidene chloride;  
 Potassium metal;  
 Sodium amide

#### List B Peroxide hazard on concentration

Test or dispose in 12 months  
 Isopropyl ether;  
 Diethyl ether;  
 Divinyl acetylene;  
 Tetrahydrofuran;  
 Vinylidene chloride  
 Diacetylene;  
 Potassium metal;  
 Methyl acetylene;  
 Sodium amide;  
 Dioxane;  
 Acetal  
 Decahydronaphthalene (Decalin);  
 Tetrahydronaphthalene (Tetralin)  
 Ethylene glycol dimethyl ether;  
 Cyclohexene;  
 Vinyl ethers  
 Diethylene glycol dimethyl ether;

Dicyclopentadiene

## IV. Perchloric Acid

- A. Use goggles for eye protection whenever the acid is handled.
- B. In wet combustions with perchloric acid, treat the sample first with nitric acid to destroy easily oxidizable matter.
- C. Any procedure involving heating of the perchloric acid should be conducted in a ventilated hood equipped with water wash down.
- D. Perchloric acid hoods should be constructed of materials that are acid resistant, non-reactive, and impervious to perchloric acid, such as stainless steel.
- E. Organic material should not be stored in the perchloric hood.
- F. Do not allow perchloric acid to come in contact with strong dehydrating agents (concentrated sulfuric acid, anhydrous phosphorous pentoxide, etc.)
- G. Perchloric acid should be used only in standard analytical procedures from well recognized analytical texts. Researchers should take the properties and hazards of perchloric acid into consideration before use.
- H. If a laboratory hood or exhaust system has been exposed to perchloric acid heated above ambient temperature, tests should be conducted for explosive perchlorates before any inspection, cleaning, maintenance, or any other work is done on any part of the exhaust system or hood interior.

## V. Electrical Equipment

### A. General

1. Extension cords shall not be used as permanent wiring. Power strips that are equipped with an overcurrent protection device (circuit breaker) may be used. A power strip will not be plugged into another power strip.
2. Power cords on appliances should be inspected for damage regularly. Frayed or otherwise damaged cords should be replaced before using.
3. To eliminate exposed wiring, outlet boxes or junction boxes shall be provided with coverplates, and receptacles shall be provided with faceplates.
4. Ground-fault circuit interrupters should be used over sinks and in other wet areas. Ground-fault circuit interrupters should be actuated every 6 months to insure proper function.
5. Overcurrent protection devices (circuit breakers) on panels shall be individually labeled to indicate the equipment or location of equipment served by the device.

### B. Laboratory Refrigerators

Laboratory refrigerators used for storing or cooling flammable liquids will be in compliance with NFPA 45 - Fire Protection for Laboratories Using Chemicals, section 9.2.2.2 and A.9.2.2.2. Self-defrosting refrigerators, either modified or unmodified, will not be used for storing or cooling flammable liquids.

### C. Electrical apparatus

1. Unattended electrical heating equipment should be provided with a manual reset overtemperature shutoff switch, in addition to normal temperature controls.
2. Electric motors used to drive blenders or stirrers in open containers of flammable liquids or combustible liquids heated above their flash points should be suitable for Class I, Division 2 locations as defined in Article 500-5 of the National Electrical Code.
3. Electrical equipment and apparatus in cold rooms should be protected from moisture due to condensation.

### D. Exposed live current

Only experienced researchers who have been trained to work safely with test instruments and equipment on energized circuits may remove enclosures and guards to perform testing on energized electrical circuits.

## VI. Working Alone

Working with hazardous chemicals alone, especially after regular hours in a laboratory poses an additional risk to life and property. If an unanticipated event occurs and the researcher is incapacitated, available safety equipment, such as emergency showers, fire extinguishers, or antidotes, become worthless to provide emergency assistance to injured individuals or to mitigate the losses incurred. Each Laboratory needs to incorporate into its Individual Chemical Hygiene Plan a working alone procedure suited to the needs of the lab.

Suggestions for provisions that may be incorporated are:

1. Prohibiting working alone in laboratories, or prohibiting working alone for certain procedures.
2. Buddy System
  - a. Arrange with someone working nearby to periodically check on one another.
  - b. Arrange to take scheduled breaks with another researcher working nearby.
  - c. Arrange to periodically check in with another person telephonically, or through radios.
3. Remote monitoring by Web Cam or Closed Circuit Television.

## VII. Unattended Operations

- A. Unattended electrical heating equipment should be provided with a manual reset overtemperature shutoff switch, in addition to normal temperature controls.
- B. Unattended operations that depend on a flowing cooling water supply should be provided with a manual reset shutoff device that will shut off the heat supply upon loss of cooling water.
- C. Arrangements should be made, where possible, to periodically check unattended operations for abnormal conditions.
- D. For operations left running after normal hours, leave the lights on and leave a sign on the door indicating that an unattended procedure is in progress. The sign should also give emergency phone numbers in case of incident.

## VIII. Glassware

(from **Prudent Practices for Handling Hazardous Chemicals in Laboratories**. National Research Council. Washington, D.C.: National Academy Press, 1981. pp. 25-26.)

Accidents involving glassware are a leading cause of laboratory injuries.

1. Careful handling and storage procedures should be used to avoid damaging glassware. Damaged items should be discarded or repaired.
2. Adequate hand protection should be used when inserting glass tubing into rubber stoppers or corks, when inserting glass pipets into dispensing bulbs, or when placing rubber tubing on glass hose connections. Tubing should be fire polished or rounded and lubricated, and hands should be held close together to limit movement of glass should fracture occur. The use of plastic or metal connectors should be considered.
3. Glass-blowing operations should not be attempted unless proper annealing facilities are available.
4. Vacuum-jacketed glass apparatus should be handled with extreme care to prevent implosions. Equipment such as Dewar flasks should be taped or shielded. Only glassware designed for vacuum work should be used for that purpose.
5. Hand protection should be used when picking up broken glass. (Small pieces should be swept up with a brush into a dustpan.)
6. Proper instruction should be provided in the use of glass equipment designed for specialized tasks, which can represent unusual risks for the first-time user. (For example, separatory funnels containing volatile solvents can develop considerable pressure during use.)

## IX. Laboratory (Fume) Hood Usage

The Environmental Health and Safety Office will inspect laboratory hoods annually to determine proper function and adequate face velocity. The following are considerations for the laboratory hood users that will facilitate optimum hood performance.

- A. Environmental Health and Safety should be consulted for new hood installations.
- B. Laboratory hoods should not be relied upon to provide explosion (blast) protection unless specifically designed to do so.
- C. When perchloric acid is evaporated or heated above ambient temperatures in a laboratory hood, the hood should be specifically designed for perchloric acid.
- D. For new installations or modifications of existing installations, fixed electrical services and their controls should be located external to the hood and within easy reach.
- E. For new installations or modifications of existing installations, controls for other services (gas, air, water, etc.) should be located external to the hood and within easy reach.
- F. Sash openings should be kept to a minimum.
- G. Chemicals and apparatus should be located within the hood should be kept at least 6 inches behind the plane of the sash.
- H. Personnel should keep their faces outside the plane of the sash.
- I. Storage in hoods should be kept to an absolute minimum.
- J. Keep the hazardous materials at least six inches back from the plane of the sash to reduce the amount of chemicals drawn into the operator's breathing zone.

## X. Autoclaves

### What do I need to consider when decontaminating my samples using an autoclave?

Autoclaves must be used properly to effectively decontaminate potentially biohazardous materials. The following elements all contribute to autoclave effectiveness.

- Temperature: Adequate chamber temperature is at least 121°C (250°F).
- Time: Adequate autoclaving time is a minimum of 30 minutes, measured after the temperature of the material being sterilized reaches 121°C and 15 psi pressure. The tighter the autoclave is packed, the longer it will take to reach 121°C in the center of the load.
- Contact: Steam saturation of the load is essential for effective decontamination. Air pockets or insufficient steam supply will prevent adequate contact. To ensure adequate steam contact, leave autoclave bags partially open during autoclaving to allow steam to penetrate into the bag. Add a small amount of water inside the bag to help ensure heat transfer to the items being decontaminated (do not add water if it will cause biohazardous materials to splash out of the bag).
- Containers: Use leak-proof containers for items to be autoclaved. Place plastic bags inside a secondary container in the autoclave in case liquids leak out. Plastic or stainless steel containers are appropriate secondary containers. Make sure plastic bags and pans are autoclavable, to avoid having to clean up melted plastic.
- Indicators: Tape indicators can only verify that the autoclave has reached normal operating temperatures for decontamination. Most chemical indicators change color after being exposed to 121°C, but cannot measure the length of time spent at 121°C. Biological indicators (such as *Bacillus stearothermophilus* spore strips) and certain chemical indicators (such as Sterigage) verify that the autoclave reached adequate temperature for a long enough time to kill microorganisms.
- Use a chemical indicator in every load to monitor the effectiveness of individual autoclave runs (temperature only).
- Once a month, use either a biological indicator (such as *Bacillus stearothermophilus* spore strips) or a chemical indicator that measures both time and temperature (such as Sterigage). Bury the indicator in the center of the load to validate adequate steam penetration. Keep a log book to record the results.

### How do I safely use my autoclave?

Because an autoclave uses saturated steam under high pressure to achieve sterilizing temperatures, proper use is important to ensure operator safety. Prevent injuries when using the autoclave by observing the following guidelines:

- Wear heat resistant gloves, eye protection and a lab coat, especially when unloading the autoclave.
- Prevent steam burns and shattered glassware by making sure that the pressure in the autoclave chamber is near zero before opening the door at the end of a cycle. Slowly open the autoclave door and allow the steam to escape gradually.
- Allow items to cool for 10 minutes before removing them from the autoclave.
- Never put sealed containers in an autoclave. They can explode. Large bottles with narrow necks may also explode if filled too full of liquid.
- Never put solvents, volatile or corrosive chemicals (such as phenol, chloroform, bleach, etc.), or radioactive materials in an autoclave. Call EH&S at 2-5518 if you have questions about proper disposal of these materials.
- Inspect your autoclave components regularly. If you find a problem, notify your area mechanic. Do not operate an autoclave until it has been properly repaired

## XI. HYDROFLUORIC ACID

1. Wear neoprene gloves, sleeve covers, apron, foot covering, goggles, and face shield. Do not get in eyes, on skin, or on clothing. **EXERCISE EXTREME CAUTION.**
2. Work only in a fume hood. Do not breathe vapor, mist, or fumes.
3. Do not work alone.
4. Read the hazard alert section of the MSDS for HF.
5. Know the location of emergency shower and eyewash station.
6. Have first aid supplies at hand. (nebulizer and 1% Ca gluconate solution for inhalation burns, 25% Magnesium sulfate and ice or Ca gluconate ointment for skin exposure.)
7. If exposed:

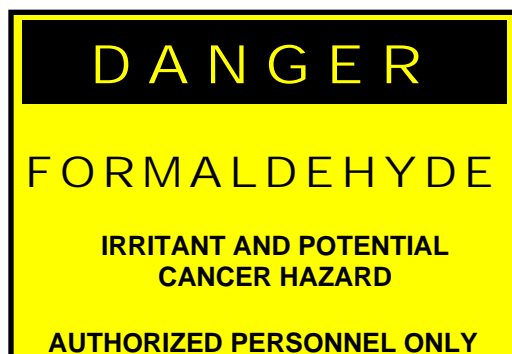
SKIN	EYES	INHALED	INGESTED
IMMEDIATELY flush with water. Remove contaminated clothing while in shower (goggles last). Call for emergency medical assistance. If no neutralizer is present continue flushing until medical assistance arrives. Apply 2.5% calcium gluconate gel to skin burns.	IMMEDIATELY flush with copious amounts of water, holding lids open. (Hold eyes open, flush 30 minutes, then instill 1% Ca Gluconate solution). Immediately call for medical assistance.	IMMEDIATELY give oxygen with nebulizer of 1% Ca Gluconate solution. Immediately call for medical assistance.	Do NOT induce vomiting. If victim conscious give 2-4 cups of milk or water. Get medical aid IMMEDIATELY. Speed is of the utmost importance.

Remove all clothing possibly involved. Take victim to hospital after flushing. Take hazard alert info sheet to hospital. Notify emergency room that HF burn case is on the way. If delay, soak burn area (not eyes) with 25% MgSO<sub>4</sub> solution (cold). Use ice to reduce pain (no analgesics).

8. CAUTION - Pain can be delayed; even if you suspect that you may have been exposed, treat as above and seek medical treatment.
9. IN CASE OF FIRE, use water spray to cool fire-exposed containers. Use agent appropriate for surrounding fire. Do not get water inside containers. For large fires use spray, fog, or alcohol-resistant foam. DO NOT use straight streams of water. For small fires use carbon dioxide, dry chemical, dry sand, or alcohol-resistant foam.
10. IN CASE OF SPILLS, neutralize spill with sodium bicarbonate. Assure adequate personal protection with clothing and respirator if needed. Use water spray to disperse the gas/vapor. Absorb spill using an absorbent, non-combustible material such as vermiculite or earth. Notify Environmental Health and Safety for assistance with large spills. Avoid runoff into storm drains and ditches.
11. Wash thoroughly after handling.
12. Keep all containers tightly sealed when not immediately in use.
13. Store in a cool, dry, well-ventilated area away from incompatible substances and metals.
14. DO NOT store in metal or glass containers.

## XII. FORMALDEHYDE and FORMALIN

(37% SOLUTION in METHYL ALCOHOL)



Formaldehyde is a colorless, flammable gas with a strong pungent odor. The aqueous solution formalin is 37-40% formaldehyde.

Exposure to formaldehyde vapors can be irritating to the eyes, nose, and upper respiratory tract. In certain individuals, repeated skin exposure to the liquid can cause sensitization that may result in allergic dermatitis.

Formaldehyde is anticipated to be a human carcinogen. Visit [www.ehs.ucr.edu](http://www.ehs.ucr.edu) for additional information

### Minimizing Exposure to Formaldehyde for Health Protection

- Read the MSDS sheet as it pertains to fire hazard, health hazard, exposure treatment, and spill control measures.
- **All work** must be done in a chemical fume hood.
- Wear protective clothing (lab coat, nitrile gloves, safety goggles/ face shield)
- Label all secondary containers with contents and hazard warnings “**TOXIC**” and “**FLAMMABLE**”
- Wash thoroughly after handling.
- Know the location of emergency shower and eye wash station and fire extinguisher.

### Special Safety Precautions

- If formalin contacts the body/ eyes, flush the affected area with water for at least 15 minutes and report the incident to your supervisor immediately, who will arrange for transport to Riverside Industrial Medical or US Health Works when medical treatment is indicated or requested.

EYES	SKIN	INGESTED	INHALED
Flush with water at least 15 minutes, holding lids open. Call for medical aid immediately.	Flush immediately with soap and water. Remove contaminated clothing. Get medical aid if irritation develops. Wash clothing before reuse, destroy contaminated shoes.	DO NOT INDUCE VOMITING. Only if victim is conscious and alert, give 2-4 cups of milk or water. Call for medical aid immediately.	Call for medical aid immediately. Remove to fresh air. Give artificial respiration if not breathing. Give oxygen if breathing is difficult.

- Contact lenses are best worn in areas where formalin ONLY when chemical splash goggles are used.
- **All solutions** of formalin and tissues preserved in formalin must be stored in tightly sealed containers to prevent leaks, spills, and airborne exposure. Keep away from heat, ignition sources, and strong oxidizers.
- **Don't** pour formalin waste into sinks, place in tightly sealed, labeled waste containers. Visit the EH&S web site to submit waste disposal requests (<http://www.ehs.ucr.edu/services/waste.html>) or fax request form to 827-5122
- Small spills of diluted formalin solutions must be cleaned up immediately. Cover the spill with paper towels or other absorbent material. **Don't** mop a spill. Using a dust pan, scoop the absorbed formalin into a plastic bag (wear gloves/ eye protection), double bag, seal, and label the waste. Contact EH&S for pickup

**Caution** If the spill is large, evacuate area immediately; close all doors to contain vapors, and call EH&S during normal business hours, or **9-1-1** after hours. Be prepared to give the location of spill, approximate amount involved, name and phone number. Have someone wait for emergency response personnel outside building and direct them to the spill area.

- **For fires** use dry chemical, carbon dioxide, water spray, or alcohol-resistant foam. Do not use straight streams of water. Collect contaminated water for proper disposal.

## Appendix B

# Safety and Hazard Information Sources at UCR

- A: *Prudent Practices for Handling Hazardous Chemicals in Laboratories*, 1981, National Research Council, Washington D.C.: National Academy Press. UCR Science Library QD51 N32x 1981
- B: *CRC Handbook of Laboratory Safety*, 5<sup>th</sup> ed., 2000, A.K. Furr, ed., Boca Raton, Fla.: CRC Press. UCR Science Library Ref QD51 H27 2000.
- C: *Improving Safety in the Chemical Laboratory: A Practical Guide*, 2<sup>nd</sup> ed., 1991, J. A. Young, ed., New York:Wiley. UCR Science Library QD51 I48 1991
- D: *Safe Storage of Laboratory Chemicals*, 1984, A. Pipetone, ed., New York:Wiley. UCR Science Library QD51 S22 1984 (1991 ed. in EH&S Office)
- E: *Chemical Compatibility/Segregation*, from the EH&S website, <http://www.ehs.ucr.edu/resources/wastecategory.pdf>
- F: *Hazardous Chemicals Desk Reference*, 4<sup>th</sup> ed., 1997, R.J. Lewis, Sr., ed., New York:Van Nostrand Reinhold. UCR Science Library Ref T55.3.H3 L49 1997.
- G: *Patty's Industrial Hygiene and Toxicology*, 4<sup>th</sup> ed., 1991, G. Clayton and F.E. Clayton, eds., New York:Wiley. UCR Science Library Ref RC967 P37 1991
- H: *Rapid Guide to Chemical Incompatibilities*, 1997, R.P. Pohanish and S. A. Greene, New York:Van Nostrand Reinhold. UCR Science Library Ref T55.3 H3 P644 1997
- I: *Toxic and Hazardous Industrial Chemicals Safety Manual*, 1988, The International Technical Information Institute, Tokyo:Japan. UCR Science Library Ref T55.3 H3 K34 1988
- J: *Handbook of Laboratory Health and Safety*, 2<sup>nd</sup> ed., 1995, R.S. Stricoff and D.B. Walters, New York:Wiley. UCR Science Library QD51 S92 1995
- K. *Dangerous Properties of Industrial Materials*, 7<sup>th</sup> ed., 1987, N.I. Sax and R.J. Lewis Sr., (eds). New York, Van Nostrand Reinhold. UCR Science Library T55.3.H3 S3 1988 Ref.
- L. *NIOSH Pocket Guide to chemical Hazards*, 1990, U.S. Dept. of Health and Human Services, Public Health Service, CDC, NIOSH. June, 1990.
- M. UCR Environmental Health and Safety (EH&S) office (951)827-5528, web site: <http://www.ehs.ucr.edu/> and for Material Safety Data Sheet and Chemical Safety Information: <http://www.ehs.ucr.edu/services/msds.html>

## Appendix C

# Health Hazard Definitions and Hazard Assessment

Appendix A to CCR Title 8 section 5194 Health Hazard Definitions <http://www.dir.ca.gov/Title8/5194a.html>

Although safety hazards related to the physical characteristics of a substance can be objectively defined in terms of testing requirements (e.g., flammability), health hazard definitions are less precise and more subjective. Health hazards may cause measurable changes in the body - such as decreased pulmonary function. These changes are generally indicated by the occurrence of signs and symptoms in the exposed employees such as shortness of breath, a non-measurable, subjective feeling. Employees exposed to such hazards must be apprised of both the changes in body function and the signs and symptoms that may occur to signal that change.

The determination of occupational health hazards is complicated by the fact that many of the effects or signs and symptoms occur commonly in non-occupationally exposed populations, so that effects of exposure are difficult to separate from normally occurring illnesses. Occasionally, a substance causes an effect that is rarely seen in the population at large, such as angiosarcomas caused by vinyl chloride exposure, thus making it easier to ascertain that the occupational exposure was the primary causative factor. More often, however, the effects are common, such as lung cancer. The situation is further complicated by the fact that most substances have not been adequately tested to determine their health hazard potential, and data do not exist to substantiate these effects.

There have been many attempts to categorize effects and to define them in various ways. Generally, the terms "acute" and "chronic" are used to delineate between effects on the basis of severity or duration. "Acute" effects usually occur rapidly as a result of short-term exposures, and are of short duration. "Chronic" effects generally occur as a result of long-term exposure, and are of long duration.

The acute effects referred to most frequently are those defined by the American National Standards Institute (ANSI) standard for Precautionary Labeling of Hazardous Industrial Chemicals (Z129.1- 1982) - irritation, corrosivity, sensitization and lethal dose. Although these are important health effects, they do not adequately cover the considerable range of acute effects that may occur as a result of occupational exposure, such as, for example, narcosis.

Similarly, the term chronic effect is often used to cover only carcinogenicity, teratogenicity, and mutagenicity. These effects are obviously a concern in the workplace, but again, do not adequately cover the considerable range of chronic effects, excluding, for example, blood dyscrasia (such as anemia), chronic bronchitis and liver atrophy.

The goal of defining precisely, in measurable terms, every possible health effect that may occur in the workplace as a result of substance exposures cannot realistically be accomplished. This does not negate the need for employees to be informed of such effects and protected from them.

At <http://www.dir.ca.gov/Title8/5194b.html> Appendix B of the California Code of Regulations outlines the principles and procedures of hazard assessment.

For purposes of this section, any substances that meet any of the following definitions, as determined by the criteria set forth in that Appendix B are health hazards:

1. **Carcinogen:** A substance is considered to be a carcinogen if:

- a. It has been evaluated by the International Agency for Research on Cancer (IARC) Monographs, Vols 1-34, and found to be a carcinogen or potential carcinogen; or
  - b. It is listed as a carcinogen or potential carcinogen in the Third Annual Report on Carcinogens published by the National Toxicology Program (NTP); or
  - c. It is regulated by OSHA as a carcinogen.
2. **Corrosive:** A substance that causes visible destruction of, or irreversible alterations in, living tissue by chemical action at the site of contact. For example, a substance is considered to be corrosive if, when tested on the intact skin of albino rabbits by the method described by the U.S. Department of Transportation in Appendix A to 49 CFR Part 173, it destroys or changes irreversibly the structure of the tissue at the site of contact following an exposure period of four hours. This term shall not refer to action on inanimate surfaces.
3. **Highly Toxic:** A substance falling within any of the following categories:
- a. 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.
  - b. 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.
  - c. A substance that has a median lethal concentration (LC50) in air of 200 parts per million by volume or less of gas or vapor, or 2 milligrams per liter or less of mist, fume, or dust, when administered by continuous inhalation for one hour (or less if death occurs within one hour) to albino rats weighing between 200 and 300 grams each.
4. **Irritant:** A substance that is not corrosive but that causes a reversible inflammatory effect on living tissue by chemical action at the site of contact. A substance is a skin irritant if, when tested on the intact skin of albino rabbits by the methods of 16 CFR 1500.41 for four hours exposure or by other appropriate techniques, it results in an empirical score of five or more. A substance is an eye irritant if so determined under the procedure listed in 16 CFR 1500.42 or other appropriate techniques.
5. **Sensitizer:** A substance that causes a substantial proportion of exposed people or animals to develop an allergic reaction in normal tissue after repeated exposure to the substance.
6. **Toxic:** A substance falling within any of the following categories:
- a. A substance that has a median lethal dose (LD50) of more than 50 milligrams per kilogram but not more than 500 milligrams per kilogram of body weight when administered orally to albino rats weighing between 200 and 300 grams each.
  - b. A substance that has a median lethal dose (LD50) of more than 200 milligrams per kilogram but not more than 1,000 milligrams per kilogram of body weight when administered by continuous contact for 24 hours (or less if death occurs within 24 hours) with the bare skin of albino rabbits weighing between two and three kilograms each.
  - c. A substance that has a median lethal concentration (LC50) in air of more than 200 parts per million but not more than 2,000 parts per million by volume of gas or vapor, or more than two

milligrams per liter but not more than 20 milligrams per liter of mist, fume, or dust, when administered by continuous inhalation for one hour (or less if death occurs within one hour) to albino rats weighing between 200 and 300 grams each.

7. **Target Organ Effects:** The following is a target organ categorization of effects that may occur, including examples of signs and symptoms and substances that have been found to cause such effects. These examples are presented to illustrate the range and diversity of effects and hazards found in the workplace, and the broad scope employers must consider in this area, but are not intended to be all-inclusive.
- a. **Hepatotoxins:** Substances that produce liver damage.  
Signs and Symptoms: Jaundice, liver enlargement.  
Substances: Carbon tetrachloride; nitrosamines.
  - b. **Nephrotoxins:** Substances that produce kidney damage.  
Signs and Symptoms: Edema, proteinuria.  
Substances: Halogenated hydrocarbons, uranium.
  - c. **Neurotoxins:** Substances that produce their primary toxic effects on the nervous system.  
Signs and Symptoms: Narcosis, behavioral changes, decreases in motor functions.  
Substances: Mercury, carbon disulfide.
  - d. **Agents that act on the blood or hematopoietic system, decrease hemoglobin function, deprive the body tissues of oxygen.**  
Signs and Symptoms: Cyanosis, loss of consciousness.  
Substances: Carbon monoxide, cyanides.
  - e. **Agents that damage the lung, substances which irritate or damage the pulmonary tissue.**  
Signs and Symptoms: Cough, tightness in chest, shortness of breath.  
Substances: Silica, asbestos.
  - f. **Reproductive toxins:** Substances that affect the reproductive capabilities including chromosomal damage (mutations) and effects on fetuses (teratogenesis).  
Signs and Symptoms: Birth defects, sterility.  
Substances: Lead, DBCP.
  - g. **Cutaneous hazards:** Substances that affect the dermal layer of the body.  
Signs and Symptoms: Defatting of the skin, rashes, irritation.  
Substances: Ketones, chlorinated compounds.
  - h. **Eye hazards:** Substances that affect the eye or visual capacity.  
Signs and Symptoms: Conjunctivitis, corneal damage.  
Substances: Organic solvents, acids.

## Hazard Determination

<http://www.dir.ca.gov/Title8/5194b.html>

The quality of a hazard communication program is largely dependent upon the adequacy and accuracy of the hazard determination. The hazard determination requirement of this standard is performance-oriented. Manufacturers, importers, and employers evaluating substances are not required to follow any specific methods for determining hazards, but they must be able to

demonstrate that they have adequately ascertained the hazards of the substances produced or imported in accordance with the criteria set forth in this Appendix.

Hazard evaluation is a process that relies heavily on the professional judgment of the evaluator, particularly in the area of chronic hazards. The performance orientation of the hazard determination does not diminish the duty of the manufacturer, importer or employer to conduct a thorough evaluation, examining all relevant data and producing a scientifically defensible evaluation. For purposes of this standard, the following criteria shall be used in making hazard determinations that meet the requirements of this standard.

### **1. Carcinogenicity:**

As described in subsection 5194 (d)(4) and (<http://www.dir.ca.gov/Title8/5194a.html>), a determination by the National Toxicology Program, the International Agency for Research on Cancer, or OSHA that a substance is a carcinogen or potential carcinogen will be considered conclusive evidence for purposes of this section.

### **2. Human Data:**

Where available, epidemiological studies and case reports of adverse health effects shall be considered in the evaluation.

### **3. Animal Data:**

Human evidence of health effects in exposed populations is generally not available for the majority of substances produced or used in the workplace. Therefore, the available results of toxicological testing in animal populations shall be used to predict the health effects that may be experienced by exposed workers. In particular, the definitions of certain acute hazards refer to specific animal testing results (see Appendix A <http://www.dir.ca.gov/Title8/5194a.html> ).

### **4. Adequacy and Reporting of Data:**

The results of any studies that are designed and conducted according to established scientific principles, and which report statistically significant conclusions regarding the health effects of a substance, shall be a sufficient basis for a hazard determination and reported on any material safety data sheet. The manufacturer, importer, or employer may also report the results of other scientifically valid studies that tend to refute the findings of hazard.

## **Appendix D Sample Posting for Designated Areas**

**WARNING:  
Designated Area  
for use of**

**\***

**\* Insert one or more as appropriate - "Select Carcinogens", "Reproductive Toxins", "Highly Toxic Chemicals"**

## Appendix E

### LAB SAFETY & ENVIRONMENTAL ASSESSMENT AUDIT

<b>GENERAL HOUSEKEEPING</b>		Y	N	*
1	<b>Hallways clear</b> of chemicals, combustibles, surplus equipment and debris for the required exit width. For a fire rated corridor this is 44" min. If the space allows, any materials in the hall must be <b>secured</b> along one side, so as to prevent the creation of a convoluted path.			
2	<b>Aisles</b> in the lab clear and wide, 36 in or more whenever possible.			
3	<b>Bench tops</b> clear, organized and maintained to eliminate harmful exposures/unsafe conditions. <b>Food and drink not consumed or stored</b> in chemical use areas or refrigerators.			
4	<b>Fume hood</b> chemical storage is minimized and not blocking airflow to slots in the baffle. Use is generally six inches from front edge and sash below 18" or certification mark.			
5	<b>Shelves</b> are relatively clean &, well organized.			
6	<b>Storage cabinets</b> are clean & well organized. Within one room, in excess of 10 gal of flammable liquids are stored in approved flammable storage cabinets.			
<b>GENERAL LABORATORY SIGNS</b>				
7	Are <b>eyewash/safety shower</b> visible within service area or signs are posted to location?			
8	Are disaster & <b>emergency</b> response lists <b>posted and visible</b> ?			
9	Are the <b>doors</b> labeled with up to date, <b>responsible party</b> & hazards signs? (check the placard)			
10	Are <b>OSHA safety &amp; health protection on the job &amp; In case of injury</b> posters in a common area?			
11	Are " <b>Danger: High Voltage</b> " signs posted when appropriate (electrophoresis, etc.)?			
12	Are " <b>lasers are in use</b> " caution signs posted (where appropriate)?			

**HAZARDOUS MATERIALS STORAGE AREA SIGNS**

13 Do all flammable storage locations have “**FLAMMABLES KEEP FIRE AWAY**” signs posted?

--	--	--

14 Do all hazardous material storage locations have the appropriate **hazard warning signs** posted?

( Corrosive ( acid &  base);  Oxidizer;  Toxic;  Highly Toxic or Poisons;  Biohazard;  
 Radioactive)

--	--	--

15 When Cal/OSHA regulated **Carcinogens** are stored and/or used, is the designated use area posted with the notice of use? (commonly used are: methylene chloride (a.k.a. dichloromethane, benzene & formaldehyde for complete list:  
[www.dir.ca.gov/title8v/sb7g16a110.html](http://www.dir.ca.gov/title8v/sb7g16a110.html))

--	--	--

16 Are **radiation signs** and labels posted where **radioactive materials** are used and/or stored?

--	--	--

17 Are **biohazards** signs and labels posted where **biohazardous materials** are used and/or stored?

--	--	--

18 Are **all containers labeled with complete chemical names** and associated **hazards** or an **abbreviation system** posted with this information in every room where these abbreviations are used on containers?

--	--	--

**SEISMIC ISSUES**

19 Are all **Cabinets**, shelf units (> 42”) and equipment seismically **restrained**?

--	--	--

20 Do all **shelves** have **seismic lips** or other restraints?

--	--	--

21 Are **flexible hose connections** used for all lab equipment and apparatus to connect to utilities?

--	--	--

**CHEMICAL STORAGE**

22 Are all chemicals segregated by hazard class?

*Circle these classes that stored together:*

- separate **oxidizers** from *organics, reducing reagents and combustibles*;
- separate powerful **reducing agents** from *readily reduced substrates*;
- pyrophoric** compounds from *flammables*;
- acids** from *bases*,

--	--	--

23	Is the use of <b>secondary containment</b> for inventory common? (Corrosion resistant storage trays or tubs that can hold 110 % of the volume of the largest liquid container. For solids, select a convenient size.)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
24	All acids and caustics stored <b>below eye level</b> wherever practical?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
25	All <b>pesticide storage</b> cabinets/areas are labeled as such, locked with MSDS readily available?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
26	<b>Controlled substances</b> in locked location? (DEA regulated materials)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
27	Are all compressed <b>gas</b> cylinders <b>segregated</b> into hazard classes and stored separate from other chemicals. Empty cylinders clearly marked.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
28	Are all <b>compressed gas cylinders</b> stored upright, <b>secured</b> from falling and checked for both current use and functioning valves at least annually?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
29	<b>ARE ALL FLAMMABLE MATERIALS STORED AWAY FROM IGNITION SOURCES?</b>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
30	<b>NO FLAMMABLE LIQUIDS ARE BOTTOM DISPENSED FROM NON-FLASH ARRESTOR, NON-SELF-CLOSING BOTTOM, GRAVITY DISPENSING CONTAINER, RIGHT?</b>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
31	All <b>chemical storage cabinets</b> are <b>vented</b> to the fume hood duct exhaust?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
32	All <b>time sensitive materials</b> (such as peroxide formers) are marked with the date when they arrive, when they are opened and are not retained past the expiration date?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>ELECTRICAL EQUIPMENT</b>				
40	Only <b>grounded or double-insulated</b> electrical equipment is used?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
41	<b>Extension cords</b> are all used on a temporary basis only (< 8hr), except power strips?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
42	There are no <b>trip-hazards</b> in walkways or <b>frayed cords</b> (exposed live current wires), right?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>HAZARDOUS WASTE</b>				
44	All chemical, biological and radioactive hazardous wastes located and managed to <b>prevent cross-contamination</b> ?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

45	All <b>liquids wastes</b> are kept in <b>secondary containers</b> , gray tubs?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
46	All hazardous wastes are kept in containers with <b>positive closures</b> (screw-top)? (no beakers, etc)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
47	All hazardous wastes containers are <b>kept closed</b> except when actively adding waste?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
48	All <b>chemical wastes</b> are <b>segregated</b> by hazard class, right?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
49	All <b>chemical wastes</b> are <b>properly labeled</b> as waste with chemical names and type of hazard and satellite accumulation area start dates using the UCR hazardous waste labels?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
50	No waste is accumulated for longer than <b>6 months</b> , right?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
51	All <b>biohazardous</b> waste is properly labeled and disposed, right? <ul style="list-style-type: none"> <li>All bags labeled with room and date and stored in a rigid, leadproof, container with tight fitting lid.</li> <li>No bags stored for 1 week or more.</li> </ul>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
52	All biohazards and medical waste is collected in <b>RED bags</b> and containers, right?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
53	All <b>radioactive</b> wastes are segregated, labeled with isotope and radiation sign? <ul style="list-style-type: none"> <li>If chemicals are in the same container the hazardous waste label is posted as well, right?</li> </ul>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
54	All <b>sharps waste</b> is properly disposed in rigid containers that do not allow for sharp edges or points to protrude, right?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>ENGINEERING CONTROLS</b>				
55	<b>Room ventilation</b> vents are clear of obstructions, air quality is adequate, the pressure in labs or rooms with hazardous materials is negative to the halls and offices, right?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
56	All <b>fume hoods</b> are <b>certified</b> within last year and a functioning air flow indicator is present, yes?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
57	<b>Biological safety cabinets</b> - <b>certified</b> within last year.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>PERSONAL PROTECTIVE EQUIPMENT</b>				
58	Is <b>safety eyewear</b> (safety glasses, goggles, laser goggles, face shield, etc.) available, stored properly & <b>worn</b> when in the lab?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
59	Are <b>gloves</b> appropriate to the task available & reusable gloves inspected before each use, properly stored?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

<b>60</b>	Lab coats & aprons available & worn when needed.			
-----------	--	--	--	--

<b>61</b>	Respiratory protection available when engineering controls cannot be used, stored properly, and worn when needed.			
-----------	---	--	--	--

<b>62</b>	All appropriate personal protective equipment available, worn when needed and <b>open-toed footwear is forbidden</b> in the lab.			
-----------	--	--	--	--

**EMERGENCY EQUIPMENT & SUPPLIES**

<b>63</b>	Safety shower/eyewash located within 10 seconds travel from hazardous materials use areas and the access is kept clear.			
-----------	---	--	--	--

<b>64</b>	Safety shower/eyewash tested and recorded <b>monthly</b> by physical plant			
-----------	--	--	--	--

<b>65</b>	Fire extinguishers easy to access, and inspected monthly, or at more frequent intervals, and serviced at least annually. CCR 8, §1922(a)(4)			
-----------	---	--	--	--

<b>66</b>	Circuit breaker panel at least 30 in. clear access, circuits labeled.			
-----------	---	--	--	--

<b>67</b>	Spill kits present, appropriate (e.g., the use of hydrofluoric acid requires special material), and kept well supplied.			
-----------	---	--	--	--

<b>68</b>	First aid kits present & well supplied. Materials with limited shelf-life should be removed when expired. (No ammonia inhalant ampoules.)			
-----------	---	--	--	--

<b>69</b>	Telephone access for emergencies within the area at all hours.			
-----------	--	--	--	--

**DOCUMENTS that are required by law to be available to lab personnel**

- The Departmental Injury & Illness Prevention Program
- The Departmental Chemical Hygiene Plan
  - o The written procedures for using chemical safely (Standard Operating Procedures SOPs)
- Records of safety training provided in the department (with the employees signature)
- Exposure control plan for bloodborne pathogens has been completed if using, blood, blood products, human tissue or human cells or cell lines.