



SOUTHERN OREGON UNIVERSITY

SCIENCE HALL

CHEMICAL HYGIENE PLAN

Occupational Exposure to
Hazardous Chemicals in Laboratories

Reference OAR437 Division 2 subdivision 2
and 29 CFR 1910.1450

Current Revision May 2022

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Revised Yearly

FORWARD

On January 31, 1990 the Occupational Safety and Health Administration (OSHA) promulgated a final standard (29 CFR 1910.1450) for occupational exposure to hazardous chemicals in laboratories. Included in the standard, which became effective on May 1, 1991, is a requirement for all employers covered by the standard to develop and carry out a Chemical Hygiene Plan (CHP). The Southern Oregon University (SOU) Science Hall is covered by the standard.

A CHP is a written plan to protect employees from chemical hazards in the laboratory. A CHP must include procedures to assure safety and health in the laboratories, criteria for the implementation of control measures, provisions for training and information dissemination, provisions for medical consultation, designation of responsible personnel to maintain safe conditions, and identification of particularly hazardous substances (i.e., labeling). Since we annually purchase many different chemicals at SOU, this is an important undertaking.

This document describes the Chemical Hygiene Plan developed for SOU Science Hall. For definitions in the CHP refer to Appendix A--Laboratory Standard (29 CFR 1910.1450). All laboratory personnel must know and follow the provisions outlined in this plan. In addition, employees are expected to develop safe personal chemical hygiene habits aimed at minimizing chemical exposures to themselves and coworkers. This CHP will be reviewed, evaluated and updated at least annually and must be made readily available to employees, their representatives and any representative of the Assistant Secretary of Labor for Oregon OSHA.

While the legal requirements outlined above and specified in this plan may appear difficult and possibly obstructive to science at SOU, they are neither. A fairly simple set of procedures that many SOU researchers use presently are now required by law. The major emphasis will be an increase in documentation and a greater emphasis on training.

The State (OR-OSHA) may monitor SOU laboratory operations periodically and, if the Chemical Hygiene Plan is not being followed, the University could be fined substantially. More importantly, following the CHP will assure that all SOU employees work in a safe and healthy setting.

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Appendices

The Standards and chemical lists below are also available on the web at www.osha.gov.

Appendix A – OSHA Standards

Laboratory Standard and Appendix A: 29 CFR 1910.1450

Laboratory Standard:

https://www.osha.gov/pls/oshaweb/owadisp.show_document?p_id=10106&p_table=STANDARDS

Appendix A:

https://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=standards&p_id=10107

Hazard Communication Standard and Appendix A: 29 CFR 1910.1200

https://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=standards&p_id=10099

ANSI Eye and Face Protection Standard: 29 CFR 1910.133

ANSI / ISEA Z358.1-2014 and D3 for splash protection

https://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=STANDARDS&p_id=9778

Appendix B - Chemical Lists

OSHA Subpart Z: Table of Air Contaminants – PELs

OSHA Subpart Z: Substances with a Specific Standard

<https://www.osha.gov/SLTC/hazardoustoxicsubstances/index.html>

https://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=standards&p_id=9992

CDC, National Institute for Occupational Safety and Health (NIOSH) - Carcinogen List

<https://www.cdc.gov/niosh/topics/cancer/npotocca.html>

IARC, International Agency for Research on Cancer (IARC) Carcinogenic Risks to Humans

<http://monographs.iarc.fr/ENG/Classification/>

Appendix C - SOU CHP Meeting Minutes

Stored on (Box:) STEM General Information > CHEMICAL HYGIENE & SAFETY > Chemical Hygiene Plan > CHP Meeting Minutes

LABORATORY CHEMICAL HYGIENE PLAN

1 CHEMICAL HYGIENE RESPONSIBILITIES

- 1.1 Director of Science Technology Engineering and Math (STEM)
The Director of STEM has the ultimate responsibility for chemical hygiene throughout the science programs and, with the assistance of staff and faculty, provides ongoing support for chemical hygiene at SOU.
- 1.2 Chemical Hygiene Officer
The Chemical Hygiene Officer is responsible for the annual review, evaluation, and updating of the provisions of this Chemical Hygiene Plan.
- 1.3 Chemical Hygiene Committee
The Chemical Hygiene Committee is responsible for providing technical guidance in the annual review, evaluation and updating of the Chemical Hygiene Plan. The committee is composed of the following members:

JOB TITLE	DEPARTMENT or PROGRAM
Chemical Hygiene Officer	STEM
Representative	Environmental Health and Safety (EHS)
STEM Director	STEM
Staff Representative	Biology
Staff Representative	Chemistry
Faculty Representative	Biology
Faculty Representative	Chemistry/Physics
Faculty Representative	Environmental Science

2 EMPLOYEE TRAINING

2.1 Training of Employees

All laboratory employees exposed or potentially exposed to hazardous substances must participate in chemical hygiene training.

A representative of the Science Hall Office or a Program designee will provide the names of new employees affected by SOU's Science Hall Chemical Hygiene Plan to EHS. At the time of initial assignment, a new employee receives the required training from EHS. Refresher information is provided as needed.

2.2 Elements of the Program

The training program will cover the following areas:

- 1) Explanation of OAR 437 Div. 2 (29 CFR 1910.1450): Occupational Exposure to Hazardous Chemicals in Laboratories. Appendix A
- 2) How to obtain and use the Chemical Hygiene Plan.
- 3) Training on applicable details of the CHP.
- 4) Location and availability of reference materials, Safety Data Sheets (SDSs), and lists of hazardous substances with applicable permissible exposure limits. (PEL) Appendix B

2.3 Training on New Hazards

Whenever an employee orders a new chemical, the employee is responsible for looking up the SDS and/or consulting the available safety information. Lab supervisors will provide training for their employees if appropriate.

2.4 Training Records

Training records are maintained at EHS.

2.5 Reference Materials

The following is a partial list of reference materials and their locations. More resources are available on line.

Reference	Location
Chemical Hygiene Plan	https://inside.sou.edu/ehs/index.html (Box:) STEM General Information > CHEMICAL HYGIENE AND SAFETY > Chemical Hygiene Plan
Safety Data Sheets (SDS's)	https://inside.sou.edu/ehs/index.html click MSDS link

3 RECORDKEEPING

3.1 Record Types

EHS maintains Employee exposure monitoring records (section 5).
Human Resources maintain Employee medical records (section 6).

EHS maintains Employee OSHA required training records (section 2) and Annual fume hood survey records (section 10).

3.2 OSHA Standard

EHS assures that such records are kept, transferred, and made available in accordance with 29 CFR 1910.20--OSHA Recordkeeping Standard. (Appendix A)

4 HAZARD IDENTIFICATION

4.1 Labels on Incoming Containers

Suppliers of chemical products must label their materials in accordance with the OSHA Hazard Communication Standard [29 CFR 1910.1200 (Appendix A)]. As a minimum, the following information must appear on containers of hazardous substances shipped to SOU:

- 1) "Identity" of the material.
- 2) Hazard warnings.
- 3) Name and address of the manufacturer or importer.

No container is accepted unless it is properly labeled with the required information.

4.2 Safety Data Sheets for Incoming Chemicals

Safety Data Sheets (SDS) are obtained from manufacturers and/or distributors for all chemicals purchased.

SDSs for hazardous materials are available at SOU MSDS online,
<https://msdsmanagement.msdsonline.com/a282f150-053b-487f-8bb3-bafee63e998d/ebinder/?nas=True>

4.3 Laboratory Generated Chemicals

The following provisions apply to chemical substances developed in the laboratory:

- 1) If the composition of the chemical substance is known, the Lab Supervisor (SOU employees in charge of lab activities) determines if it is a hazardous chemical as defined by the OSHA Hazard Communication Standard. If the chemical is determined to be hazardous, the Lab Supervisor provides appropriate training as required by this CHP (see section 2--Employee Training).
- 2) If the chemical produced is a byproduct whose composition is not known, it is assumed that the substance is hazardous and subject to the CHP.
- 3) If the chemical substance is produced for another user outside of the laboratory, the Lab Supervisor complies with the OSHA Hazard Communication Standard 29 CFR 1910.1200 including the requirements for preparation of material safety data sheets and labeling.

5 EMPLOYEE EXPOSURE

5.1 Permissible Exposure Limits

Reasonable precaution is taken by Lab Supervisors (SOU employees in charge of lab activities) to limit exposure of OSHA regulated substances. Tables to help laboratory employees to identify and obtain the permissible exposure limits (PEL's) for OSHA regulated substances are available in the Chemical Hygiene Plan Appendix B or at <https://www.osha.gov/law-regs.html>. PEL's are specified in 29 CFR part 1910, subpart Z.

5.2 Employee Exposure Determination

Initial Monitoring

EHS monitors an employee's exposure to any substance regulated by an OSHA standard only if there is reason to believe that exposure levels for that substance routinely exceed the PEL for that substance. The standard for that substance is used to determine the method for monitoring. If there is no cause to suspect a hazard or an exposure, no monitoring is done.

Some circumstances which might prompt exposure monitoring include:

- 1) The manner in which a chemical procedure or operation is conducted, i.e. use of open vessel instead of a closed system.
- 2) The use of a procedure that involves significant quantities or that is performed repeatedly over an extended period of time.
- 3) Accidental breakage of a hazardous material container.
- 4) Caustic splash to eyes, face, or body.
- 5) Signs and symptoms of exposure, e.g. odor, taste, skin or eye irritation, shortness of breath, nausea, headache, etc., which are experienced by an employee.

An employee will request monitoring by filling out an Exposure Monitoring Form. Monitoring forms can be found in appendix C of the Chemical Hygiene Plan. Exposure monitoring will be evaluated by EHS to see if monitoring is indicated.

Periodic Monitoring

If monitoring is performed and this initial monitoring shows no evidence of exposure, the monitoring is discontinued. If initial monitoring indicates an exposure, steps are taken by SOU or their representative to reduce the exposure to permissible limits. Monitoring is performed periodically to verify that the steps to reduce the exposure have been effective.

Termination of Monitoring

Monitoring is terminated after complying with the applicable standard for the hazardous material.

Monitoring Results

Results of exposure monitoring are given to the employee within 15 working days after their receipt, and are maintained on file at EHS for 30 years after an employee's last day of employment.

6 MEDICAL CONSULTATION

6.1 Circumstances Leading to Medical Consultation

Laboratory employees are provided the opportunity for medical attention when:

- 1) The employee exhibits signs and symptoms associated with chemicals to which he/she has been exposed.
- 2) The employee is subjected to events such as a spill, leak, explosion, or other occurrence where there is a likelihood of a significant exposure to hazardous chemicals.

6.2 Routine Exposures over PEL's for Substance Specific Standards

If air monitoring results indicate that laboratory employee exposures are above the limits prescribed for an OSHA regulated substance, then medical monitoring is provided as required in the applicable standard for the regulated substance.

6.3 Medical Examination

Medical examinations are provided by licensed physicians at no cost to employees, and are scheduled at a reasonable time for the employee.

6.4 Information Provided to the Physician

SOU shall provide the following information to the physician:

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

6.5 Medical Examination Results

The physician informs the employee of the results of the examination and provides the personnel officer with a written opinion.

Doctors' written opinions are retained in the employee's personnel file. Faculty personnel files are kept forever and staff files are kept for 75 years after an employee's last day of employment.

7 SPECIFIC LABORATORY AREAS

7.1 Requirements for Designated Areas

Laboratory areas that have special or unusual hazards must be posted as a designated area. A Designated Area may be the entire laboratory, an area of a laboratory, or a device such as a laboratory hood. All Designated Areas must be clearly marked with a sign.

7.2 Warning Signs and Labels

- 1) Laboratory areas that have special or unusual hazards should be posted with warning signs. (Standard signs and symbols have been established for a number of special situations, such as radioactivity hazards, biological hazards, and laser operations.) Visit <https://www.osha.gov/dsg/hazcom/index.html>
- 2) Signs must be posted to show the locations of safety showers, eyewash stations,

- exits, fire extinguishers, and personal protective equipment.
- 3) Waste containers must be labeled for the type of waste that can be safely deposited.

7.3 Food Handling

- 1) SOU employees do not eat, drink, smoke, or apply cosmetics or nasal decongestants in any laboratory while using chemicals. After working with chemicals, wash hands thoroughly before performing these activities.
- 2) Laboratory areas where food is permitted are prominently marked with a sign (e.g., EATING AREA--NO CHEMICALS).
- 3) Glassware or utensils that have been used for laboratory operations are never used to prepare or consume food or beverages.
- 4) Laboratory refrigerators, freezers, ice chests, or cold rooms, are not used for food storage. Separate equipment should be dedicated to either food or chemical storage and prominently labeled. (e.g. CHEMICALS STORAGE – NO FOOD)

8 LABORATORY PROTECTIVE EQUIPMENT & ACCIDENT REPORTING

8.1 General Principles

The need for specific types of safety equipment is dependent upon the types of operations and the nature and quantity of the materials in use and must be assessed on a case by case basis.

All laboratories in which chemicals are used have **fire extinguishers** and **eyewash fountains**. **Safety showers are present when appropriate**. In addition, personal protective equipment such as **eye and face protection, gloves, respiratory protection, and other protective clothing** is worn **when appropriate**.

8.2 Portable Fire Extinguishers

Portable fire extinguishers suitable to the conditions and hazards involved are provided and maintained in an effective operating condition.

Portable fire extinguishers are conspicuously located and readily accessible. Extinguishers are not obstructed or obscured from view.

Portable fire extinguishers receive maintenance service at least once a year and a written record is kept showing the maintenance or recharging date. EHS and Facilities Management and Planning are responsible for this maintenance.

8.3 Safety Showers and Eyewash Fountains

Safety showers and eyewash fountains are clearly marked. Employees must be familiar with their location and use.

Access to safety showers and eyewash fountains must be free of clutter at all times. Showers will be operated and inspected annually by EHS.

Eye washes need to be operated and inspected according to the manufacturer's specifications. Eye wash stations will be operated and inspected weekly by Science Building Personnel.

8.4 Other Emergency Equipment

- 1) **Emergency Gas Shut Off Buttons** are provided in all rooms that are appropriate. They are maintained and inspected according to the manufacturer's specifications.
- 2) **An Automatic External Defibrillator (AED)** is provided for the building. The AED will be inspected monthly by EHS.

8.5 Fire Alarm Plan

- 1) When you hear a fire alarm, move quickly to the nearest exit. Faculty should exit with their students. As faculty and staff exit, please announce the fire alarm to any lingering individuals and direct them to exit with you. If someone remains, note for the fireman who and where they were inside.
- 2) Each program will have an exit strategy, a plan to shut down the labs quickly and get out in under two minutes. Hoods will operate briefly at the onset of the alarm to give everyone one minute to shut the hoods and exit the lab.
- 3) Everyone should exit the building through the nearest exit. Everyone should gather in the grassy area in front of the building, clearing the access road for emergency vehicles.
- 4) Once the all clear is sounded, you should wait 5 minutes before entering classrooms and 10 minutes before entering labs to give the air time to refresh.

8.6 Accident Reporting

- 1) Emergency telephone numbers to be called in the event of fire, accident, flood, or hazardous chemical spill are posted prominently in each laboratory.
- 2) All accidents must be reported to supervisors, and an SOU Work Related Injury/Illness Form must be filled out. If medical care is anticipated a SAIF 801 form is also completed.
- 3) EHS is notified of all accidents. EHS investigates all accidents to establish cause and to make recommendations to improve safety.

9 PERSONAL PROTECTIVE EQUIPMENT

9.1 Eye and Face Protection

Eye and Face Protection must be worn in the laboratory whenever there is a reasonable probability of an injury that could be prevented by their use.

All eye and face protection must be in accordance with the most recent OSHA requirement for Eye and Face Protection. In 2016, ANSI / ISEA Z358.1-2014 and D3 for splash protection.

9.2 Glove Protection

Chemical-resistant gloves are available for use when hands may come in contact with hazardous chemicals. Guides to choose the appropriate gloves for specific chemicals are available in the Biology & Chemistry Prep Rooms and the Chemistry Storeroom.

Resources are also available on line.

Inspect gloves immediately after each use.
Discard disposable, damaged or deteriorated gloves.

9.3 Respirators

Employees are provided the proper respiratory equipment when their use is necessary to maintain exposure below permissible exposure limits. Users that are required to wear respirators due to exposure will have a medical evaluation and be fit tested. For voluntary usage, no medical evaluation or fitting is required and the individual may use a mask similar to N95. For required respirator usage, the individual must comply with the OSHA guidelines listed.

Respirators are selected and used in accordance with the requirements of 29 CFR 1910.134--OSHA Respiratory Protection Standard. Minimum requirements include the following:

- 1) Respirators are **selected** on the basis of hazards to which the worker is exposed.
- 2) The user is instructed and trained in the proper use of respirators and their limitations.
- 3) Where practical, the respirators are **assigned to individual workers** for their exclusive use.
- 4) Respirators are regularly **cleaned and disinfected**. Those issued to more than one worker, are thoroughly cleaned and disinfected after each use.
- 5) Respirators are stored in a convenient, clean, and sanitary location.
- 6) Respirators used routinely are **inspected** during cleaning. Worn or deteriorated parts are replaced. Respirators for emergency use are thoroughly inspected at least once a month and after each use.
- 7) Appropriate **surveillance of work area conditions** and degree of employee exposure or stress is maintained.
- 8) There are regular **inspections and evaluations** to determine the programs continued effectiveness.
- 9) Persons are not to be assigned to tasks requiring use of respirators unless it has been determined that they are **physically able** to perform the work and use the equipment.
- 10) **Approved or accepted respirators** are used when they are needed. The respirator furnished provides adequate respiratory protection against a particular hazard for which it is designed in accordance with National Institute of Occupational Safety & Health (NIOSH) standards.

10 FUME HOOD PROGRAM

10.1 Safe Use of Fume Hoods.

Employees apply the following safe practices when using a fume hood:

- 1) **Maintain current knowledge about** the physical and chemical properties of the materials you work with by consulting the Safety Data Sheets and other available references.
- 2) Assume that a fume hood under alarm is **NOT** operating properly.

- 3) Before using, check the **fume hood's operating indicator light**. If there are questions about proper performance, resolve them before using the hood. When in alarm the hood is to be closed and not used.
- 4) Based upon the hazards posed by the substances being manipulated determine whether the hood is **adequate for the work** being completed.
- 5) Perform all chemical manipulations at least **six inches inside** the hood face.
- 6) Locate all laboratory equipment **as far back in the hood** as practical and make certain that hood exhaust slots are not blocked.
- 7) **Elevate large pieces** of equipment off the work surface to reduce turbulence and improve airflow characteristics, thus optimizing hood performance.
- 8) **Avoid cross drafts** in front of the hood from pedestrian traffic in the vicinity of the hood. Rapid movements by the user also tend to disrupt the airflow into the hood and reduce the containment provided.
- 9) **Minimize chemical storage** in the fume hood to avoid impairing its effectiveness.
- 10) **Do not allow paper**, disposable gloves, or other debris to be drawn into the slots at the rear of the hood.
- 11) **Avoid placing your head** inside the hood while performing chemical manipulations.
- 12) If time, shut off burners and close sashes before leaving in an emergency. During any emergency, Fume Hoods will be closed for safety reasons.

10.2 Annual Hood Performance Surveys

Hood face velocity surveys are conducted yearly by EHS or their designee. All movable sashes are marked at the locations where they provide an average of 80 linear feet per minute capture velocity at the hood face. Copies of the annual fume hood surveys are kept in the EHS office. The people responsible for correcting deficiencies in fume hood performance are Facilities Management and Planning.

11 SAFE WORK PRACTICES IN LABORATORIES

11.1 Safe Work Practices

- 1) Know the safety rules and procedures that apply to the work that is being done. Review the potential hazards (e.g., physical, chemical, biological) and appropriate safety precautions before beginning any new operation.
- 2) Know the location of and how to use the emergency equipment as well as how to obtain additional help in an emergency.
- 3) Know the types of protective equipment available and use the proper type for each job.
- 4) Be alert to unsafe conditions and bring them to the attention of the Building Manager, Lab Supervisor, or their designee immediately so that corrections can be made as soon as possible.
- 5) Avoid hazards to the environment by following DEQ guidelines for waste disposal practices.
- 6) Be certain all chemicals are correctly and clearly labeled.
- 7) Horseplay is forbidden in the laboratory.
- 8) Use equipment only for its designed purpose.

- 9) Position and clamp reaction apparatus in order to permit manipulation without the need to move the apparatus until the entire reaction is completed.
 - 10) Secondary containers of chemicals are labeled. (Containers that are intended only for the immediate use of the employee who performed the transfer are exempt from labeling requirements.)
 - 11) Labels are informative, durable, and, identify contents, and initials of the person who prepared the container.
- 11.2 Health and Hygiene
- 1) Wear eye and face protection whenever it is appropriate.
 - 2) Use protective apparel, including face shields, gloves, and other special clothing or footwear as needed. Sandals or exposed feet are prohibited in laboratories.
 - 3) Confine long hair and loose clothing when in the laboratory.
 - 4) Avoid exposure to gases, vapors, and aerosols. Use appropriate safety equipment and work in a fume hood whenever such exposure is likely.
- 11.3 Housekeeping
- 1) Work areas should be kept clean and free from obstructions.
 - 2) Wastes should be deposited in appropriate receptacles.
 - 3) Spilled chemicals should be cleaned up immediately and disposed of properly.
 - 4) Containers and chemical wastes are disposed of promptly, by using appropriate procedures. Such materials, as well as chemicals that are no longer needed, should not accumulate in the laboratory.
 - 5) Floors should be cleaned regularly.
 - 6) Stairways and hallways will not be used as storage areas.
 - 7) Do not block access to exits, emergency equipment, or controls.
- 11.4 Guarding for Safety
- All mechanical equipment is adequately furnished with guards that prevent access to live electrical connections or moving parts.
- 11.5 Shielding for Safety
- 1) Safety shielding is used for any operation having potential for explosion such as whenever a:
 - a) Reaction is carried out under non-ambient conditions.
 - b) Reaction is attempted for the first time.
 - c) Familiar reaction is carried out on a larger than usual scale (e.g., 5-10 times more material).
 - 2) Shields must be placed so that all personnel in the area are protected from hazard.
- 11.6 Glassware, Sharps and Needles
- 1) All labs using glassware have a clearly labeled broken glass container. Broken glassware is immediately disposed of in this container.
 - 2) High-vacuum evacuated glass apparatus is shielded to contain chemicals and glass fragments should implosion occur.
 - 3) Glass-blowing operations should not be attempted unless proper annealing

facilities are available.

- 4) When inserting glass tubing into rubber stoppers or hoses lubricate the glass and rubber with glycerol and protect hands with gloves.
 - 5) All labs using sharps (needles, razor blades, etc.) have a clearly labeled sharps container. Used sharps are disposed of in this container.
 - 6) Once full the sharps containers are transported to the Student Health Center where they are included in the regular medical waste disposal stream.
- 11.7 Unattended Operations
When conducting unattended operations, it is essential to plan for interruptions in utility services such as electricity, water, and inert-gas.
- 11.8 Systems under Pressure
- 1) Reactions should never be carried out in, nor heat applied to, an apparatus that is a closed system unless it is designed and tested to withstand pressure. Pressurized apparatus should be equipped with relief devices.
 - 2) If the reaction cannot be opened directly to the air, an inert gas purge and bubbler system should be used to avoid pressure buildup.

12 SPECIFIC CHEMICAL GROUPS

12.1 Handling Chemical Materials

- 1) Always consult SDS's before working with new materials.
- 2) Adequate quantities of spill control materials should be readily available.
- 3) Chemicals (especially liquids) are transported in closed containers.

12.2 Flammable Materials

- 1) For fluids, correctly interpret hazards by evaluating such properties as flash point, auto-ignition temperature, explosive limits, vapor density, and compatibility with other reagents.
- 2) Use steam baths, hot plates, or heating mantles instead of open flames whenever possible. Before lighting a match or a burner, be sure that there are no open solvent containers or flammable vapors in the area.
- 3) If flammable liquids are dispensed, ensure all metal vessels are bonded/grounded.
- 4) When not in use flammable substances are stored in closed containers.

12.3 Corrosive Materials

- 1) It is essential that approved eye and face protection be worn in all laboratories where corrosive chemicals are handled.
- 2) Gloves and other chemically resistant protective clothing are available for use and will be used when appropriate to protect against skin contact.
- 3) To avoid a flash steam explosion due to the large amount of heat evolved, always add acids or bases to water (and not the reverse).
- 4) Acids and bases should be segregated for storage.
- 5) Liquid corrosives should be stored below eye level.
- 6) Wear appropriate respiratory protection or perform manipulations of materials in

a fume hood when working with materials that pose an inhalation hazard.

12.4 Reactive and Explosive Materials

- 1) Pay special attention to work practices which minimize friction, shock, heat, or contamination which can detonate these materials.
- 2) All materials prone to peroxidation should be dated upon receipt and not kept for prolonged periods once they have been opened.
- 3) Pay special attention to substances that are inherently unstable and can detonate under certain conditions of pressure and temperature (e.g., acetylene, carbon disulfide, and substances prone to auto-polymerization).

13 SPECIAL LABORATORY EQUIPMENT AND PROCEDURES

13.1 Compressed Gases

- 1) Cylinders are positioned so that the cylinder valve is accessible at all times. The main cylinder valve should be closed as soon as the gas is no longer being used.
- 2) Cylinders not in use are stored properly.
- 3) Avoid dragging, rolling, or sliding cylinders. Move cylinders by using a suitable hand truck with a strap, chain, or other device for securing the cylinder. Never drop cylinders or permit them to strike each other violently.
- 5) Leave the valve-protection cap on each cylinder until it has been secured against a wall or bench, or placed in a cylinder stand, and is ready to be used.
- 6) Place cylinders where they will not become part of an electric circuit.
- 7) Bond and ground all cylinders, lines, and equipment used with flammable compressed gases.
- 8) Check for leaks with a water and soap solution. Never use a flame.
- 9) Use compressed gases only in a well-ventilated area. Toxic, flammable, and corrosive gases should be used in a hood. Only small cylinders of toxic gases should be used.
- 10) Never tamper with safety devices in valves or cylinders.
- 11) Use a trap or suitable check valve when discharging gas into a liquid to prevent the liquid from getting back into the cylinder or regulator.
- 12) Use appropriate safety equipment such as safety goggles, face shield, and rubber gloves when using corrosive gases.
- 13) Do not force a cylinder valve that is stuck or frozen. Seek advice from the vendor.
- 14) A regulator should be attached to a cylinder without lubrication and without forcing the threads.
- 15) After the regulator has been attached to the cylinder valve outlet, turn the delivery pressure adjusting screw counter-clockwise until it turns freely. This prevents unintended gas flow through the regulator.
- 16) Open the cylinder valve slowly until the inlet gauge on the regulator registers the cylinder pressure: If the cylinder pressure reading is lower than expected, this may indicate that the cylinder valve is leaking.
- 17) With the flow control valve at the regulator outlet closed, turn the delivery pressure adjusting screw clockwise until the required delivery pressure is reached. The regulator itself should not be used as a flow control by adjusting the pressure

- to obtain different flow rates.
- 18) When done using the gas, close the cylinder valve and release the regulator pressure.

13.2 Cold Traps and Cryogenic Hazards

- 1) Gloves and a face shield must be used when preparing cold baths.
- 2) Neither liquid nitrogen nor liquid air should be used to cool a flammable mixture in the presence of air.
- 3) Insulated gloves are worn when handling dry ice, which should be added slowly to the liquid portion of the cooling bath to avoid foaming over.

14 CONCLUSION

SOU Science Hall employees are committed to the proper handling and use of chemicals from receipt to disposal.