# CHEMICAL HYGIENE PROGRAM

# Foreword

The protection of the safety and health of its employees, students and environment is a high priority of the Colorado School of Mines (Mines or the School). On January 31, 1990, the Occupational Safety and Health Administration (OSHA) promulgated a rule related to occupational exposures to hazardous chemicals in laboratories. This rule is designed to help protect laboratory workers from the hazards of the chemicals they use.

Included in the standard is a requirement that all employers covered by the standard develop a Chemical Hygiene Plan (CHP). A CHP is a written program which sets forth work practices, equipment use and maintenance procedures, and personal protective equipment requirements that protect employees from the hazards presented by chemicals used in the lab.

According to OSHA, the CHP must include standard operating procedures, criteria for the implementation of chemical control measures, measures to ensure proper operation of engineering controls, provisions for the training of workers, provisions for medical consultation in the case of exposure, designation of responsible people in the lab, and identification of procedures for the use of particularly hazardous substances or procedures. This document satisfies this requirement.

It is up to each lab supervisor to supplement this plan with more detailed information about the proper use of the particular chemicals used in their lab. These supplements may be in the form of written procedures, literature libraries, video presentations, and/or group or individual training. The lab supervisor and Chemical Hygiene Officer, if one is appointed, are responsible for the interpretation and enforcement of policies described in this CHP. The Environmental Health & Safety staff is available to provide technical assistance with this effort. Contact us at (303) 273-3316 or mberton@mines.edu for more information.

# 1.0 Chemical Hygiene Responsibilities and Program Coverage

### 1.1 Chemical Hygiene Responsibilities

Duties specific to laboratory chemical use are described in this section.

### A. Laboratory Supervisor

The laboratory supervisor has the ultimate responsibility for chemical hygiene throughout the laboratory, and, with the assistance of campus laboratory safety programs, supports the chemical hygiene efforts of lab workers.

Specifically, the lab supervisor shall:

- Develop and implement appropriate chemical hygiene policies and practices specific to the operations of the lab(s) they are responsible for. The form included in Appendix A is designed to provide a mechanism to assist with this work.
- Perform regular, formal chemical hygiene inspections, including inspections of emergency equipment. The frequency of these will be set by the laboratory CHP, based on the professional judgment of the lab supervisor. Weekly housekeeping inspections and monthly equipment inspections are suggested.
- Develop Standard Operating Procedures (SOPs) specific to their lab's operations.
- Determine the proper level and type of personal protective equipment for lab operations.
- Ensure that appropriate training has been provided to employees.
- Maintain a current knowledge concerning the legal requirements of regulated substances in the laboratory.
- Review and improve the Chemical Hygiene Plan on an annual basis.

**B. Chemical Hygiene Officer**

The lab supervisor may name a Chemical Hygiene Officer (CHO) with appropriate training and experience to assist with the activities described above. If no person is named CHO, the lab supervisor will retain responsibility for all chemical hygiene activities.

**C. Laboratory Workers**

The laboratory workers are individually responsible for planning and conducting each laboratory operation in accordance with the Chemical Hygiene Plan and developing good personal chemical hygiene habits.

**D. Environmental Health & Safety Department**

The Environmental Health and Safety Department (EHS) offers a range of chemical health and safety issues services. These services are designed to provide general assistance in meeting regulatory compliance and safety concerns. They need to be supplemented by laboratory-specific safety programs in order to achieve full regulatory compliance.

**E. Chemical Hygiene Committee**

The Mines Safety Committee will act as the University Chemical Hygiene Committee. In this role, it will provide technical and policy oversight of laboratory activities which involve the use of hazardous chemicals.

## 1.2. Scope and Application of this Plan

This standard applies where "laboratory use" of hazardous chemicals occurs. Laboratory use of hazardous chemicals means handling or use of such chemicals in which all of the following conditions are met:

- the handling or use of chemicals occurs on a "laboratory scale"; that is, the work involves containers which can easily and safely be manipulated by one person;
- multiple chemical procedures or chemical substances are used; and
- protective laboratory practices and equipment are available and in common use to minimize the potential for employee exposures to hazardous chemicals.

At a minimum, this definition covers employees (including student employees, technicians, research faculty, and principal investigators) who use chemicals in teaching and research laboratories at the School. Certain non-traditional laboratory settings may be included under this standard at the option of individual departments within the University. Also, it is the policy of the School that laboratory students, while not legally covered under this standard, will be given training commensurate with the level of hazard associated with their laboratory work.

Where the use of hazardous chemicals provides no potential for employee exposure, such as in procedures using chemically impregnated test media and commercially prepared test kits, a Chemical Hygiene Plan is not required.

## 1.3. Coordination with Other Standards and Guidelines

Although this standard deals only with use of hazardous chemicals, employees may also encounter potential physical, biological or radioactive hazards in the laboratory. In addition, other campus policies and procedures affect the use of hazardous chemicals. For example, the Mines Hazardous Waste Management Plan describes the proper procedures for the disposal of laboratory chemicals. In the event that there is a conflict between provisions of various standards, the Environmental Health & Safety Department (EHS) should be contacted to assist in resolving the discrepancy.

# 2.0 Employee Information and Training

## 2.1 Information

It is essential that laboratory employees have access to information on the hazards of chemicals and procedures for working safely. Supervisors must ensure that laboratory employees are informed about and have access to the following information sources:

- The contents of the OSHA lab standard, Occupational Exposure to Hazardous Chemicals in Laboratories, and its appendices (29 CFR 1910.1450).
- The Mines Chemical Hygiene Plan (this document) and local lab standard operating procedures.
- The Permissible Exposure Limits (PEL) for OSHA regulated substances.
- Material Safety Data Sheets (MSDS) for laboratory chemicals. These are available from collections at the Chemical Storage and Distribution Facility, on the Internet (http://hazard.com/msds), and are also located in many individual laboratories. Departments will make such information available to the employees using the chemicals.

## 2.2 Training

Each laboratory supervisor is responsible for ensuring that laboratory employees are provided with training about the hazards of chemicals present in their laboratory work area, and methods to control exposure to such chemicals. Each employee shall receive training at the time of initial assignment to the laboratory, prior to assignments involving new exposure situations, and at a regular frequency.

**A. Availability**

Training is available in the form of:

- Literature describing proper lab practices (see Sections 5 and11).
- Video libraries at the EHS and in the departments.
- Group and individual training, conducted by lab personnel or EHS staff.

**B. Content**

Employee training programs will include, at a minimum, the following subjects:

- Methods of detecting the presence of hazardous chemicals (observation, signage and labeling, odor, real-time monitoring, air sampling, etc.).
- Symptoms associated with exposures to hazardous chemicals.
- Good laboratory practice, including general techniques designed to reduce personal exposure and to control physical hazards, as well as specific protective mechanisms and warning systems used in individual laboratories.
- Emergency response actions appropriate to individual laboratories.
- Applicable details of the departmental Chemical Hygiene Plan, including general and laboratory-specific Standard Operating Procedures.
- An introduction to the Mines Hazardous Waste Management procedures.

# 3.0 Criteria for Implementation of Control Measures

## 3.1 General Criteria

This Chemical Hygiene Plan is intended to limit laboratory workers' exposure to OSHA-regulated substances. Laboratory workers must not be exposed to substances in excess of the permissible exposure limits (PEL) specified in OSHA rule 29 CFR 1910, Subpart Z, Toxic and Hazardous Substances or Threshold Limits Values set by the American Conference of Governmental Industrial Hygienists. PELs refer to airborne concentrations of substances and are averaged over an eight-hour day. A few substances also have "action levels". Action levels are air concentrations below the PEL which nevertheless require that certain actions such as medical surveillance and workplace monitoring take place.

An employee's workplace exposure to any regulated substance must be monitored if there is reason to believe that the exposure will exceed an action level or a PEL. If exposures to any regulated substance routinely exceed an action level or permissible exposure level, control measures must be implemented.

**A. Professional Judgment**

The lab supervisor can use professional judgment to assess the nature of chemical exposure resulting from a lab procedure and prescribe engineering controls and personal protective equipment to be used during the procedure. This judgment will be documented through use of Standard Operating Procedures and Laboratory Chemical Safety Summaries written for the chemicals in use.

**B. Air Sampling**

Air sampling for evaluating employee exposure to chemical substances shall be conducted on an as needed basis (to be determined by the lab supervisor). Conduct air sampling if there is reason to believe that exposure levels for regulated substances that require sampling routinely exceed the action level, or in the absence of an action level, the PEL.

Air sampling will be conducted according to established industrial hygiene practices. It may be conducted by lab workers, EHS staff or outside consultants. The results of air sampling studies performed in the laboratory should be sent to the Environmental Health and Safety Department for records maintenance.

## 3.2 Criteria for Implementation of Specific Control Measures

Engineering controls, personal protective equipment, hygiene practices, and administrative controls each play a role in a comprehensive laboratory safety program. Implementation of specific measures must be carried out on a case-by-case basis, using the following criteria for guidance in making decisions.

**A. When to Use Fume Hoods**

The laboratory fume hood is the major protective device available to laboratory workers. It is designed to capture chemicals that escape from their containers or apparatus and to remove them from the laboratory environment before they can be inhaled. Characteristics to be considered in requiring fume hood use are physical state, volatility, toxicity, flammability, eye and skin irritation, odor, and the potential for producing aerosols. A fume hood should be used if a proposed chemical procedure exhibits any one of these characteristics to a degree that

1. airborne concentrations might approach the action level (or permissible exposure limit),
2. flammable vapors might approach one tenth of the lower explosion limit,
3. materials of unknown toxicity are used or generated, or
4. the odor produced is annoying to laboratory occupants or adjacent units.

Procedures that can generally be carried out safely outside the fume hood (depending on the capacity of the general ventilation system to remove any airborne contaminants) include those involving:

1. water-based solutions of salts, dilute acids, bases, or other reagents,
2. very low volatility liquids or solids,
3. closed systems that do not allow significant escape to the laboratory environment, and
4. extremely small quantities of otherwise problematic chemicals.

The procedure itself must be evaluated for its potential to increase volatility or produce aerosols.

**B. When to Use Safety Shields or Other Containment Devices**

Safety shields, such as the sliding sash of a fume hood, are appropriate when working with highly concentrated acids, bases, oxidizers or reducing agents, all of which have the potential for causing sudden spattering or even explosive release of material. Reactions carried out at non-ambient pressures (vacuum or high pressure) also require safety shields, as do reactions that are carried out for the first time or are significantly scaled up from normal conditions.

Other containment devices, such as glove boxes or vented gas cabinets, may be required when it is necessary to provide an inert atmosphere for the chemical procedure taking place, when capture of any chemical emission is desirable, or when the standard laboratory fume hood does not provide adequate assurance that overexposure to a hazardous chemical will not occur. The presence of biological or radioactive materials may also mandate certain special containment devices.

Local exhaust ventilation may be required for equipment that exhausts toxic or irritating materials to the laboratory environment.

Ventilated chemical storage cabinets or rooms should be used when the chemicals in storage may generate toxic, flammable or irritating levels of airborne contamination.

## C. When to Use Personal Protective Equipment

Laboratory supervisors or CHO's shall designate areas, activities, and tasks which require specific types of personal protective equipment. Protective equipment shall not be worn in public areas, in order to prevent the spread of chemical or biological contamination from laboratory areas.

### Eye Protection

Eye protection is required for all personnel and any visitors whose eyes may be exposed to chemical or physical hazards. Side shields on safety spectacles provide some protection against splashed chemicals or flying particles, but goggles or face shields are necessary when there is a greater than average danger of eye contact. A higher than average risk exists when working with highly reactive chemicals, concentrated corrosives, or with vacuum or pressurized glassware systems.

### Protective Clothing

Lab coats or other similar clothing protectors are strongly encouraged for all laboratory personnel. Lab coats are required when working with select carcinogens, reproductive toxins, substances which have a high degree of acute toxicity, strong acids and bases, and any substance on the OSHA PEL list carrying a "skin" notation.

Bare feet are not permitted in any laboratory. Sandals and open-toed shoes are strongly discouraged in all laboratories and are not permitted in any situation where lab coats or gloves are required.

### Gloves

Gloves made of appropriate material are required to protect the hands and arms from thermal burns, cuts, or chemical exposure that may result in absorption through the skin or reaction on the surface of the skin. Gloves are also required when working with particularly hazardous substances where possible transfer from hand to mouth must be avoided.

Gloves should be carefully selected using guides from the manufacturers. General selection guides are available; however, glove resistance to chemicals will vary with the manufacturer, model and thickness. Therefore, review a glove-resistance chart from the manufacturer you intend to buy from, before purchasing gloves.

### Respiratory Protection

Respiratory protection is generally not necessary in the laboratory setting and must not be used as a substitute for adequate engineering controls. Availability of respiratory protection for emergency situations may be required when working with chemicals that are highly toxic and highly volatile or gaseous. If an experimental protocol requires exposure above the action level that cannot be reduced, respiratory protection will be required. All use of respiratory protective equipment is covered under the Mines Respiratory Protection Program.

# 4.0 Management of Engineering Controls

The engineering controls installed in the laboratory are intended to minimize employee exposure to chemical and physical hazards in the workplace. These controls must be maintained in proper working order for this goal to be realized.

No modification of engineering controls will occur unless testing of the modification indicates that worker protection will continue to be adequate. Improper function of engineering controls must be reported to the lab supervisor immediately. The system shall be taken out of service until proper repairs have been executed.

### 4.1 Local Exhaust Ventilation

The following procedures shall apply to the use of local exhaust ventilation:

- Openings of local exhaust will be as close as possible to the source of the contaminants.
- Local exhaust fans shall be turned on when exhaust hoods are being used.
- After using local exhaust, operate the fan for an additional period of time sufficient to clear residual contaminants from the ductwork.
- The ventilation system shall be inspected annually by the Plant Facilities Department.
- Prior to a change in chemicals or procedures, the adequacy of the available ventilation systems shall be determined by the lab supervisor.

### 4.2 Laboratory Hoods

Prior to the introduction of new chemicals, the adequacy of hood systems available shall be determined by the lab supervisor.

Ductless fume hoods recirculate exhaust air through filters back into the room. Therefore, they can not be used for volatile toxic materials and should be posted as "Not for use with toxic materials."  Consult EHS staff before using these hoods to control air contaminants.

### 4.3 Chemical Storage Cabinets

Storage cabinets for flammable and hazardous chemicals will be ventilated as needed. They will be provided with a spill containment system appropriate to the chemicals stored in them.

### 4.4 Biosafety Cabinets, Glove Boxes and Isolation Rooms

The exhaust air from a biosafety cabinets, glove box or isolation room will pass through scrubbers, HEPA filters, or other treatment before release into the regular exhaust system.  Biosafety cabinets will be certified annually and each time they are moved. This certification is arranged by the EHS Department.

### 4.5 Cold Rooms and Warm Rooms

Temperature control rooms generally do not have fresh air ventilation. Do not use volatile chemicals in them! Also note that liquid nitrogen stored in these rooms can displace oxygen and cause oxygen deficient conditions.

### 4.6 Emergency Equipment

Eye washes must be flushed weekly by the user. This will ensure that the eye wash is working, and that the water is clean, should emergency use become necessary. Fire extinguishers are checked annually by the EHS Department.

# 5.0 Standard Operating Procedures for Laboratory Chemicals

Standard Operating Procedures (SOPs) are generally accepted practices for use of chemicals in particular situations. These SOPs can be overridden in specific instances when appropriate. It is advisable to document the reasons for such modifications. When SOPs are not available for a specific lab situation, the lab supervisor and CHP will develop them, in consultation with the references cited below and the EHS staff.

## 5.1 General Principles

## A. Controlling Chemical Exposure

Each laboratory employee shall minimize personal and coworker exposure to the chemicals in the laboratory. General precautions which shall be followed to achieve this goal during the handling and use of all chemicals are as follows:

- A chemical mixture shall be assumed to be as toxic as its most toxic component. Possibilities for substitution will be investigated.
- Laboratory employees shall be familiar with the symptoms of exposure for the chemicals with which they work and the precautions necessary to prevent exposure.
- Eating, drinking, and smoking are prohibited in areas where laboratory chemicals are present. Hands shall be thoroughly washed after working with chemicals. Storage, handling and consumption of food or beverages shall not occur in chemical storage areas, nor refrigerators, nor with glassware or utensils also used for laboratory operations.
- Each employee shall keep the work area clean and uncluttered. All chemicals and equipment shall be labeled with appropriate hazard warnings. At the completion of each work day or operation, the work area shall be cleaned.
- Mouth suction for pipeting or starting a siphon is prohibited.
- Skin contact with all chemicals shall be avoided. Employees shall wash exposed skin prior to leaving the laboratory.

- Additional specific precautions based on the toxicological characteristics of individual chemicals shall be implemented as deemed necessary by the lab supervisor.

### B. Laboratory Equipment

The following rules shall apply to the use of laboratory equipment:

- All laboratory equipment shall be used only for its intended purpose.
- All glassware will be handled and stored to minimize breakage; all broken glassware will be immediately disposed of in the broken glass container.
- All evacuated glass apparatus shall be shielded to contain chemicals and glass fragments should implosion occur.
- Waste receptacles shall be identified as such by signs attached to the receptacle.
- All laboratory equipment shall be inspected on a periodic basis and replaced or repaired as necessary.

### C. Planning for Emergencies

Before work with laboratory chemicals begins, plans for various emergencies will be developed. The circumstances to be covered include fire, chemical spill, and personnel exposure. In addition, the following work practices will be observed:

- Spill containment will be established around areas in which more than one liter of liquid is used.
- Workers manipulating chemicals will always be in easy communication of other people while handling chemicals
- Emergency equipment will be checked on a daily basis for unusual conditions.

General information for emergency response at Mines is given in Section 7.

# 6.0 Particularly Hazardous Procedures

The OSHA Lab Standard requires that special consideration be given to use of chemicals or procedures with particular hazards. The definition of "particularly hazardous chemicals" is given in the OSHA lab standard. Examples of such chemicals are given in Chapter 3 of *Prudent Practices*. A brief list of examples is in Appendix B. This consideration requires either the development of special operating procedures or prior approval of the laboratory supervisor as indicated by a written permit describing the conditions for the work to be done.

## 6.1 Work with Particularly Hazardous Substances

When laboratory procedures include the use of highly hazardous chemicals, special precautions shall be implemented as deemed necessary by the lab supervisor. These precautions will be developed for work with select carcinogens, reproductive toxins and substances which have a high degree of acute toxicity. Development of these precautions will consider including the following provisions in the special procedures:

- Establishment of a designated area for the use of the high hazard chemicals.
- Signage and access control to the work area where the chemical is used.
- Special precautions such as use of containment devices such as glove boxes; isolation of contaminated equipment; practicing good laboratory hygiene; and prudent transportation of very toxic chemicals.
- Planning for accidents and spills.
- Special storage and waste disposal practices.

*Prudent Practices* provides detailed recommendations for work with particularly hazardous substances.

## 6.2 Pre-approval of Particularly Hazardous Work

A permit system shall be utilized for all laboratory activities which do not follow standard or special operating procedures. The permit system shall be implemented and enforced by the laboratory supervisor. These activities include off-hours work, sole occupancy of lab and unattended operations. A sample permit is given in Appendix B. The toxicity of the chemicals used, the hazards of the procedures to be done, and the knowledge and experience of the laboratory workers must be considered in deciding which work will be allowed with pre-approval.

<u>Off-Hours Work Procedures</u>: Laboratory personnel are not permitted to work after hours in the lab, except when permit conditions are met and approved by the laboratory supervisor.

<u>Working Alone</u>: Work shall not be performed in the laboratory when the only person in the room is the laboratory person performing the work. Under unusual conditions, crosschecks, periodic security guard checks, or other measures may be taken as established by a permit and approved by the laboratory supervisor.

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

- An appropriate permit will be written, approved by the laboratory supervisor, and posted.
- A sign will be posted at all entrances to the laboratory.
- Precautions shall be made for the interruption of utility service during the unattended operation (loss of water pressure, electricity, etc.).
- The person responsible for the operation will return to the laboratory at the conclusion of the operation to assist in the dismantling of the apparatus.

# 7.0 Chemical Spills, Releases and Accidents

## 7.1 Emergency Response

**Telephone numbers** of emergency personnel, supervisors and other workers as deemed appropriate are posted on the lab entrance by the EHS Department. These signs will be updated annually for accuracy.

## 7.2 In Case of Fire

The School's policy is that the first reaction to a fire is to evacuate the occupants of the building. Fire extinguishers are available in labs and are inspected annually. They may be used to fight small fires and to assist in evacuation from fire situations. Fire extinguisher training is available through the EHS Department.

## 7.3 In Case of Spills

In the event of a chemical spill, release or other accident, lab workers will respond as outlined in the University Emergency Response plan. The size of the spill and its hazards will guide the appropriate response. If there is any doubt about the lab worker's ability to safely clean up the spill, call the EHS at (303) 273-3316 (24 Hours). Note that proper emergency response depends upon knowledge of the hazards present in the lab. For this reason, a campus wide inventory of the hazardous chemicals in Mines labs is conducted annually.

## 7.4 In Case of Personnel Exposures

All employees shall be instructed in the location and proper usage of emergency showers and eyewashes. The eyewash and emergency shower shall be inspected and flushed weekly. In case of medical emergency, call 911 or CSM Public Safety. Note that medical consultation after such exposures is provided as detailed in Section 8.0.

## 7.5 Emergency Phone Numbers

- CSM Police (24 hours) 911
- Environmental Health and Safety Department (303) 273-3316 (24 hours)
- Poison Control Center (800) 222-1222

# 8.0 Medical Consultations and Examinations

## 8.1 Availability

All employees who work with hazardous chemicals will have an opportunity to receive medical attention, including any follow-up examinations which the examining physician determines to be necessary, under the following circumstances:

- Whenever an employee develops symptoms associated with a hazardous chemical to which the employee may have been exposed in the laboratory.
- Where exposure monitoring reveals an exposure level routinely above the action level or PEL for an OSHA regulated substance for which there are exposure monitoring and medical surveillance requirements.
- Whenever an event takes place in the work area such as a spill, leak, explosion or other occurrence resulting in the likelihood of a hazardous exposure.

EHS will be contacted whenever the need for medical consultation or examination occurs, or when there is uncertainty as to whether any of the above criteria have been met.

## 8.2 Arranging for Exams

All medical examinations and consultations will be performed by or under the direct supervision of a licensed physician and will be provided through EHS, without loss of pay and at a reasonable time and place. In the event of a life-threatening illness or injury, dial 911 and request an ambulance.

## 8.3 Information

The School will provide the examining physician with the following information:

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

The above information will be collected and transmitted by the lab supervisor and will be submitted to the EHS as well as to the examining physician.

## 8.4 Report

The examining physician will provide to the lab supervisor and EHS a written report including the following:

- Any recommendation for further medical follow-up.

- The results of the medical examination and any associated tests.
- Any medical condition which may be revealed in the course of the examination which may place the employee at increased risk as a result of exposure to a hazardous chemical found in the workplace.
- A statement that the employee has been informed by the physician of the results of the consultation or medical examination and any medical condition that may require further examination or treatment.

The written opinion will not reveal specific findings of diagnoses unrelated to occupational exposure.

# 9.0 Recordkeeping

### 9.1 Accident Reports

Accident investigations will be conducted by EHS with assistance from the lab supervisor as deemed necessary. Accident reports will be written and retained for 5 years.

### 9.2 Exposure Evaluations

Any records of exposure evaluation carried out by individual departments will be kept within the department and also sent to the EHS Department. Raw data will be kept for one year and summary data for the term of employment plus 30 years.

### 9.3 Medical Consultation and Examinations

Results of medical consultations and examinations will be kept by EHS for a length of time specified by the appropriate medical records standard. This time will be at least the term of employment plus 30 years as required by OSHA.

### 9.4 Training

Individual employee training records should be kept in the individual's department or college file for five years.

### 9.5 Equipment Inspection

Records of inspections of equipment will be maintained for 5 years. Data on annual fume hood monitoring will be kept in the EHS Department. Fume hood monitoring data are considered maintenance records and as such the raw data will be kept for one year and summary data for 5 years.

# 10.0 Annual Chemical Hygiene Plan Review

The laboratory supervisor and Chemical Hygiene Officer will review the laboratory's Chemical Hygiene Plan every March. Results will be provided EHS and the department laboratory manager. Laboratory supervisors are responsible for assigning responsibility for taking corrective action for any deficiency noted.

# 11.0 References and Other Information Sources

## A. Literature References

National Research Council, **Prudent Practices for Handling and Disposing Hazardous Chemicals in Laboratories**, National Academy Press, Washington, D.C., 1995.

Code of Federal Regulations, 29 CFR part 1910 subpart Z section 1910.1450, **Occupational Exposure to Hazardous Chemicals in Laboratories**, 1990.

American Chemical Society, **Safety in Academy Chemistry Laboratories**, 5th ed., Washington, D.C., 1991.

Department of Risk Management, **UVM Fumehood Operation & Safety Guidelines**, University of Vermont, Burlington, VT, 1991.

# Table of Contents of *Prudent Practices in the Laboratory*

Prudent Practices in the Laboratory: Handling and Disposal of Chemicals, National Academy Press, Washington, D.C. 1995.

## Chapter 1: The Culture of Laboratory Safety

The New Culture of Laboratory Safety; Responsibility and Accountability for Laboratory Safety; Special Safety Considerations in Academic Laboratories; The Safety Culture in Industry; Factors That Are Changing the Culture of Safety; Organization of This Book

## Chapter 2: Prudent Planning of Experiments

Levels of Formality in Experiment Planning; Individual Responsibilities for Planning Experiments; Institutional Policies and Emergency Response Planning; Steps for Planning an Experiment

## Chapter 3: Evaluating Hazards and Assessing Risks in the Laboratory

Sources of Information; Toxic Effects of Laboratory Chemicals; Flammable, Reactive, and Explosive Hazards; Physical Hazards; Biohazards; Hazards from Radioactivity

## Chapter 4: Management of Chemicals

Source Reduction; Acquisition of Chemicals; Inventory and Tracking of Chemicals; Storage of Chemicals in Stockrooms and Laboratories; Recycling of Chemicals, Containers, and Packaging

## Chapter 5: Working With Chemicals

Prudent Planning; General Procedures for Working with Hazardous Chemicals; Working with Substances of High Toxicity; Working with Biohazardous and Radioactive Materials; Working with Flammable Chemicals; Working with Highly Reactive or Explosive Chemicals; Working with Compressed Gases

## Chapter 6: Working with Laboratory Equipment

Working with Water-Cooled Equipment; Working with Electrically Powered Laboratory Equipment; Working with Compressed Gases; Working with High/Low Pressures and Temperatures; Using Personal Protective, Safety, and Emergency Equipment; Emergency Procedures

## Chapter 7: Disposal of Waste

Chemically Hazardous Waste; Multihazardous Waste; Procedures for the Laboratory-Scale Treatment of Surplus and Waste Chemicals

## Chapter 8: Laboratory Facilities

Laboratory Inspection Programs; Laboratory Ventilation; Room Pressure Control Systems; Special Systems; Maintenance of Ventilation Systems

## Chapter 9: Governmental Regulation of Laboratories

Risk and Regulation; The OSHA Laboratory Standard: Occupational Exposure to Hazardous Chemicals in Laboratories; The Resource Conservation and Recovery Act; The Clean Air Act; SARA Title III, Community Right-To-Know and Emergency Notification and Response; The Toxic Substances Control Act; Regulation of Laboratory Design and Construction

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# B. Internet Resources

**Laboratory Chemical Safety Summaries**
http://www.hhmi.org/science/labsafe/lcss/start.htm

**Material Safety Data Sheets**
http://hazard.com/msds

**OSHA Regulations and Technical Information**
http://www.osha-slc.gov

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# Appendix A: Laboratory Specific Chemical Hygiene Procedures

1) Lab Supervisor: __________________ CHO __________________

2) Chemical Users (names or group): __________________ __________________ __________________

3) Department(s): __________________ __________________

4) Laboratory Location: Room _________ Building __________________

5) Material(s) or Hazard Group:

__________________ __________________

a) Quantity used (in the next year):

<1 liter or 100 gm

1 liter/100 gm to 5 liter/1 kg

5 liter/1 kg to 20 liter/5 kg

> 20 liter/5 kg

b) Concentration used: Dilute (<5%) Intermediate (5-25%) Concentrated (>25%)

6) What hazard(s) does these material(s) present?

Flammability Corrosivity
Reactivity Acute Toxicity
Chronic Toxicity Carcinogenicity/Teratogenicity/Mutagenicity

7) Chemical Safety Information and Training

Is safety information for these materials available? Yes No
Has training in the safe use of these materials been provided to all potential users?
Yes No

8) What control measures are necessary to use the material(s) safely?

a) Engineering Controls (indicate room number and hood to be used):

Fume hood Biosafety cabinet Gas monitors

b) Personal Protective Equipment:

Lab coats Proper Gloves Eye protection Respiratory protection

c) Emergency Response Equipment:

Safety shower Eyewash Spill control equipment Fire extinguisher

9) How will user exposure to these chemicals be assessed?

Professional judgment of lab supervisor Air sampling

Other ___________________

10) Is medical monitoring required for users of these materials? Yes No

11) Where and with what equipment are the material(s) to be stored?

Room ___________________

General storage Spark-proof refrigerator/freezer

Flammables cabinet Corrosives cabinet

12) Method of disposal

Chemical waste pick-up Neutralized or consumed during process

Methods used to minimize generation of hazardous waste:

_________________________________________

As part of your protocol planning effort, please identify ways which you can minimize the amount of chemical waste generated and attach a short narrative description of these methods to this form.

I accept responsibility for the proper use of these materials in the labs named above and have assigned chemical hygiene responsibilities within the lab to people with appropriate training and /or experience.

Lab Supervisor Signature ___________________ Date ___________________

# Instructions for Chemical Hygiene Procedures Form

1) Lab Supervisor

Identify the person responsible for the overall conduct of the work involving the chemical above. Identify the Chemical Hygiene Officer (CHO). If no CHO is identified, the lab supervisor will serve in that role.

2) Chemical Users

Identify the people or the group who will be actually using the materials. If a group of short-term workers will perform the work, indicate this and the individual who will supervise the work.

3) Department(s)

Identify the department(s) under whose control this work will be done.

4) Laboratory Location

Identify the room and building this material will be used in.

5) Material(s) or Hazard Group

Identify the materials to be used by:

1) The chemical names, or

2) If several chemicals from within one of the hazard groups (e.g., corrosives, flammables, toxics, reactives, radioactives, etc.) a single form can be filled out for the group. Identify the numbers of the materials to be used within the group,

3) Quantity to be used: Check a range for the approximate quantity of the chemical(s),

4) Concentration: Check a range for the approximate concentration of the material(s).

6) What hazard(s) does the material(s) above present?

Identify the hazards that the material(s) named present.

7) Chemical Safety Information

Appropriate safety information for the materials used consists of laboratory chemical safety summaries, material safety data sheets or other technical literature that provides the information necessary to anticipate and provide protection against the hazards associated with the material. Contact the

Chemical Storage and Distribution Facility (3555) for help in gathering and interpreting this information. Training for those who will or might be exposed to this substance and the specific hazards associated with the material is also required.

8) What control measures are necessary to use the material(s) safely?

List those pieces of lab equipment necessary for the use of this chemical in the quantity and concentration indicated. See the Mines Chemical Hygiene Plan for general criteria for use of these measures.

9) How will user exposure to these chemicals be assessed?

The OSHA Lab Standard requires that worker exposure to all hazardous chemicals be assessed before work begins and during lab operations if necessary. Indicate how worker exposure will be assessed. Describe "Other" if used.

10) Is medical monitoring required for users of the material(s)?

OSHA requires medical monitoring for workers using many different chemicals, including asbestos, formaldehyde and lead. For complete information about these requirements, contact the Environmental Health & Safety Department.

11) Where are the(se) materials stored?

Indicate the room and type of storage area where these materials will be stored.

12) Method of disposal

The proper disposal method for all chemical waste is through the chemical waste pick-up request system. The School is required by law to demonstrate its efforts to minimize the amount of hazardous waste it generates. List the methods that will be used to minimize generation of hazardous waste.

# PERMIT FOR USE OF NON-STANDARD LABORATORY OR SPECIAL OPERATING PROCEDURES

This permit shall be utilized for all laboratory activities which do not follow standard or special operating procedures and which thus require pre-approval by the laboratory supervisor.

Location of Work: Building _____________ Room______

Occurrence (date(s)): _________ to ________

Authorized Personnel: ______________ ________________

Unusual Circumstances:

___ Working alone
___ Working after hours
___ Unattended Operations
___ Other (explain): ____________________________________________________

Hazards Present

____ Highly toxic chemicals
____ Shock sensitive Explosive chemicals
____ Flammable chemicals
___ Other (explain): ____________________________________________________

Special Conditions Required:
____ Spill Containment
____ Designated area (secured from general access; hazards signage)
____ Regular communication with _______________
___ Other (explain):_____________________________________________________

Approved by (one signature required, copy to other person):

_______________________________________  _________
Laboratory Supervisor/Chemical Hygiene Officer  Date

# Appendix B: Work with High Hazard Chemicals

## Table 1: Carcinogens, Reproductive Toxins or Highly Toxic Chemicals

The chemicals listed below are extremely hazardous due to their toxic effects. This is not an exclusive list, and may be expanded, based on the professional judgment of the laboratory supervisor. Workers must have knowledge of the dangers of these chemicals prior to use, and documentation of training in safe working procedures.

<u>Biologically active compounds</u>

·protease inhibitors (e.g. PMSF, Aprotin, Pepstatin A, Leopeptin);

·protein synthesis inhibitors (e.g. cycloheximide, Puromycin);

·transcriptional inhibitors (e.g. a-amanitin and actinomycin D);

·DNA synthesis inhibitors (e.g. hydroxyurea, nucleotide analogs (i.e. dideoxy nucleotides), actinomy cin D, acidicolin);

·phosphatase inhibitors (e.g. okadaic acid);

·respiratory chain inhibitors (e.g. sodium azide);

·kinase inhibitors (e.g. NaF);

·mitogenic inhibitors (e.g. colcemid); and

·mitogenic compounds (e.g. concanavalin A).

Castor bean (Ricinus communis) lectin: Ricin A, Ricin B, RCA toxins

Diisopropyl fluorophosphate: highly toxic cholinesterase inhibitor; the antidote, atropine sulfate and 2-PAM (2-pyridinealdoxime methiodide) must be readily available

N-methyl-N'-nitro-N-nitrosoguanidine: carcinogen (this chemical forms explosive compounds upon degradation)

Phalloidin from Amanita Phalloides: used for staining actin filaments

Retinoids: potential human teratogens

Streptozotocin: potential human carcinogen

Urethane (ethyl carbamate): an anesthetic agent, potent carcinogen and strong teratogen, volatile at room temperature

Table 2: Shock Sensitive and Pyrophoric Chemicals

The classes of chemicals listed below may explode when subjected to shock or friction. Therefore containers must have appropriate labels regarding the formation of peroxide hazards on concentration.

Do not distill or evaporate these materials without first testing for the presence of peroxides (discard or test for peroxides after 6 months)

·acetaldehyde di·diethylene glycol dimethyl ether (diglyme)

·dioxane

·ethylene glycol dimethyl ether (glyme)

·ethylene glycol ether acetates

·ethylene glycol monoethers (cellosolves)

·furan

·methylacetylene

·methylcyclopentane