LABORATORY SAFETY PLAN

UNIVERSITY OF MINNESOTA

DEPARTMENT OF CHEMISTRY AND BIOCHEMISTRY

DULUTH CAMPUS

Based on the Chemical Hygiene Plan Developed by
Department of Environmental Health and Safety
University of Minnesota

September 2017

Emergency Contacts Telephone Posting

LABORATORY/SERVICE AREA INFORMATION

Department of Chemistry and Biochemistry	246 Chemistry (Dept. Office)
Supervisor Name: Elizabeth Minor	726–8056
Department Safety Officer: Randall Helander (Chem 311)	726–7858
Department Safety Officer: Greg Mielke (SSB 241)	726–8308

CAMPUS-WIDE EMERGENCY COORDINATORS

	Work
Andrew Kimball	726–6764
Jean Cranston	726–7273
Laura Lott	726–6917

OTHER IMPORTANT CAMPUS EMERGENCY NUMBERS

SPILL RESPONSE TEAM	Andrew Kimball	(763)226–7011 (cell) (218)726-6764 (EHSO-Duluth)
UTILITY PROBLEMS	Facilities Mgmt. Dept.	726–8262
After Hours	(4:30pm – midnight)	726–8147
UMD HEALTH SERVICES		726–8155

OFF-SITE EMERGENCY NUMBERS

FIRE DEPARTMENT	911
POLICE DEPARTMENT	911
MINNESOTA STATE DUTY OFFICER	(800)422–0798
NATIONAL RESPONSE CENTER	(800)424–8802
ST. LUKE'S HOSPITAL URGENT CARE CENTER	249–6095

LOCATION OF EMERGENCY RESPONSE EQUIPMENT

FIRE EXTINGUISHERS: Located in all research labs and in the hall on all floors.
FIRE ALARM: Pull stations located in all hallways and near exit stairways of all floors.
SPILL CONTROL EQUIPMENT: CHEM 304 (Chemistry Stockroom)
FIRST AID KIT: CHEM 304/306 and SSB 141

This list serves both OSHA and EPA/MPCA Emergency Telephone Posting Requirements and MUST be posted near telephone in laboratories, shops and areas where hazardous waste is handled or stored.

Table of Contents

UMD Department of Chemistry and Biochemistry

Laboratory Safety Plan

Last Updated by DEHS: July 2010
Last Updated by Department of Chemistry and Biochemistry: September 2017

Chapter 1 – Introduction

1. Purpose

This Laboratory Safety Plan (LSP) describes policies, procedures, equipment, personal protective equipment and work practices that are capable of protecting employees from potential health hazards in laboratories. This plan is intended to meet the requirements of the federal Laboratory Safety Standard, formally known as "Occupational Exposure to Hazardous Chemicals in Laboratories." This LSP also addresses the concerns of the federal OSHA Hazard Communication Standard, the Minnesota Employee Right To Know Act (MERTKA) and the federal Toxic Substance Control Act (TSCA).

This LSP is intended to safely limit laboratory workers' exposure to OSHA- and MERTKA-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. PELs for regulated substances are provided in Appendix B. PELs refer to airborne concentrations of substances and are averaged over an eight-hour day. A few substances (listed under Individual Chemical Standards in the Federal column in Appendix C) 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 limit there must also be employee medical exposure surveillance.

MERTKA requires employers to evaluate their workplaces for the presence of hazardous substances, harmful physical agents, and infectious agents and to provide training to employees concerning those substances or agents to which employees may be exposed. Written information on agents must be readily accessible to employees or their representatives. Employees have a conditional right to refuse to work if assigned to work in an unsafe or unhealthful manner with a hazardous substance, harmful physical agent or infectious agent. Labeling requirements for containers of hazardous substances and equipment or work areas that generate harmful physical agents are also included in MERTKA.

Toxic Substances Control Act (TSCA) requires that prudent laboratory practices be developed and documented for research involving new chemicals that have not had their health and environmental hazards fully characterized. Laboratories engaged in research must consider the applicability of TSCA on their operation. TSCA, administered by the U.S. Environmental Protection Agency (EPA) under the New Chemicals Program [http://www.epa.gov/oppt/newchems/], is intended to ensure that the human health and environmental effects of chemical substances are identified and adequately addressed prior to commercial use or transport of those substances. A new chemical is a chemical substance that is produced or imported and not yet listed on the TSCA Chemical Substance Inventory. Each laboratory or research group that synthesizes or imports new chemicals must determine if and how TSCA applies to their laboratory activities.

2. Scope and Application

The Laboratory Safety 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:

i. 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,
ii. multiple chemical procedures or chemical substances are used, and

iii. 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, supervisors, lead researchers and physicians) who use chemicals in teaching, research and clinical laboratories at the University of Minnesota. 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 University 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.

This standard does not apply to laboratories whose function is to produce commercial quantities of material. Also, 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, this standard will not apply. The researchers listed in the following table are covered by this Laboratory Safety Plan.

Principal Investigator	Building	Room #
Steve Berry	SSB	160
Robert Carlson	Chem	401 & 402
John Evans	Chem	213
Peter Grundt	Chem	137, 320 & 336
Ahmed Heikal	SSB	260
Anne Hinderliter	SSB	161
Joseph Johnson	SSB	261
Paul Kiprof	Chem	120 & 126
Melissa Maurer-Jones	Chem	114
Venkatram Mereddy	Chem	140
Elizabeth Minor	RLB	101
Alan Oyler	Chem	224
Katie Schreiner	RLB	201
Erin Sheets	SSB	260
Viktor Zhdankin	Chem	328, 334 & 403

3. Coordination with Other Standards and Guidelines

The Laboratory Safety Standard and MERTKA address occupational safety issues. Other federal, state and local standards that address use of hazardous chemicals and other materials are listed in Appendix B. Note particularly the listed chemicals with individual standards in the ‘Federal’ column, since these compounds generally have *action limits* (usually set at half the TLV), *air monitoring requirements*, and *medical monitoring requirements.* If a researcher is using one of these chemicals, or in the unlikely event that there is a conflict between provisions of various standards, the Department of Environmental Health and Safety should be contacted.

4. Responsibilities

Implementation of the Laboratory Safety Standard at the University is a **shared responsibility**. Employees, supervisors, Research Safety Officers, department heads, deans, upper administrative staff, and DEHS staff all have roles to play. These roles are outlined below.

A. Central and Upper Level Administration (President, Vice Presidents, Provosts, Chancellors and Vice Chancellors)

Upper level administrators are responsible for:

- promoting the importance of safety in all activities;
- promoting the same attitude among all levels of employment at the University;

- supporting a broad-based laboratory safety/chemical hygiene program that will protect U of MN laboratory employees from health effects associated with hazardous chemicals, physical or biological agents; and
- ensuring that deans, directors and department heads provide adequate time and recognition for employees who are given laboratory safety responsibilities.

Performance will be measured by:

- DEHS's documentation and annual reporting of the level of compliance within each of the reporting units.

B. Deans, Directors and Department Heads

Andrea Schokker, the Dean of the Swenson College of Science and Engineering, and Elizabeth Minor, the Head of the Department of Chemistry and Biochemistry, are responsible for:

- identifying at least one technically-qualified research safety officer for the unit. (Colleges or institutes that are made up of a number of large laboratory-based departments are urged to assign research safety officers (RSO) within each department. Large departments may assign one research safety officer for each division);
- transmitting the name of the designated RSO to the UMD Chemical Hygiene Officer;
- ensuring that the designated RSO is adequately trained regarding the roles and responsibilities of the position;
- ensuring that the designated RSO modifies this generic Laboratory Safety Plan to incorporate location-specific information;
- carries out his/her assigned responsibilities
- evaluating the performance of the RSO(s) as part of overall job performance; and
- taking appropriate measures to assure that department activities comply with University and OSHA laboratory safety policies;

Performance will be measured by:

- DEHS's record of a trained, RSO for the unit.
- DEHS's record of a current, tailored Laboratory Safety Plan for the unit.

C. Department of Environmental Health and Safety (DEHS)

The UMD Chemical Hygiene Officer (Jean Cranston) and the entire DEHS staff will participate in providing resources for departments in the development of their individual health and safety programs. The Department of Environmental Health and Safety is responsible for:

- preparing and updating the University's generic Laboratory Safety Plan;
- distributing the LSP to departments or other units who will tailor and implement the plan;
- training designated departmental RSOs regarding their responsibilities for safety and compliance with regulations and University standards that apply to research; and
- monitoring the progress of departments toward achieving compliance.

Performance will be measured by:

- documentation that a review and an evaluation of the generic LSP occurs at least annually, and updates are made as necessary;
- annual feedback to DDDs regarding records of RSO training, and current LSPs within the units;

D. Research Safety Officer (also known as Department Safety Officer)

The RSO's roles and responsibilities are described in greater detail in the RSO Toolkit. In the Department of Chemistry and Biochemistry, Randall Helander has been assigned as the Head RSO, overseeing all laboratories within the department, while Greg Mielke serves as the primary RSO for laboratories located within the Swenson Science Building. Briefly, the RSOs will:

- serve as liaison between the Department of Chemistry and Biochemistry and DEHS;
- know the rules, to help researchers comply with applicable state, federal and university requirements, including where applicable to regulated substances;

- in cooperation with the Departmental Safety Committee, develop and implement a Laboratory Safety Plan for the department. The safety plan must be reviewed annually and modifications must be submitted for approval;
- consult with laboratory personnel regarding safety protocols for specific procedures;
- in cooperation with the Departmental Safety Committee, develop and oversee a training program to ensure all researchers within the Department of Chemistry and Biochemistry understand their responsibilities and the policies that apply to their research;
- in cooperation with the Departmental Safety Committee, coordinate inspections of laboratories and ensure laboratory supervisors address any noted deficiencies;
- in cooperation with DEHS, assure that safety equipment is in place and operative;
- keep records to document departmental safety training and compliance with state, federal and university requirements.

Performance will be measured by DEHS's documentation that:

- review and evaluation of the tailored LSP occurs at least annually;
- the research safety officer's personal training records are current.

E. Supervisors/Principal Investigators

The immediate supervisor of a laboratory employee is responsible for:

- assuring that potential hazards of specific projects have been identified and addressed before work is started;
- ensuring there are written, laboratory-specific standard operating procedures for the protocols carried out in the laboratory that incorporate directions about how to mitigate the hazards of the procedures.
- informing and training employees regarding the specific hazards in their area and in the work they will be doing;
- scheduling time for the employee to attend designated training sessions;
- enforcing U of MN safety policies and safe work practices;
- conducting periodic audits of the research space under the supervisors control;
- reporting hazardous conditions to the college or departmental research safety officer;
- investigate laboratory accidents and send an Accident Investigation Worksheet (Appendix K) with recommendations to the departmental research safety officer for review.

Performance will be measured by:

- home department's documentation of current, pertinent safety training for the supervisor and each employee in the supervisor's group;
- home department's documentation of regular audits for laboratory space under the control of the supervisor.

F. Employee

Employees who have significant responsibility for directing their own laboratory work are responsible for assuring that potential hazards of specific projects have been identified and addressed before work is started. **All laboratory employees, however, are responsible for:**

- attending safety training sessions;
- following safety guidelines applicable to the procedures being carried out;
- assuring that required safety precautions are in place before work is started; and
- reporting hazardous conditions as they are discovered.

Performance will be measured by:

- supervisor's assessment of employee's adherence to topics covered in safety training.

Chapter 2 – Standard Operating Procedures

As noted in Chapter 1, **Principal Investigators** are responsible for ensuring that there are **written standard operating procedures (SOPs)** for the research protocols conducted in their area. The SOPs must identify the hazards of the protocol, as well as measures to be taken to mitigate those hazards. The references listed below may provide enough detail to serve as the SOPs for some research protocols. Other protocols may require more tailoring, as described in Section 5 of this chapter.

1. Chemical Procedures

A. Prudent Practices in the Laboratory (Appendix D)

Laboratory standard operating procedures found in Prudent Practices in the Laboratory: Handling and Disposal of Chemicals (National Research Council, 1995) are adopted for general use at the University of Minnesota. Departmental Research Safety Officers have hard copies of this text, and the entire contents are accessible on the web. Note especially the following topics which are covered in Chapters 5 and 6 of Prudent Practices:

Chapter 5 (Working with Chemicals) Introduction • 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) • Introduction • 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

B. Controlled Substances

In conducting research with controlled substances, University authorized employees must comply with federal and state laws and regulations regarding their uses, including registration with the Drug Enforcement Administration (DEA), storage requirements, inventory maintenance and substance disposal. A condensed guide to federal regulations as well as policies and forms pertaining to controlled substances are available on the Controlled Substances webpage.

Alcohol used for education, scientific research, or medicinal purposes can be purchased tax-free through University Stores (www.ustores.umn.edu), which holds the University of Minnesota site license for alcohol purchases with the Federal Bureau of Alcohol, Tobacco, and Firearms (BATF). Further information and links to the ordering form are available by clicking on Tax Free Alcohol Ordering Procedures.

C. The American Chemical Society's "Safety in Academic Chemistry Laboratories"

ACS's "Safety in Academic Chemistry Laboratories" another useful manual which presents information similar to that found in Prudent Practices, but in a considerably condensed format.

D. Hazardous Waste Management

Extensive and detailed policies regarding hazardous waste management are specified in the University's *Chemical Waste Management Guide Book*. Please refer to this text for approved waste handling procedures.

E. Emergency Procedures for Chemical Spills

The procedures listed below are intended as a resource for your department in preparing for emergencies before they happen. If you are currently experiencing an emergency such as a chemical spill, please follow the procedure below, or contact the Department of Environmental Health and Safety at 218-726-7273.

Complete spill response procedures are described in the UMD Chemical Spill Cleanup Guidelines. However, a quick reference guide is included below for convenience.

Quick Reference Guide

Evacuate

- Leave the spill area; alert others in the area and direct/assist them in leaving.
- Without endangering yourself: remove victims to fresh air, remove contaminated clothing and flush contaminated skin and eyes with water for 15 minutes. If anyone has been injured or experiencing difficulties due to exposure to toxic chemicals or chemical vapors, call 911 and seek medical attention immediately.

Confine

- Close doors and isolate the area. Prevent people from re-entering spill area.

Report

- From a safe place, call Environmental Health and Safety Office (EHSO) 218 726-7273 during working hours, 911 after hours (The 911 operators will put you in contact with the on call UMD Police officer who will assist in directing your call to appropriate emergency response personnel). For more info on emergency response please consult the EHSO emergency contact information at http://www.d.umn.edu/ehso/EmergencyPg2.html.
- Report that this is an emergency and give your name, phone and location; location of the spill; the name and amount of material spilled; extent of injuries; safest route to the spill.
- Stay by the phone, EHSO staff will advise you as soon as possible.
- EHSO with assistance from the Fire Department will clean up or stabilize spills, which are considered high hazard (fire, health or reactivity hazard). In the case of a small spill and low hazard situation, EHS will advise you on what precautions and protective equipment to use.

Secure

- Until emergency response personnel arrive: block off the areas leading to the spill, lock doors, post signs and warning tape, and alert others of the spill.
- Post staff by commonly used entrances to the area to direct people to use other routes.

After an accident, supervisor(s) must complete and fax in reporting forms within 8 business hours. Workers' Compensation policy and reporting forms are available on the web (Appendix I).

2. Biohazardous Procedures

All UMD researchers working with human blood or body fluids, or other pathogens must follow the university's Exposure Control Plan, and complete the Boodborne Pathogens Training, available on the web at http://www.dehs.umn.edu/bio_pracprin_blood_bpt.htm. All researchers working with infectious material including attenuated lab & vaccine strains (bacteria, viruses, parasites, fungi, prions), biologically-derived toxins, rDNA, and artificial gene transfer must follow requirements of the University's Biosafety Program detailed in the Biosafety Manual and on the Institutional Biosafety Committee's website.

A. Biosafety Manual

The University's Biosafety Manual is made up of three components; researchers must implement all three components in their lab safety manual.

- Biosafety Principles and Practices;
- CDC/NIH's text Biosafety in Microbiological and Biomedical Laboratories (BMBL).
- Individual lab-specific Standard Operating Procedures (SOPs) that:
  - specify the biohazards being used
  - identify the material handling steps that may pose a risk of exposure (sharps, injecting animals, centrifugation, aerosol production, transport, etc.)
  - describe equipment and techniques used to reduce the above risk of exposure
  - give instructions for what to do in case of an accidental exposure/spill
  - list wastes that will be generated and how to properly dispose of wastes

B. Institutional Biosafety Committee (IBC)

The IBC is charged under Federal Regulations (NIH) and University of Minnesota Regents' Policy with the oversight of all teaching and research activities involving:

- Recombinant DNA
- Artificial gene transfer
- Infectious agents including attenuated lab & vaccine strains
- Biologically derived toxins

See the IBC web site for procedures to apply for approval for the above work.

C. Select Agents

Labs in possession of organisms or toxins that are federally designated as select agents are required to be registered with the Centers For Disease Control if quantities exceed the exemption amounts. See the Biosafety Section of the DEHS web site for a list of select agents, exemption quantities, and procedures for their use.

D. Additional Biosafety References

World Health Organization (WHO) *Laboratory Safety Manual*, available on the web at, http://www.who.int/csr/delibepidemics/WHO_CDS_CSR_LYO_2004_11/en/.

National Research Council's text *Biosafety in the Laboratory: Prudent Practices for Handling and Disposal of Infectious Materials* (1989), available on the web at http://books.nap.edu/books/0309039754/html/R1.html#pagetop.

3. Radioactive Procedures

At UMD all researchers using radioactive materials at the University of Minnesota must:

- contact the Radiation Protection Division;
- obtain a permit for the possession and use of radioactive materials;
- complete required training modules; and
- comply with the radiation policies and procedures of the university (contained in the UMD Radiation Protection website).

The UMD Radiation Protection Website contains information on a number of topics including license committees, the permitting process, purchasing procedures, transfer procedures, general safety, personnel dosimetry, waste management, emergency management (spill control), record keeping, and regulatory guides such as declared pregnancy workers and risks from ionizing radiation exposure.

Initial training is required for all personnel who are authorized to access radiation areas. Training material/modules can be viewed through the UMD EHSO website http://www.d.umn.edu/ehso/TrainRad2.html. After viewing the training modules, users must fill out a questionnaire and then receive specific, on-site training required by permit holder (trainer).

4. General Safety Procedures

Other policies and procedures that insure safe practices in University of Minnesota laboratories addres the following:

Laboratory and General Safety

- Controlled Substances
- Emergency Eyewash and Safety Shower Installation and Maintenance
- Emergency Procedures
- Extension Cords in University Buildings
- Eye Protection/Personal Protective Equipment
- Flammable and Combustible Liquid Quantities in U of M Laboratories
- Foot Protection/Safety-Toe Shoes
- Greenhouse Policy-Fumigation/Smoke Generation Procedure
- Holiday Decorations
- Labeling Chemicals
- Lock Out/Tag Out
- Portable Fire Extinguishers-Type and Placement
- Public Corridors
- Respiratory Protection Program
- Step Ladders-Care and Use
- Supervisors Injury/Illness Investigation Form
- Termination of Laboratory Use of Hazardous Materials
- Temperature Standard
- UMD Campus Smoke-Free Policy
- UMD Indoor Air Quality
- Working with PCBs

Fire Safety

- Flammable and Combustible Liquid Quantities in U of M Laboratories
- Fire Safety at the University
- Portable Fire Extinguishers-Type and Placement

5. Laboratory-Specific Standard Operating Procedures

Each PI must have written Standard Operating Procedures (SOPs) for the research protocols conducted in his or her laboratory. Like the Lab Safety Plan, the SOPs must be accessible to researchers. Keeping hard copies in the lab or having them on a computer in the laboratory fulfills the accessibility requirement. SOPs developed through DEHS will be posted periodically in Appendix G.

Laboratory-specific SOPs are valuable research tools that supplement the departmental Laboratory Safety Plan. The process of writing SOPs requires an individual to think through all steps of a procedure and perform a risk assessment before beginning work. The SOP provides a written means to inform and advise researchers about hazards in their work place, allows for standardization of materials and methods, and improves the quality of the research. A well-written SOP can be used to comply with the federal Laboratory Safety Standard, which states that the Laboratory Safety Plan must include:

> "standard operating procedures relevant to safety and health considerations to be followed when laboratory work involves the use of hazardous chemicals."

SOPs should include exposure controls and safety precautions that address both routine and accidental chemical, physical or biological hazards associated with the procedure. A laboratory safety information sheet is available in Appendix E. This checklist, which prompts researchers to identify hazards and safety measures for the protocol, can be attached to existing procedures which may lack safety information. A template for writing new SOPs and guidance for writing biologically-related SOPs are available in Appendix H.

6. General Emergency Procedures

The procedures listed below are intended as a resource for your department in preparing for emergencies before they happen. If you are currently experiencing an emergency such as a chemical spill, please contact the UMD Environmental Health and Safety Office (http://d.umn.edu/ehso/EmergencyPg2.html) or dial 911.

For all other emergencies call 911.

7. Planning for Unplanned Shutdowns

Researchers should develop written procedures to deal with events such as loss of electrical power (affecting fume hoods, coolers etc.) or other utilities (water), or temporary loss of personnel due to illnesses such as pandemic flu.

Chapter 3 – Criteria for Implementation of Chemical 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. Assistance is available from the Department of Environmental Health and Safety.

1. Engineering Controls

A. Fume Hoods

The laboratory fume hood is the major protective device available to laboratory workers. It is designed to capture chemicals that escape from containers or apparatus during experimentation and remove them from the laboratory environment before they are 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 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.

In specialized cases, fume hoods will contain exhaust treatment devices, such as water wash-down for perchloric acid use, or charcoal or HEPA filters for removal of particularly toxic or radioactive materials.

B. Safety Shields

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 operating conditions.

C. Biological Safety Cabinets

Biological Safety Cabinets (BSC), also known as tissue culture hoods or laminar flow hoods, are the primary means of containment for working safely with infectious microorganisms. Cabinets are available that either exhaust to the outside or that recirculates HEPA filtered air to the laboratory. They are not to be used for working with volatile or hazardous chemicals unless they are specifically designed for that purpose and are properly vented. Generally, the only chemical work that should be done in a BSC is that which could be done safely on a bench top involving chemicals that will not damage the BSC or the HEPA filter. For proper cabinet selection and use see, the CDC publication Primary Containment for Biohazards.

D. Other Containment Devices

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. High strength barriers coupled with remote handling devices may be necessary for safe use of extremely shock sensitive or reactive chemicals.

Highly localized exhaust ventilation, such as is usually installed over atomic absorption units, may be required for instrumentation 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.

2. Personal Protective Equipment

A. Skin Protection

As skin must be protected from hazardous liquids, gases and vapors, proper basic attire is essential in the laboratory. Long hair should be pulled back and secured, and loose clothing (sleeves, bulky pants or skirts) avoided to prevent accidental contact with chemicals or open flames. However, bare feet, sandals and open-toed or perforated shoes are not permitted in any laboratory. Short pants and short skirts are not permitted unless covered by a lab coat. Long pants should be worn to cover skin that could be exposed during a spill.

Lab coats are strongly encouraged as routine equipment for all laboratory workers. It is the responsibility of the employer to purchase and wash lab coats for employees who request them or are required to wear them. Lab coats are required when working with radioactive materials, biologically-derived toxins, Biosafety Level II organisms, carcinogens, reproductive toxins, substances which have a high degree of acute toxicity, and any substance on the OSHA PEL list carrying a "skin" notation. See Appendix B for chemical listings. Lab coats cannot be assumed to provide complete protection against all agents, but will provide an extra layer that can be removed if accidentally contaminated, buying time for the researcher to get to the emergency shower and minimize direct skin contact. For strong acids and bases, a lab apron impervious to liquids would be a more appropriate choice.

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. Thus gloves are required for work involving pure or concentrated solutions of 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.

Since no single glove material is impermeable to all chemicals, gloves should be carefully selected using guides from the manufacturers. General selection criteria are outlined in Prudent Practices, p. 132, and glove selection guides are available on the web. However, glove-resistance to various chemicals materials 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. When guidance on glove selection for a particular chemical is lacking, double glove using two different materials, or purchase a multilayered laminated glove such as a Silvershield or a 4H.

B. 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 flying particles, but goggles or face shields are necessary when there is a greater than average danger of eye contact with liquids. A higher than average risk exists when working with highly reactive chemicals, concentrated corrosives, or with vacuum or pressurized glassware systems. Contact lenses may be worn under safety glasses, goggles or other eye and face protection. Experts currently believe the benefits of consistent use of eye protection outweigh potential risks of contact lenses interfering with eye flushing in case of emergency.

C. 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 (or PEL) that cannot be reduced, respiratory protection will be required. Rarely, an experimental situation may potentially involve IDLH (immediately dangerous to life or health) concentrations of chemicals, which will require use of respiratory protection. All use of respiratory protective equipment is covered under the University of Minnesota Respiratory Protection Program.

3. Hygiene Practices

Eating, drinking and chewing gum are all strictly prohibited in any laboratory with chemical, biological or radioactive materials. Researchers must also restrict other actions (such as applying cosmetics, lip balm or rubbing eyes) which could inadvertently cause exposure to research materials. Consuming alcohol and/or taking illegal drugs in a research laboratory are strictly prohibited as such actions potentially endanger the health and safety of not only the user, but everyone in the building. Infractions will be met with serious disciplinary action.

Before leaving the laboratory, remove personal protective equipment/clothing (lab coat and gloves) and wash hands thoroughly. Do NOT wear laboratory gloves, lab coats or scrubs in public spaces such as hallways, elevators or cafeterias.

4. Administrative Controls

Supervisors shall consider the hazards involved in their research, and in written research protocols, detail areas, activities, and tasks that require specific types of personal protective equipment as described above. Researchers are strongly encouraged to prioritize research so that work with hazardous chemical, biological or physical agents occurs only during working hours (8 am – 5 pm, Monday through Friday). After-hours (nights and weekends) work should be restricted to nonhazardous activities such as data analysis and report writing. If hazardous materials must be used at nights or on weekends, ensure that at least one other person is within sight and ear-shot to provide help in an emergency. Undergraduate workers are prohibited from working alone in the laboratory unless there is a review and formal approval by the department's DSO and/or safety committee.

Research Safety Officers must coordinate and/or conduct inspections of laboratories in their area of responsibility and ensure laboratory supervisors address any noted deficiencies. An audit checklist is available in Appendix F. DSOs can report cases of continued non-compliance to the unit head and to the UMD Environmental Health and Safety Office (EHSO). The DSO, in conjunction with EHSO and the unit head, has the authority to halt research activities that present an imminent hazard.

In the event that a research lab is moving or leaving the university altogether, the principle investigator is responsible for cleaning up the lab space. If the principle investigator does not take proper care to clean-up the laboratory, then the department for which they worked under becomes responsible. We strongly encourage departments to develop administrative controls to prevent this from happening. A good tool to use is the laboratory closeout checklist available on the DEHS website. Otherwise, DEHS does offer laboratory clean-up services for an hourly fee.

Chapter 4 – Management of Chemical Fume Hoods and Other Protective Equipment

1. Monitoring Safety Equipment

Fume hoods must be monitored daily by the user to ensure that air is moving into the hood. Any malfunctions must be reported immediately to Facilities Management 218-726-8262. The hood should have a continuous reading device, such as a pressure gauge, to indicate that air is moving correctly. Users of older hoods without continuous reading devices should attach a strip of tissue or yarn to the bottom of the vertical sliding sash. The user must ensure the hood and baffles are not blocked by equipment and bottles, as air velocity through the face may be decreased. DEHS staff will measure the average face velocity of each fume hood annually with a velometer or a thermoanemometer. A record of monitoring results will be made.

If biological safety cabinets are used for Biosafety Level 2 work, including handling human cells, they must be certified annually by an outside contractor. A list of contractors is available on the Biosafety section of the DEHS web site. It is the responsibility of the department to schedule and pay for the contractor to perform annual certification.

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. The user should post a log near the eye wash to document that it is being flushed every week. These logs are considered equipment maintenance records and therefore, should be kept for 1 year. An eyewash record template is available through the DEHS website. The user should also coordinate with EHSO 218-726-7273 to ensure that emergency showers and eye washes are tested annually.

Fire extinguishers will be checked annually by a University contractor. The user is responsible for checking regularly to ensure that other protective equipment is functioning properly. Environmental Health and Safety staff can assist with these evaluations, should assistance be necessary.

General laboratory conditions must be monitored periodically by the users. A generic laboratory audit form is included in Appendix F, and may be tailored for use by individual laboratories. The departmental Department Safety Officer or the University's Chemical Hygiene Officer may also use this form for spot-checks of the laboratories.

2. Acceptable Operating Range

The acceptable operating range for fume hoods is 80 to 150 linear feet per minute, at the designated sash opening (usually 18 inches). If, during the annual check, a hood is operating outside of this range, EHSO staff may request that you check to ensure the baffles are adjusted properly, and that the exhaust slots are not blocked by bottles and equipment. If these adjustments do not help, EHSO staff will report the deficiency to the appropriate Facilities Management personnel for servicing.

3. Maintenance

During maintenance of fume hoods, laboratories must clean out and if necessary, decontaminate the fume hood and restrict use of chemicals to ensure the safety of maintenance personnel. See "Safe Practices During Servicing of Exhaust Systems in Research Facilities."

4. Training

Training in the appropriate use and care of fume hood systems, showers, eyewashes and other safety equipment must be included in the initial and update training described in Section 5.

5. New Systems

When new ventilation systems, such as variable air volume exhaust, are installed in University facilities, specific policies for their use will be developed by the Department of Environmental Health and Safety and employees will be promptly trained on use of the new equipment.

Chapter 5 – Employee Information and Training

All laboratory researchers and their supervisors (Principal Investigators included) must be trained according to the requirements of the Laboratory Safety Standard. Colleges and non-academic departments that engage in the laboratory use of hazardous chemical, physical or biological agents are responsible for identifying such employees. The employees must be informed about their roles and responsibilities as outlined in this standard, as well as hazards associated with their work and how to work safely and mitigate those hazards.

DEHS provides web-based training modules on the basic information and training topics described below on the 'Training' page of the DEHS website. At a minimum, new laboratory employees should complete the modules "Introduction to Research Safety", "Chemical Safety", and "Chemical Waste Management".

In addition, each laboratory supervisor is responsible for ensuring that laboratory employees are provided with training about the specific hazards present in their laboratory work area, and methods to control such hazards. Such training must be provided at the time of an employee's initial assignment to a work area and prior to assignments involving new potential exposures, and must be documented. Refresher training must be provided at least annually.

Volunteers conducting research in University laboratories, in addition to completing the training described below, must complete the Volunteers Agreement and Release. If the volunteer is a minor, a parent or guardian must also sign the agreement. A minor who is paid to work in a research laboratory must file an Application for Child Labor Exemption with the Minnesota Department of Labor and Industry.

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 Laboratory Safety Standard

"Occupational Exposure to Hazardous Chemicals in Laboratories" and its appendices (29 CFR 1910.1450).

The University of Minnesota's Laboratory Safety Plan

This generic LSP is available to all employees on the UMD Environmental Health and Safety Office's web site. Individual department Laboratory Safety Plans are available within those departments.

The Permissible Exposure Limits (PELs)

PELs for OSHA regulated substances can be found in Appendix B. Also included in Appendix B are the ACGIH Threshold Limit Value (TLV) list, a list of OSHA health hazard definitions, lists of "select carcinogens" and reproductive toxins, and chemicals having a high degree of acute toxicity.

Signs and symptoms associated with exposures to hazardous chemicals.

Laboratory Chemical Safety Summaries (LCSSs) are included on pages 235-413 of the 1995 edition of Prudent Practices. LCSSs are similar to Material Safety Data Sheets (MSDS), but are tailored to the hazards of laboratory use of those chemicals. The LCSSs include toxicity information, and signs and symptoms of exposure to the chemicals.

Safety Data Sheets (SDSs, formerly known as MSDSs)

Copies of all relevant SDS are maintained by the Department of Chemistry and Biochemistry's Laboratory Services Coordinators, Randall Helander, Greg Mielke, and Neil Weberg. The SDS for all incoming chemicals are filed in binders located in the Department of Chemistry and Biochemistry Stockroom (306 Chemistry Building). Separate binders should be kept in individual Research Labs in an easily accessible location for materials that are used in large quantities, which are used frequently, or which are particularly toxic.

SDSs are available online through links from the Department of Environmental Health and Safety's web site. Hard copies of SDS for many laboratory chemicals are also available from DEHS.

Information on chemical waste disposal and spill response

The UMD Hazardous Chemical Waste Management website provides detailed information on proper waste handling procedures.

2. Training

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

Methods of detecting the presence of hazardous chemicals include visual observation, odor, real-time air monitoring, time-weighted air sampling, etc.).

Basic toxicological principles;

Principles include toxicity, hazard, exposure, routes of entry, acute and chronic effects, dose-response relationship, LD50, threshold limit values and permissible exposure limits, exposure time, and health hazards related to classes of chemicals.

Prudent laboratory practices;

Prudent laboratory practices include 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. Appropriate use of fume hoods is to be specifically addressed.

Description of available chemical information;

Container labels, Safety Data Sheets, etc.

Emergency response actions appropriate to individual laboratories;

Emergency Contact Form: Lists of emergency phone numbers, location of fire extinguishers, deluge showers, eyewashes, etc.

Applicable details of the departmental Laboratory Safety Plan;

Details should include general and laboratory-specific Standard Operating Procedures.

An introduction to the Hazardous Chemical Waste Management guidebook

3. Updates

Update training is required for all laboratory researchers and supervisors / principal investigators (PI's) at least annually. Departmental Safety Officers (DSOs) are responsible for coordinating and tracking update training. Often, DSOs may arrange for departmental-wide update-training sessions, focusing on results of laboratory audits, and highlighting issues that may need improvement. New on-line videos Training Modules are available on the UMD EHSO's Training site and may be used to supplement these training sessions. Individual PI's may conduct research-group-specific safety reviews to supplement or even stand in place of departmental update sessions. However, documentation (paper or electronic) of safety training must be maintained according to the requirements outlined in Chapter 10 of this Lab Safety Plan.

Chapter 6 – Required Approvals

‘High hazard’ research is that which due to the nature of the hazard, or the quantity of the material, or the potential for exposure poses higher than usual risk to the worker. Such research may require formal review and approval by a researcher’s departmental safety committee, perhaps with involvement of DEHS personnel. High hazard research could include gases or chemicals listed in Tables 1-5 of this Laboratory Safety Plan, or certain biological or physical agents. RSOs should conduct laboratory audits and consult with Principal Investigators to identify research programs which may fall into this ‘high hazard’ category.

PI’s whose research is identified as ‘high hazard’ should provide copies of their SOPs to the RSO and their department’s safety committee for review and approval. The committee should respond with any comments or requests for changes in a timely manner, and keep a written record of approvals within the department

Research currently being conducted at _________________uses the following particularly hazardous substances:

Safe Operating Procedures for these substances are given in Table 6.

Chapter 7 – Medical Consultation and Examination

1. Employees Who Work With Hazardous Substances

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

Signs or symptoms of exposure
Whenever an employee develops signs or symptoms associated with a hazardous substance or organism to which the employee may have been exposed in the laboratory, the employee will be provided an opportunity to receive an appropriate medical examination.

Exposure monitoring
Where exposure monitoring reveals an exposure level routinely above the action level (or in the absence of an action level, the PEL) for an OSHA regulated substance for which there are exposure monitoring and medical surveillance requirements, medical surveillance will be established for the affected employee as prescribed by the particular standard.

Exposure incident
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, the affected employee will be provided an opportunity for a medical consultation. Such consultation will be for the purpose of determining the need for a medical examination.

Physical Injury
Whenever an employee is physically hurt or injured on the job, the affected employee will be provided an opportunity for a medical consultation and/or examination. Physical injuries include but are not limited to cuts, burns, punctures and sprains.

Contact the Chemical Hygiene Officer 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.

2. Medical Examinations and Consultations

In the event of a life-threatening illness or injury, dial 911 and request an ambulance. Employees with urgent, but non-life-threatening, illnesses or injuries should go to Essentia Health -Duluth Clinic Occupational Medicine, the St. Luke's Occupational Health Clinic, or to the nearest medical clinic (see designated Medical Provider below). If off-hours medical attention is required, the employee should be taken to:

Essential Health - St. Mary's Medical Center (Duluth) Emergency Room 407 East Third St., Duluth MN, or	St Luke's Hospital Emergency Room 915 East 1st St, Duluth MN

All medical examinations and consultations will be performed by or under the direct supervision of a licensed physician. The initial examination or consultation will be provided without cost to the employee, without loss of pay and at a reasonable time and place.

3. Workers' Compensation Procedures and Forms

It is very important that even minor job-related injuries or illness are reported. These statistics help the Department of Environmental Health and Safety track trends that may indicate occupational hazards that need evaluation. To report an illness or injury, go to the UMD-Workers' Compensation (http://www.d.umn.edu/human-resources-equal-opportunity/working-umd/workers-compnon-wc) page which provides links to all required forms.

The above explain the appropriate procedures and provide the necessary reporting forms.

In Summary, supervisors must complete and submit the following reports

- First Report of Injury (must be completed within 8 business hours/1 business day of knowledge of the incident). See guidelines for completing the report.
- Supervisor Incident Investigation Report (must be completed within 3 business days of knowledge of the incident).

The supervisor or designee must provide the injured employee with paper copies of the following as soon as possible.

- Temporary Prescription Drug ID Card
- Minnesota Workers' Compensation System Employee Information Sheet
- Work Status Report

Employees must complete and submit the following report:

- Employee Incident Report (as soon as possible)

Submit report to:

UMD Workers' Compensation Coordinator
255 Darland Administration Building,
Phone: (218)-726-6827
Fax (218)-726-8827

4. Information Provided to Physician

The employee's supervisor or department will collect and transmit the following information to the examining physician:

- The identity of the hazardous substance(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 signs and symptoms of exposure that the employee is experiencing, if any; and
- A Work Status Report for the physician to complete and return to Cathy Rackliffe, UMD Workers Compensation Coordinator.

5. Information Provided to the University of Minnesota

The UMD Workers Compensation Coordinator should request that the examining physician must provide the University with a written report including the following:

- The results of the medical examination and any associated tests;
- The employee's workability,
- Any recommendation for further medical follow-up;
- 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; and

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

- **Designated Medical Providers** *(Note: An employee may choose to receive treatment from a Designated Medical Provider or a physician of the employee's choice)*

Occupational Health/Medicine

Duluth Campus

Provider	Clinic Hours:
St. Luke's Occupational Health Clinic 218-249-6822 4702 Grand Avenue Duluth, Minnesota 55807	Monday through Friday, 8:00 a.m.-4:30 p.m.
Essentia Health -Duluth Clinic Occupational Medicine 218-786-3392 400 East Third Street Duluth, Minnesota 55805	Monday through Friday, 8:00 a.m.-4:30 p.m.

Minor injuries

Provider (for non-student employees)	**Clinic Hours:**
UMD Quick Care Clinic 218-726-8666 Kirby Student Center 247 1120 Kirby Drive Duluth, MN 55812-3085	During Academic Year Monday through Friday: 8:00 a.m. - 2:30 p.m. Summer hours: Closed
UMD Health Services 218-726-8155 615 Niagara Court Duluth, Minnesota 55812-3065	During Academic Year Monday, Tuesday, Thursday and Friday: 8:00 a.m. - 4:00 p.m. Wednesday: 8:00 a.m. - 6:00 p.m. Summer hours: Monday through Friday, 9:00 a.m.-3:00 p.m.

Serious burn injuries
Essentia Health-Duluth Burn Intensive Care Unit Tel. 218-727-8762 TTY Hearing Impaired: 218-720-1950 502 East Second Street Duluth Minnesota

Chapter 8 – Personnel

The following individuals and groups have responsibilities for implementation of various aspects of the University of Minnesota's Laboratory Safety Plan.

Chemical Hygiene Officers

The University of Minnesota's Chemical Hygiene Officer is Jodi Ogilvie, Department of Environmental Health and Safety. Address: N-302 Boynton Health Service. Phone: 612-301-1214.

The UMD Chemical Hygiene Officer is Jean Cranston, Department of Environmental Health and Safety. Address: 17 Darland Administration Building, 1049 University Drive, Phone: 218-726-7273.

College or Departmental Research Safety Officer

The research safety officers for the Department of Chemistry and Biochemistry are Randall Helander and Greg Mielke. The specific duties of each safety officer will be determined at the college or departmental level.

College or Departmental Safety Committee

The designation of a safety committee to assist the safety officer in his/her required duties is strongly encouraged. Names of the safety committee members are as follows:

Name
Paul Siders, *committee chair*
John F. Evans, *member*
Peter Grundt, *member*
Ahmed Heikal, *member*
Randall Helander, *member and head DSO/RSO*
Greg Mielke, *member and Swenson Building RSO*
Viktor Zhdankin, *member*

UMD Environmental Health and Safety Office

The UMD Environmental Health and Safety Office offers assistance in a wide range of health and safety issues. A list of services offered, and staff phone numbers are included in our website: http://www.d.umn.edu/ehso Phone: 218-726-7273

Occupational Physician

See Chapter 7, Medical Providers.

Chapter 9 – Additional Employee Protection for Work with Particularly Hazardous Substances

Additional employee protection will be considered for work with particularly hazardous substances. These include select carcinogens, reproductive toxins and substances that have a high degree of acute toxicity (see Appendix B). Pages 90–93 of the 1995 edition of *Prudent Practices* provides detailed recommendations for work with particularly hazardous substances. These pages may be accessed from UMD-EHSO's web site at http://www.d.umn.edu/ehso. Also, UMD-EHSO has hard copies of the entire 1995 edition available for departmental Research Safety Officers. Laboratory supervisors and principal investigators are responsible for assuring that laboratory procedures involving particularly hazardous chemicals have been evaluated for the level of employee protection required. Specific consideration will be given to the need for inclusion of the following provisions:

1. **Planning;**
2. **Establishment of a designated area;**
3. **Access control**
4. **Special precautions such as:**
   - use of containment devices such as fume hoods or glove boxes;
   - use of personal protective equipment;
   - isolation of contaminated equipment;
   - practicing good laboratory hygiene; and
   - prudent transportation of very toxic chemicals.
5. **Planning for accidents and spills; and**
6. **Special storage and waste disposal practices.**

Research currently being conducted at ___________________uses the following particularly hazardous substances:

Safe Operating Procedures for these substances are given in Table 6.

Chapter 10 – Record Keeping, Review and Update of Laboratory Safety Plan

1. Record Keeping

Exposure evaluation
Any records of exposure evaluation carried out by the Department of Chemistry and Biochemistry (including continuous monitoring systems) will be maintained in the department office and also sent to the Department of Environmental Health and Safety. Results of exposure evaluations carried out by DEHS/EHSO will be kept by DEHS and sent to the affected department. Raw data will be kept for one year and summary data for the term of employment plus 30 years.

Medical consultation and examination
Results of medical consultations and examinations will be kept by the treating physician 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.

Training
Historically, individual employee training was been recorded on form BA 725A and kept in the individual's department or college for five years. More recently, web-based training and many in-person training sessions for employees are tracked electronically in the university's PeopleSoft system. The records must include the name and title of the trainer, the trainee, the date and the content of training. Training records for laboratory volunteers must also be maintained for at least five years. Hard copy and/or electronic forms must be available in the event of an audit by the University Audit Department or state or county regulators.

Fume hood monitoring
Data on annual fume hood monitoring will be kept in the Department of Environmental Health and Safety Office. 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.

Eyewash Records
Eyewash user logs should be kept on file for 1 year, because they are considered maintenance records.

Laboratory audits and reports
Department Safety Officers must coordinate and/or conduct formal audits of laboratories in their sphere of responsibility at least annually. A checklist is available in Appendix F, and a template report form is available in Appendix M. Checklists and reports should be kept for at least 5 years.

Accident investigation reports
Research Safety Officers work with PIs and researchers to complete the Accident Investigation Form in Appendix K. Reports should be kept for at least 5 years.

2. Review and Update of Laboratory Safety Plan

On an annual basis, this Laboratory Safety Plan will be reviewed and evaluated for effectiveness by the Department of Environmental Health and Safety and updated as necessary. Any changes in the Laboratory Safety Plan will be transmitted to college and departmental research safety officers, who are responsible for carrying out a similar review and modification of their plans, and submitting a revised copy to the Chemical Hygiene Officer.

Table 1 – Poisonous Gases

The gases on this list are either on the Department of Transportation's Category 1 list, or the Linde Specialty Gases company's Group 6 – Very Poisonous list. These chemicals are highly toxic gases at ambient temperature and pressure. They have an extremely high potential for causing significant harm if not adequately controlled.

Arsine	Boron trichloride	Chlorine pentafluoride
Chlorine trifluoride	Cyanogen	Cyanogen chloride
Diborane	Dinitrogen tetroxide	Fluorine
Germane	Hydrogen selenide	Nitric oxide
Nitrogen dioxide	Nitrogen trioxide	Nitrosyl chloride
Oxygen difluoride	Phosgene	Phosphine
Phosphorus pentafluoride	Selenium hexafluoride	Stibine
Sulfur tetrafluoride	Tellurium Hexafluoride	Tetraethyldithiopyrophosphate
Tetraethylpyrophosphate		

Guidance: Departments may choose to add other chemicals to the above list. For example, sulfur-containing compounds such as mercaptans can cause significant odor problems when used in the laboratory. Pre-approval of the conditions under which they can be used may prevent odor complaints.

Table 2 – Shock Sensitive Chemicals

The classes of chemicals listed below may explode when subjected to shock or friction. Therefore users must have appropriate laboratory equipment, information, knowledge and training to use these compounds safely.

- Acetylenic compounds, especially polyacetylenes, haloacetylenes, and heavy metal salts of acetylenes (copper, silver, and mercury salts are particularly sensitive)
- Acyl nitrates
- Alkyl nitrates, particularly polyol nitrates such as nitrocellulose and nitroglycerine
- Alkyl and acyl nitrites
- Amminemetal oxosalts: metal compounds with coordinated and hydrazine, or similar nitrogenous donors and ionic perchlorate, nitrate, permanganate, or other oxidizing group
- Azides, including metal, nonmetal, and organic azides
- Chlorite salts of metals, such as $AgClO_2$ and $Hg(ClO_2)_2$
- Diazo compounds such as CH_2N_2
- Diazonium salts, when dry
- Fulminates such as mercury fulminate ($Hg(CNO)_2$)
- Hydrogen peroxide (which becomes increasingly treacherous as the concentration rises above 30%, forming explosive mixtures with organic materials and decomposing violently in the presence of traces of transition metals
- N-Halogen compounds such as difluoroamino compounds and halogen azides
- N-Nitro compounds such as N-nitromethylamine, nitrourea, nitroguanidine, and nitric amide
- Oxo salts of nitrogenous bases: perchlorates, dichromates, nitrates, iodates, chlorites, chlorates, and permanganates of ammonia, amines, hydroxylamine, guanidine, etc.
- Perchlorate salts (which can form when perchloric acid mists dry in fume hoods or associated duct work. Most metal, nonmetal, and amine perchlorates can be detonated and may undergo violent reaction in contact with combustible materials)
- Peroxides and hydroperoxides, organic
- Peroxides (solid) that crystallize from or are left from evaporation of peroxidizable solvents (see the following Section 3)
- Peroxides, transition-metal salts
- Picrates, especially salts of transition and heavy metals, such as Ni, Pb, Hg, Cu, and Zn
- Polynitroalkyl compounds such as tetranitromethane and dinitroacetonitrile
- Polynitroaromatic compounds especially polynitrohydrocarbons, phenols, and amines (e.g., dinitrotoluene, trinitrotoluene, and picric acid)

Note: Perchloric acid must be used only in specially-designed perchloric acid fume hoods that have built-in wash down systems to remove shock-sensitive deposits. Before purchasing this acid, laboratory supervisors must arrange for use of an approved perchloric acid hood.

Table 3 – Pyrophoric Chemicals

The classes of chemicals listed below will readily oxidize and ignite spontaneously in air. Therefore, users must demonstrate to the department that they have the appropriate laboratory equipment, information, knowledge and training to use these compounds safely.

- Grignard reagents, RMgX
- Metal alkyls and aryls, such as RLi, RNa, R_3Al, R_2Zn
- Metal carbonyls such as $Ni(CO)_4$, $Fe(CO)_5$, $Co_2(CO)_8$
- Alkali metals such as Na, K
- Metal powders, such as Al, Co, Fe, Mg, Mn, Pd, Pt, Ti, Sn, Zn, Zr
- Metal hydrides such as NaH, $LiAlH_4$
- Nonmetal hydrides, such as B_2H_6 and other boranes, PH_3, AsH_3
- Nonmetal alkyls, such as R_3B, R_3P, R_3As
- Phosphorus (white)

Table 4 – Peroxide-Forming Chemicals

The chemicals listed below can form explosive peroxide crystals on exposure to air, and therefore require special handling procedures after the container is opened. Some of the chemicals form peroxides that are violently explosive in concentrated solution or as solids, and therefore should never be evaporated to dryness. Others are polymerizable unsaturated compounds and can initiate a runaway, explosive polymerization reaction. All peroxidizable compounds should be stored away from heat and light. They should be protected from physical damage and ignition sources. A warning label should be affixed to all peroxidizable materials to indicate the date of receipt and the date the container was first opened. Due to these special handling requirements, users must have the appropriate laboratory equipment, information, knowledge and training to use these compounds safely.

A. Severe Peroxide Hazard with Exposure to Air (discard within 3 months from opening)

- diisopropyl ether (isopropyl ether)
- divinylacetylene (DVA)
- vinylidene chloride (1,1-dichloroethylene)
- potassium metal
- sodium amide (sodamide)
- potassium amide

B. Peroxide Hazard on Concentration

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

- acetaldehyde diethyl acetal (acetal)
- cumene (isopropylbenzene)
- cyclohexene
- cyclopentene
- decalin (decahydronaphthalene)
- diacetylene (butadiene)
- dicyclopentadiene
- diethyl ether (ether)
- diethylene glycol dimethyl ether (diglyme)
- dioxane
- ethylene glycol dimethyl ether (glyme)
- ethylene glycol ether acetates
- ethylene glycol monoethers (cellosolves)
- furan
- methylacetylene
- methylcyclopentane
- methyl isobutyl ketone
- tetrahydrofuran (THF)
- tetralin (tetrahydronaphthalene)
- vinyl ethers

C. Hazard of Rapid Polymerization Initiated by Internally-Formed Peroxides

Liquids (discard or test for peroxides after 6 months)

- Chloroprene (2-chloro-1,3-butadiene)
- vinyl acetate
- styrene

- vinylpyridine

D. Gases (discard after 12 months)

- butadiene
- vinylacetylene (MVA)
- tetrafluoroethylene (TFE)
- vinyl chloride

Table 5 – Carcinogens, Reproductive Toxins or Highly Toxic Chemicals

The chemicals listed below are extremely hazardous. Workers must have knowledge of the dangers of these chemicals prior to use, and documentation of training in safe working procedures.

Biologically active compounds

- 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), actinomycin 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

Jaquirity bean lectin (Abrus precatorius)

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

Appendix ChemA. UMD Department of Chemistry and Biochemistry Training Program

The general requirements for employee training are outlined in a memo from Norbert Norman, dated January 7, 1993, in this appendix. Specific procedures employed by the UMD Department of Chemistry and Biochemistry are described below.

I. New Employees

A. All new employees

i. Chemical Hygiene training tapes.

All new employees complete laboratory safety training. Employees familiarize themselves with the Department's *Laboratory Safety Plan*. They then complete three on-line tutorials furnished by the Department of Environmental Health and Safety. These are listed in Appendix ChemC. The tutorials are completed using the UofM ULearn program. After completing the steps above, the employee signs and dates the Department's safety-training record in the Department office.

ii. Annual Group Training

At the beginning of each academic year the Department of Chemistry and Biochemistry will conduct, in cooperation with EHS, a general training session which includes the subjects listed in Section 5.2 of the generic LSP. A record of those in attendance is maintained by EHS and the Research Safety Officer in the Department of Chemistry and Biochemistry. All new employees with laboratory duties are required to attend this training session. This session is also used as the annual refresher training requirement for all employees (see section II of this appendix).

iii. Laboratory-Specific Training (Research Laboratories)

Laboratory-specific training will be provided to new laboratory employees by the Principle Investigator or Laboratory Supervisor. The nature of the training depends on the nature of the work assignment. A list of topics to be covered is included in appendices ChemB and ChemC. Upon completion of this training, the PI or Supervisor should list the items covered on the BA 725A training record form under the comments section, and both the trainee and supervisor should sign and date the form. The form is then filed in the Department of Chemistry and Biochemistry office in the employee's personnel file.

B. New Teaching Assistants

Teaching assistants who will be assigned to laboratory instruction complete additional instruction, provided by the laboratory services coordinator. This consists of a tour of the instructional laboratories pointing out appropriate safety procedures and the locations of safety showers, eyewashes, first aid kits, etc.

II. Refresher Training

All employees in the Department of Chemistry and Biochemistry, including Teaching Assistants (Graduate and Undergraduate) and Research Laboratory Workers shall receive a yearly refresher from their supervisor.

III. Research Students

While not specifically covered by this Research Safety Plan, graduate and undergraduate research students, who are not employees, shall be required to complete the Laboratory Safety training tutorials as described in appendix ChemC, and shall be provided with the laboratory-specific training described in appendix ChemD. A record of this training should be placed in the student's academic record file. A Student Safety Training Record, which is basically a modified B.A. Form 725A, is available in the Department of Chemistry and Biochemistry office for this purpose.

Annual refresher training for returning research students should also be provided as described in section II in this appendix.

IV. Resources

A list of online training tutorials is provided in Appendix ChemC.

The following videotapes, which are used primarily for students in instructional laboratories, are located in the Department of Chemistry and Biochemistry Stockroom:

Safety: Isn't It Worth It? — Fisher Scientific.
This tape features "Quincy" and is used primarily in the first quarter of organic laboratories.

Better Safe Than Sorry — Twin Cities Public Television and Minnesota ACS Student Affiliate Chapter. 16 minutes. This tape is used in the first quarter of general chemistry laboratory courses.

Laboratory Glassware Safety Presentation — Corning. 8 minutes.

Appendix ChemB. Orientation and Training Checklist

This is to certify that ____
has been trained in the following items which will satisfy the requirements for an effective laboratory safety and health program, according the UMD Office of Environmental Health and Safety.

ITEM **DATE**

1. Reviewed key elements of the Departmental Chemical Hygiene Plan ____________
2. Shown location and reviewed details of the Departmental or Laboratory Chemical Inventory and MSDS file ____________
3. Viewed generic lab safety and MSDS video tapes on reserve at Library Reference Desk. Successfully completed quizzes (available from UMD EHS office, 31 DAdB) ____________
4. Reviewed physical properties, symptoms of exposure, acute and chronic health effects, and special hazards of hazardous chemicals in the lab ____________
5. Reviewed chemical labeling and storage procedures ____________
6. Reviewed hazardous chemical waste disposal procedures ____________
7. Shown location and explained use of fume hood, glove box, personal protective equipment, and other exposure control items ____________
8. Shown location and reviewed use of emergency equipment, i.e. deluge shower, emergency eyewash, fire extinguisher, chemical spill equipment, first aid kit, and emergency call list or poster ____________
9. Reviewed emergency procedures in event of a fire, chemical spill, explosion, or personal injury ____________
10. Reviewed any standard Operating Procedures (SOPs) developed for safe handling of particularly hazardous substances, if applicable ____________

Signed: ______________________________ ______________________________

Employee — Principle Investigator or Supervisor

Appendix ChemC. Online Training Tutorials

1. Introduction to Research Safety
2. Chemical Safety
3. Chemical Waste Management

Appendix ChemD. Employee Training, Suggested Laboratory Specific Topics

1. Location of MSDS files, Department Laboratory Safety Plan and other information on hazards and procedures to control exposure
2. Location of hazardous material storage and special use areas, *i.e.*:
   a. Laboratory chemical storage locations and storage plan (separation of incompatibles, *e.g*., flammables from oxidizers, etc.)
   b. Acutely toxic chemical and carcinogen special use areas
   c. Physical hazard locations (*e.g.*, lasers, ionizing radioisotopes, etc).
   d. Biohazard storage and use areas
3. Review of specific hazardous substances, especially those with a TLV or PEL, within each lab where the worker may be assigned duties. Classes of hazardous substances include:
   a. Chemical hazards (*e.g.*, acids, flammables, toxics, reactives, etc).
   b. Physical energy hazards (*e.g.*, non-ionizing radiation, noise, etc).
   c. Biological hazards (*e.g.*, viral and bacterial agents, mold spores, etc).
4. Methods of controlling exposure
   a. Use of fume hoods, glove boxes, enclosures, barriers, etc.
   b. Special procedures when working with potentially hazardous substances (*e.g.*, centrifuging radio-isotope solutions, etc).
   c. Use of personal protective equipment; respirators, gloves, aprons, eye protection, etc.
5. Hazardous waste disposal procedures
   a. Follow Procedures in the U of M Hazardous Chemical Waste Disposal Guidebook
   b. Containers labeled properly
   c. Start/End dates listed
   d. Properly stored/separated/capped
   e. Manifest filled out/signed
6. Review of potential safety hazards. Classes of safety hazards include;
   a. Air or water reactive and unstable chemicals
   b. Explosion or implosion hazard potential of reactions
   c. Pipetting procedures and proper disposal of sharps
   d. Electrical hazard of overloaded circuits and ungrounded plugs
   e. Storage of flammables in non-explosion proof refrigerators
   f. Eating and/or drinking in labs
   g. Unguarded or unprotected equipment
7. Location of emergency use equipment, such as:
   a. Fire extinguishers
   b. Deluge shower/emergency eyewash
   c. First aid kit
   d. Chemical spill kit for small spills
   e. Emergency call list

Appendix ChemE. Compliance Assurance Measures

Safety Checks for Research Laboratories

The Laboratory Safety Officer shall perform at least annually a check of each research laboratory in the department and report the results to the principal investigator for each laboratory. The Principle Investigator will be responsible for correcting any problems in cooperation with the laboratory safety officer.

The checklist can be found on the DEHS website (http://www.d.umn.edu/ehso/Documents/Lab Self Inspection Form_1.docx).

Safety Checks for Instructional Laboratories

The Laboratory Safety Officer shall perform at least annually a check of each instructional laboratory in the department and report the results to the laboratory services coordinator. The laboratory services coordinator will be responsible for correcting any problems in cooperation with the laboratory safety officer and any faculty with instructional responsibilities in laboratory involved.

Although students are not University employees and are not included in the OSHA Laboratory Standard, it is University and Departmental policy that students should be accorded appropriate safety instruction and safeguards.

Posting of Emergency Response Information

The Laboratory Safety Officer shall maintain a current sheet of Emergency Response Information (see appendix ChemH), and shall post that sheet in each laboratory. This item will be included in the annual safety checks for laboratories.

Sample Accident Report Form

MEMO: Date

TO: Accident Report File
Departmental Safety Coordinator

FROM: _________________________, Laboratory Safety Officer

SUBJECT:

Description of Accident: Include date, location, personnel involved, and general description.

Follow-up: Include follow-up measures already taken, as well any corrective measures which should be taken or considered.

Appendix ChemF. LSP Compliance Steps

1. INVENTORY of all chemical, physical (*i.e.*, noise, radiation, temp extremes, etc) and biological hazards in each laboratory or workspace
   - Each lab/workspace should have a separate inventory which is updated periodically
2. MSDS FILES: Material Safety Data Sheets for each hazardous chemical and hazard information on all physical and biological hazards
   - Central file for Department Office
   - MSDS binder with each chemical MSDS keyed to inventory for ease of locating
3. STORAGE & LABELLING: All chemicals must be properly stored in cabinets with incompatibles stored separately. All containers containing chemicals must be labeled properly except those which are single use or shift
4. EXPOSURE CONTROL MEASURES: See Chapter 5 of Prudent Practices in the Laboratory
5. EMERGENCY PROCEDURES: See emergency procedures poster
6. EMPLOYEE TRAINING & DOCUMENTATION: Initially before starting work, when switching job assignments or new hazards introduced into lab, at least annually.
7. WRITTEN PROGRAM: U of M generic plan available on DEHS web site at www.dehs.umn.edu. For departmental specific plan, contact department Laboratory Safety Officer.
8. SPECIAL PROVISIONS AND SOPs. Guidance for writing SOPs available in publication; Prudent Practices in the Laboratory.

Appendix ChemG. Chemical SOP Form

Project Name: ______________________________

Principle Investigator: ______________________________

Names of Others Participating in Project

a. ____________________ c. ____________________
b. ____________________ d. ____________________

Hazardous Chemical Name

a. ____________________
b. ____________________
c. ____________________

Specific Hazards

a. ____________________
b. ____________________
c. ____________________

Labs to be Used For ____________________
Experiment: ____________________
Storage Location(s): ____________________

Max. Amount Used/Day: ____________________
Max. Amount Used/Month: ____________________
Max. Amount Ordered: ____________________
Max. Amount Stored: ____________________

Location of MSDS: ______________________________

Outline of Experimental Procedures: ______________________________

____

____

____

Special Usage Requirements:

Ventilation: Fume Hood Required? Y / N Other: ____________________

Personal Protective Equipment

Glove Type: ____________________ Goggles: ____________________
Lab Coat: ____________________ Face Shield: ____________________
Respirator: ____________________ Other: ____________________

Special Weighing Procedures (if applicable): ______________________________

____

Emergency Procedures: ______________________________
Inhalation Exposure: ______________________________
Skin/Eye Exposure: ______________________________
Spill Response: ______________________________

Waste Disposal Procedures: ______________________________

____

Appendix ChemH. Emergency Response Information

General Emergency Response

IN CASE OF AN EMERGENCY, CALL 911 OR DIAL CAMPUS POLICE 7000.

These telephone numbers connect you with an operator trained to respond to medical or fire emergencies. Talk directly into the mouthpiece of the receiver and advise the operator of the emergency. The operator can call on the proper additional emergency services.

Two fire alarm boxes are located on each floor of the building. Locate these alarms and be familiar with their proper activation.

In case of fire or other emergency requiring evacuation of the building, pull down the handle on the fire alarm box to sound the building alarm. This action will also alert Campus Police and will indicate to them the building in which the emergency is located. Floor plans are posted near the elevator on each floor. Be familiar with the evacuation routes of the floor in which you may have a laboratory or be working.

In the event of an alarm:

1. Discontinue working in your area. Render any reaction stable if it can be done quickly.
2. Notify others in your area if they are not aware of the alarm sounding.
3. Leave the room and close all doors to assist in controlling the spread of the fire and fumes.
4. Exit the building by way of the nearest safe exit route. Walk quickly but do not panic.
5. Wait until an authorized fire or safety official gives the "all-clear" signal before reentering the building.

Emergency Response to a Chemical Spill

Your laboratory should have access to the following chemicals and equipment for cleaning up spills. The spill control kits and broom and dust pans should be on each floor.

1. A neutralizing agent. The spill control kits are clearly labeled as to which type of neutralizing agent should be used. The four types of spills are: (1) acid; (2) caustic, or basic; (3) solvent; and (4) mercury
2. Gloves, plastic bags, whisk broom, and dust pan are included in each section of the spill control kits.

Procedure:

1. Do not attempt to clean up spills of highly toxic or dangerous materials unless you can do so without harming yourself and other people.

In case of a spill of a highly toxic or dangerous material, evacuate the laboratory and shut the door. Call Emergency (911 or 7000) for help with dangerous spills that may require self-contained breathing apparatus for cleanup. Inform people in adjacent laboratories and offices of the spill and to stay out of the area of the spill.

2. Wear protective clothing when cleaning up a spill.
3. Spills of acids and bases can be neutralized by the neutralizing agent in the spill control kits. The neutralizing agent should be poured around the perimeter of the spill and then poured inward to dike the spill. Thoroughly mix the slurry with the scoops provided. The acid neutralizer will bubble and turn from red to blue. The caustic neutralizer may also bubble and it turns from yellow to blue. Continue adding neutralizer until color change is complete.
4. Spills of volatile organic solvent should be covered with an adsorbent immediately to prevent fumes form igniting. Turn off room circuit breakers and any flames. Pour the solvent absorbent around the perimeter and inward to dike the spill. Mix the absorbent until it appears as a dry, free-running, non-adhering, granular material.
5. Spills of toxic solids should be swept up and placed in a labeled plastic bag. The person or persons cleaning up the spill should make sure to wear personal protective equipment before attempting to clean up the spill.

6. Once the spill has be neutralized or absorbed use the scoop provided to place the mixture in a plastic bag. Label the bag with the following information:
    1) material spilled
    2) date and time of the spill
    3) person or persons who cleaned up the spill
7. Give the labeled plastic bag containing the spill to the lab supervisor or Research Safety Officer for proper disposal.

Emergency Response to Laboratory Fire

1. Alert people in your laboratory or immediate area to the fire. Evacuate the laboratory and have someone pull the handle on the local fire alarm box.
2. Have someone call Emergency (911 or 7000) from a safe place to give more details about the fire.
3. Put out the fire with the appropriate extinguisher if training or experience or common sense tells you that you can. Fight the fire from a position of escape. If the fire is very small, it may be extinguished by smothering it with a nonflammable material such as an inverted beaker or watch glass. Take no risk if the fumes from the burning material are unknown to you.
4. Contain the fire by closing hoods and doors when evacuating area.
5. A person with clothing on fire should be drenched under the safety shower (located at exit of each lab). Afterward, wrap the person in a blanket to protect against shock. Use a fire blanket (located in the red containers in the main halls) only as a last resort, since it may trap heat and increase the severity of a burn.
6. Do not use elevators to leave the building. Leave the building by using the stairs. Keep the lights on in your laboratory

Emergency Response to a Water Flood

If you discover water leaking or flooding and there is evidence of a secondary problem (*e.g.*, hot electrical wires, reaction with chemicals, etc.)

1. Do not attempt any remedial action. Instead notify Campus Police (7000).
2. If you feel that no secondary problem exits, turn off the source of water if possible. If the water is intended to cool an electrically powered device or an electrically heated chemical reaction, turn off the electricity also.
3. If the source of the water is not immediately obvious to you, call the Physical Plant (8262) during normal working hours (7:30 am to 4:30 pm), or Campus Police (7000) after hours or on weekends, and describe the situation to the dispatcher. Be specific as to the location and possible source of the leak.
4. Pickup of water: Between 7:30 am and 4:30 pm, Monday - Friday, the Building Supervisor will assist or arrange pickup of water. At other times, or perhaps before the Supervisor can get to the scene, you and your colleagues may wish to begin the pickup of the water by using a wet-vac machine or mops. Contact the custodian for assistance.
5. Notification of occupants of affected areas: When necessary, notify at least one of the usual occupants of the affected rooms or the Building Supervisor as soon as appropriate.

Emergency Response to Gas Leak

If you enter your laboratory and smell natural gas, or other suspicious gas odor:

1. Evacuate the laboratory and call Campus Police (7000) or "Emergency" (911) immediately. Do not turn on the lights or any other electrical equipment.
2. Notify all persons in the area of the situation and assign persons to prevent entry into the lab.
3. Turn off the circuit breakers to the lab located in the hallway.
4. If a cylinder of toxic compressed gas in your laboratory has a small leak, move it into a hood if possible. If you suspect that the cylinder has a serious leak, evacuate the laboratory and call Campus Police (7000) or "Emergency" (911) immediately.

UMD Department of Chemistry and Biochemistry Policy on Mercury Thermometers

Department should continue its efforts toward further reduction of mercury containing devices. At present, mercury thermometers with > 200 °C range are needed only occasionally in Advanced Lab and Chem 3514. A limited number of such thermometers (about 20) should be kept in the Stockroom in a special drawer. The thermometers can be checked out to students only in spill-resistant containers. All mercury thermometers with range –20 to 110 °C are not needed anymore and will be removed from the Stockroom.

Procedure for handling mercury spills

Minor mercury spills, such as broken thermometers, in general can be handled by the department. Teaching assistant, responsible for the lab, should secure the area with the broken thermometer and notify the departmental Research Safety Officer (Randall Helander) or the Department Head (Elizabeth Minor) if the Research Safety Officer cannot be found at the time. The Research Safety Officer will evaluate the spill and apply the appropriate spill control kit or will call to the UMD DEHS.

All new teaching assistants will be informed about departmental policies on mercury thermometers at a safety training session in the beginning of academic year.

Appendix ChemI. General Safety Guidelines for Laboratory Work

1. Wear appropriate eye protection at all times.
2. Do not work alone while doing laboratory work that may be hazardous.
3. Do not smoke in laboratories.
4. Do not eat in the laboratory. Never store food in a chemical refrigerator
5. Do not use mouth suction for pipetting or for starting a siphon.
6. Perform all experiments that involve toxic, volatile, or malodorous materials in the hood or in an enclosed container such as a vacuum system of glove box.
7. Be familiar with the hazardous properties of the chemicals you will use. Read the SDSs for the reagents you will be using.
8. Wear protective clothing and gloves that are not permeable to the chemicals being used. Confine long hair.
9. Do not operate equipment unless you have been instructed in its proper use.
10. Keep the laboratory free of clutter. Never store chemicals on the floor. Leave book bags and coats in the hallway.
11. Dispose of chemical waste properly, no matter how small the quantity.
12. Make sure that you know the location of all safety equipment before beginning laboratory work.
13. Wash hands thoroughly with soap and water after working with chemicals
14. Protect your laboratory and laboratories and offices on floors below from floods. Never plug a sink and leave water running unattended.
15. Secure all compressed gas cylinders to walls or benches.

Laser Safety Control

Laser safety control measures are based on three aspects of the hazard evaluation: a) the ability of the laser to injure personnel, b) the laser environment, and c) the personnel who may be exposed to the radiation. An effective means for evaluating and controlling laser hazards is to classify each laser according to its relative hazard and then specify controls for each class that will ensure safety.

A. Laser Classification

Commercially available lasers have an attached label specifying the classification of that laser. Lasers are divided into four classes based on the intensity of the radiation and the potential for producing biological effects.

Class I Lasers in this class are not considered hazardous, even if the direct beam is concentrated into the eye. In the case of ultra-violet or infrared lasers, the radiation at its maximum concentration will not cause injury to the eye or skin at its maximum possible duration during one day of operation.

Class II Lasers in this class are only hazardous if the viewer overcomes the natural aversion response to bright light and the eye is exposed for longer than the 0.25 second blink reflex time. The chance of injury is remote, although possible if a person stares into the beam. The majority of “low-power” lasers today are helium-neon devices with a continuous-wave power of one milliwatt or less.

Class III These “medium-power” or “moderate-risk” lasers can cause injury within the natural aversion time. Skin injury is normally not possible and one can safely view a reflection off a rough, dull surface. Class III lasers are subdivided in Class IIIa and IIIb. Class IIIa covers visible lasers that cannot injure a normal person when viewed with the unaided eye, as with binoculars. Class IIIb consists of lasers that can produce accidental injury if viewed directly.

Class IV These “high-power” lasers present a high risk of injury and are capable of producing a fire. One cannot safely view either the direct beam or the reflected beam without proper eye protection.

B. Laser Hazard Control Guidelines

Class I Controls

No user safety rules are necessary, but looking into the direct beam should be discouraged as a matter of good practice.

Class II Controls

Never allow a person to stare continuously into the laser source. Never direct the laser beam at a person's eye unless a useful purpose exists, and the exposure level and duration do not exceed Maximum Permissible Exposure limits found in the American National Standards Institute's standard, Z136, for the safe use of lasers.

Class III Controls

Class III lasers shall be labeled in accordance with Section 8 of this manual.

Never point the laser at an individual's eye.

The laser system shall only be used under the supervision of a responsible person who is familiar with the potential hazards of the laser.

The laser shall be made inaccessible to unauthorized personnel, preferably with a key switch. A key switch is required for Class IIIb lasers.

Enclose as much of the beam path as possible to prevent an individual from placing his/her head or reflecting objects into the beam path.

Terminate primary and secondary beams at the end of their useful paths, if possible. A non-reflective, fire resistant surface should be used for the backstop.

Use beam shutters and laser output filters to reduce beam power to less hazardous levels when the full output is not required.

A warning light or buzzer should indicate laser operation. This is especially important when the beam is not visible, *i.e.*, Class IIIb ultraviolet or infrared lasers.

Operate the laser only in a well controlled area—for example, in a closed room with covered windows, or none at all—and place a warning sign on the door.

The laser beam path should be well above or well below eye level for any standing or sitting observer. The laser should be firmly mounted to assure that the beam travels along the intended path. Use proper safety eyewear if there is a chance that the beam or a hazardous specular reflection will expose the eyes.

Avoid placing the unprotected eye along or near the beam axis as an attempt to align the beam since the chance of a hazardous specular reflection is greatest in this area.

Do not look into the laser beam with optical instruments unless an adequate protective filter is used.

Remove unnecessary mirror-like surfaces from the vicinity of the beam path.

Class IV Controls

Class IV lasers shall be labeled in accordance with Section I of this manual.

Enclose the entire laser beam path if possible. This could revert the laser device to a less hazardous classification.

If entire beam path cannot be enclosed, indoor laser operation shall take place in a room with provisions to prevent inadvertent direct viewing of the laser beam and all reflections at the wavelength(s) generated.

Eye protection is mandatory for all individuals working in the controlled area. If the laser beam irradiance represents a skin or fire hazard, a suitable shield shall be used between the laser beams(s) and personnel.

Use remote firing and video monitoring or remote viewing through a laser safety shield where feasible.

Use remote firing and video monitoring or remote viewing through a laser safety shield where feasible.

Use beam shutters and laser output filters to reduce the beam irradiance to less hazardous levels whenever full beam power is not required.

The laser shall have a key-switch, master interlock to prevent unauthorized use.

The laser system shall be used only under the supervision of a responsible person who is familiar with the potential hazards of the laser system.

Use dark, absorbing, diffuse, fire-resistant targets and backstops when possible.

A warning sign shall be posted outside of each entrance to rooms having Class IV installations. If the sign is self-illuminating, it must be electrically connected to the laser system such that the act of turning on the power supply will cause the sign to light or will activate an aural/visual indicator to remind the user to turn on the warning sign. If the sign is not self-illuminating, a warning light shall be installed within three feet of the sign. The light shall be yellow or red if of fixed intensity and may be white if it flashes. Low intensity strobe lights also may be used. Operation of the warning light shall be electrically connected as for the self-illuminated signage previously described.

Precautions shall be taken to protect against electrical shock from the high-voltage power supply.

The laser laboratory should have adequate ventilation if toxic materials or cryogenic fluids are used with the laser.

Combustible anesthetic gases should be excluded from laser surgical procedures.

Eye Protection

Rarely do you find an experienced laboratory technician, chemist, or science instructor who can not tell you about a "close call" in the laboratory. One never knows when an accident will occur. The number one safety precaution is Safety Goggles. A simple lab technique like decanting a solvent or measuring out a corrosive liquid can result in a tiny droplet being splashed out of the container. If that droplet were to land in your eye, serious eye damage or even blindness could be the result.

The LSP states that all students, laboratory assistants, instructors, stockroom personnel, and visitors in the science laboratory, chemical storage areas, and laboratory and lecture preparation areas are required to wear safety goggles. Eye protection is necessary every time there is a chance of spraying or splattering a chemical. When working with a dry powder reagent, a dusty situation could allow particulate matter to enter your eyes. Every person entering a laboratory, even visitors and maintenance personnel, must wear appropriate eye protection.

Many individuals try to avoid wearing safety goggles because they are uncomfortable. Or they put them on for a short time and then lower them to dangle around their necks. I even saw one student wearing safety goggles, pull the goggles up onto his forehead so he could see better while he was measuring a solvent into a 10 mL graduated cylinder. What made the situation even worst, is that he lifted both the bottle of solvent and the graduated cylinder to eye level and only several inches from his eyes so he could see better. Even if you are very careful in your technique in the laboratory, you cannot predict what your neighbor might do. So never remove your goggles in the laboratory.

The Department of Chemistry and Biochemistry Stockroom sells safety goggles that have been selected for their safety and comfort. If you take care of them, they can last the full time you are at the University. They meet the American National Standards Institute (ANSI) Z87.1 requirement for impact resistance and splash protection. Replacement lenses are also available in the bookstore.

If doing a reaction that is potentially dangerous, (exothermic or gas releasing), a face shield should be worn in addition to the safety goggles. The face shields provide an additional barrier protecting the face and neck in addition to the eyes. Also in the issue rooms and research labs free standing plastic shields are available. The shield is placed in front of the chemical apparatus and is narrow enough that you can wrap your arms around the shields to make adjustments in the equipment or start the reaction.

For those persons wearing contact lenses, the experts have developed a suitable rule: Wearing contact lenses in the lab is acceptable and does not create an additional hazard for the wearer. However, appropriate safety goggles must be worn. Some soft lenses do absorb organic vapors and corrosive vapors like hydrogen chloride or ammonia. So if you are wearing contact lenses and notice any discomfort while working with volatile solvents, or corrosive liquids or gases then the lenses should be taken out.

Skin Protection

The skin consist of cells and tissues made of proteins, lipids, and carbohydrates. When hazardous chemicals touch your skin, they may react with these tissues, or be absorbed into one or more layer of the skin. The result could be irritation and rashes, chemical burns, and possibly permanent damage. When absorbed, some hazardous chemicals can enter the bloodstream and collect in and damage organs like the nerves, liver, and kidneys. And some chemicals can harm the red blood cells and other cells of the blood. A condition in which the one becomes allergic to chemicals can also result from overexposure by absorption. Therefore, wearing gloves and other skin protection is important while handling hazardous chemicals in the laboratory.

The LSP gives specific procedures to protect your skin when working in the laboratory. Before using a hazardous chemical, select a glove that is resistant to that particular chemical. The Resistance to Chemicals of Common Gloves Material Chart will allow you to select a glove before using the solvent. In most labs disposable gloves are available and heavier rubber gloves can be obtained from the stockroom or lab instructor if a strong corrosive will be used.

It is worth noting that aromatic and halogenated hydrocarbons will attack all types of natural and synthetic glove material. Should swelling occur, the user should change to fresh gloves and allow the swollen gloves to dry and return to normal. If using one of these solvents, then whenever you leave the lab, remove the gloves to allow any absorbed solvent to escape. All gloves wear out after a period of time. Dispose of questionable gloves rather than risk injury.

Before using the gloves, check for rips, pinholes and defects by air inflation. However, do not blow into the gloves with your mouth. Use the air lines available in the lab. After working with toxic materials, rinse the gloves before taking them off. While removing the gloves, be careful not to contaminate yourself. The used decontaminated gloves should be disposed of immediately in the trash.

Another form of skin protection is the laboratory coat. Most lab coats are made of material that resists water and other liquids to some degree. The lab coats can protect your clothing from getting small holes caused by droplet of corrosive liquids. If you will be working with a strong corrosive, ask the stockroom manager for a rubber apron.

A common problem in the educational science laboratory is the wearing of open shoes like sandals or thongs. The feet should be covered completely to protect them from chemicals and broken glass. And under no circumstances should a person enter the laboratory bare-footed.

Handling Hazardous Chemicals

Be aware that all chemicals are hazardous to some degree, and protect yourself from accidental skin, eye, and respiratory contact.

Know the hazards of the materials you are working with. If you are using an unfamiliar procedure or chemical, conduct a literature search for reports of known or suspected hazards. Material Safety Data Sheets, (MSDSs), are an important primary source of information on physical properties, health hazards, reactivity, and spill cleanup procedures.

A. General Guidelines

1. Whenever possible, perform hazardous reactions in a properly functioning hood using appropriate shielding.
2. Never taste a laboratory chemical.
3. Take special precautions when scaling up a reaction. A reaction that is safe under published conditions may be violent when multiplied in scale.
4. Read labels carefully, and keep labels clean so that they are legible. Replace deterioration labels before a chemical becomes unidentifiable.
5. Clearly labels ampoules, product vials, reaction vessels, and all other containers. Labels should include chemical names, structures when appropriate, date and name of owner. If you know of special risk, include appropriate warnings. Unidentified materials cannot be disposed of and can cause serious accidents.
6. If it is necessary to smell a chemical, do so by wafting the vapors toward your nose with your hand so that the minimum amount is inhaled.
7. Never pour a chemical back into its original bottle after measuring out too much. This can contaminate the original contents.
8. Never combine the contents of two or more bottles of the same reagent. If one of the bottles is contaminated, the resulting combination is now contaminated.
9. Be aware of chemical incompatibilities before mixing to avoid explosive or uncontrollable reactions, generation of toxic gases, etc.

B. Handling of Organic Peroxides

Peroxides are a group of compounds that contain an oxygen-oxygen bond. As a class, organic peroxides are the most explosive substances that are normally found in the laboratory. Peroxides are sensitive to light, heat, and friction, as well as to strong oxidizing and reducing agents. Explosions involving peroxides are unpredictable and violent.

1. Store peroxidizable chemicals away from source of heat, light, sparks, other ignition sources, and mechanical shock.
2. Peroxide-forming compounds should be kept at a cool temperature. Do not refrigerate peroxides if solid peroxide may precipitate or freeze out. Solid material is especially sensitive to shock.
3. Do not store peroxide-forming compounds in glass bottles having ground glass or screw caps, or metal cans with metal screw caps. Serious explosions can occur by merely unscrewing the top of a glass bottle that contains peroxides. Metal cans with plastic caps and polyethylene bottles are safer containers for ethers and other peroxidizable compounds. The safest container is the one supplied by the manufacturer.
4. Test peroxidizable substances before using, and periodically in storage as specified in item 2 above. Chemicals test using Quantofix Peroxide Test Papers (available from Aldrich). The Department of Chemistry and Biochemistry stockroom keeps a supply of these on hand.
5. Peroxides may be removed from solvents by passing the solvent through a column of alumina or Dowex-1 resin. The column MUST NOT be allowed to run dry and the packing should be handled as other peroxide waste. It is less dangerous, however, to use a new bottle of peroxide-free solvent than to purify solvent containing peroxides.
6. Serious accidents can occur when substances capable of forming peroxides are distilled. Consider other methods of purification. If distillation is necessary, the following precautions should be observed where peroxide formation is suspected. Test for peroxides before distilling. The peroxide test strips can indicate the concentration of peroxide in ppm allowing you to know just how much peroxides are present. Do the distillation under an inert atmosphere. Do not allow air to come in contact with hot solvent. Add a suitable reducing agent to the distillation flask, such as sodium/benzophenone for ethers. Make sure that no compounds that react vigorously with the reducing agent are present in the distillation flask. Do not carry the distillation to dryness; leave at least 10% liquid in the flask. Wear goggles, face shield and use a free standing safety shield when distilling peroxidizable chemicals. Conduct the distillation in a hood with the sash closed. Be aware that freshly distilled peroxidizable material may reform peroxide with two weeks of distillation
7. Spills should be cleaned up immediately by absorption on solusorb or other suitable absorbents.

C. Handling of Common Chemicals that are Particularly Hazardous

Many compounds found in older literature have been found in recent years to be more hazardous than once thought. When the research was preformed, these compounds were readily available and the chronic effects were not known. Therefore, if you use a procedure not recently published, you must check the MSDSs of the reagents to get the most recent information on hazardous health affects. For the compounds listed below, consider finding a substitute solvent or reactant to avoid possible risk. If you cannot find as substitute, then take special precautions to avoid exposure.

1. **Benzene** is considered a Category I Carcinogen by OSHA. Chronic poisoning can occur by inhalation of relatively small amounts over a long period of time. The toxic action is primarily on the blood-forming organs. Benzene has been documented to cause leukemia. Benzene is readily absorbed through the skin. Toluene should be substituted whenever possible. OSHA permissible exposure limit is 1 ppm.
2. **Carbon Tetrachloride** is another dangerous solvent found in many literature references. At one time, carbon tetrachloride was used in fire extinguishers (if you ever find an old extinguisher with CCl_4, contact the Research Safety Officer immediately). Keep exposure to the liquid and its vapors to an absolute minimum. High concentration in the air can lead to death from respiratory failure. Less severe exposure can lead to kidney and liver damage. In addition to inhalation hazard, it can be readily absorbed through the skin. Methylene chloride, (dichloromethane), is a much safer chlorinated hydrocarbon. However, almost all chlorinated hydrocarbons have been found to be toxic to some degree. The current threshold limit value for carbon tetrachloride is 5 ppm.
3. **Chloroform** is a compound similar to carbon tetrachloride with one less chlorine atom ($CHCl_3$). Therefore, it has many of the adverse health affects as carbon tetrachloride. Repeated exposure can

cause kidney, liver and heart damage. In laboratory animals it has been shown to be a carcinogen and mutagen. Use methylene chloride as a substitute. The PEL for chloroform is 2 PPM.

4. **Formaldehyde** use as preservative of biological tissue has been found to be a human carcinogen. Repeated inhalation can cause cancer of the lungs, nasopharynx, and/or nasal passages. It can cause respiratory tract irritation and edema. It can also cause eye and skin irritation. Formaldehyde is a colorless, pungent, irritant gas that is water soluble and most frequently found in 37% aqueous solution commonly known as formalin. Always use formalin in a hood and wear gloves and splash-proof goggles. The threshold limit value for formaldehyde is 0.75 ppm.
5. **Ethyl ether** is an extremely flammable solvent use in Grignard reactions and extractions. The greatest danger of ethyl ether is its very low flash point (–30 °C). The vapors of ether are heavier than air and can "crawl" along the bench top to a source of ignition. Tends to form peroxides especially anhydrous. It is a depressant to the central nervous system and can cause unconsciousness or even death on severe exposure. Carry out reactions using ethyl ether in the hood.
6. **Perchloric Acid** usually found as 72% aqueous solution is a very strong acid and oxidizer. Contact with combustible materials at elevated temperatures may cause fire or explosion. Handle with extreme care as severe burns can result from skin contact. Wear heavy rubber gloves and apron in addition to splash-proof goggles.

Chemical Storage

A. General Guidelines

1. Do not store excessive quantities of chemicals in research laboratory. Purchase the minimum amount required and dispose of unneeded chemicals in a timely fashion.
2. Date bottles of chemicals when they are opened. Peroxidizable chemicals such as isopropyl ether should be tested periodically or discarded according to the time limits. Discard any chemical of dubious purity (by the usual waste disposal procedures) if it cannot be purified safely.
3. Store reagents on shelves or in cabinets. Store large bottles of chemicals on the lowest shelves of any chemical storage area. Do not allow bottles to extend over the edge of a shelf.
4. Do not store chemicals on bench tops. They are more readily knocked over and are unprotected from potential exposure to fire.
5. Hoods should not be used for chemical storage. Hood storage interferes with air flow in the hood, causes clutter, and increases the fuel load in the event of a hood fire. If small quantities of chemicals are stored in the hood, they should be placed on an elevated shelf.
6. No chemicals (either reagents or waste chemicals) should be stored on the floor. Floor storage presents a major safety hazard because bottles can break if knocked over or struck together.
7. Chemicals requiring refrigerated storage should be properly labeled and sealed to prevent escape of any vapors. Use only refrigerators designated for chemical storage. Flammable liquids MUST be stored only in explosion-safe refrigerators. Do not refrigerate chemicals unnecessarily.
8. Seal caps of open bottles of volatile chemicals using Parafilm. This will prevent odor problems and deterioration of air/moisture sensitive reagents.
9. Inspect storage areas periodically for damaged containers such as cracked bottles or caps or rusted cans. Replace loose or deteriorating labels.

B. Storage of Specific Classes of Chemicals

1. Provide separate storage areas for corrosive chemicals, solvents, oxidizing agents, pyrophoric materials, and air- or water-reactive materials.
2. Store acids separate from bases. Store ammonium hydroxide in a separate cabinet, preferably ventilated.
3. Store oxidizers, including oxidizing acids such as nitric and perchloric acids separate from oxidizable compounds such as acetic acid. Perchloric acid MUST be stored where it cannot contact organic material.
4. Store highly toxic chemicals in unbreakable secondary containers labeled with a description of the contents. Cyanides and sulfides MUST be kept safe from any contact with acids. Store cyanides in a

closed cabinet, not in a location visible to passersby. Dispose of cyanides for which you have no current use.

5. Store pyrophoric materials separate from flammable materials, in a dry, inert atmosphere such as a nitrogen-filled desiccator or a glove box.

C. Solvent Storage

1. Solvents are classified by the National Fire Protection Association (NFPA) by flash point (Fp) and boiling point (bp) as follows:

   Flammable liquids (Class 1): Flash point < 100 °F (37.8 °C)

Class IA	Fp < 73 °F (23 °C), bp < 100 °F (38 °C)
Class IB:	Fp < 73 °F (23 °C), bp > 100 °F (38 °C)
Class IC	Fp > 73 °F (23 °C) but < 100 °F (38 °C)
Class IIA	Fp > 100 °F (38 °C) but < 140 °F (60 °C)
Class IIIA	Fp > 140 °F (60 °C) but < 200 °F (93 °C)
Class IIIB	Fp > 200 °F (93 °C)

   Flash point is defined as the minimum temperature at which a liquid gives off vapor in sufficient concentration to form an ignitable mixture with air near the surface of the liquid. Many common solvents such as acetone, ethanol, and hexane are Class IB liquids. Ethyl ether and low-boiling petroleum ether are Class IA liquids. Storage of flammable and combustible liquids is regulated by fire codes. The following storage procedures and regulations are taken largely from NFPA codes 45 and 30.

2. Store flammable and combustible liquids in approved flammable liquid storage cabinets. Such cabinets may be vented, but this is not required. If the cabinet is not vented, the vent openings should be sealed with the bungs supplied with the cabinet. The total volume of flammable and combustible liquids stored in the cabinet should not exceed the maximum quantities recommended by the manufacturer of the cabinet. No more than 3 cabinets may be located in a single fire area (laboratory).

3. Quantities of flammable liquids greater than one liter should be stored in approved safety cans. Glass containers no larger than 1 gallon (4 L) are acceptable if purity would be adversely affected by storage in metal.

4. The largest allowable laboratory container for a Class IA solvent is 1 gallon (4 L) for glass, plastic, or metal, or 2 gallon (8L) for approved safety cans. Five gallon (20 L) cans may not be stored or used anywhere in the department except in the stockroom solvent storage rooms. It is recommended that the Class IA solvents such as ethyl ether be purchased only in 1 gallon (4 L) or less quantities.

Ventilation

The primary form of protection from overexposure by inhalation in UMD science laboratories is fume hoods. Every wet research or instructional laboratory is equipped with at least one negative pressure fume hood that pulls vapors of hazardous chemicals away from the user. If the laboratory does not have a hood, then a negative pressure glove box should be used or an appropriate respirator.

The LSP states that whenever exposure by inhalation is likely to exceed the threshold limits described in the MSDS for that particular chemical, a fume hood should be used. Therefore, before using a compound check the MSDS for that compound to determine whether it should be used exclusively in a fume hood. The LSP also provides guidelines for threshold limit value (TLV) or permissible exposure level (PEL). If the TLV or PEL is less than 50 ppm or 100 mg/M3 then the chemical should be used only in a fume hood.

Before using a fume hood, check to see that it is working properly. This can be accomplished by closing the sash to within one inch of being completely closed and taking a small strip of tissue or Kimwipes an placing it near the one inch opening. If the hood is working, the strip of tissue should be drawn into the hood demonstrating negative pressure. If the hood is not working, call Facilities Management (8262) so a maintenance worker can check to see if a fan belt is broken or a circuit breaker has been tripped. Most hoods are also equipped with a magnehelic gauge which indicates air pressure inside the exhaust duct. There is a red needle which indicates present air pressure. There is also a black needle with a round section on its end which indicates the set point where the red needle should be if the hood is drawing the appropriate amount of air. Ensure that the red needle is at least touching the black circular part of the black needle. The hoods are set to draw an average face velocity of 100 fpm + or –10 % at a sash height of 18 inches. Thus, there is a sash lock at the 18 inch height. The sash should not be moved above this lock when the hood is in use.

The hood performance can be greatly affected also by these factors:

1. Objects obstructing the return ducts. In particular, often people store chemical in hood. This cluttering of the hood interferes with the air being pull from the back bottom portion for the hood. Remove unnecessary chemical and equipment and return them to their proper location.
2. The position of the equipment or apparatus should be at least 6 inches back from the front sash. This can improve the capture rate by 1000 times.
3. Positioning the sash in the down position greatly increases the flow rate through the aperture. It is strongly recommended that the hood sash be kept down whenever possible.
4. Secondary currents created by portable fans, traffic in front of the hood, and wind conditions outside the building can push fumes into the room.
5. Positioning of the baffle at the rear wall of the hood determines whether the air will be drawn from the top or bottom of the hood. This baffle plate should be in the down position for fumes lighter than air and when using a burner in the hood. The position of the baffle should be up for fumes that are heavier than air. Most hoods are set at the median position to draw moderately from both points. Only the Building Supervisor and laboratory supervisors are authorized to change the baffle position.

Departmental Policy on Pregnant Students in Chemistry Laboratory

A wide range of chemical reagents and solvents used in chemistry laboratories may be potentially hazardous to the embryo or fetus. These chemical agents in particular include chlorinated hydrocarbons, dimethylsulfoxide, benzene, and many other common solvents and chemical substances. Therefore, it is the responsibility of course instructors or research supervisors to take all practical steps to reduce a pregnant student's exposure to chemicals. It is the student's responsibility to declare her pregnancy in a written note addressed to the course instructor or research supervisor. Upon receiving this information, the course instructor or research supervisor should make appropriate arrangements preventing any physical contact of the pregnant student with chemicals used in the laboratory. This may include the student not entering the laboratory during some or all of the lab period(s). In these cases alternative arrangements will be decided by the instructor. The student's written note and the instructor's written response describing specific arrangements for the student should be filed in the departmental office.

The following modified footnote is required in the syllabi of courses that include laboratory component:

Individuals who have any disability or physical condition (such as pregnancy or allergy), which might affect their ability to perform in this class are encouraged to inform their instructor at the start of the semester. Adaptation of the methods, materials or testing may be made as required for equitable participation.

Other Appendices

A. 29 CFR 1910.1450 - Occupational Exposure to Hazardous Chemicals In Laboratories

B. Limits to Exposure to Toxic & Hazardous Substances

C. Other Standards & Guidelines

D. Prudent Practices in the Laboratory

E. Cardiovascular Division Laboratory safety Information Sheet

F. Laboratory Audit Checklist

G. Select SOPs

H. SOP Template

I. Workers Compensation Accident/Injury Reporting Policy & Forms

J. Environmental Health & Safety Office Phone Numbers

K. Accident Investigation Worksheet

L. Toxic Substances Control Act (TSCA) Fact Sheet

M. Audit Report Template