LABORATORY SAFETY MANUAL

ENVIRONMENTAL HEALTH AND SAFETY UNIVERSITY OF WASHINGTON

My Lab Specific
Information

Preface

UNIVERSITY OF WASHINGTON

Laboratory Safety Manual

February 2007

Environmental Health and Safety
UNIVERSITY OF WASHINGTON

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January 23, 2007

TO: Principal Investigators and Laboratory Supervisors

FROM: Karen VanDusen Karen VanDusen
Director

SUBJECT: Updated Laboratory Safety Manual

It is with pleasure that I offer this revision of the University of Washington's Laboratory Safety Manual. This represents a collaborative effort between the members of the Chemical Hazards Advisory Committee (CHAC), the Environmental Health and Safety Department, and UW researchers. Thank you all.

In particular, I want to acknowledge and thank the CHAC chair, Elaine Faustman, Professor, Environmental and Occupational Health Sciences, and the following CHAC members:

Paul Hopkins, Professor and Chair, Chemistry
Tony Miller, Buyer, Purchasing
Gary Pedersen, Director, Chemistry
Sam Tillery, Manager, Facilities Services' Health Science Maintenance Zone
Lia Wetzstein, Environmental Science Lab Coordinator and Lecturer, Interdisciplinary Arts and Sciences, Tacoma Campus

As a result of this collaborative effort, I believe you will find this Manual to be more concise, updated with the latest regulatory and worker safety concerns, and reorganized to be more laboratory "user-friendly."

Prior to recycling your old manual, remember to update and transfer your own "laboratory-specific" information from your old manual to the new manual (see the Quick Start Guide at the front of the manual). If you need a new binder, please contact the Occupational Health and Safety Office at 206-543-7388 or uwcho@u.washington.edu. They will be happy to answer any questions you may have about this update.

Please review the contents of this manual with your employees frequently to assure they understand the key regulatory requirements and University policies under which you are expected to operate your laboratories. There is increased regulatory oversight being given to laboratories in institutions of higher education by agencies such as the Environmental Protection Agency. This makes it essential that you maintain your commitment to fully implementing the requirements for safe handling and disposal of chemicals.

If you have any questions, please contact our Department at 206-543-7262 or check out our web page at http://www.ehs.washington.edu/ .

Thank you for doing your part to keep the University of Washington, an exemplary institution where promoting and practicing environmental, health, and safety principles are part of the "University way" of pursuing our educational, research, and service missions.

Acknowledgments

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A. Purpose

The University of Washington (UW) has committed to create, maintain and enhance a safe and healthful environment for all individuals associated with the institution, including students, faculty, staff, hospital patients, and visitors. This commitment is stated in the University Handbook, Vol.4; Part VI; Chapter 4, Section 1, which can be viewed at *http://www.washington.edu/faculty/facsenate/handbook/handbook.html*:

> *"The University of Washington shall create, maintain, and enhance a safe and healthful environment for all individuals associated with the institution, including students, faculty, staff employees, hospital patients, and visitors. Environmental health and safety activities and procedures shall be administered so as to achieve the highest ethical and professional standards in accord with legal and contractual requirements. Accident prevention measures shall be integrated in all academic and operational activities.*
>
> *"Each dean, director, chairperson, and supervisor is responsible for safety performance in their respective units. The Department of Environmental Health and Safety will provide technical assistance in establishing procedures and monitoring performance in activities involving public health and safety and environmental protection*
>
> *"Because of the personal nature of safety performance, everyone with supervisory responsibility will be expected to directly participate in the supervision of programs to assure that safe working conditions are maintained. Faculty and staff shall be directly responsible for their own safety, for the safety of students and employees under their supervision; and for the safety of their fellow employees. This responsibility can neither be transferred nor delegated. Supervisors shall provide training for accident prevention, as necessary, for those working under their directions."*

To accomplish this in chemical laboratories, the safety program must be documented in the laboratory's chemical hygiene plan.

1. Chemical Hygiene Plan (CHP)

Washington Administrative Code (WAC) 296-828 requires that laboratories document their safety procedures in a “Chemical Hygiene Plan.” For University of Washington chemical laboratories, placing laboratory-specific information and safety requirements in a convenient location in the front of the generic Laboratory Safety Manual is the method used to create the Chemical Hygiene Plan (CHP).

For large files of laboratory-specific information which may be kept elsewhere than in the front of the manual/CHP, such as laboratory safety training records, you must reference the location of large files in the laboratory-specific information area.

2. Regulations Pertaining to the Chemical Hygiene Plan

This generic Laboratory Safety Manual contains information applicable to all University of Washington laboratories and explanatory materials to comply with regulations. Pertinent regulations covering laboratories include:

a. Hazardous Chemicals in Laboratories, WAC 296-828

State of Washington regulatory standard WAC 296-828, Hazardous Chemicals in Laboratories, is the primary Washington regulation covering laboratories performing chemical manipulations, and it may be also referred to as the *Laboratory Safety Standard*. A copy of the WAC standard is provided as Appendix A. In chemical laboratories, this standard supersedes most of the requirements in other regulations.

b. 2003 City of Seattle Fire Code

The city of Seattle requires compliance with the 2003 Seattle Fire Code, which contains substantial information from the 2003 International Fire Code (International Fire Code).

c. Chemical Waste Management

The Laboratory Safety Manual also includes information on chemical waste management in order to assist laboratories in complying with State of Washington regulatory standard WAC 173-303, Dangerous Waste Regulations. Information in Section 3 of the manual outlines requirements of these requirements and describes how to safely accumulate and dispose of chemicals.

3. Chemical Hygiene Plan Accessibility

The Chemical Hygiene Plan must always be accessible to laboratory employees and students at all times that the laboratory is occupied. If multiple rooms are included in the laboratory, the plan must be available without having to get a key from another person. It must also be available on request to UW Environmental Health and Safety (EH&S) staff and Washington State Department of Labor and Industries representatives.

4. Other Plans and References

This Chemical Hygiene Plan/Laboratory Safety Manual is a part of a complete safety program. Other University documents impacting laboratory operations may include the department's Health and Safety Plan, the Radiation Safety Manual and the Biosafety Manual.

5. Applicability to Students

It is the policy of the University that students in laboratories, while not legally covered under these procedures, are afforded the same level of protection as University employees. (Students who are not employees are not covered by Workers' Compensation in the event of an injury.)

B. Scope and Application

In general, the policies and procedures in the Laboratory Safety Manual apply at all locations that serve as assigned workplaces and educational settings for University of Washington faculty, staff and students. This includes the Seattle, Bothell and Tacoma campuses, and other University-owned property, University-leased space, and temporary field locations that are under the control of UW personnel.

Any laboratory which meets the definition of a chemical laboratory must complete a Chemical Hygiene Plan for the laboratory by adding laboratory-specific information to this manual. Laboratories which do not meet the definition of a chemical laboratory may refer to this manual for general safety information, but must comply with general industry regulations concerning chemical management.

1. Chemical Laboratory

A chemical laboratory is defined as an area (which can be a single room, a group of rooms, or a part of a room identified as a particular researcher's laboratory), where chemical manipulations are done for research, educational, or clinical purposes. The manipulations must involve mixing different hazardous chemicals in a variety of manipulations, and are done on a small scale (one person can easily handle the volume of the chemical in use). According to WAC 296-828, a chemical laboratory must also utilize safety practices or safety equipment to reduce the risks of the hazardous chemicals. In addition, the chemical laboratory may not be a production type facility where one process is performed repeatedly to produce a product for others.

2. Chemical and Non-Chemical Hazards

Hazardous chemicals are considered to be those which present either a health hazard (such as an acute skin burn from a corrosive acid or a disease from a chronic, long term exposure) or could cause a physical hazard from a chemical action (such as a fire or explosion). Hazardous chemicals can often be identified from the labels, which could state "Danger," "Warning," or "Caution" or words to that effect, or the label could have some symbol which indicates a hazard. The chemical's Material Safety Data Sheet (MSDS) may also indicate that the chemical has dangerous properties, could cause some disease or injury, or that personal protective equipment such as gloves are recommended when handling the chemical.

In addition to chemical hazards, the Laboratory Safety Manual provides information about general hazards (e.g., electrical safety, high noise, etc.) which may be present in the laboratory environment. A glossary of useful terminology applicable to this manual related to both chemical and non-chemical hazards is provided in Appendix B.

C. Responsibilities

1. Laboratory Chemical Hygiene Officer (CHO)

Each chemical laboratory must have an assigned Chemical Hygiene Officer who is knowledgeable about the laboratory's procedures, is actively involved or observant of those procedures being performed, and has the authority to enforce correct procedures. The Chemical Hygiene Officer is generally the Principal Investigator, but may be the laboratory supervisor, manager, or other senior person with authority. The CHO must be identified by name in the laboratory-specific information which should be in the front of the Laboratory Safety Manual.

To aid in compiling laboratory specific-information, templates for noting laboratory-specific information are available in Appendix C and an electronic copy is available at http://www.ehs.washington.edu/ . These templates make it easier to identify the CHO by name and to remember when the annual review of the Chemical Hygiene Plan should be accomplished. The CHO is responsible for the following:

a. Rules

Establish safe work practices and rules, and enforce compliance with the practices and rules. The CHO cannot delegate or transfer this responsibility.

b. Document Safety Procedures

Ensure specific laboratory safety procedures are documented for all laboratory research activities. This is done by documenting laboratory-specific requirements in the front of this manual and by developing standard operating procedures. Methods for developing standard procedures are described in Section 6 of this manual, and forms and examples are provided in Appendix D.

c. Hazardous Conditions

Identify hazardous conditions that could result in personal injury or property damage. An inspection checklist is available in Appendix E, Checklists, to aid in evaluating the laboratory periodically.

d. Signage/Labels

Ensure appropriate signage is posted and ensure hazardous material containers (including hazardous waste containers) are labeled.

e. Chemical Inventory

Ensure an accurate chemical inventory is entered into the MyChem inventory management system and that the inventory is updated at least annually.

f. Training

Ensure employees and students are trained in the hazards of the chemicals present, and the required safety procedures including selection and use of personal protective equipment (PPE).

g. Visitors

1) Ensure visiting scientists performing procedures within the laboratory receive equivalent training as other employees on the hazards and safety

precautions including requirements for use of PPE, before starting their chemical use.

2) Ensure other visitors such as maintenance staff, trucking services staff, and “open house” visitors are protected from the hazards within the laboratory, and that surfaces and equipment are decontaminated and cleaned prior to allowing visitors to contact such surfaces and equipment. (Information about equipment decontamination for servicing by maintenance personnel is in Section 4.G of this manual and online at http://www.ehs.washington.edu/forms/fso/lab_equip.pdf and information about decontaminating equipment and facilities for disposal or lab relocation is in Section 4.H.)

h. Children

Ensure the laboratory is not used as a child care area, in accordance with University of Washington Administrative Policy Statement 10.9 (which can be viewed at http://www.washington.edu/admin/rules/APS/10.09.html).

Minors ages 14-17 in the laboratory for purposes of education, as volunteer workers, or as employees may not be exposed to agents that pose higher health risks. These risks include such materials as human body fluids, radioactive and hazardous substances, or jobs requiring personal protective equipment other than gloves, boots, eye protection or hard hats (for more information, refer to http://depts.washington.edu/worksafe/).

i. Pets

Ensure that staff do not bring pets into laboratories, in accordance with WAC 478-124-080 (which can be viewed at http://apps.leg.wa.gov/WAC/default.aspx?=cite=478-124-080).

j. Updates

Update the laboratory-specific information as conditions or procedures change.

k. Annual Review

Annually, check the EH&S web page for the current version of the LSM and notices of updates, review your LSM and laboratory-specific information and procedures (i.e., the CHP), and make any necessary changes. Note your annual review (such as on a form similar to the template in Appendix C) and file in the laboratory-specific information section in the front of your manual.

l. Accident Follow-up

Investigate and report all accidents and initiate corrective action.

m. Seattle Fire Department Permits

Obtain applicable Hazardous Material Permits from the Seattle Fire Department as necessary. This is typically of interest if a laboratory relocates or a new research project will involve highly hazardous chemicals. Contact EH&S at 206-543-0465 for advice.

2. Department Chair or Director

The department Chair or Director is responsible for the following.

a. Safety of Occupants

Provide safe conditions for all faculty, staff, students, and visitors in their areas of control. This responsibility cannot be delegated or transferred.

b. Laboratory Control Methods

Review the control methods used by the principal investigator or laboratory supervisor and ensure that required authorizations to use restricted or regulated hazardous chemicals are on file in the department.

c. Records

Ensure that all safety records are kept and maintained as described in Section 8 (Record Keeping) of this manual.

d. Accidents

Review all accident reports and ensure that appropriate corrective actions have been taken to prevent reoccurrence.

e. Laboratory Closures/Moves

Ensure that laboratory closures or moves are done responsibly, as described in Section 10.

3. Employees/Students

Employees and students have a responsibility to:

a. Guidelines and Policies

Know and comply with safety guidelines and policies required for all assigned tasks.

b. Unsafe Conditions

Report unsafe conditions to the laboratory's Chemical Hygiene Officer, Principal Investigator, faculty member, immediate supervisor, or to EH&S (206-543-7262).

c. Personal Protective Equipment

Select, maintain and use personal protective equipment appropriately, in accordance with their training. Students must provide their own personal protective equipment (PPE), as specified by the instructor, for use in academic laboratories and classrooms.

4. Environmental Health and Safety Department

Environmental Health and Safety (EH&S) is responsible for the following.

a. Generic Chemical Hygiene Plan

Produce and update the Laboratory Safety Manual, which provides the generic information for each laboratory's Chemical Hygiene Plan. Make the manual available as either an electronic copy or a paper copy for purchase through the EH&S website. Announce updates on the EH&S website, in the EH&S newsletters, and by email using the MyChem contacts with active inventories.

Assist laboratories, as needed, with the development of the laboratory specific information required to complete their Chemical Hygiene Plan.

b. Regulatory Agencies

Act as a liaison between the University and regulatory agencies.

c. Laboratory Safety

Act as a resource regarding laboratory safety issues.

d. Laboratory Surveys/Audits

Conduct laboratory surveys and assist in implementation of self-auditing procedures.

e. MSDS Database

Maintain an online Material Safety Data Sheet (MSDS) database that is available to the campus community. This database system (MyChem) also contains department-maintained chemical inventories, and a list of surplus chemicals.

f. Training

Conduct general training courses in laboratory safety.

5. UW Chemical Hazards Advisory Committee (CHAC)

The CHAC is composed of faculty and technical staff who are responsible for providing consultation, technical assistance and recommendations to the Executive Director of Health Sciences Administration and the Director of EH&S relating to hazardous substances in laboratories. Programs which may be reviewed include development of the CHP, hazard communication, community right-to-know notifications, chemical safety, carcinogen/mutagen/teratogen safety, and hazardous waste management. Membership of the committee at time of development of this manual is listed in the acknowledgements at the start of this manual. Current membership may be obtained by calling EH&S at 206-543-7262.

6. UW Chemical Hygiene Officer (UW CHO)

The Director of EH&S will appoint a University Chemical Hygiene Officer to assist the laboratory CHOs, to interpret the policies and requirements in the Laboratory Safety Manual as needed, and to recommend changes in policies and programs to the CHAC as needed. This individual can be contacted by emailing uwcho@u.washington.edu or by telephone to 206-543-7262.

Section 2
Chemical Management

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A. Basic Laboratory Safety Practices

1. Working Alone

Do not work alone in the laboratory if the procedures being conducted are hazardous. If you are working after hours, let personnel in other laboratories know of your presence or develop an accountability system with your supervisor or co-workers.

2. Chemical Exposure

Skin contact with chemicals should be avoided. Do not smell or taste chemicals.

Mouth suction must not be used to pipet chemicals or to start a siphon; instead a pipet bulb or an aspirator must be used to provide a vacuum.

3. Washing Hands

Wash hands well with soap and water before leaving the laboratory area. Never wash with organic solvents. (See Section 5.B Personal Protective Equipment and Appendix G Gloves.)

4. Food and Drink

Food and drink increase the change of exposure to chemicals and are prohibited from being prepared or consumed in laboratories using chemicals. Smoking is prohibited inside all University owned or occupied facilities and vehicles (see http://www.ehs.washington.edu/psosmoking/index.shtm).

a. Glassware/Utensils

Glassware or utensils that have been used for laboratory operations must never be used to prepare or consume food or beverages.

b. Storage of Food/Beverages

Laboratory refrigerators, ice chests, and cold rooms must not be used for food or beverage storage.

5. Vacuum

Use extra care when evacuating air from glassware. Shield or wrap the glassware to contain chemicals and glass fragments should implosion occur. When possible use thick wall vacuum glassware.

6. Access to Emergency Exits and Equipment

Storage, even temporary storage, and equipment must not block doorways, corridors, aisles, stairways, and laboratory emergency kickout panels to assure unobstructed access to exits in the event of an emergency. Likewise, emergency equipment, such as eyewashes, deluge showers, fire extinguishers, and fire alarm pull stations, must not be blocked and must be quickly accessible.

7. Laboratory Signs

Laboratory signs must be posted as described in Section 4.C. These signs may provide information (*e.g.*, emergency numbers), prohibit unsafe behavior or require protective measures, or designate locations of various supplies and equipment.

Magnetic or framed signs that can be easily moved may be used to designate a temporary hazard. Warning signs must be removed when the hazard no longer exists, such as a sign indicating the presence of a chemical that is no longer kept in a laboratory.

B. Chemical Inventory and Material Safety Data Sheets

Laboratory chemical inventories are required to be entered into MyChem, the University of Washington's campus-wide chemical inventory database. Conducting chemical inventories helps laboratory staff keep track of chemicals and prevents unnecessary chemical purchases.

MyChem is a user-friendly web-based system for maintaining chemical inventories. MyChem was also designed for emergency planning in compliance with federal, state and local regulations. Current MyChem chemical inventories are kept by the UP Police Department so that emergency personnel can know beforehand what chemicals may be involved in an accident and also who to contact in the event of an emergency. Laboratory staff must maintain chemical inventories in MyChem to facilitate compliance with Seattle, Tacoma, or Bothell Fire Department Hazardous Material Storage and Use Permits (occupancy permits) and EPA Community Right-To-Know reporting.

MyChem also stores more than 425,000 Material Safety Data Sheets (MSDSs). MSDSs provide an overview of the hazards of products used in the workplace. All employees have the right to ready access MSDSs for the chemicals they are working with.

1. Access to MyChem

For access to MSDSs, go to http://mychem.ehs.washington.edu and login using your UWNetID and password.

To request new access to your site-specific chemical inventories and the Chemical Exchange, register your name and your specific inventory locations at https://www.ehs.washington.edu/pubcookie/epo/mychemcomboform.php or call EH&S at 206-543-0467. You can also sign up for the hands-on MyChem computer class at the same time.

To register for a hands-on MyChem computer class, go to http://www.ehs.washington.edu/psotrain/corsdesc.shtm#mychem.

To obtain a copy of the MyChem User's Manual, call EH&S at 206-543-0467 or email mychem@u.washington.edu.

2. Conducting your Chemical Inventory

Personnel must inventory all chemicals found in the laboratory and specify the maximum amount normally found at this location. Inventories must be reviewed and updated annually and updated whenever there are significant changes in your chemical inventory, such as when you are moving a laboratory or starting a new project.

A worksheet that helps you inventory prior to entry into MyChem is available at http://www.ehs.washington.edu/epomychem/mychemworksheet.pdf.

While conducting your inventory, examine containers for deterioration and integrity. Chemicals that are expired, in bad shape or no longer needed must be managed as hazardous chemical waste. For more about chemical waste management, see Section 3 of this manual.

After completing the inventory, the Chemical Hygiene Officer should print two copies of the inventory from MyChem: one copy for the lab and one for home in case of an after-hours emergency in the laboratory.

3. Material Safety Data Sheets (MSDSs)

Material Safety Data Sheets (MSDSs) are documents that describe the physical and health hazards of chemicals. Manufacturers of chemicals must provide MSDSs for chemicals that they sell. Although many MSDSs have limited application in laboratories due to their orientation towards industrial use of large quantities of a chemical, they provide basic information that all persons using that chemical need to know.

MyChem is the University of Washington's centralized MSDS database for chemicals used by University personnel (see 2.B.1). EH&S maintains the MyChem MSDS database.

Laboratory staff and students must have ready access to MSDSs for all chemicals used in the laboratory. The department or laboratory may choose whether to maintain the MSDSs in either electronic or paper format. The source of the MSDS is less important than the requirement that all personnel using chemicals or working around the chemicals must be able to demonstrate that they can retrieve the MSDS for a chemical within a short period (such as within five minutes). MyChem allows researchers to link to electronic MSDSs directly, so is a suitable tool for fulfilling this requirement.

EH&S recommends laboratories maintain paper copies of MSDSs for the hazardous chemicals most likely to spill and/or cause injury to someone. Having an MSDS immediately available when someone has been exposed to a hazardous chemical helps emergency personnel decide how to respond and treat that person.

If you are unable to access MyChem or cannot locate an MSDS in MyChem, EH&S can help. Call EH&S at 206-616-3441 to request assistance during business hours. For MSDSs which are in the MyChem system, EH&S will obtain the MSDS for you and fax a copy within a work shift. Chemicals that do not have an MSDS in the system will take longer to research and obtain. After business hours, contact the UWPD at 206-543-9331; UWPD will contact an EH&S representative.

A Safety Data Sheet (SDS) generated in accordance with the Globally Harmonized System of Classification and Labeling of Chemicals provides similar information to an MSDS and is an acceptable alternative to an MSDS.

Please forward a copy of any MSDS or SDS received in your laboratory that is not already online in MyChem to EH&S (Box 354400, c/o MSDS Coordinator) for addition to the MyChem database.

C. Chemical Procurement

Most chemical products can be purchased without restriction from the manufacturer, from University Stores, or through the UW Purchasing Department. However, the following rules and guidelines apply to some chemicals.

1. Hazardous Chemicals

Order only the amount of chemicals needed. Many manufacturers will supply smaller quantities or containers if requested by the purchaser. Do not stockpile chemicals. Chemicals that are expired and/or appear to be no longer useful are considered hazardous waste.

Purchase hazardous chemicals in plastic coated bottles (when available) instead of uncoated glass bottles.

If possible, hazardous chemicals should be received directly by the laboratory. If it is received in an office, there should be a safe location such as a designated table with adequate open space reserved for temporary storage of the package.

When the package is opened, it should be verified that the proper chemical was sent, that the container is intact, and that the label is legible. The date of receipt should be written on the container's label.

2. Pharmaceuticals

Pharmaceuticals not regulated by the Drug Enforcement Agency (DEA), *e.g.* antibiotics, heparin, sterile water, and over the counter drugs, can be purchased without restriction through the University Drug Services. For more information, see http://weber.u.washington.edu/~druginfo. If you know exactly what is needed, use http://healthlinks.washington.edu/fdr/ to see the pharmacy formulary list and drug information. If you do not know exactly what is needed, email questions to drugsvcs@u.washington.edu or call 206-548-6058.

3. DEA Controlled Substances

Drug Enforcement Administration (DEA) controlled substances such as tranquilizers and controlled materials needed to make certain drugs must be ordered through University Drug Services (see above). Authorization to buy these substances requires prior registration using a *Controlled Substance Registration Form* signed by your department chair. Controlled substances must be kept in locked cabinets that have limited access. University Drug Services requires that an accurate inventory be kept for all controlled substances and that expired or no longer needed substances be returned to them for destruction.

4. Non-Denatured Ethyl Alcohol

Non-denatured ethyl alcohol may only be purchased from University Stores. Some restrictions apply. For more information call 206-543-1980 (University Stores South Campus).

5. Radioactive Materials

The State of Washington Department of Health, Division of Radiation Protection, licenses radioactive materials use. Using radioactive materials requires the prior approval of the EH&S Radiation Safety Office. Orders for radioactive materials must be placed through the UW Purchasing Department.

6. Highly Hazardous Materials

Materials that are extremely hazardous to property, health or the environment (explosives, pyrophoric materials, highly water reactive chemicals, and highly toxic gases, for examples) must not be procured until the necessary permits and administrative, engineering and environmental controls are in place. Hazardous materials must be stored and used in accordance with numerous regulations including, but not limited to, the International Fire Code and local amendments. See Section 2.G: Special Chemical Hazards for examples. Contact the EH&S Facility Safety Office at 206-543-0465 for more information.

7. Compressed Gas Cylinder Procurement

Whenever possible gas cylinders should be purchased through University Stores to ensure that the supplier has a cylinder return authorization program (http://www.washington.edu/admin/purchstores/stores/cylinders.html). If University Stores cannot obtain the necessary gas cylinder, the purchaser must get a written return agreement from the distributor or manufacturer prior to purchasing the gas. It is important that the return agreement include a statement requiring the manufacturer to take back both the cylinder and any unused gas. The purchaser should retain this agreement until the manufacturer has accepted the returned cylinder.

8. Chemical Exchange

The UW Chemical Exchange program facilitates the free exchange of chemicals campus-wide via MyChem, the online chemical inventory system. Consider checking the online Chemical Exchange (accessible only to UW employees) for chemicals before you buy new chemicals. For more information about this program, see the MyChem website at http://www.ehs.washington.edu/epomychem/index.shtm.

D. Chemical Storage

1. Segregate Incompatibles

To avoid dangerous interactions among incompatible chemicals, chemicals should be physically segregated by observing the general classes listed in Table 2-1 and by checking the MSDS. Incompatible chemicals within these classes should also be segregated. You can contact EH&S at 206-543-7388 for additional information about chemical hazard classes and compatible storage.

Table 2-1 Chemical Use Category Segregation Table

Acids	Segregate acids from active metals such as sodium, potassium, magnesium, etc.
	Segregate oxidizing acids from organic acids such as glacial acetic acid and from flammable and combustible materials, such as cardboard boxes.
	Segregate acids from chemicals which could generate toxic or flammable gases upon contact, such as sodium cyanide, iron sulfide, calcium carbide, etc.
	Segregate acids from bases.
Bases	Segregate bases from acids, metals, explosives, organic peroxides and easily ignitable materials.
Flammables	Store in approved safety cans or cabinets. Segregate from oxidizing acids and oxidizers. Keep away from any source of ignition: heat, sparks, or open flames.
Oxidizers	Store in a cool dry place. Keep away from combustible and flammable materials. Keep away from reducing agents such as zinc, alkali metals, and formic acid.
Cyanides	Segregate from acids and oxidizers.
Water Reactive Chemicals	Store in a cool dry place away from any water source. Have a Class D fire extinguisher available in case of fire.
Pyrophoric Substances	(Materials that will react with the air to ignite when exposed, e.g., white phosphorus.) Store in a cool dry place, making provisions for an airtight seal.
Light Sensitive Chemicals	Store in amber bottles in a cool, dry, dark place.
Peroxidizable Chemicals	Store in airtight containers in a dark and cool place. Most peroxidizable compounds are flammable and should be stored in a flammable liquid storage cabinet or room. Label containers with receiving, and opening dates. Periodically test for the presence of peroxides. Discard before exceeding expiration date.
Toxic Chemicals	Store according to the nature of the chemical, using appropriate security where necessary.
Nitrated compounds	Nitrated compounds can be considered explosive; special care and handling may be required.

2. General Chemical Storage Guidelines

Follow good storage practices no matter wherever the chemicals are stored (i.e. cabinets, refrigerators, or shelves).

a. Good Storage Practices

1) Cabinets - Whenever practical, chemicals should be stored in approved cabinets.

2) Shelves - All shelves should be securely anchored to walls and fitted with 2-inch lipped edges or enclosed in cabinets with latched doors.

3) Heavy Objects - Heavy objects should be stored on lower shelves.

4) Corrosives – Corrosives should be stored only below eye level.

5) Secondary Containment - When practical, chemicals in the same hazard class should be stored in secondary containment tubs that are chemically resistant and unbreakable.

6) Consistent Chemical Storage Locations - Particularly hazardous substances (high acute toxicity chemicals, select carcinogens, mutagens, and teratogens) should be stored together if compatible. Signs should be posted indicating their location and unique hazards.

7) High Degree of Toxicity - Chemicals with a high degree of toxicity (*e.g.* venoms, mycotoxins, and select agents) should be doubly contained and stored in a locked area accessible only by authorized personnel. Use containers that are chemically resistant and non-breakable.

8) Chemical Waste - Store chemical wastes following the same guidelines as above. Original container labels must be obliterated and the containers must be labeled with a completed University of Washington hazardous waste label. Secondary containment is required if chemical waste is stored near a floor drain or other drain to sanitary sewer. Avoid mixing incompatible waste materials. Serious laboratory accidents, such as a death at the University of Washington in the early 1970's, have occurred when people have mixed incompatible waste materials. For more information about chemical waste, see Section 3 of this manual.

b. Incorrect Storage Practices

1) Acids - Do not store inorganic acids with flammable solvents. Contact of a concentrated oxidizing acid with a flammable solvent may result in a fire or an explosion. Other incompatible chemical storage practices are shown above in section D.1.

2) Heat/Direct Sunlight - Exposure of chemicals to heat or direct sunlight should be avoided. Even if the chemical is stable, plastic containers have degraded from sunlight.

3) Storage on Floors, on Bench Tops or in Fume Hoods - Chemicals should not be stored on the floor or clutter bench tops. Storing chemicals in a fume hood will compromise the effectiveness of the hood.

4) Storage Height – Do not store heavy containers on the floor or above waist level. Do not store corrosives above eye level. Do not store items closer than 18 inches from the ceiling if the area has fire sprinklers.

5) Hallway Storage – Do not store chemicals in hallways, corridors and exit ways.

3. Chemical Storage Quantity Limits

a. Control Zones

Chemical quantities in most University buildings are limited by the Seattle Fire Code (SFC), which is based on the 2003 International Fire Code (IFC). (Note: Local amendments to IFC have also been made by Tacoma and Bothell Fire Departments.) Limits by hazardous material classification apply to a control zone that may include up to an entire floor of a building. Quantity limits may be increased if fire sprinklers protect the building or if hazardous materials are located in cabinets. Researchers and other building occupants must cooperate with each other to make sure that hazardous material quantities do not exceed code limits. This can be aided by maintaining an accurate chemical inventory in MyChem.

Some specific quantity limits per control zone are listed in the table on the next page (Table 2-2, Example Hazardous Material Quantity Limits). This table is not complete and there are also many additional criteria in the implementation of the limits. Although some labs may be grandfathered under 1997 Uniform Fire Code limits, most of the UFC limits are identical with 2003 IFC. To assure compliance with the IFC, contact EH&S Fire Safety at 206-543-0465.

Table 2-2 Example Hazardous Material Quantity Limits

Material	Quantity Limits per Control Zone	IFC Citation	Comments
Class I-A Flammable Liquids	30 gallons	2703.1.1	Limits increased if stored in approved cabinets, or the zone is sprinklered.
Combination Class I-B/ I-C Flammable Liquids	120 gallons	2703.1.1	Same as Class 1-A.
Flammable Gas	1000 cubic feet	2703.1.1	Same as Class 1-A.
Organic Peroxide, Class I to V	5 pounds or more	2703.1.1	Limit depends on class.
Pyrophoric	4 pounds	2703.1.1	Only allowed in sprinklered buildings.
Water Reactives, Class 1 to 3	5 pounds or more	2703.1.1	Limit depends on class.
Highly Toxic Materials	10 pounds or 20 cubic feet (gas)	2703.1.1	Gas may only be used and stored in approved ventilated cabinets or exhausted enclosures.
Corrosives	810 cubic feet	2703.1.1	Limits increased if stored in approved cabinets, or the zone is sprinklered.
Liquid Corrosives	500 gallons	2703.1.1	Same as Corrosives.
Toxics	500 pounds	2703.1.1	Same as Corrosives.

b. Flammable Liquids in Basements

Flammable liquids are prohibited in basement laboratories except for laboratories conforming to Seattle Fire Department Administrative Rule 34.03.04. The rule is online at http://www.seattle.gov/fire/FMO/firecode/adrules/AdRule34.03.04.pdf. For assistance, contact EH&S at 206-543-0465.

c. Additional Requirements

In a laboratory, a maximum of 10 gallons of flammable liquids, in approved containers, may be stored outside of a flammable liquid cabinet. See the following table, Table 2-3, Approved Flammable Liquid Storage Containers, for container types and limits. Flammable liquid containers larger than 5 gallons are not permitted in laboratories without specific approval.

Table 2-3 Approved Flammable Liquid Storage Containers
(Ref NFPA 30, Table 6.2.3)

Container Type	Flammable Liquids			Combustible Liquids	
	Class I-A	Class I-B	Class I-C	Class II	Class III
	Flash Point < 73 °F Boiling Point < 100 °F (Ethyl ether)	Flash Point < 73 °F Boiling Point ≥ 100 °F (Hexane)	Flash Point > 73 °F and ≤ 100 °F (Diesel fuel)	Flash Point > 100 °F and < 140 °F (Mineral spirits)	Flash Point ≥ 140 °F (Kerosene)
Glass	0.5 L (1.05 pt) *	1 L (1.05 qt) *	5 L (1.3 gal)	5 L (1.3 gal)	20 L (5.3 gal)
Metal	5 L (1.3 gal)	5 L (1.3 gal)	5 L (1.3 gal)	5 L (1.3 gal)	5 L (1.3 gal)
Rigid Plastic IBCs (UN 31H or 31H2)	0	0	0	3000 L	3000 L
Composite IBCs w/flexible inner receptable (UN31HZ2)	0	0	0	0	0
Polyethylene UN 1H1	5 L (1.3 gal)	20 L (5.3 gal)	20 L (5.3 gal)	450 L	450 L
Safety Can	10 L (2.6 gal)	20 L (5.3 gal)	20 L (5.3 gal)	20 L (5.3 gal)	20 L (5.3 gal)
* Containers may be up to 20 Liters for reagents of Analytical Purity Grade or High Grade.					

E. Chemical Labeling

1. Original Container

The label on an original container must be legible, be written in English and include the chemical name, the hazard warnings and the manufacturer's name and address. If a container label becomes illegible during use, you must affix an extra copy of the original container label or a completed generic label.

Chemicals that form peroxides or other hazardous products when exposed to air must be labeled with the date the container was first opened.

2. Transfer to Secondary Container

Chemicals are often transferred from the original container to another container. The secondary container must be labeled with the chemical name (which should be the same name as on the MSDS) and hazard warnings. Examples of secondary container labels are shown in Figures 2-1 and 2-2. The label should also include the initials of the person who made the transfer and the date of the transfer.

3. Labeling Instructions

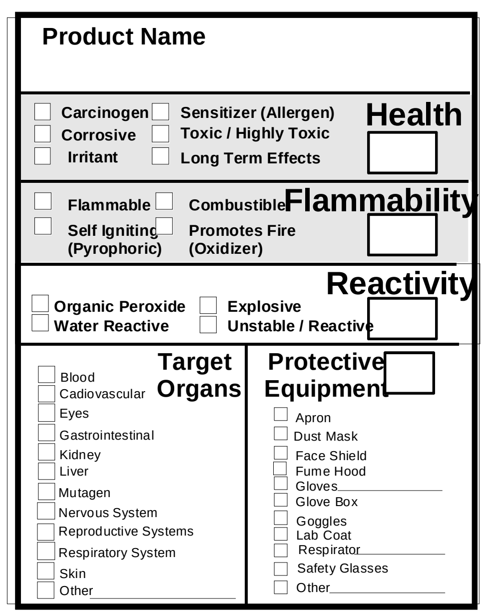
Your department may require a specific type of label. Any laboratory-specific requirements for types of labels should be identified in the laboratory-specific information section of the Laboratory Safety Manual. Types of labels routinely used on secondary containers are shown below.

A container that is too small for labels; installed into a process but routinely opened; or would become unusable for its intended purpose if labeled must still be identified unless the container will not be used beyond the end of the day. Use any labeling method that enables employees and visitors from other agencies such as the fire department to identify the chemicals and their hazards. Examples include a sign identifying the materials and their hazards and color or numeric codes or room diagrams identifying locations of the chemicals and hazards.

a. UW Hazard Label

The UW Hazard Label (Figure 2-1) has color coding, hazard check boxes and numeric ratings. This label is peel and stick and is available at University Stores in two sizes, 1.5" x 4" (#0020-403) and 4.5" x 3.5" (#0020-401).

Figure 2-1 UW Hazard Label



b. Handwritten Label

Handwritten labels as shown in Figure 2-2 may be used to label secondary containers. The container's contents must be identified and the chemical's hazards must be described. EH&S recommends that you also add the name and date associated with the container to help with chemical management.

Figure 2-2 Handwritten Label

ACETONE

Flammable
Skin, eye, and respiratory
tract irritant
CNS depressant
February 10, 2006

c. HMIS® Label

HMIS® is a commercially available rating and labeling system as shown in Figure 2-3. Developed by the National Paint and Coatings Association, it is a complete hazard communication program in which the hazard ratings are related to personal protective equipment. More information is available at http://www.paint.org/hmis/index.cfm. These labels may be used for secondary containers. The chemical's name and hazard ratings must be written on the label and the chemical's hazards must be described.

Figure 2-3 HMIS® Label

d. Globally Harmonized System (GHS) Labels

The Globally Harmonized System for Classifying and Labeling Chemicals is a system coordinated internationally which uses standardized hazard terms, warning statements, and pictograms or icons on product labels. (The label format is also standardized.) If you are making a secondary container label of a product labeled in accordance with the GHS, you must include the product name and hazards, but you do not need to include all the warning statements and pictograms or icons.

4. Labeling Wastes

Waste containers must be labeled following guidelines in this manual in Section 3 for hazardous chemical waste. For radioactive waste, see Section 14 of the UW Radiation Safety Manual. For biological waste, see page IV-42 of the UW Biohazard Manual. If re-using a container to hold waste, the container must be compatible and appropriate for the waste. Completely deface all old labels.

F. Transporting Chemicals

Avoid transporting chemical containers which may have contamination on the outside (*i.e.*, avoid the need to wear gloves or other PPE while transporting chemicals). If gloves must be worn, either be escorted by another person to open and close doors and press elevator buttons or remove the glove from one hand and use it to open doors while holding the chemical in the other hand.

1. Transporting between Floors and Buildings on Campus

This section applies to transportation by hand or by cart. Do not transport chemicals in your personal vehicle. In general, when possible, use freight-only elevators when moving chemicals.

a. Moving a Single Chemical

1) The person doing the moving must be trained in the hazards of the chemical and know what to do in the event of a spill of that chemical.

2) Chemical bottles should be labeled, securely capped and placed in a

bottle carrier.

3) Chemical containers that are glass and do not have closing caps or handles should be placed in bottle carriers or larger containers and surrounded by vermiculite or other absorbent material.

4) A lecture bottle should be moved in a manner that protects the valve.

b. Moving Multiple Chemicals

1) The person doing the moving must be trained in the hazards of the chemicals and what to do in the event of a spill of those chemicals. The person must also have a spill kit that can handle the spill of those chemicals.

2) Chemicals should be segregated and packaged by hazard class in a larger container.

3) Containers used to transport multiple chemicals should be lined with an absorbent material such as vermiculite to cushion the load and absorb and contain any spills.

4) Carts used to move chemicals should be stable under the load and have wheels large enough to negotiate uneven surfaces without tipping or stopping suddenly.

5) For laboratory moves, EH&S can arrange for a contractor to pack and move your chemicals for you, or you can pack and move them yourself using proper DOT packaging and a UW Motor Pool vehicle (if on campus). For more information, see Section 10 of this manual.

c. Compressed Gas Cylinders

When moving compressed gas cylinders, they must:

1) Have metal outlet cap/plug installed,

2) Have the valve cap installed if the cylinder has one, and

3) Be secured in a cart or container designed to prevent the cylinder from falling over while being moved.

(See subsection G.3 below for more information about compressed gasses.)

2. Transporting Chemicals off Campus

a. Limitations

You cannot transport hazardous chemicals in your personal vehicles without prior authorization by the UW. You can transport certain hazardous materials in a UW owned and operated Motor Pool vehicle. For more information or for authorization, call 206-616-5835 or email chmwaste@u.washington.edu. If you are transporting chemicals for a move, please see F.2 c. below.

If you ship hazardous materials by vehicle or air, you are required by law to be trained and certified (see F.2.b). This includes situations when you use a commercial contractor (FedEx, United Parcel Service, Yellow Freight, *etc*) to transport a hazardous material for you. You are responsible for complying with all applicable transportation regulations, which ensure the safety of your chemicals as well as those who transport them.

b. Training

Training is required for all people who classify, prepare, package, label, document, or offer a hazardous material for transport. Shippers can receive training by taking the EH&S class *Shipping and Transporting Hazardous Materials*. Class times and registration can be found on our website at http://www.ehs.washington.edu/psotrain/corsdesc.shtm.

c. Laboratory Moves

EH& S will arrange to have a contractor package your chemicals and transport them to your new location if off-campus. There are some materials that they cannot transport (temperature restrictive materials, DEA regulated materials, and radioactive, infectious or explosive materials). See Section 10 Moving In/Moving Out for more details. For more information, call 206-616-5835 or email chmwaste@u.washington.edu.

G. Special Chemical Hazards

Personnel need to take special precautions with chemicals that are reactive, explosive, in compressed gas cylinders, highly toxic, or experimental.

1. Reactive Chemicals

A chemical is a reactive if it has the capability to undergo violent chemical change, such as explosions or production of toxic fumes, in certain situations. Purchase and use these chemicals in small quantities or find a suitable alternative. Take extreme care when handling and storing these compounds.

a. Compounds That Generate Toxic Gases

Some compounds that contain sulfide or that have a cyanide (-CN) functional group can generate toxic gases in sufficient quantities to present a danger to human health when combined with other compounds, such as hydrochloric acid. Examples are shown in Table 2-4.

Table 2-4 Toxic Gas Generators

Copper (II) cyanide	Mercury (II) cyanide	Sodium cyanoborohydride
1,4-Dicyanobutane	Methyl sulfide	Sodium dicyanoaurate (I)
Diethyl cyanophosphonate	Octyl cyanide	Sodium sulfide
Fumaryl chloride	Potassium cyanide	Toluene diisocyanate
Heptyl cyanide	Sodium cyanide	

b. Oxidizers

Oxidizers are chemicals that initiate or promote combustion of other materials. Oxidizing agents include halogenated inorganics, nitrates, chromates, persulfates and peroxides. Examples are shown in Table 2-5.

Table 2-5 Oxidizers

Ammonium dichromate	Lithium perchlorate	Potassium chlorate
Ammonium nitrate	Nitric acid	Potassium permanganate
Chlorine (liquid or gas)	Nitric oxide	Sodium nitrate
Chromic acid	Oxygen (liquid or gas)	Strontium nitrate
Guanidine nitrate	Perchloric acid	Sulfuric acid

c. Chemicals That May Polymerize

Polymerization is a chemical reaction in which small molecules combine to form larger molecules. Polymerization can be hazardous when the reaction releases large amounts of energy or drastically increases the volume of the chemical. Examples are shown in Table 2-6.

Table 2-6 Chemicals that May Polymerize

Acrylic acid	Isopropenyl acetate	Vinyl bromide
Acrylonitrile	Styrene	2-Vinylpyridine
1,3-Butadiene		

d. Pyrophoric Chemicals

A chemical that will ignite spontaneously in air below 130 °F (54 °C) is a pyrophoric. The oxidation of the compound by oxygen proceeds so rapidly that ignition occurs spontaneously. Examples are shown in Table 2-7.

Table 2-7 Pyrophoric Chemicals

Barium metal	Phosphorus (all forms)	Tantalum powder
Europium (II) sulfide	Potassium metal	Tert-butyllithium
Lithium - tin alloys	Rubidium metal	Triethylphosphine
Lithium diisopropyl amide	Silane	Tri-n-butylphosphine
Methyl lithium	Sodium metal	

e. Water Reactive Chemicals

Water reactive chemicals react violently with water to release a gas that is either flammable or presents a health hazard. Alkali metals, many organometallic compounds, and some hydrides react with water to produce heat and flammable hydrogen gas. Examples are shown in Table 2-8.

Table 2-8 Water Reactive Chemicals

Alpha-toluenesulfonyl fluoride	Oxalyl chloride	Sodium metal
Antimony trichloride	Phosphorus pentachloride	tert-Butyllithium
Calcium hydride	Phosphorus pentasulfide	Titanium (IV) chloride
Hydrobromic acid	Phosphoryl chloride	Trimethylchlorosilane
Lithium aluminum hydride	Potassium metal	

2. Potentially Explosive Chemicals

An explosive chemical, when subjected to heat, impact, friction, electric or chemical charges, can produce a sudden, quick release of pressure, gas, and heat. When detonated in an uncontrolled or unexpected circumstance, explosives can result in serious bodily harm or extensive property damage. Shock sensitive explosives are known to detonate even when bumped or handled normally. Common potentially explosive chemicals at the UW are:

a. Nitrated Compounds

Nitrated organics and inorganics constitute the largest class of compounds that are explosive when dehydrated.

Purchase nitrated compounds in small quantities. Do not break the seal on the cap until the chemical is needed.

When you purchase a nitrated compound, weigh the container and note the weight on the bottle. Prior to subsequent use, weigh the container again. If the container weighs less, add an appropriate solvent to replace the weight lost. After the reagent is opened and an aliquot is taken, again note the weight of the container. Visually inspect the container for problems prior to each use and wipe down the bottleneck, cap, and threads with a wet cloth before resealing. Examples of nitrated compounds are shown in Table 2-9.

Table 2-9 Nitrated Compounds

Diphenyl hydrazine	3-Nitrotoluene	Trinitrophenol (Picric acid)
Nitrocellulose	Trinitrobenzene	Trinitrotoluene

Picric acid is a nitrated compound usually purchased as a solid wet with 10% water. Extreme heat, blasting cap, or electric charge can detonate picric acid. It becomes highly unstable if allowed to dehydrate. When wet, picric acid is an orange colored, compact crystalline solid with the consistency of lumpy sand. When dry, picric acid is a crystalline solid with visible air pockets below the surface.

Picric acid will readily form explosive metal picrates. These metal picrates are extremely shock sensitive and will detonate with the slightest movement or vibration. Do not allow picric acid to contact metal that is readily oxidized or be stored in a container with a metal cap. Lead, iron and copper metals are particularly dangerous, due to metallic picrate formation.

b. Organic Peroxide-Forming Solvents

Organic peroxide-forming solvents become shock sensitive when allowed to oxidize and form appreciable quantities of explosive peroxides. Most of these solvents are also flammable. Most peroxide forming solvents are colorless, mobile liquids. Oxidation can occur when the solvent is exposed to atmospheric oxygen. This reaction is catalyzed by light as well as by temperature and pressure changes.

Below is a list of good laboratory practices. For more information, see the Peroxide Forming Chemicals Management and Assessment Guidelines online at http://www.ehs.washington.edu/forms/epo/peroxideguidelines.pdf.

1) Highly Concentrated Peroxides - Over a period of time, peroxide concentrations can increase to hazardous levels. Solvents with high concentrations of peroxides will appear viscous or contain needle-like crystals. If peroxides are visible, no further handling is recommended. Contact EH&S at 685-2848 for assistance with professional testing and stabilization.

2) Explosive Capability - Peroxides formed in organic solvents have caused some laboratory accidents, including unexpected explosions during distillation and use. Such formulations are considered low powered explosives in that they will detonate in moderate concentrations by modest shock, friction, or when heated.

3) Required Procedures - Purchase peroxide forming solvents in small quantities that contain an inhibitor, such as butylated hydroxytoluene (BHT), which will delay the formation of peroxides until the inhibitor is used up. Label the container with the date received and opened. Do not break the seal on the container until the solvent is needed. Once opened, store solvent in an airtight amber glass bottle or metal container, with an inert gas, such as nitrogen, in the headspace.

   The biggest dangers of organic peroxides in these solutions are opening the container and distilling. Do **NOT** open or move the container if you see crystals on or around the container cap. Call for assistance if you are concerned about opening the container (EH&S, 206-685-5835).

4) Testing Peroxides - It is a good laboratory practice to use test strips to test the solvent for peroxides prior to each use. After each use, wipe down the bottleneck, cap and threads with a cloth before resealing. Reduce formed peroxides and add an inhibitor as necessary to keep the concentration of peroxides below 10 ppm. Test and treatment methods can be obtained by calling EH&S at 206-685-5835. Extreme caution should be exercised if concentrations of peroxides exceed 30 ppm.

5) Distillation and Evaporation Precautions - Always test for peroxides before distillation or evaporation because these procedures will increase the concentration of any peroxides present. Do not distill or evaporate solvents containing any amount of peroxides. Use a water bath over a hermetically sealed electrical mantle to safely heat the solvent. Use any distilled solvent immediately, or add an inhibitor.

6) Use of Inhibitors – Inhibitors slow the formation of peroxides in the future. They do not reduce or remove peroxides. Organic peroxides should be reduced safely.

7) Monitoring Expiration Date - Use the solvent before the manufacturer's expiration date. Peroxide-forming solvents exceeding their expiration

date cannot be discarded through EH&S until the contents have been tested for peroxides. Examples of peroxide formers are shown in Table 2-10 on the next page.

Table 2-10 Organic Peroxide Forming Solvents

Severe Hazard	High Hazard	Moderate Hazard
3 months *Once exposed to oxygen, rapidly oxidizes forming explosive peroxides.*	**6 months** *Once exposed to oxygen, oxidizes at a moderate rate forming explosive peroxides.*	**12 months** *Once exposed to oxygen, slowly oxidizes forming explosive peroxides.*
Diisopropyl ether Divinylacetylene Potassium amide Potassium metal Sodium amide Vinylidene dichloride (1,1-Dichloroethylene)	Acetaldehyde Cumene Cyclohexene Cyclopentene Diethyl ether Di-n-propyl ether p-Dioxane Furan Methyl isobutyl ketone Tetrahydrofuran Vinyl ethers	Ethylene glycol ethers Ethyl vinyl ketone Oleyl alcohol Tetrabutylammonium fluoride Thorium nitrate hydrate

c. Azides

Organic and inorganic azides, $R\text{-}N_3$, can explode when heated or exposed to ground glass joints. Some azides are shock sensitive. Metal azides are relatively insensitive to shock, but may explode when heated. Sink disposal of azides can be extremely hazardous because they can form metal azides that are shock sensitive, like iron azide. Azides present a hazard around ground glass joints because they can be shock sensitive.

d. Fulminates

Fulminates are compounds that contain a carbon-nitrogen-oxygen group. Metal fulminates such as mercury, silver, gold are highly explosive. Explosions are typically initiated by heat. Silver fulminates can form in undiscarded Tollen’s reagent.

3. Compressed Gases and Gas Cylinders

a. Purchasing Compressed Gas

Whenever possible, researchers should purchase compressed gas through University Stores. University Stores maintains an inventory of many commonly used compressed gases and has arrangements with a number of suppliers that will save researchers money when ordering gases that are not in the Stores inventory.

Special Fire Department permits and engineering controls may be required to use toxic or corrosive gases. Prior to ordering these gases, contact the EH&S Facility Safety Office at 206-543-0465 for an assessment.

Inspect the cylinder when it arrives to make sure it is the gas you ordered. Never accept a cylinder with damaged labels, dents, gouges, or burn/heat marks.

b. Safe Practices

The following safe practices should be followed when working with compressed gas cylinders:

1) All cylinders must be clearly labeled by the gas supplier or the user with the cylinder's contents, concentrations, hazard classifications, and safety precautions. Unlabeled cylinders must be disposed of as hazardous waste and users will be charged for an analysis of the contents before its disposal.

2) Secured Cylinders - Cylinders must be secured during storage, transport and use so that they cannot be knocked over. During use, an approved bracket anchored to a fixed structure must be used. It is recommended that the cylinder be secured by two straps or chains located at 1/3 and 2/3 of the cylinder height above the floor, because cylinders secured by a single strap have been found to escape the strap during an earthquake.

3) Valve Caps - Cylinder valve caps must be in place when the cylinder is being moved or is not in use for an extended period of time.

4) Moving - Cylinders should be moved with a cart or hand truck designed for strapping on cylinders. Avoid taking compressed gas cylinders in particularly crowded elevators.

5) Turning Off - Turn the gas supply off at the cylinder valve first, de-pressurize the system, and then turn off the regulator.

6) When Not Using - If the gas cylinder is not in use, separate oxidizing gases from flammable gases by 20 feet or a one-hour firewall.

7) Use, store, and transport cylinders in an upright position.

8) Highly toxic gases must be stored and used in an approved gas cabinet with fire suppression and release controls.

c. Returning or Disposing Cylinders

Whenever possible, gas cylinders should marked FULL / PARTIAL / EMPTY and returned to the manufacturer, supplier, or University Stores as described earlier in this section concerning procurement of gas cylinders (Section 2.C.7). Additional information is also described in Section 3.P.

4. Highly Toxic Substances

Various regulatory agencies define highly toxic chemicals differently.

In laboratories, "Particularly Hazardous Substances" (listed in Appendix H) require additional actions. These actions include implementing additional controls and noting those additional controls on the applicable Standard Operating Procedure(s), using the chemicals only in specifically designated locations, and describing the approval needed prior to a person using that chemical. Contact EH&S at 206-543-7388 or email uwcho@u.washington.edu for more information.

The International Fire Code uses another definition for "highly toxic and poisonous materials" for signage and fire safety reasons. Highly toxic materials are defined by their lethal doses in toxicology tests: LD_{50} of 50 mg/kg or less (oral), LD_{50} of 200 mg/kg or less (dermal), and LD_{50} of 200 ppm or less (inhalation). Further information about these codes can be viewed at http://www.ehs.washington.edu/fsohazmat/hazmatl.shtm and in the 2003 IFC, Chapter 37, Highly Toxic and Toxic Materials.

The Centers for Disease Control and Prevention recognizes "select agents and toxins" which are listed at http://www.cdc.gov/od/sap/docs/salist.pdf. The regulation pertaining to select agents and toxins is available at http://www.cdc.gov/od/sap/index.htm. These materials are allowed in only specific spaces on campus and only can be used by approved individuals. If you intend to use any of these select agents and toxins, pre-approval is required before obtaining them. Please contact the Biosafety Officer at 206-221-7770 to initiate the approval process.

5. Synthesizing Chemicals

A laboratory synthesizing chemicals for use by others should consider themselves to be a resource for others receiving the chemical who may need hazard information. Staff synthesizing a hazardous chemical should provide those others with as much information about the safety precautions when using the chemical as is feasible.

If you produce a chemical substance for use by another agency outside the University of Washington system, the Hazardous Chemicals in Laboratory standard (WAC 296-828) requires that you produce a label and a Material Safety Data Sheet for that substance in accordance with WAC 296-839, MSDS and Label Preparation. For more information, please see the EH&S web page at http://www.ehs.washington.edu/epo/chemmanage/index.shtm.

A Material Safety Data Sheet must also be available if transporting a synthesized chemical in a vehicle.

Section 3
Chem Waste Management

Section 3
Chemical Waste Management

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A. Hazardous Chemical Waste Responsibilities

Hazardous chemical waste must be managed properly. The responsibilities of the laboratory worker and of EH&S are as follows:

1. Laboratory Workers

Laboratory workers must have training commensurate with their duties. First, they must be able to determine whether their chemical wastes are hazardous by using the guidelines in this chapter. For hazardous waste, they must know the hazards of the waste and label the waste accordingly understand and abide by accumulation rules, which include labeling, storage and handling requirements. They must also know how to request collection of wastes by EH&S. They must prevent the accumulation of "legacy chemicals" and "inherently wastelike chemicals" (also defined in this chapter) by cleaning out their chemical inventory on a regular basis (yearly at a minimum). Laboratory workers must know the rules for disposal of chemicals and contaminated items to trash and sanitary sewer.

Training is available through EH&S. Hazardous waste management is taught in the Managing Hazardous Chemicals in the Workplace course and the Online Hazardous Waste Training course. Sign up for Managing Hazardous Chemicals in the Workplace through the EH&S training webpage at http://www.ehs.washington.edu/psotrain/corsdesc.shtm. The Online Hazardous Waste Training, which is primarily intended as a refresher course, is at http://www.ehs.washington.edu/psotrain/hazwaste/index.shtm.

2. UW EH&S Environmental Programs Office

The Environmental Programs Office (EPO) collects the wastes and manages its proper disposal. EPO audits waste facilities to ensure that they will handle and dispose of the waste correctly, and handles paperwork required by federal law that ensures that the waste is properly recycled, treated, or incinerated. EH&S provides guidance and training for laboratory workers on proper hazardous waste management.

Both EH&S and laboratory workers should work together to reduce hazardous waste using the guidelines in this section.

B. What qualifies as Hazardous Waste?

Chemicals that are corrosive, flammable, toxic, reactive, and/or “persistent in the environment” are by legal definition "hazardous". At the UW, some additional chemicals are managed as hazardous waste because they are carcinogenic/mutagenic or are not allowed in the trash because they generate dusts or other hazards.

In order to determine whether or not your chemical is hazardous, use your knowledge, the chemical’s original label and/or the chemical’s Material Data Safety Sheet (MSDS) to determine if the waste is corrosive, flammable, toxic, reactive, “persistent in the environment” and/or mutagenic or carcinogenic, as defined in the below subsections.

1. Flammable/Ignitable

A chemical is flammable if it is one of the following:

a. A liquid having a flash point less than 140 °F (*e.g.*, ethanol, xylene, diethyl ether). The flash point is defined as the lowest temperature at which a chemical can form an ignitable mixture with air (by evaporating in the space above an open beaker, for example.) MSDSs include information about flash points.

b. A solid or gas capable, under standard temperature and pressure, of causing fire through friction, absorption of moisture or spontaneous chemical changes and, when ignited, burns so vigorously and persistently that it creates a hazard.

c. A solid, liquid, or gas that evolves oxygen either at room temperature or under slight heating (*e.g.*, peroxides, chlorates, perchlorates, nitrates, and permanganates.)

2. Corrosive

A chemical is corrosive if it is one of the following:

a. An aqueous solution having a pH of less than or equal to 2 or greater than or equal to 12.5.

b. A solid that, when mixed with an equal part of water, will form a solution with a pH as described above.

3. Reactive

A chemical is reactive if it is one of the following:

a. Normally unstable compound that readily undergoes violent change without detonating (*e.g.,* acrylonitrile, butyl hydroperoxide).

b. When mixed with water, the chemical reacts violently, forms potentially explosive mixtures, or generates toxic gases in sufficient quantities to present a danger to human health (*e.g.*, sodium metal, chloropropionyl chloride).

c. The compound contains cyanides or sulfides that when exposed to pH conditions between 2.0 and 12.5 could generate toxic gases in sufficient quantities to present a danger to human health (*e.g.*, sodium sulfide, arsenic sulfide).

4. Toxic

Toxicity is based upon the LC_{50} (concentration of substance required to kill 50% of the tested population) for fish or the LD_{50} (dose amount of substance required to kill 50% of the tested population) for rats. Table 3-1 establishes five categories of toxicity: X, A, B, C, and D. The X category (Tox-X) is the most toxic; the smallest dose or lowest concentration is lethal to 50% of the population. If data is available for more than one toxicity test, the data showing the severest toxicity should be used.

Table 3-1 Chemical Waste Toxicity Categories

Toxic Category	Fish LC_{50} (ppm)*	Oral (rat) LD_{50} (mg/Kg)	Inhalation (rat) LC_{50}(mg/L)	Dermal (rabbit) LD_{50} (mg/Kg)
X	<0.01	<0.5	<0.02	<2
A	0.01- <0.1	0.5 - <5	0.02 - <0.2	2 - <20
B	0.1- < 1.0	5 - <50	0.2 - <2	20 - <200
C	1.0- <10.0	50 - <500	2 - <20	200 - <2,000
D	10.0 - 100.0	500 - 5,000	20 - 200	2,000 - 20,000

* LC50 must be for an exposure period greater than 24 hours

Chemical waste that qualifies for any of these categories is hazardous waste. Chemical waste that qualifies for toxic categories X, A, or B is "extremely hazardous waste" and is subject to additional requirements, such as a maximum waste accumulation volume of one quart (see below). Chemical waste with toxicity below the D category is not regulated as hazardous waste, but may still be managed as hazardous waste at UW if it is carcinogenic/mutagenic.

For diluted wastes and for wastes containing more than one constituent, an Equivalent Concentration (EC) for the mixture must be calculated. If the EC is greater than or equal to 0.001%, the waste is toxic. The formula for the EC is:

$$EC(\%) = \Sigma X\% + \frac{\Sigma A\%}{10} + \frac{\Sigma B\%}{100} + \frac{\Sigma C\%}{1{,}000} + \frac{\Sigma D\%}{10{,}000}$$

For example, a mixture of 0.01% aldrin (toxic category A), 1.0% endrin (toxic category A), 4.0% benzene (toxic category D), 2.0% phenol (toxic category C) and 5% dinoseb (toxic category B) in water (nontoxic) exceeds the toxicity criteria as shown in the following calculation:

$$EC(\%) = 0\% + \frac{(1.0\% + 0.01\%)}{10} + \frac{5.0\%}{100} + \frac{2.0\%}{1{,}000} + \frac{4.0\%}{10{,}000} = 0.153\%$$

If you are not confident enough or not willing to use the above equation to determine whether or not your chemical mixture is toxic, we encourage you to fill out and submit a Waste Evaluation Request, online at http://www.ehs.washington.edu/forms/epo/1957.pdf. We will evaluate your waste and advise you on proper disposal of your chemical.

5. Persistent

Persistent chemicals are those that do not biodegrade quickly in the environment. The state of Washington has recognized two main categories of persistent chemicals: halogenated organic compounds and polycyclic aromatic hydrocarbons.

a. Halogenated Organic Compounds

A halogenated organic compound (HOC) is a molecule that includes one or more atoms of fluorine, chlorine, bromine, or iodine.

When a waste mixture contains one or more halogenated organic compounds, the total halogenated organic compound concentration is determined by summing the concentration percentages of each halogenated organic compound. If a waste mixture contains more than 0.01% HOC, the waste is persistent and therefore hazardous.

For example, a waste contains 0.009% carbon tetrachloride, 0.012% DDT, and 0.020% 1,1,1-trichloroethylene. The total halogenated organic compounds concentration calculation indicates the mixture is persistent, as follows:

Total HOC Concentration = 0.009% + 0.012% + 0.020% = 0.041%

b. Polycyclic Aromatic Hydrocarbons

The following polycyclic aromatic hydrocarbons (PAHs) are regulated: acenapthylene, acenapthene, anthracene, benzo(a)anthracene, benzo(b)fluoranthene, benzo(k)fluoranthene, benzo(q,h,i)perylene, benzo(a)pyrene, chrysene, dibenz(a,h)anthracene, indeno(1,2,3-c,d)pyrene, fluoranthene, fluorene, naphthalene, phenanthrene, and pyrene.

When a waste contains one or more of these PAHs, determine the total concentration by summing the concentration percentages of each regulated polycyclic aromatic hydrocarbons. If the waste contains more than 1% PAHs, the waste is persistent and therefore hazardous.

For example, a waste contains 0.08% chrysene and 1.22% 3,4-benzo[a]pyrene. The total polycyclic aromatic hydrocarbon concentration calculation demonstrates the mixture is persistent as follows:

Total PAH Concentration = 0.08% + 1.22% = 1.30%

6. Carcinogenic

The Washington Department of Ecology briefly regulated chemical wastes that are suspected or known to be carcinogenic. However, these rules were challenged and the Department of Ecology retracted those rules.

EH&S nevertheless strongly encourages you to manage chemical waste that is carcinogenic or mutagenic as if it were hazardous waste, even if it is not toxic (according to the definition above, which accounts for acute and immediate toxicity.)

7. Trash "Authorized Chemicals" List

Please refer to the "trash list" of chemicals authorized to be disposed of as solid waste online at http://www.ehs.washington.edu/epowaste/trashlist.shtm. These rules overlap with the Hazardous Waste rules above but are helpful in some cases. See also Subsection E below.

8. Local Sewer Limits

Please refer to the King County local sewer limits rules in Subsection F below. These rules overlap with the Hazardous Waste rules above but are helpful for some common laboratory chemicals.

9. Waste Evaluation Request

If you are unsure whether your waste is hazardous, you may submit an online Waste Evaluation Request. Fill out all information completely, and attach an MSDS for the chemical(s) to it. We will evaluate your waste stream for you and advise you on proper disposal.

C. Hazardous Waste Accumulation Rules

Follow the below rules for hazardous chemical waste accumulation.

1. Appropriate Containers

Accumulate waste in an appropriate container compatible with the waste. You may reuse containers, even containers that were used for other chemicals, as long as they have been rinsed well and the original labels have been defaced (rinseate may be hazardous waste according to the definitions in Subsection B.) However, containers that were designed for solid chemicals should not be used for liquids. Also, use only containers that show no sign of damage or deterioration.

You must use containers with screw top closures. The lids to waste containers should be removed only when waste is being added to the container. Use spring loaded funnels for adding waste frequently to waste containers.

Finally, do not fill the containers completely. Each container must have at least a one inch of headspace above the waste when it is collected. Request collection of your waste ahead of time to avoid overfilling your containers.

2. Hazardous Waste Labels

Label the container using the Hazardous Waste Label (Figure 3-1).

Figure 3-1 Hazardous Waste Label

Fill out the label completely, including percentages of constituents, the hazards of the waste, and contact name. If you do not know the hazards of your chemical, use the MSDS of the chemical to determine what they are. Do not date the container or label. Deface or remove any original labels remaining on the container to avoid confusion about the identity of the waste.

Booklets of twenty adhesive hazardous waste labels are available free at the following locations:

Biochemistry Stores

Location:	J014 Health Sciences Building
Hours:	Monday – Friday 8:15-12:00, 1:00-4:45
	Last day of the month 8:15-12:00, 1:00-3:30

Chemistry Department Research Stockroom (Chemstore)

Location: 036 Bagley Hall
Hours: Monday – Friday 8:30-12:00, 1:00-4:30
Closed on UW employee holidays

South Campus Stores

Location: B170 Health Sciences Building
Hours: Monday – Friday 8:30-4:00

Hazardous waste labels may also be printed out online at http://www.ehs.washington.edu/epowaste/hazwastelabel.shtm.

You may also email chmwaste@u.washington.edu to request that labels be mailed to you.

3. Location

Waste must be under the control of the individual(s) generating the waste. The waste should be in a physically safe area (*e.g.*, not on a windowsill.)
Do not accumulate large amounts of waste in the fume hood. Use flammable liquid storage cabinets for flammable waste over ten gallons in volume. Store the waste away from emergency equipment such as safety showers and emergency access panels. Do not block exits. Do not store the waste near or in sinks. Finally, if the waste is stored in an area that drains to a floor drain, the waste must be in secondary containment.

4. Segregation

Segregate regulated chemical waste by chemical compatibility. Refer to the segregation guidelines for chemicals in Section 2 for more information. Use secondary containment (tubs or buckets) for segregation of wastes accumulated in the same area.

5. Accumulation Volume Limits

Accumulate no more than 204 liters (54 gallons) of chemical waste per waste stream or 0.9 liters (1 quart) of acutely hazardous waste or extremely hazardous waste per waste stream. Lists and definitions are on our website at http://www.ehs.washington.edu/epowaste/ahw.shtm for acutely hazardous waste and at http://www.ehs.washington.edu/epowaste/ehw.shtm for extremely hazardous waste.

Also, any one type of flammable chemical waste cannot exceed the limits specified by the Seattle Fire Department. For class IA flammables, the total volume of allowed flammables, including chemicals that are not waste, is limited to 60 gallons per control area in a sprinklered building and 30 gallons in a nonsprinklered building. Contact EH&S Facility Safety Office at 206-543-9510 with questions about control areas and volume limits.

Leave some headspace (at least one inch) in each container to allow for temperature and corresponding vapor pressure changes.

Finally, chemical waste must not be stored for a period of more than one year.

6. Large Containers (Drums)

If you are accumulating wastes in containers greater than five gallons in volume, you must also ensure that:

a. Drums used to accumulate regulated wastes are in good condition and are approved by Department of Transportation (DOT) for highway mode transportation. Note: if the drums were shipped to you in the first place, they are very likely DOT-approved.

b. Drums containing liquids should have ten centimeters (four inches) of air space between the surface of the liquid and the lid.

c. Collection is requested before the drum is full, especially in the case of 55 gallon drums.

7. Inherently Wastelike Chemicals

“Inherently wastelike chemicals” include expired chemicals, chemicals in deteriorating containers and chemicals that are or appear to be unusable. State inspectors may issue fines or infractions for the presence of inherently wastelike chemicals in your laboratory. These chemicals must be disposed of as hazardous waste in a timely manner. You can also avoid inherently wastelike chemicals in the first place by not keeping chemicals past their expiration date and by conducting cleanouts of unwanted chemicals when you do your annual chemical inventory update.

Please also see the section on “legacy chemicals” in this section. Legacy chemicals are those that are left behind by laboratory staff when they leave the university or move laboratories.

D. Hazardous Waste Collection Requests

1. Hazardous Waste Collection Overview

Federal and state laws strictly regulate hazardous waste disposal. Each container of waste must be tracked from the point of collection by EH&S to its final disposal facility location, a certificate of disposal/destruction for that container must be sent back to EH&S. Hazardous waste data must be reported annually to state agencies. As a result, there is a lot of paperwork associated with hazardous waste management. However, this system ensures that the waste is disposed of safely.

EH&S collects hazardous chemical waste from all three UW campuses and all UW owned and operated facilities: there are about 3500 laboratories on and near the Seattle campus. We consolidate trips to save time, money and energy. Therefore we may only be near your area once every week or every other week.

For these two reasons, you may have to wait one to several weeks after you send your collection request before EH&S collects your waste. To help us help you, plan ahead and request collection before all your containers are full.

2. Collection Requests

Request collection of your waste by submitting a completed Chemical Collection Request form found online at http://www.ehs.washington.edu/forms/epo/1470.pdf. Fill out all information completely and fax or mail the form (contact information is on the form.)

3. Routines and Routine Collection Requests

Wastes that are generated on a regular basis may be set up as routine collections. If you set up a routine collection, EH&S assigns your chemical waste a routine number in the chemical waste database. You then simply email the routine number and waste quantity to request a pickup. We automatically know the composition of your waste, where you are located and other information associated with the waste. If you have any questions about whether your waste qualifies for the routine waste collection program, email chmwaste@u.washington.edu or call 206-616-5835.

To set up a new routine collection, fill out a New Routine Collection Request at http://www.ehs.washington.edu/forms/epo/1471.pdf.

If you already have a routine number and would like to request a pickup of that routine waste, fill out and send the online Routine Collection Request at http://www.ehs.washington.edu/forms/epo/routinepickup.php.

4. Waste Cleanouts

If you are moving or cleaning out your workplace and will need EH&S to collect a large volume of chemical waste here are some guidelines.

If you think you will have more than 50 containers of waste, call 206-616-0595 to arrange for a cleanout appointment. Call us at least a month in advance of any known deadline.

For fewer than 50 containers, fill out copies of the Chemical Collection Request form (http://www.ehs.washington.edu/forms/epo/1470.pdf), making sure to put your name on each of the copies, and fax or mail them to EH&S, EPO at Box 354110. Place completed UW Hazardous Waste Labels on each waste container. We will pick up the waste in two to four weeks after you request collection.

Consider the MyChem Chemical Exchange for your unwanted but useable chemicals. “Useable” chemicals are unexpired and preferably unopened (exceptions are made for commonly used chemicals.)

Finally, remember to update your chemical inventory in MyChem.

5. What Happens to Hazardous Waste?

EH&S has a Waste Minimization Program that reuses, recycles and treats roughly 40% of the total waste generated at the University of Washington. Recycling takes place both in laboratories and at the EH&S hazardous waste facility. For more information about this program, see the Waste Minimization subsection below or visit the website at http://www.ehs.washington.edu/epohazreduce/index.shtm.

All hazardous waste at the University of Washington that cannot be reused, recycled or treated is sent to permitted hazardous waste recycling and disposal facilities. Flammable waste is used as an alternative fuel, waste oil is refined into light or heavy oil, and most batteries are recycled. The rest is incinerated at high temperature. EH&S audits all disposal facilities to ensure that the waste is disposed of properly.

E. Trash Disposal

1. Trash Disposal of Chemicals

The King County Department of Health gives trash authorizations for chemicals on a case-by-case basis. Hazardous chemicals as well as some dust-generating chemicals are not allowed in the trash.

The list of chemicals authorized for trash disposal is located online at http://www.ehs.washington.edu/epowaste/trashlist.shtm. If your solid chemical waste is not on that list, it is hazardous chemical waste. Each trash authorization must be renewed by EH&S every three years because toxicity information on those chemicals may change. Check back occasionally to make sure your chemical may still be disposed of in the trash.

If your chemical is on the list of items allowed by King County, you must securely double-bag it and label it "non-hazardous" so that custodial staff know it is safe for them to handle. They reserve the right to refuse to pick up your trash if they think it contains hazardous waste or if it is not securely bagged.

Common items prohibited in the trash include the following:

- Liquids of any type
- Compressed gasses or pressurized containers
- Laboratory glass and sharps
- Radioactive waste
- Batteries
- Mercury, including broken empty thermometers

2. Trash Disposal of Empty Chemical Containers

"Empty" chemical containers may still contain enough chemicals in them to present a hazard to custodial staff. Below are guidelines to dispose of these containers properly.

It can be difficult to completely empty a container. The legal interpretation of the word "empty" acknowledges this difficulty. A container is legally empty when both of the following are true:

1. Contents have been removed by "normal, no-nonsense means, such as inverting and draining, shaking, scraping, or scooping", and

2. Small containers (less than 110 gallons) are empty when no more than 3% of the contents remain.

If the chemical is "acutely hazardous waste", " extremely hazardous waste", and/or a pesticide marked with danger or warning labels, then the container must be triple rinsed before it is considered legally (and safely) "empty". The rinseate from this process is hazardous waste by law. Lists and definitions are on our website at http://www.ehs.washington.edu/epowaste/ahw.shtm for acutely hazardous waste and at http://www.ehs.washington.edu/epowaste/ehw.shtm for extremely hazardous waste.

If your chemical is a known, probable, or suspected carcinogen, EH&S strongly recommends that you also triple rinse the container.

Consider reusing the empty container for hazardous waste disposal of that same chemical or other compatible chemicals. If you choose this option, completely deface or remove the label on the container and then fill out and affix a hazardous waste label to the container. Defacing and labeling are required by law and also help others in your workplace know that the container contains hazardous waste, not the original chemical.

If you choose to dispose of the empty container, do the following:

1. Dry the container, preferably in a fume hood. Ensure that there are no sources of heat or open flame in the fume hood when drying containers that contained flammable or combustible chemicals.

2. With a pen, cross out or black out the labels on the container.

3. Leave the container uncapped. Throw the cap away separately.

4. If the container fits in the trashcan, place it there. If it does not fit in the trashcan, place it next to the trash.

5. Do not leave empty containers in public areas, such as hallways or loading docks, unless you have made an agreement with Custodial Services or EH&S for pickup services.

Do not recycle glass or plastic containers that contained chemicals unless approved by EH&S. Recycled glass and plastic is used for beverage and food containers, so the recycling industry does not accept chemical containers. However, EH&S does recycle large plastic and metal drums; see http://www.ehs.washington.edu/eporecycle/drums.shtm for more details.

It is illegal to "dispose" of hazardous waste by leaving non-empty containers of chemicals in the fume hood or elsewhere to evaporate the chemical.

3. Trash Disposal of Contaminated Items

Used gloves and other commonly used items (besides empty containers) can be placed in the trash if they are not “grossly contaminated” with hazardous chemicals. If you have an item that is “grossly contaminated”, dispose of it as hazardous chemical waste.

Examples of "grossly contaminated" items include used spill clean-up materials, items such as gloves and equipment contaminated from a spill and used equipment that contains hazardous chemical residue.

Finally, EH&S encourages you to collect items that look like they might be contaminated by chemicals, such as weighing papers and gloves, in bags and then label the bags “non-hazardous waste” before you place them in the trash. Custodial staff are sometimes understandably nervous when handling laboratory trash; a white residue or a few drops of water in the trash could be a dangerous chemical. Taking an extra step to bag these items can be a nice gesture.

4. Refusal to Collect Trash

Custodians may refuse to collect trash that appears to contain hazardous items. If they refuse to collect trash, they will leave a *Notice of Improper Waste Disposal Practices* form (UoW 1970, shown in Figure 3-2). Once corrections are made, they will collect the trash.

Figure 3-2 Notice of Improper Waste Disposal Practices

UNIVERSITY OF WASHINGTON
NOTICE OF IMPROPER WASTE DISPOSAL PRACTICES
PHYSICAL PLANT DEPARTMENT
CUSTODIAL SERVICES DIVISION, HE–20

Building	Room No.	Date

ATTENTION LABORATORY PERSONNEL: Your waste was not collected by the Custodian for the following reason(s).

BIOHAZARD	☐ Biohazard sign intact or **not** defaced placed in waste container. ☐ Bloodstained items in regular trash–**not** properly bagged and/or autoclaved. ☐ Microbiological culture in regular trash–**not** properly bagged and/or autoclaved. ☐ Dead animal(s) or animal parts in regular waste. ☐ Animal bedding and/or fur in regular waste–**not** properly bagged and sealed. ☐ Autoclaved liquid waste–too wet.
CHEMICAL	☐ Empty chemical bottles left for collection–**not** rinsed clean and/or uncapped. ☐ Unknown powder in regular waste container–**not** properly bagged and sealed. ☐ Liquid remaining in containers and centrifuge vessels. ☐ Hazardous waste sticker intact or **not** defaced, placed on or in regular waste container.
LAB GLASS	☐ Lab glass in regular waste container. ☐ Box **not** sturdy, sealed, and/or dry. ☐ Total weight more than **40 lbs.** ☐ Box **not** properly labeled with name of principal investigator, room number, and "Lab Glass" shown. ☐ **Four-gallon plastic pails (for Pasteur Pipettes Only)** not properly marked with name of principal investigator, room number, and "Lab Glass" label.
RADIATION	☐ LSA box placed in regular waste. ☐ Radiation sign intact or **not** defaced, placed on or in waste container.
SHARPS	☐ "Sharps" placed in regular waste container, i.e., needles, etc. ☐ "Sharps" **not** autoclaved or properly taped, and/or properly marked with name of principal investigator and room number. ☐ "Sharps" **not** in red polypropylene sharps container.
OTHER	______________________ ______________________ ______________________

Custodian Lead or Supervisor

UoW 1970 (Rev. 3/94) **FOR PROPER WASTE DISPOSAL INSTRUCTIONS, REFER TO THE UW OPERATIONS MANUAL**

F. Sewer Disposal

All wastewater discharged to the sanitary sewer system must comply with local, state and federal standards designed to protect surface waters and maintain the quality of biosolids from wastewater treatment plants.

1. King County Local Sewer Limits

In King County, you may dispose of some chemicals down the sanitary sewer drain in some circumstances. This method of disposal is also known as "sewering". If your waste qualifies as hazardous waste (according to the criteria in Subsection B) then you may not sewer the waste.

King County has also published local discharge limits for commonly used chemicals. These limits are on the EH&S website at http://www.ehs.washington.edu/epowaste/sink.shtm. They apply only to UW Seattle, UW Bothell, and other sites within King County.

2. Outside King County

If you are outside King County (UW Tacoma, Pack Forest, and Friday Harbor), local sewer limits have not been formally adopted in these areas. In addition, operators of some very small waste treatment plants allow chemical disposal to sanitary sewer only on a case-by-case basis in order to protect the treatment plant. You are therefore not allowed to pour any chemicals down the drain without explicit permission at this time.

For more information and for assistance with obtaining permission to dispose of non-hazardous chemicals to sanitary sewer, call EH&S at 206-685-3759 or email chmwaste@u.washington.edu.

3. Sewer Discharge Log

All discharges must be recorded in a Sewer Discharge Log. The only exceptions to this rule are detergents and bleach.

Record the identity and concentration of waste, the volume discharged, the date of discharge, and the discharger's initials.

Keep the log posted near the sink or point of discharge; the emergency phone on it number must be posted in the event of an accidental release of chemicals to the sewer. Keep these logs for three years. County inspectors can ask and have asked to see Sewer Discharge Logs.

Blank Sewer Discharge Logs are available on our website at http://www.ehs.washington.edu/forms/epo/sewerdischargelog.pdf.

3. Soaps, Bleach and Acetone

When you are washing glassware or equipment, you will likely use chemicals such as detergents and bleach. Standard household bleach and other cleansers may go down the drain.

Acetone may not go down the sink at any concentration. If you use acetone to rinse off items, you must collect any excess acetone in a securely capped, properly labeled waste container and dispose of it as hazardous waste (see the hazardous chemical waste page for more information.) You may not store acetone squeeze bottles near the sink.

Do not use chromate based cleansers. There are many less toxic and non-carcinogenic alternative cleansers that work just as well.

4. Scintillation Fluids

There are only three liquid scintillation cocktail products currently approved by the State of Washington Department of Ecology for disposal down the sanitary sewer. They are soluble (or readily dispersible) in water and contain less than 10% non-ionic surfactants. Other scintillation fluids may claim to be safer, but because they contain high concentrations of flammable surfactants, they are not approved for sewer disposal.

5. Dilution Prohibition

The concentration of your chemical after you have completed your activity determines whether or not you may sewer it. Your activity can include any equipment rinsing or any chemical treatment that you do as a normal part of cleaning up after an experiment. However, it is illegal to dilute your chemical waste solely to meet sewer discharge limits.

There are two reasons why you may not dilute to meet the limits. First, if everyone were allowed to do it, the practice would use a lot of water. Secondly, many toxic chemicals, such as metals and organic compounds, partition into organic matter. At the wastewater treatment plant, these chemicals would end up in the biosolids, no matter how dilute they are. King County biosolids are sold as fertilizer for tree crops and for landscaping. Therefore, it is environmentally preferable to manage concentrated wastes as hazardous waste rather than dilute to meet the discharge limit.

For more information, see the EH&S website on sewer disposal at http://www.ehs.washington.edu/epowaste/sink.shtm.

G. Chemical Wastes of Particular Concern

1. Unknown Chemicals

Without an accurate chemical name and concentration range, unknown or unidentified chemicals cannot be safely handled or disposed of. The best way to prevent unknowns is to label all chemical containers and make sure that the labels stay in good condition over time.

If you have an unknown chemical, keep it where it is or store it temporarily in the fume hood, whichever you believe to be safer. Find out as much information as you can about the chemical by examining the container and interviewing anyone you think might know something about the chemical. If that fails, complete and mail or fax to EH&S a Chemical Collection Request, online at http://www.ehs.washington.edu/forms/epo/1470.pdf. Provide as much information about the waste as possible, such as the history, physical properties and the results of any analysis performed on the unknown.

Identification analysis performed by the approved waste disposal contractor will cost the chemical user roughly $80 per unknown. Analysis performed by the contractor is conducted in the area where the unknown is stored. After analysis, EH&S can collect the unknown for hazardous waste disposal.

2. Potentially Explosive Wastes

Some common chemicals can become highly unstable explosives over time when stored improperly and cannot be collected as hazardous waste unless they have been deactivated and stabilized. The following segments highlight the most common of these troublesome chemicals.

a. Peroxide Forming Chemicals

Peroxide forming chemicals such as p-dioxane, diethyl ether, tetrahydrofuran and acetaldehyde that have exceeded the manufacturer's expiration date will not be collected for disposal until they have been tested for peroxides. These chemicals must be managed correctly. For more information, see the *EH&S Peroxide Forming Chemicals Management and Assessment Guidelines* online at http://www.ehs.washington.edu/forms/epo/peroxideguidelines.pdf.

Chemicals containing more than 10 ppm peroxides must be deactivated before they will be collected by EH&S. Treatment methods are available through EH&S; email chmwaste@u.washington.edu to obtain more information about them. If the chemical is expired, very old, or otherwise poses great risk to laboratory workers, an outside contractor will perform deactivation and stabilization services at the expense of the laboratory.

b. Picric Acid and Other Polynitroaromatic Compounds

Polynitroaromatic compounds are commonly used in laboratories and are safe in the form in which they are sold. They are ordinarily sold with 3 to 10% water added to stabilize them. However, they will become explosive if allowed to dry out. Dry polynitroaromatic compounds must be wet with 10% water before they can be collected by EH&S.

c. Sodium Azide

Sodium azide, although not inherently unstable, can form highly explosive heavy metal azides if contaminated or used improperly. Do not pour sodium azide into the sanitary sewer. Disposal of sodium azide solutions to the sewer can cause the formation of lead or copper azides in plumbing. Routine sewer disposal of sodium azide has caused several serious explosions.

d. Nitrocellulose

Several nitrocellulose products, primarily paper and tubes, are used in some laboratories. Nitrocellulose burns vigorously in ambient conditions and may explode when heated under confinement. When completely dehydrated, it is considered a low level explosive. As a result, these products should never be autoclaved for decontamination. Nitrocellulose products must be soaked in water before disposal through EH&S.

3. Legacy Chemicals

Legacy chemicals are unwanted chemicals that are sometimes left behind by principal investigators when they vacate a laboratory (when they move to a different location or retire). Principal investigators are required to completely clean out laboratories before they leave, including all hazardous chemicals and waste (see Section 10, Moving In/Moving Out.)

If you move into a laboratory that has legacy chemicals in it, you should bring this issue to your department administrator immediately. If your department cannot, for whatever reason, solve the problem, then these legacy chemicals are yours. Unless you think that you will use them, you must arrange to request their collection as hazardous waste and follow all waste accumulation rules, including hazard identification, labeling and segregation.

H. Hazardous Waste Minimization

On average, EH&S collects and processes about 200,000 kg of hazardous chemical waste a year. Since 1985, we have been working to reduce the amount of hazardous waste that must be incinerated or landfilled. For the last five years, the UW reused, recycled, or treated about 40% of our hazardous chemical waste. This section outlines some of the basic elements of this effort and how you can participate.

More information is available on our website. See http://www.ehs.washington.edu/epohazreduce/index.shtm for more details on the UW Waste Minimization Program. There you will find an extensive and detailed list of services and resources, along with guides to conducting your research sustainably.

1. Chemical Procurement and Chemical Exchange

Purchase only what you'll use, especially if you're purchasing a hazardous chemical. One recent study showed that up to 40% of the hazardous waste produced by laboratories is actually unused and expired chemicals, and in the end they can cost you more than what you saved purchasing them.

Shop for free chemicals in the MyChem Chemical Exchange. Or, if you have chemicals in good condition that you do not need, consider listing them in the MyChem Chemical Exchange. For more information, see the EH&S website at http://www.ehs.washington.edu/eporecycle/chemex.shtm.

2. Treatment and Recycling in the Laboratory

You are encouraged to treat or recycle your own waste. However, by law EH&S must account for the waste that you treat or recycle. EH&S staff are available to help you get started, and in some cases offer free materials for recycling and treatment. Please visit our website at http://www.ehs.washington.edu/epohazreduce/index.shtm for more details.

3. Hazardous Materials Recycling

Both EH&S and UW Recycling (Property Transport and Services) manage the recycling of materials that would otherwise be disposed of as hazardous waste. See http://www.ehs.washington.edu/eporecycle/index.shtm for all the common (and sometimes uncommon) items we recycle, from batteries to computer monitors to elemental mercury to scrap metal.

I. Solid Waste and Recycling

Below are guidelines for recycling a number of common non-chemical items in laboratories.

EH&S encourages you to recycle boxes and packaging as soon as possible unless you have sufficient storage space for them. Storing boxes in aisles or in front of emergency equipment or exits, or necessary fire panels, is illegal and dangerous.

1. Paper and Cardboard

Paper, cardboard and other common recyclables are managed by UW Recycling. For more information, see UW Recycling's procedures webpage at http://www.washington.edu/admin/recycling/procedures.html.

2. Plastic and Glass

Plastic and glass chemical containers are not recyclable at this time. The glass and plastic recycling industry uses recycled material to make food and beverage containers and bans chemical containers, even if rinsed clean, from their recycling streams. UW Recycling and the EH&S Environmental Programs Office are currently pursuing limited recycling for some laboratory plastics.

3. Packaging Materials

UW Recycling also coordinates the recycling of wooden pallets, packaging "peanuts", plastic wrap and other packaging materials. Styrofoam packaging is handled on a case-by-case basis. For more information on all these items, see http://www.washington.edu/admin/recycling/procedures.html.

4. Media and Printer Cartridges

In April 2007, media, including CDs, tapes, cell phones and laserjet cartridges, and “household” batteries will be recycled through the E-Media boxes on campus. This is a joint effort of UW Recycling and EH&S Environmental Programs Office. See the UW Recycling website for more information.

Recycle all toner cartridges through University Stores. Put a note on the cartridge saying "Stores - recycle" and give it to the Stores delivery person.

5. Batteries

Large, heavy, and/or unusual research or clinical batteries, as well as large volumes of batteries, are handled two ways. Small amounts (less than five pounds) of “household” batteries are handled through the E-Media collection system as of April 2007. Collection of large amounts of batteries are requested directly of EH&S. Routine collection requests for batteries uses a process similar to that of laboratory hazardous chemical waste, as outlined below.

a. One-Time Battery Collection

Drop off small amounts of batteries (fewer than five pounds) at one of the “E-Media” drop-off sites on campus. For locations, visit our website at http://www.ehs.washington.edu/eporecycle/batteries.shtm.

To request a larger one-time collection of laboratory batteries, segregate your batteries and fill out and send in an online Battery Collection Request at http://www.ehs.washington.edu/forms/epo/1943.pdf. For information about the segregation of your batteries, please see our guidelines at http://www.ehs.washington.edu/eporecycle/batterysegregation.shtm. We will pick up your batteries in one to two weeks.

b. Routine Battery Collection

If you are a laboratory and routinely generate batteries, you will follow a procedure identical to that of hazardous waste routines. If you want to set up a new routine, fill out a New Routine Collection Request at http://www.ehs.washington.edu/forms/epo/1471.pdf. If you already have a routine number and would like to request a pickup of that routine waste, fill out and send the online Routine Collection Request at http://www.ehs.washington.edu/forms/epo/routinepickup.php.

J. Sharps and "Lab Glass"

The following are guidelines for the disposal of sharps and "lab glass" (or broken glass) that is not contaminated with infectious, radioactive or chemical materials.

1. Sharps

Sharps are a restricted waste according to state and local regulators and must not be disposed of as special waste. The term "sharps" is a regulatory waste classification associated with those instruments used to puncture, cut, or scrape body parts and that, as waste, can cause punctures or cuts to solid waste handlers or the public. This is interpreted to mean that any instrument that looks like it is meant to be used in this manner must be disposed of as sharps waste. The sharps definition includes, but is not limited to, hypodermic needles, syringes, IV tubing with needles attached, lancets, scalpel blades, glass Pasteur pipettes, microtome blades, dental scalers and razor blades.

Such items must be disposed of in an authorized sharps container which is leak proof, rigid, puncture-resistant, and durable plastic. It is red in color and equipped with a tight-fitting lid for use during handling and transport. Five sizes of sharps containers are available from University Stores. Sharps containers should be labeled with the Principal Investigator's name and the room number and disposed of when full.

Sharps disposal, like all biological waste at the University of Washington, is dependent upon the location of generation. Please refer to the location-specific Biological Waste Flow Charts, which are located online at http://www.ehs.washington.edu/rbsresplan/sharp.shtm#flowcharts.

2. "Lab Glass" (Broken Glass)

"Laboratory glass" (including plasticware) is any item that could puncture regular waste bags and therefore endanger waste handlers. "Laboratory glass" must be placed in sturdy plastic bag lined cardboard boxes for safety during transport through the building. University Stores carries a cardboard box (Stores #0737-235) that can be used for this purpose. Any cardboard box may be used, provided it is sturdy and of a size that will not weight more than 40 pounds when full.

Boxes must be labeled with the room number and principal investigator's name and sealed with a special "laboratory glass" tape. This tape is available from South Campus Stores (Stores #0020- 350).

The sealed box is placed alongside the regular waste container for collection by Custodial Services.

Never use these boxes for the disposal of sharps, biohazardous materials that have not been autoclaved, liquid wastes, chemically contaminated laboratory glassware/plasticware or chemical containers that cannot be disposed of as regular solid waste.

Laboratory glass that is disposed of in cardboard boxes must be clean or appropriately decontaminated prior to disposal.

Glass Pasteur pipettes not used for biological materials may be disposed of in a large plastic bucket which is labeled with lab glass tape, the principal investigator's name and room number. These buckets are not autoclavable so they must never be used for biologically contaminated items.

K. Infectious or Biological Waste

For infectious waste, see Section IV-G of the UW Biohazard Safety Manual and refer to the Biological Waste Flow Charts on the EH&S website at http://www.ehs.washington.edu/ohsreslab/biowaste.shtm.

L. Radioactive Waste

For radioactive waste, see the UW Radiation Safety Manual, Section 14 (Radioactive Waste).

M. Mixed Waste

Most mixed wastes consist of low level radioactive wastes combined with hazardous materials.

University of Washington policy as well as state and federal law prohibit the disposal of mixed waste. There is no means for disposing of mixed material. If a lab attempts to dispose of mixed waste as either radioactive waste or chemical waste the fines and penalties to the University of Washington will be severe and could result in a Cease and Desist Order. Fines and fees of up to $250,000 per year may be assessed against the University of Washington by federal and state agencies if mixed wastes were generated and/or stored on campus.

Exceptions to the production of mixed waste includes liquid scintillation cocktails which can be legally shipped to a contract waste disposal vendor to be burned, and radioactive materials mixed with a hazardous component that can be neutralized or deactivated in the laboratory.

N. Liquid Scintillation Cocktails

Several Liquid Scintillation Cocktail (LSC) manufacturers now produce non-hazardous fluids, some marketed as being sanitary sewer disposable. There are currently only a few LSCs approved for sanitary sewer disposal by the State of Washington. They are listed at http://www.ehs.washington.edu/rsowaste/rad_scint_sewer.shtm.

O. Animals and Animal By-Products

Special consideration is needed when disposing of dead animals, animal body parts/tissues, animal bedding, or animal waste.

1. Contaminated Animals and Animal By-Products

Animals and animal by-products contaminated by infectious agents, radioactive materials, highly toxic chemicals, or stored in fixatives require special disposal procedures. Contact EH&S at 206-221-7770 for disposal guidance.

2. Non-Contaminated Animals and Animal By-Products

Contact Property and Transportation Services at 206-685-1565 to arrange for disposal of non-contaminated animals and animal by-products. Contact the Facility Manager with the UW Department of Comparative Medicine at 206-543-0641 to make arrangements to deliver the whole animal to them for disposal.

P. Gas Cylinders

All gas cylinders used on campus must be either rented or, if purchased, purchased through University Stores. This ensures the cylinders come from suppliers that have a return authorization program for unused gas.

Any non-returnable cylinder must be disposed of through EH&S. Cost of disposal will be charged to the purchaser. Any abandoned cylinders will be recharged to the associated department. Cylinders or lecture bottles containing an unknown substance must be analyzed prior to disposal. Currently, the cost of analysis on an unknown cylinder is approximately $1,600 per cylinder, paid by the laboratory.

Empty lecture bottles may be discarded as scrap metal after the main valve is unscrewed and detached and the bottle has been flushed with an inert gas or rinsed with an appropriate solvent.

Cylinders containing constituents which are normally part of air should be vented to the atmosphere until they are empty. Empty cylinders may be discarded as scrap metal after the main valve is unscrewed and detached and the cylinder has been flushed with an inert gas of rinsed with an appropriate solvent. Calibration gas cylinders containing hazardous constituents in the 1 to 100 ppm range may be eligible for venting.

For assistance about the disposal of gas cylinders, complete and submit a Waste Evaluation Request at http://www.ehs.washington.edu/forms/epo/1957.pdf or email chmwaste@u.washington.edu.

Section 4
Lab Equip & Facilities

Section 4
Laboratory Equipment and Facilities

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A. Emergency Eyewashes and Showers

Emergency washing equipment is required when using corrosives (acids and caustics), strong irritants (which cause inflammatory effects upon contact), and toxic materials that can be absorbed through the skin to cause ill health effects.

Emergency washing facilities must be accessible (unobstructed) and personnel should be able to reach the equipment within 10 seconds (not more than 50 feet and perhaps closer if access is through a normally closed door). Equipment must be accessible at all times without requiring a key or overcoming other security safeguards.

A hand held drench hose no longer qualifies as an approved eyewash station but may be used as a supplemental washing facility. Such drench hoses have been augmented with approved eyewashes through a special project. If your lab has a drench hose without eyewash but an eyewash is needed, submit a work request to have an eyewash installed. Contact EH&S at 206-543-7388 if you have questions.

Emergency washing equipment is tested annually by Facilities Services to ensure it continues to meet ANSI standard water flow requirements. A tag indicating the last test date should be found on the equipment. Call Facilities Services for maintenance at 206-685-1411.

Each emergency eyewash must be activated weekly by laboratory staff to check that it works and provides a strong enough stream of water to reach the eyes of someone bending over it, and to help keep the water clean. Record this weekly test where it can be audited such as in your lab notebook or lab equipment maintenance record book.

B. Fire Safety Equipment

1. Flammable Liquid Storage Cabinets

Flammable liquid storage requirements are required if you are storing over ten gallons of flammable liquids. Flammable liquid storage cabinets are **not** fireproof. Cabinets are designed to only protect the contents from extreme temperatures for a limited time. Contact EH&S at 206-543-0465 for further information on flammable liquid storage cabinets.

a. UL or FM Approval

Flammable liquids should be stored in an Underwriter's Laboratory (UL) listed or Factory Mutual (FM) approved flammable liquid storage cabinet outfitted with approved automatic or self-closing doors. All new cabinets must have UL or FM approval and should be mechanically vented. (Note: Some existing wooden cabinets that are not labeled with UL or FM approval are still in service and approved for use.)

b. Label

Cabinets must be labeled "Flammable - Keep Fire Away".

c. Capacity

Do not over fill cabinets. Check manufacturer's recommendations for storage limits.

d. Bottles

All bottles should be placed on the shelves, never stacked. Keep all containers tightly closed.

e. Incompatible Chemicals

Do not store incompatible chemicals in these cabinets.

f. Cabinet Doors

Cabinet doors should never be propped open unless the mechanism is a designed part of an approved cabinet.

g. Secondary Containment

There should be a secondary containment on each shelf and at the bottom of the unit. These plastic or rubber trays retain spills.

h. Unapproved Storage

Tops of cabinets are not storage shelves. Do not store combustible materials on or beside these cabinets.

2. Flammable Storage Refrigerators

Flammable chemicals or chemical mixtures that need to be stored below room temperature must be stored in U.L. listed Flammable Material Storage Refrigerators or Freezers. These refrigerators and freezers are specifically designed by the manufacturer to have non-sparking interiors. All laboratory refrigerators and freezers must be prominently labeled with a warning sign indicating whether it can be used for flammable or non-flammable storage. For these warning signs or information regarding a Flammable Storage Refrigerator purchase, contact EH&S at 206-543-0465. For more information on flammable storage refrigerators, see http://www.ehs.washington.edu/fsofire/flamfrig.shtm.

C. Laboratory Signs

1. Emergency Numbers

Post a list of telephone numbers to be called in case of fire, accident, hazardous chemical spill or other emergency. The list should be posted prominently in each laboratory next to a telephone.

2. Evacuation Plan

A plan showing evacuation route(s), as well as emergency and safety equipment should be posted prominently in each laboratory. See Appendix C for an example laboratory floor plan.

3. Emergency/Safety Equipment Location Signs

Signs must be posted identifying the location of exits, safety showers, eyewash stations, fire extinguishers, first aid equipment, and other safety equipment. Contact University Stores and/or Facilities Services to obtain and post these signs.

4. Food and Drink Prohibitions

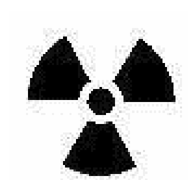
Label areas, refrigerators, freezers and other locations where food and beverages are not to be consumed or stored. Food prohibition stickers can be obtained from University Stores or by contacting EH&S.

5. Area and Equipment Warnings

Warnings should be posted in areas or on equipment where special or unusual hazards exist, such as biohazards, lasers, magnetic fields, radioactive materials, or particularly hazardous substances. Hazard areas are frequently indicated by familiar symbols, such as Figures 4-1 and 4-2. All workers in the laboratory must be familiar with these indicators and aware of the presence of the hazards. For Biosafety warning signs, refer to the UW Biosafety Manual. For radiation warning symbols, refer to the UW Radiation Safety Manual. These manuals are available electronically on the EH&S website.

Figure 4-1 Biohazard Warning Symbol

Figure 4-2 Radiation Warning Symbol

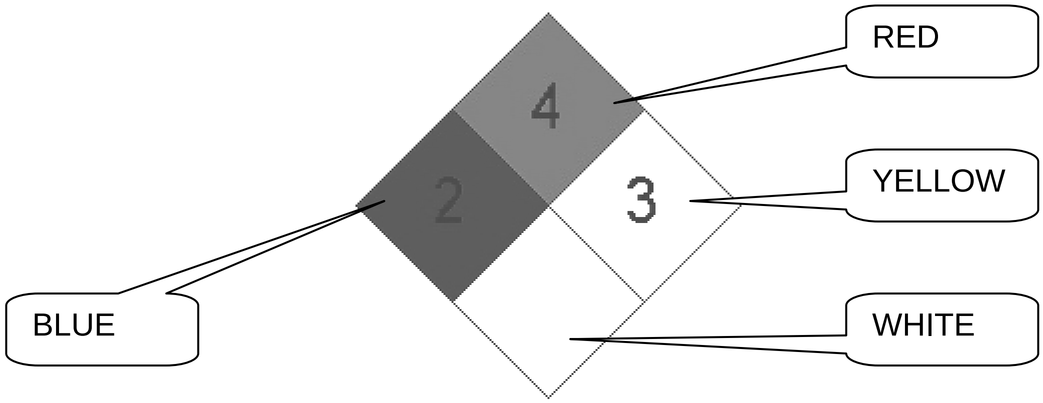


6. National Fire Protection Agency (NFPA) Signs

Rooms where hazardous materials are stored or used in quantities that exceed certain thresholds (“H” occupancy as defined in the International Fire Code), and rooms dedicated to storing hazardous materials, must be posted with a National Fire Protection Association (NFPA) diamond sign (NFPA Standard 704) on all doors. Call 206-543-0465 for further information and signs. The Seattle Fire

Department now requires these signs on all new or renovated laboratories and EH&S will post these signs.

Figure 4-3 NFPA Standard 704 Hazardous Material Sign



a. Fire, Health and Reactivity Fields

Brief descriptions of the number codes for the Fire, Health and Reactivity fields are given in Table 4-1. The codes for these fields range from “0” (zero) to “4”, with “0” meaning essentially no hazard, and “4” indicating an extreme hazard.

Table 4-1 NFPA Standard 704 Numeric Codes

Hazard:	**Fire Hazard**	**Health Hazard**	**Reactivity**
Color:	Red	Blue	Yellow
Location:	Top Quadrant	Left Quadrant	Right Quadrant
Numeric Code	Description of Numeric Rating		
4	Flash Point <73°F, Boiling Point <100°F	Deadly	May Detonate
3	Flash Point <73°F and Boiling Point ≥100°F, or Flash Point 73°F - 100°F	Extreme danger	Shock and heat may detonate
2	Flash Point >100°F and ≤200°F	Hazardous	Violent chemical change
1	Flash Point ≥200°F	Slightly hazardous	Unstable if heated
0	Will not burn	Normal material	Stable

b. Specific Hazard Field

The bottom diamond segment is white, with any specific hazard codes printed in it. These specific hazards include OX (oxidizers), ACID (acids), ALK (alkali materials), COR (corrosive materials), and ~~W~~ (use no water).

D. Laboratory Ventilation

Washington State Department of Labor and Industries has set full shift (eight-hour) and short-term (fifteen-minute) permissible exposure limits (PELs) for many chemicals to prevent adverse health effects in workers (See Section 5.A.1). Local exhaust ventilation systems (such as fume hoods) may be needed in order to control airborne contaminants and reduce exposure levels to these acceptable limits. For assistance in measuring chemical exposures, contact EH&S at 206-543-7388.

1. Laboratory Design

a. Room Air Pressure

Room air pressure should be negative to the hallway so that accidental releases are kept in the lab and not released into the hallway and the building.

b. Vents

Do not block or cover supply and exhaust vents. Occupant changes to lab ventilation may compromise the safety features of the laboratory and local exhaust systems such as fume hoods, biosafety cabinets, etc.

2. Fume Hoods

A fume hood is ventilation equipment that vents separately from the building's heating, ventilation and air conditioning (HVAC) system. The primary means of controlling airborne chemical exposure is a fume hood. Fume hoods should be used when working with toxic compounds or compounds with a boiling point below 120°C. (However, some aqueous solutions may be an exception to this rule.) It may be necessary to use a closed system such as a glove box or bag for highly hazardous chemical materials.

EH&S maintains a roster of fume hood designs which have been approved for purchase, on the EH&S web site at http://www.ehs.washington.edu/fsofumehoods/approvedfumehoods.shtm.

a. Fume Hood Use

1) Verify Operation – Make sure the fume hood is operating before starting work. Some new fume hoods have monitoring devices that indicate acceptable working conditions. Otherwise, a strip of Kimwipe taped to the underside of the sash can be used as an indicator of air flow. (Since this strip may flutter even when the air flow is inadequate, the strip should be placed and its movement observed when you know that the air flow is proper – such as at the same time that EH&S measures the air velocity.)

2) Exhaust Fan Speed – Laboratory fume hoods in recently remodeled and newer buildings have two speed exhaust fans with local control at the hood. The low exhaust setting is only appropriate for storage -- not for working with chemicals outside of their original containers. The high setting provides protection for working with chemicals.

3) Minimize Cross Drafts and Eddy Currents – Air flow into the fume hood is adversely affected by cross drafts and eddy currents. Cross-drafts occur when people walk in front of a fume hood or when nearby windows or doors are open. Eddy currents occur around the person using the fume hood and around objects inside it. To limit these effects, fume hoods should not contain unnecessary objects and the slots within the fume hood which direct air flow must not be blocked. The slot at the rear of the work surface is essential for proper air movement. If large pieces of equipment or large numbers of bottles are placed in front of the slot, they should be raised up on blocks or placed on a shelf to allow air to flow into the slot. Equipment should be placed as far to the back of the fume hood as practical. Work should be performed at least six inches inside the fume hood opening to prevent cross drafts and eddy currents from pulling contaminated air into the room.

4) Sliding Sashes – The sash should be kept as low as possible to improve overall performance of the hood. The more closed the sash is, the better protection from an unexpected chemical reaction. Procedures should be done with the sash at the level of the maximum approved sash height marking, or lower. Use a separate safety shield, such as a face shield, when working with an open sash.

5) Chemical Evaporation –It is illegal to evaporate chemicals in the hood to “dispose” of them. Any open apparatus used in hoods which emit large

volumes of volatile chemicals should be fitted with condensers, traps, or scrubbers to contain and collect hazardous vapors or dusts.

6) Storage – Do not store chemicals or supplies in the fume hood. Chemicals and supplies should be stored in vented cabinets.

7) Flammable Liquid Vapor – Laboratory fume hoods are designed to reduce flammable vapors below lower explosive limits when properly operated and maintained. As an added precaution, use only non-sparking and explosion proof electrical equipment (hot plates, stirring plates, and centrifuges) in fume hoods where a large volume of flammable liquid vapor may be generated. Take care with flammable liquids and heat sources.

8) Containers – All containers of chemicals must be securely capped when not in use.

9) Container Labels – The container must be labeled with the chemical identity and appropriate hazard warnings or the material must be used up during the work period and will be under continuous control of the researcher using it.

b. Fume Hood Prep for Maintenance

1) Prior to any maintenance of fume hoods the entire interior surfaces must be decontaminated and cleaned with warm soapy water followed by a rinse to remove residue by the researchers using the hood.

2) Frequently, maintenance requires access to the storage cabinets below the hood. If this access is required, the entire cabinet needs to be emptied, decontaminated, cleaned, and rinsed as described above.

3) See Part 4.G for details and the required form.

c. Fume Hood Testing

1) EH&S performs a functional performance test annually to assure hoods are performing as designed. If a hood fails, it may need to be taken out of service until repaired. EH&S will notify the researchers and post a “do not use” sign if repair is required.

2) If you are having problems with your fume hood, contact EH&S at 206-543-9510. EH&S will troubleshoot the problem and may refer it to Facilities Services for repair.

3. Perchloric Fume Hoods

Procedures using concentrated perchloric acid (>70%) or which heat any amount or concentration of perchloric acid must be performed in a closed system or within a specially designed perchloric acid fume hood with wash down systems to prevent the accumulation of explosive perchlorates in the hood and ducting. For assistance in locating a perchloric acid fume hood, call EH&S at 206-543-9510.

4. Glove Boxes

Glove boxes generally operate under either positive or negative pressure to the lab, depending on the process or material used. Positive pressure glove boxes are used when you are trying to protect your material from contamination. Negative pressure glove boxes are used to provide increased operator protection. Glove boxes should be thoroughly tested before each use and there should be a method of monitoring the integrity of the system (such as a pressure gauge).

5. Biological Safety Cabinets

Biological Safety Cabinets (BSCs) are laboratory hoods designed to protect the worker and laboratory from the biohazards (infectious agents) of the experiment by drawing air across the samples and away from the worker and into a HEPA filter.

There are two types of BSCs. The Class II type A and Class II type B1 units recirculate filtered air into the laboratory and are not designed for chemical use for this reason. The Class II type B2 unit is designed for use of some chemicals but is not a substitute for a fume hood. The use of chemicals in this type of hood needs to be carefully evaluated so that the protective barrier (HEPA filters) is not destroyed by the chemicals.

Biological Safety Cabinets are certified annually by EH&S. If a BSC fails the certification, it may not be used until repaired, unless specifically authorized by the Institutional Biosafety Officer.

BSCs may not be repaired or moved until decontaminated by EH&S.

For additional information on the proper use of BSCs, Class II type B2 design, cabinet certification, troubleshooting problems, or decontamination, please contact EH&S at 206-543-9510.

6. Laminar Flow Hoods

Laminar flow hoods are designed to protect the work surface from contaminants, and blow out into the face of the person using the hood. Therefore, any chemical use will cause the person to be exposed to the chemical. Toxic, volatile chemicals may not be used in a laminar flow hood.

7. Ductless Laboratory Hoods

In some cases, installation of a ducted fume hood may be impossible, and installation of a "ductless hood" is requested for approval by EH&S. This type device uses special filters or absorbents to clean the contaminated air in the hood prior to recirculating the air back into the room. Recirculation of potentially contaminated air into the room presents special dangers and special requirements must be met. The requesting department must demonstrate that the following concerns are addressed as long as the hood is in use:

a. Chemical Characterization

Each of the chemicals to be used in the ductless hood must be completely characterized as to the quantity which may be released within the hood at one time and the frequency of use. The hood manufacturer will need this information for the design of the hood. Once designed, use of other chemicals in the hood must be forbidden unless the hood manufacturer approves the alternate chemical. Records as to the design of the hood and the design chemical usage must be maintained in the laboratory.

b. Hood Approval

The Principal Investigator must verify that the size, shape and layout of the proposed hood as offered by the hood manufacturer is appropriate for the intended use. The PI must also develop a management plan for the hood, which addresses staff training, procedures for using the hood including emergency procedures, ongoing maintenance and certifications for the hood, and recordkeeping. This plan needs to assure continuity if management of the hood is taken over by another individual. A description of the items required in the management plan is available from EH&S. Hood approval by EH&S is contingent on submittal of the hood design information from the proposed manufacturer and submittal of the management plan.

c. Laboratory Staff Information and Training

All personnel in the laboratory must be trained as to the fact that the ductless hood recirculates air back into the room, that only certain, designated chemicals may be used within the hood, and that failure to properly operate and maintain the hood may result in personnel exposures.

Also, a sign must be placed on the hood identifying what chemicals may be used and warning that the air is recirculated back into the room from the hood.

8. Cold and Warm Rooms

a. Room Design

Cold and warm rooms should be designed or retrofitted with doors that allow anyone trapped inside to get out easily. The electrical system within environmental rooms should be independent of the main power supply so that persons are never left in these areas without light.

b. Chemical Use

Cold rooms and warm rooms usually re-circulate the air using a closed air-circulation system. Hazardous chemicals must not be stored in these rooms because ambient concentrations of volatile chemicals can accumulate to dangerous levels.

Flammable solvents should not be used in cold rooms. Ignition sources in these rooms could ignite vapors.

Avoid using volatile acids in cold rooms because vapors can corrode the cooling coils, leading to possible refrigerant leaks.

If solid carbon dioxide (dry ice) is placed into a cold room, its sublimation will raise the carbon dioxide levels within the room, possibly to dangerous levels. Use extra precautions if you must use or store dry ice in these spaces.

9. Other Ventilation Systems

A ventilation engineer must install all other local exhaust systems used in the laboratory. Do not attach canopy hoods or snorkel systems to existing fume hood exhaust ducts without consulting a ventilation engineer at Facilities Services Design Division, 206-543-8200. All local exhaust systems should have a visual indicator that the system is functioning properly at all times, even if the indicator is just a Kimwipe.

a. Discharge of Hazardous Vapors

Laboratory apparatus that may discharge hazardous vapors (vacuum pumps, gas chromatographs, liquid chromatographs, and distillation columns) must be vented to an auxiliary local exhaust system such as a canopy or a snorkel, if not already vented to a fume hood.

b. Hazardous Chemicals

Hazardous chemicals should be stored in cabinets fitted with auxiliary local ventilation.

c. Isolation/Clean Rooms

Isolation rooms typically operate under negative pressure and clean rooms typically operate under positive pressure to the anterooms or hallways. These rooms require considerable engineering. Procedures for entering and exiting these areas should be written out and employees should be trained accordingly.

10. Maintenance of Ventilation Systems

All ventilation systems need routine maintenance for blocked or plugged air intakes and exhausts, loose belts, bearings in need of lubrication, motors in need of attention, corroded duct work, and minor component failure. Contact UW Facilities Services if a ventilation system has a problem (Upper Campus at 206-685-1411; South Campus at 206-543-3010). When maintenance is scheduled for fume hood exhaust systems, warning signs will be posted on the affected fume hoods and researchers must cease fume hood use during the maintenance procedures in accordance with the requirements listed on the sign.

a. Filters

Filters should be replaced periodically in certain types of ventilation systems, such as electrostatic precipitators, cyclones for dust collection, and biosafety cabinets. For laboratory maintained equipment, keep a record of these filter changes in a notebook or file that can be easily located in case a regulatory agency requests a copy of this documentation.

b. Monitoring Devices

Monitoring devices should be included in new ventilation systems to make the user aware of malfunctions. All personnel within the laboratory need to understand the meaning of associated alarms and readout devices, and the actions to take if an alarm or unacceptable reading occurs.

E. Other Facility Conditions

1. General Laboratory Environment

a. Floors and Walkways

1) Flooring - Floors should be level, with no protuberances which could cause a tripping hazard. Openings in the floor should be covered if possible or else protected or guarded to prevent falls. Carpets, mats, and rugs (if present) must be secure. Material spills should be cleaned up as soon as possible.

2) Obstructions - Equipment should not be placed where it would impede exit, either during normal operations (such as a file drawer which may open into an aisle) or in case of equipment failure (such as chemical reactions escaping a fume hood placed at the entrance to a room). Hoses and electrical cords should be strung along the ceiling instead of crossing aisles on the floor.

b. Seismic Bracing and Earthquake Preparedness

Details concerning seismic bracing are noted in Section 9.A.5. Facility Services must perform all facility modifications, such as installing mounting brackets on the walls.

c. Plumbing Systems

Piping systems and plumbing connections in a room should be labeled. Such plumbing systems may include sewage lines, potable water lines, non-potable water systems, cryogenic and pressurized gases, or other systems. All personnel should know what to do in case of a leak in any system.

If experimental procedures will require connecting laboratory apparatus to any plumbing, personnel must also know how to avoid improper connections (i.e., avoiding mistakes such as connecting to the wrong system or making an inappropriate cross-connection). Public Health regulations require additional safe guards to the plumbing system when connecting chemical equipment or experiments to potable water systems. Check with EH&S and Facilities Services prior to any connections to potable water systems.

d. Lighting

1) Light Fixtures – Light fixtures should be operational and diffusers should be installed. If emergency lighting and exit signs are not functional, immediately initiate a work request with Facilities Services (Upper Campus: 206-685-1411; South Campus: 206-543-3010).

2) Lighting Intensities – Light intensities should be adequate for the tasks being performed. If lighting seems inadequate when all fixtures are working, consider obtaining additional fixtures, especially if the laboratory arrangement is temporary. If this will not resolve the problem, please call EH&S at 206-543-7388. In a few cases, increased lighting may be required to reduce potential hazards from activities such as laser use or ultraviolet light applications. In these unusual situations, contact EH&S Radiation Safety at 206-543-0463.

e. Noise and Vibration

When possible, equipment that produces irritating noise and vibration should be replaced with equipment designed to produce less noise and vibration. If equipment in the area is producing noise levels that require people to raise their voices to be heard while standing next to each other, potentially hazardous noise levels are being produced. These levels can be evaluated by contacting EH&S at 206-543-7388.

Equipment should not be purchased which produces noise levels greater than 80 dBA without specific written approval from EH&S (206-543-7388). A formal hearing protection program may need to be implemented for the installation and use of such equipment.

f. Indoor Air Quality

1) Occupant Activities – Many complaints about odors are due to occupant-generated problems. Such sources include dried-out drain traps in sinks and floor drains, chemical spills inside a laboratory or adjacent area, rotting food within a room, and expected or unexpected chemical reactions creating a stench within a room. The room occupants should check these potential problems. Additional information is available at http://www.ehs.washington.edu/ohsshoptrade/iaq.shtm.

2) Facility-Related – Recurring poor indoor air quality may be due to inadequate or mal-functioning general HVAC systems. In some cases, odors may come from a leak in a plumbing system (such as natural gas or sewage), an open drain that was never capped by Facilities Services when a piece of equipment was decommissioned, or a construction project in an adjacent area. If these conditions are suspected, contact Facilities Services (Upper Campus: 206-685-1411; South Campus: 206-543-3010).

3) If an unknown odor persists, contact EH&S at 206-543-7388.

g. Asbestos, Lead and Other Hazardous Facility Components

1) Asbestos – Asbestos may be found in various building components (often in plumbing insulation and fireproofing, and sometimes in floor tiles, ceiling tiles, wall finishes and other building materials). Asbestos may also be found in various equipment components (such as fume hood and safety cabinet wallboard, and autoclave and oven gaskets) and various supplies such as heat-resistant gloves and heat-resistant cloth. Non-asbestos materials should be used whenever possible in place of the asbestos materials and all personnel should avoid damaging suspected asbestos-containing materials. Do **NOT** use an ordinary vacuum cleaner or dry sweeping to clean up suspect dust from these materials. Such materials are handled by an on-campus contractor by a work order through Facilities Services. Contact EH&S at 206-543-7388 concerning asbestos questions.

2) Lead – As a building or equipment component, lead is frequently found in old paints on walls and metal surfaces, in paints used on the exterior of ships and buildings, as a barrier when density is needed (such as in an x-ray radiation shield) or as a weight when a heavy material is needed (such as an equipment counter-balance). The primary health hazard would come from inhaling or ingesting dusts from these materials, but skin contact with these materials should also be minimized. If a laboratory operation routinely creates lead dusts or melts lead, the process should be evaluated by EH&S (206-543-7388).

3) Other Building Materials – Other structural materials that could present a health hazard include poly-chlorinated biphenyls (PCBs) in fluorescent light fixtures and transformers, liquid mercury switches in piped gas systems, mercury in fluorescent and high pressure light bulbs, flammable or toxic gases in piped gas systems, and potentially hazardous materials in sewage plumbing and ventilation ducts. If any leak of such

material is suspected, Facilities Services should be immediately contacted (Upper Campus: 206-685-1411; South Campus: 206-543-3010).

h. Building Repairs and Alterations

Building occupants are not authorized to repair or alter facilities. Facility problems such as broken flooring and broken electrical cover plates should be corrected by initiating a work request with Facilities Services Maintenance and Alterations. Submit work requests via their website at http://www.washington.edu/admin/facserv/maintalt.html.

2. Electrical Hazards

Even small electrical currents passing through the body may cause injury or death. Observe the following precautions to reduce electrical risks.

a. Circuit Breaker Access

1) Access – Maintain at least three feet clearance in front of any circuit breaker panels within the laboratory.

2) Utility Access in Other Rooms – If you must enter other rooms to access the circuit breakers, you must be observant of any conditions in that room which may indicate a hazard. Such conditions could include puddles in front of the circuit breaker box or temporary barriers preventing entry to the circuit breaker box. (If a barrier is deliberately placed, such as a sign indicating that entry is restricted due to some hazard, obtain permission from the agency placing the barrier before entry.)

b. Permanent Wiring and Outlets

Request permanent wiring be installed for situations when you would be using extension cords for periods longer than 8 hours. All building electrical repairs and wiring must be done by Facilities Services. If conduits appear damaged or cover plates over electrical outlet boxes are damaged or missing, please report that information to the Building Coordinator for forwarding to Facilities Services.

c. Equipment Cords and Extension Cords

1) Cord Design – Extension cords should be a minimum of 14 gauge size (heavy-duty) and be in good condition with no splices, knots, deterioration, taping, damage, or sharp, permanent bends. Extension

cords may never be used in place of permanent wiring. Consider instead power strip outlets or surge protectors with build-in circuit breakers.

2) Cord Placement – Carpeting, heavy objects, and equipment that may abrade or melt an electrical cord should never be placed on top of electrical cords. Cords should serve only one fixture or piece of equipment. Cords should never be strung through holes in walls or ceilings, or over metal fixtures such as pipes or equipment racks, because cord movement may abrade the cord.

d. Chemical Splashes into Electrical Equipment

Place equipment so as to reduce the chances of a spill of water or chemical on the equipment. If a spill occurs while the equipment is unplugged, the spill should be promptly cleaned, and the equipment must be inspected before power is applied.

e. Grounding

Equipment must be properly grounded (using three-prong plugs for 110-volt power), especially in “wet” areas. Electrical outlets in “wet” areas must have ground fault circuit interrupters (GFCIs). (However, these devices only interrupt flow of electricity to ground and may not stop flow of electricity when completing an electric circuit with two “live” wires.)

f. Equipment Modifications

Any problems with electrically powered equipment should be brought to the attention of the PI or laboratory supervisor. If equipment set-up is modified, someone knowledgeable with the apparatus should check the new set up, before power is applied. Equipment operators must understand the hazards of equipment and apparatus in use, and be familiar with the correct operation of that equipment. Power line cords should be unplugged before any modifications or repairs are made to equipment. Even though power may need to be applied to equipment while calibrations are performed, the operator must remain wary of the energized state of the equipment and not adjust the equipment beyond safe operational parameters.

3. Lock-Out/Tag-Out Concerns

a. Hazardous Situations

In addition to common electrical hazards, other energy hazards may exist in the laboratory that require special procedures, called Lock-Out/Tag-Out procedures. These situations may include equipment with internal pressurized systems (hydraulic or gas), multiple electrical energy source systems (where electricity is supplied through more than one cord), systems containing batteries or capacitors, and gravity systems (where a weight is held at a height). Such systems must be labeled with a warning sign. Anyone using such systems must know of the hazard and that only trained and authorized individuals may repair and modify the equipment.

b. Precautions

Trained and authorized personnel must perform all repairs and modifications. When repairs and modifications are performed, the energy source must be prevented from being activated, using appropriate techniques such as de-energizing the system, inserting blanks into pressure systems, and locking out controls with individualized locks.

4. Equipment Guards and Mounting

a. Guards

Belts, pulleys, and other exposed moving equipment parts must be guarded. Equipment covers should be in place.

b. Instruction Manuals

Operator's manuals should be available and workers using the equipment should know where such manuals can be found, and should review the manuals prior to using the equipment.

c. Mounting

Equipment designed to be used in a particular location should be permanently fixed in place to prevent movement from vibration or earthquake. This is especially important for equipment which may topple (e.g., a drill press) or which needs to be balanced (e.g., a centrifuge).

5. Confined Spaces

Laboratories may contain equipment (such as large tanks or ovens) or facility arrangements (such as tunnels, sumps or pits) that laboratory staff may need to enter. If potentially hazardous exposures may occur in a confined space, the space will need to be controlled as a permit-required confined space. Special training and other precautions are required for permit-required confined space entry.

Contact EH&S at 206-543-7388 for space evaluations. Contact EH&S at 206-543-7201 or at *www.ehs.washington.edu* to arrange for the training.

F. Pressure Vessels and Systems

1. Vessels

Pressure vessels, autoclaves, and steam sterilizers operating at pressures greater than 15 pounds per square inch, gauge (psig) or larger than 6 inches in diameter fall within the Washington State Boiler Codes for public spaces. As such, there are strict requirements for design, testing, and approval. The units must be placed on the University's insurance carrier's inspection list maintained by Facilities Services.

2. Pressure Systems

Pressure vessels and systems with operating pressures greater than 15 pounds per square inch, gauge (psig) are of potential concern. Design should produce a protection factor of 4:1 up to 10:1 depending upon design parameters and whether the system can be safely tested. A pressure relief device to safely release pressures greater than 10% above the operating pressure should be installed.

3. Precautions

a. Large-Scale Processes

Large-scale processes (exceeding 100 psig or involving more than 10 to 20 grams of reaction compounds) should be carried out in containment devices designed for high pressures.

b. Hazards

Hazards from explosions due to over-pressurizations include flying scraps and glass, and spills of potentially harmful reaction compounds.

c. Small Scale / Low Pressure Procedures

Avoid damage during small scale / lower pressure procedures. Procedures to avoid damage include the use of barriers, use of undamaged components, use of tubing and glassware designed for the temperatures and pressures involved, and application of the minimal amount of cold (such as by using dry ice) or heat (such as by using low temperature steam) instead of application of extreme temperatures or spot applications.

G. Decontamination of Equipment for Service

Laboratory personnel are responsible for providing a clean and unobstructed work area for all maintenance and service personnel. Floors should be cleaned regularly and kept free of obstructions.

1. Custodial Services

UW Custodial Services will clean floors in laboratories only if requested. Contact Custodial Services at 206-685-1500. Custodial floor care equipment should not be used to clean-up spills or chemicals.

2. Servicing of Lab Area or Equipment

To protect maintenance and facility workers, any laboratory area or equipment needing servicing is required to be emptied of chemicals, cleaned and/or decontaminated and unobstructed. The area or equipment must have a signed *Notice of Laboratory Equipment Decontamination (UoW 1803)* attached before service will be provided. This form is available online at http://www.ehs.washington.edu/forms/fso/lab_equip.pdf.

Facilities Services and maintenance personnel are trained to reject servicing the requested area or equipment if it has not been decontaminated. Conditions which can lead to service rejection include such things as visible debris from absorbents or glassware, “diapers” or papers taped to surfaces which were supposedly decontaminated and cleaned, and visible or sticky spilled materials.

If the laboratory is expected to be unattended when service personnel arrive, an informal note should be left stating a contact name and phone number in case there are questions about the work area, or if equipment needs to be moved.

H. Decontamination of Equipment for Disposal

Laboratory equipment is often contaminated with hazardous materials and/or may be inherently unsafe. UW Surplus Property cannot accept some types of laboratory equipment and cannot accept laboratory equipment containing hazardous materials.

To surplus contaminated or potentially contaminated laboratory equipment, you must first make sure that the equipment is safe for handling and resale by following the directions on the Notice of Laboratory Equipment Decontamination (UoW 1803 at http://www.ehs.washington.edu/forms/epo/surplusdecon.pdf). The Chemical Hygiene Officer (Laboratory Supervisor or Principal Investigator) must sign this notice to certify that all of the applicable instructions on this form have been followed. Affix this Notice to the equipment. Surplus Property will not pick up equipment that does not have this notice attached or does not appear to be clean and empty.

Examples of equipment that must be decontaminated include centrifuges, incubators, fume hoods, cryostats, ovens, biosafety cabinets, refrigerators, freezers, sinks, storage cabinets, lockers, bins, and tanks. (Tanks have the potential to be a confined space hazard and thus require special procedures, call 206-543-7388.)

Any equipment capable of generating dangerous radiation or containing radioactive sources must be checked by the EH&S Radiation Safety Office prior to public sale. Please contact the Radiation Safety Office 206.543.6328. These items include:

- Gas chromatographs
- Germicidal UV lamps
- Lasers
- Scintillation counters
- X-ray equipment
- Any item with a radioactive sticker

The following items CANNOT be accepted by Surplus Property. Contact the EH&S Environmental Programs Office at 206.616.5835 for information on how to dispose of these items.

- Capacitors, transformers (note: some equipment may contain transformers, such as x-ray equipment and electron microscopes. These transformers may be accepted but must be drained of oil and the oil must have been tested and certified by EH&S as being non-PCB oil.)
- Gas cylinders and other pressurized containers/vessels
- Instruments containing mercury
- Equipment containing asbestos, including but not limited to: autoclaves, laboratory ovens, fireproof file cabinets, anything that produces high heat.

The type of decontamination will vary depending on the hazardous material and the type of equipment. Note that personal protective equipment should be used when decontaminating equipment. Below are some requirements and guidelines for decontamination, as well as contact information for questions.

1. Equipment Used to Process/Store Chemicals

Safely remove or drain chemicals from the equipment, including any oil or coolant. Collect the chemical(s) for reuse or dispose of as hazardous waste. If applicable, use an inert gas or liquid to purge or rinse out chemical residues. In some cases, rinseate will need to be disposed of as hazardous waste as well. See our website at www.ehs.washington.edu/epowaste or call the EH&S Environmental Programs Office at 206-616-5835 for questions regarding hazardous waste disposal of chemicals and/or rinseate.

Decontaminate the equipment as necessary. For example, use solvents to remove viscous or non-water soluble contaminants. Then scrub decontaminated equipment thoroughly with warm soapy water. Rinse and dry. Wash and/or rinse water and solvents may need to be managed as hazardous waste. Contact the EH&S Occupational Health & Safety Office at 206-543-7388 for more specific information about decontamination.

2. Equipment Used to Process/Store Radionuclides

Conduct a thorough radiation survey of all accessible surfaces of the equipment with an appropriate instrument. If you detect radioactive contamination, you must clean the equipment with small amounts of warm detergent water. Avoid splash. Blot dry with paper towels. Commercial radiation decontamination solutions containing chelating agents may be helpful. Resurvey to assure that contamination is less than 100 counts per minute per 100 square centimeters of surface. If contamination persists or you have other questions, contact the EH&S Radiation Safety Office at 206-543-6328.

3. Equipment Used to Process/Store Biological Material

Remove all biological material from the equipment. Decontaminate with a 1:10 bleach solution. After 30 minutes of contact time, rinse metal surfaces. If you have specific biosafety questions, contact the EH&S Research and Biological Safety Office at 206-221-7770.

Before repair or relocation, biological safety cabinets must be decontaminated by EH&S or by a contractor approved by EH&S. For this service, contact EH&S at 206-543-9510.

Section 5
Employee Health & PPE

Section 5
Employee Health and PPE

Contents

Tables

A. Environmental Monitoring and Medical Surveillance

As a general principle, exposures to hazardous chemicals should be kept as low as possible and avoided when possible through good laboratory procedures. If there is reason to believe that exposure to a chemical routinely exceeds an exposure limit for a chemical, then the Principal Investigator (PI) or supervisor shall arrange to measure an employee's exposure to that chemical. For assistance in determining if air monitoring should be done, contact EH&S at 206-543-7388. In most cases, EH&S can also perform the air monitoring.

1. Exposure Limits

Exposure limits can be defined by a regulation (identified as a Permissible Exposure Limit or PEL) or by a guideline. PELs are listed in the Washington Administrative Code (WAC) at WAC 296-841-20025, which can be viewed by going to http://www.lni.wa.gov/WISHA/Rules/respiratoryhazards/PDFs/Table3-ExposureLimits.pdf . Some chemical-specific regulations set a limit called an Action Level (AL) in addition to the PEL. If an AL is exceeded, continuing actions must be taken to make sure the levels do not exceed the PEL.

There are only about 600 chemicals with a regulatory PEL, so it is frequently necessary to refer to a guideline to get an idea of a possible significant exposure. Guideline limits are considered “recommendations” and exposures should not exceed these levels. These guidelines are typically more up-to-date than the regulatory limits. Various organizations publish guidelines, as shown in Table 5-1, Guidelines for Airborne Exposure Levels.

Table 5-1 Guidelines for Airborne Exposure Levels

GUIDELINE-PRODUCING ORGANIZATION	GUIDELINE TITLE
National Institute for Occupational Safety and Health (NIOSH)	Recommended Exposure Limits (RELs)
American Conference of Governmental Industrial Hygienists (ACGIH)	Threshold Limit Values (TLVs)
American Industrial Hygiene Association (AIHA)	Workplace Environmental Exposure Limit Guides (WEEL Guides)

In addition to the organizations listed above, guidelines may also be produced by other groups, nations, and chemical manufacturers. The recommended limits can be obtained from the publications of those organizations, or may possibly be found on web pages or sometimes listed on material safety data sheets. More information is available from EH&S at 206-543-7388.

Due to lack of complete knowledge of the health effects of chemicals and possible chemical synergies, there may be an exposure issue even though levels do not exceed limits. Personnel should take reasonable steps to keep exposures and levels as low as feasible.

2. Special Chemical Air Monitoring

Washington State Department of Labor & Industries regulations specifically address the chemicals listed in Table 5-2, Special Chemical Air Monitoring, and require that air monitoring be done. Contact EH&S at 206-543-7388 for assistance if you routinely use any of these chemicals:

Table 5-2 Special Chemical Air Monitoring

Acrylonitrile	1,2-Dibromo-3-chloropropane	Methylene chloride
Asbestos	Ethylene oxide	4,4’-Methylene-dianiline
Benzene	Formaldehyde	Thiram
1,3-Butadiene	Inorganic Arsenic	Vinyl chloride
Cadmium	Lead	

3. Possible Over-Exposure

Exposures exceeding recommended limits are considered “over-exposures.” Such limits apply to airborne levels which may result from operations that generate air contaminants outside of fume hoods, from a spill of a volatile chemical, or a leak of a gas. Other routes of entry into the body besides inhalation - ingestion, direct skin or eye contact with a chemical, injection under the skin by a sharp object or high pressure source, or a combination of these routes – may also present a significant exposure. These exposures may occur if safe practices are not followed.

In some cases, workers may show signs of exposure such as a headaches, rashes, nausea, coughing, tearing, irritation or redness of eyes, irritation of nose or throat, dizziness, and loss of motor dexterity or judgment. Such conditions should be evaluated if there is no pathological cause for such symptoms. Follow-up is especially important if the symptoms disappear when the person leaves the exposure area and then reappear soon after the employee returns to work, or if two or more persons in the same laboratory work area have similar complaints.

4. Medical Evaluations

Laboratory employees who suspect they have been over-exposed, or are having symptoms consistent with over-exposure to a chemical, should contact Campus Health Services at 206-548-4848. The Occupational Health Nurse through Campus Health Services will coordinate medical consultation, exams and surveillance.

Staff involved in any emergency situation should go directly to the nearest emergency room or call 911 (on campus) for assistance, depending on the situation.

B. Personal Protective Equipment (PPE)

Eliminating a hazard through engineering or administrative controls, such as fume hoods and sashes, is the primary and preferred method of providing personal protection. In addition, skin, eyes and respiratory tract should be protected by use of appropriate laboratory clothing, eye protection and, if necessary, respirators.

Principal Investigators (PIs) or laboratory supervisors are required to assess the hazards based on the procedures performed in the laboratory and the controls in use. If they identify that PPE is required, the University must provide personal protective equipment (PPE) at no cost to the employee (except for prescription safety glasses and fitted shoes) (http://www.washington.edu/admin/rules/APS/10.04.html). The PI or supervisor must also instruct employees in how to select, inspect, use, maintain, and store the PPE. Training records should be maintained as described in Section 8 of this manual.

Although students must be protected to the same degree as employees, they are liable for purchase of their own PPE, such as safety goggles or respirators. Common use PPE such as aprons may be purchased by the department.

The laboratory should have extra PPE available, for loan to visitors if they will be allowed to participate in the experimental procedures or if general laboratory rules require that all personnel will wear the specified PPE.

Required PPE should be detailed as a laboratory-wide requirement (*e.g.*, lab coats) or in Standard Operating Procedures (for each laboratory procedure as described in Section 6 of this manual) or Job Hazard Analyses (if the procedure does not involve chemicals). PPE for some types of hazards are shown in the following table (Table 5-3).

Table 5-3 Hazards and PPE

HAZARD	PERSONAL PROTECTIVE EQUIPMENT	REFER TO
Biohazards (Germs)	Splash goggles, respirators, gloves, surgical masks, lab coats, aprons, sleeves, shoe covers, head covers	Biohazard Safety Manual
Chemicals	Gloves, chemical-resistant clothing, aprons, sleeves and shoe covers, vapor-proof or splash goggles, respirators	This section of this manual, paragraph B
Cuts/Abrasions	Cut-resistant gloves (leather, Kevlar, chain-mail)	This section of this manual, paragraph B.3
Dust	Dust goggles, respirators	This section of this manual, paragraph B
Electricity	Electrically-resistive gloves, mats, hard hats	EH&S, 206-543-7388
Falling Objects	Hard hats, steel-toe shoes, metatarsal guards	EH&S, 206-543-7388
Falls	Fall harness, strap-on hard hat	EH&S, 206-543-7388
Flying Particles	Safety glasses w/ side shields, goggles, face shields	This section of this manual, paragraph B.1
Hot Environments	Cooling vests, reflective suits	EH&S, 206-543-7388
Hot or Cold Objects	Gloves (Note: Asbestos gloves are prohibited and must be turned in as hazardous waste.)	EH&S, 206-543-7388
Intense Light	Opaque glasses, goggles, welding hoods	This manual, Section 4, paragraph F.1.d
Kneeling	Knee pads	EH&S, 206-543-7388
Lifting	No PPE available, use engineering controls/training	EH&S, 206-543-7388
Low Overhead Objects	Bump cap, hard hat	EH&S, 206-543-7388
Noise	Hearing protectors	This section of this manual, paragraph B.5
Over-Water Work	Life vests, flotation devices	EH&S, 206-543-7388
Radiation	Lead apron, lead gloves, thyroid collar, lead glasses for X-ray, lab coats/gloves for radioactive materials	Radiation Safety Manual
Repetitive Motion	No PPE available, use engineering controls/training	EH&S, 206-543-7388
Slipping	Non-skid shoes	EH&S, 206-543-7388
Splashes	Splash goggles, face shields, chemical-resistant clothing, aprons, sleeves and shoe covers	This section of this manual, paragraph B
Traffic	Reflective vest	EH&S, 206-543-7388

1. Eye Protection

Appropriate eye protection must be worn when working with chemicals. Avoid use of contact lenses in the laboratory. If you wear contact lenses, notify the PI or laboratory supervisor and always wear chemical splash goggles or a face shield.

a. Prescription Safety Glasses

Prescription safety glasses are available from optical stores. Do not use regular glasses as safety glasses; they are not strong enough.

b. Safety Glasses

Safety glasses with side-shields are designed to provide impact protection but provide little protection from chemical splashes, dusts, or hot particles.

c. Splash Goggles

Splash goggles with splash proof sides should be worn when there is a danger of a chemical splashing. Goggles that have screened sides or other vents, are not splash proof, but can be worn when working with apparatus that could produce flying particles (e.g. glassware under reduced or elevated pressure).

d. Face Shields

Face shields in addition to safety glasses or splash goggles provide maximum protection to the face and neck from flying particles and harmful liquids. Face shields also may be needed when a vacuum system is used.

e. Free Standing Barrier Shields

Free-Standing barrier shields can be used to protect yourself and bystanders from possible explosion.

f. Specialized Eye Protection

Specialized eye protection is needed when working with intense light sources such as infrared light, ultraviolet light, glassblowing, welding, and lasers. Glasses, goggles, or face shields with adequate filtration are needed. For assistance, contact EH&S Radiation Safety at 206-543-0463.

2. Apparel

a. Inadequate Clothing

In the laboratory, do not wear open-toed shoes, sandals, shorts, nylon hose, cropped tops, or any other apparel that leaves skin exposed and unprotected.

All loose clothing should be confined to avoid easily catching fire, dipping into chemicals, or becoming entangled in moving machinery.

b. Jewelry

Remove jewelry to prevent chemicals from collecting underneath, contacting electrical sources, catching on laboratory equipment, and/or damaging the jewelry itself.

c. Hair

Long hair should be tied back or confined to avoid easily catching fire, dipping into chemicals, or becoming entangled in moving machinery.

d. Lab Coats, Aprons and Sleeves

1) Laboratory coats or aprons and sleeves should be worn whenever there is a danger of contaminating skin or clothing. Clothing made from chemical-protective fabrics should be used as needed. Contaminated personal clothing may spread hazards to family and friends, as well as contaminate public areas such as doors, hallways, elevators and food services.

2) Lab coats should be removed before leaving the laboratory.

3) Contaminated laboratory coats should be laundered through the University Consolidated Laundry or similar industrial laundry service.

3. Gloves

a. When to Wear

Wear gloves whenever working with chemicals, rough or sharp-edged objects, or very hot or very cold materials.

Do not wear gloves around an unguarded, moving machine as it could snag the glove and pull your hand into it.

b. Selection

Select gloves based on the material being handled, the particular hazard involved, and their suitability for the procedures being conducted (such as whether the glove provides appropriate dexterity for the procedures). To select the appropriate chemical-protective glove, see the glove selection chart in Appendix G, read the MSDS, or consult EH&S at 206-543-7388.

Other types of gloves used in a laboratory may be designed to protect from biological hazards, sharp objects, and temperature extremes, among other hazards. Asbestos gloves are prohibited and any found in a laboratory should be turned in as hazardous waste.

c. Inspection

Inspect gloves before each use and discard if you see discoloration, punctures, and tears. Do not blow into gloves to check for integrity, but if there is no external contamination, the glove may be squeezed to determine if the trapped air is escaping through small holes.

d. Removal

Take off gloves before leaving the laboratory. If using reusable gloves, wash them with soap and water before removing them, to remove possible contaminants. Get in the habit of removing gloves without touching the outside of the glove to clothing or skin. Wash hands with soap and water after removing gloves.

e. Replacement

Replace gloves often, depending on their frequency of use and permeability of the chemical(s) handled. Do not re-use disposable gloves.

f. Contaminated Gloves

Dispose of contaminated gloves by carefully removing them and placing them in a plastic bag. If they are grossly contaminated with hazardous chemicals, then manage them as hazardous waste. For more information, see http://www.ehs.washington.edu/epowaste/chemwaste.shtm.

g. Latex Gloves

Do not wear thin latex gloves in the lab. They provide very little protection from chemicals.

Latex gloves can be the source of allergic reactions, which can range from powder abrasion dermatitis to a life threatening hypersensitivity to the latex protein (Also see Appendix G).

4. Respirators

Respirators should not be needed in a normal laboratory setting. However, if you suspect laboratory airborne hazardous chemical concentration is near the PEL contact EH&S at 206-543-7388 for a consultation.

All use of respirators at the UW must comply with the UW Respiratory Protection Program prior to first use. For more information, contact EH&S at 206-543-7388. This program includes evaluating hazards and medical fitness of each user, training, selecting equipment and understanding its limits, fit testing, and annual re-certification.

5. Hearing Protectors

Hearing protectors (earplugs or earmuffs) may be needed for some procedures or in some laboratory settings. If you suspect the noise levels may be potentially harmful, contact EH&S at 206-543-7388 for an evaluation. (A rule of thumb is that if you are in a noise environment for most of the day where you have to raise your voice to be intelligible to someone standing next to you, the noise levels may be potentially hazardous.).

Section 6
SOPs

Section 6
Standard Operating Procedures

Contents

Figures

A. Standard Operating Procedures (SOPs)

Laboratories must provide employees with standard operating procedures (SOPs) to be followed when laboratory work involves the use of hazardous substances. The SOPs must address all requirements to perform the laboratory procedures safely. The requirements may either be stated in a cover sheet attached to the laboratory protocol(s) or be integrated into a protocol.

The EH&S Laboratory Safety Standard Compliance class is available for Principal Investigators (PIs) and laboratory supervisors. This class includes information about preparing SOPs. In addition, the EH&S Managing Hazardous Chemicals in the Workplace class, designed for all laboratory staff, including PIs and supervisors, explains how to create SOPs. You can register for either of these classes online at http://www.ehs.washington.edu/psotrain/corsdesc.shtm or call EH&S at 206-543-7201 for more information. For advice in developing SOPs, call EH&S at 206-543-7388 or email uwcho@u.washington.edu.

B. SOP Components

1. Required Components

SOPs must address the following items.

a. Process Identification

Identify the chemicals, process or equipment involved. If there is any question as to the chemicals produced in the process, you should consider identifying the stock chemicals, intermediates, final compounds and wastes involved, and such factors as use of catalysts, inert compounds, heat, cold, and varied operating pressures which are involved in the process.

b. Controls

List required methods to control potential exposures, including:

1) Use of engineering controls. Some examples of engineering controls are working in an area with good ventilation (*e.g.*, ducted exhaust from equipment, fume hoods or glove boxes), storing toxic materials within a double container, and using barriers to restrict access to the area or to protect from potentially explosive situations.

2) Use of administrative controls. These controls depend on maintaining standard, mandatory laboratory practices, including substituting pre-formulated liquids instead of powders to be weighed and prepared, hygiene practices such as hand washing, and procedures for removal and disposal of contaminated PPE.

3) Use of personal protective equipment (PPE) such as gloves, lab coats, etc. The type of PPE must be specified, such as the type of glove. PPE is described in this manual in Section 5.B Employee Health and PPE.

c. Equipment Checks

Describe ways to verify that the fume hood and other control system(s) are operating correctly, before using hazardous chemicals.

d. Potentially Hazardous Situations

Provide guidance for handling spills and identifying if a spill is causing a hazardous situation. For example, laboratory personnel may be able to safely handle a spill of a liter of dilute acid anywhere in the laboratory, but may need to evacuate if 100 milliliters of a toxic chemical is spilled outside a fume hood. This also provides guidance when purchasing a chemical, as to the maximum size of container.

e. Waste Management

Identify safe disposal methods for routinely generated wastes. This includes describing procedures to neutralize or treat wastes to make handling safer or to reduce the amount of hazardous waste.

f. Particularly Hazardous Substances

Provide additional details if “particularly hazardous substances” (acute toxicants, carcinogens, mutagens, teratogens) are used. See Appendix H for a partial list of the “particularly hazardous substances.” These additional details should address using specific containment device(s) such as fume hoods or glove boxes, providing authorizations for using the particularly hazardous substance(s), describing additional procedures for decontamination and safely handling contaminated waste materials, and establishing a designated area for the procedure.

g. Authorizations

Describe any requirements for obtaining authorization before being allowed to perform the procedure, operation or activity. An example could be that a worker must have training documented before performing a certain procedure for the first time. Other required authorizations could include completing a medical examination before using a respirator when performing procedures involving certain hazardous substances (e.g., lead dust, pathological organisms). Authorizations should be required before a person could independently perform a process using reactive, explosive, or particularly hazardous substances.

2. Appearance

SOPs obtained from other organizations and SOPs written in a format required by your department can be used as long as all the basic components are addressed and as long as the SOP accurately describes your laboratory's safety requirements. If SOPs are provided by outside sources (such as equipment suppliers or another laboratory), they must be carefully reviewed to ensure they are specific to your requirements, including describing specific types of PPE.

The traditional SOP form described in this section and in Appendix D is meant to be attached as a cover sheet to a laboratory protocol or "cookbook" collection of protocols. This standardized SOP form has been used historically at the University of Washington and other institutions. It addresses all required components, in 11 basic elements. The forms in Figure 6-1 and Figure 6-2 at the end of this section provide explanation of the elements. Example SOPs can be found in Appendix D and on the web, along with electronic, blank forms, at http://www.ehs.washington.edu/forms/epo/sopchemform.doc.

If using the standardized SOP form, elements 1 through 8 must be completed for each process, class of chemicals, or individual chemical. For "particularly hazardous substances" (acute toxicants, carcinogens, mutagens, teratogens), the 8 basic elements may need to be expanded, and 3 more elements, 9 through 11, must be completed. (See Appendix H for a partial list of the "particularly hazardous substances.")

C. Example Generic SOPs

Example and generic SOPs are included in Appendix D. If used by your laboratory, these examples must be modified and customized as necessary to make them specific to your laboratory conditions. Material Safety Data Sheets (MSDSs) do not replace the need to write a SOP, but may be referenced and attached.

D. SOP Development

To develop your laboratory SOPs, EH&S suggests the following steps:

1. Step 1 – Modify Existing SOPs

EH&S recommends you review and modify any generic SOPs included in Appendix D that pertain to your laboratory. This allows you to become familiar with the elements, as described on the attached SOP forms (Figures 6-1 and 6-2).

2. Step 2 – Identify Requirements

Identify if any particularly hazardous substances are in use in your laboratory, and identify which way of writing your SOPs will best cover your laboratory's chemicals or processes. SOPs can be written in one or more of the following ways:

a. By Process

By process, such as distillation, peptide synthesis, or gel electrophoresis

If hazardous intermediates are created, carefully consider if there are specific precautions which should be noted, such as how to tell if a release or spill occurs, what symptoms may develop if a person is exposed, and any special precautions for spill clean-up and waste disposal. Pre-existing laboratory procedures or protocols do not have to be re-written to fit onto the suggested SOP form, but it is recommended that an SOP form be attached to the procedure/protocol and the elements on the SOP form be cross-referenced to appropriate places in the pre-written procedure/protocol.

b. By Individual Chemical

By each individual chemical, such as acrylamide, formaldehyde, toluene

This approach may be most useful if a limited number of hazardous substances are used in the laboratory or if using a particularly hazardous substance.

c. By Class of Chemical

By class of chemicals, such as organic solvents or peroxidizable chemicals

This approach may be most useful if a number of similar procedures are performed using similar substances.

3. Step 3 – Complete the SOPs

After modifying generic SOPs and identifying which ways of writing are most useful in your situation, continue by developing SOPs for processes, chemicals and chemical classes not previously written. Ensure all elements of the SOPs are addressed if the SOP pertains to chemicals considered particularly hazardous (those that have a high degree of acute toxicity or are select carcinogens or reproductive toxins, such as those listed in Appendix H and similar substances).

4. Step 4 – File the SOPs

After completing the SOPs, file them so that everyone can find them. If they are not physically filed in the laboratory-specific information section of this manual, the laboratory-specific information pages should be annotated to identify where the SOPs are physically located.

If you develop an SOP which you believe can be used by other departments in the University, please forward a copy electronically to the University's Chemical Hygiene Officer at uwcho@u.washington.edu.

5. Update SOPs as Needed

If you note changes to your process or chemical use which impact an SOP, or recognize improvements that can be made to the SOP, update it as soon as it is convenient. Note the revision date on the SOP.

Notify all lab personnel of the revised SOP. Replace the previous SOP in your files and anywhere else they may have been placed, including the work copies which would be referred to on a daily basis by your staff and those which may be kept at the lab benches or in individual staff members' files.

Figure 6-1 Explanation of Elements 1 to 8 on Standard Operating Procedures (SOP) Form

University of Washington

Standard Operating Procedures for Chemicals or Processes	
#1 Process (if applicable)	> *The process or type of process that involves the use of hazardous chemicals in the laboratory. Describe in general terms, such as "extraction" and "distillation" or in more detailed terms, such as "spectrophotometer analysis of cholesterol extraction"*
#2 Chemicals	> *For each process, list all chemicals, reactants, and products and describe their hazards. MSDSs may be attached.*
#3 Personal Protective Equipment (PPE)	> *1. List the protective equipment to use; when and why it is worn; how long the equipment will last; and how to store or to take care of the equipment.* *2. List unique types of clothing, eye protection, gloves, or respirators required.* *3. If respirators are needed, indicate how fit testing will be provided.*
#4 Environmental / Ventilation Controls	> *List the environmental controls and ventilation systems needed to safely use the chemicals. This may include hoods, environmental rooms, aerosol suppression devices, etc. Describe safety features on equipment.*
#5 Special Handling Procedures & Storage Requirements	> *Describe any special storage requirements for the chemicals. Include restricted access areas, special containment devices, and safe methods of transportation.*
#6 Spill and Accident Procedures	> *Indicate how spills or accidental releases should be handled and by whom.*
#7 Waste Disposal	> *Describe waste disposal procedures for these chemicals. For more information refer to Section 3 of this manual.*
#8 Special Precautions for Animal Use (if applicable)	> *Annotate "N/A" if no animal exposure is involved. If chemicals are being administered to animals, describe how employees should protect themselves from contaminated animals and animal waste. Include information about restricted access, administration of the chemical, aerosol suppression, protective equipment, and waste disposal.*
Particularly hazardous substance involved?	___ YES: Blocks #9 to #11 are Mandatory _X_ NO: Blocks #9 to #11 are Optional.
#9 Approval Required	> Optional
#10 Decontamination	> Optional
#11 Designated Area	> Optional
Name:	Title:
Signature:	Date:

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Figure 6-2 Explanation of Elements on SOP Form for Particularly Hazardous Substances

University of Washington

Standard Operating Procedures for Chemicals or Processes		
#1 Process (if applicable)	> See Figure 6-1.	
#2 Chemicals	> See Figure 6-1.	
#3 Personal Protective Equipment (PPE)	> See Figure 6-1.	
#4 Environmental / Ventilation Controls	> *List the environmental controls and ventilation systems needed to safely use the chemicals. This may include hoods, environmental rooms, aerosol suppression devices, etc. Describe safety features on equipment. Provide details of ventilation or equipment (such as glove boxes) used to control the particularly hazardous substance(s).*	
#5 Special Handling Procedures & Storage Requirements	> See Figure 6-1.	
#6 Spill and Accident Procedures	> See Figure 6-1.	
#7 Waste Disposal	> *Describe waste disposal procedures associated with the particularly hazardous substance(s). Include disposal of items contaminated by the particularly hazardous substance(s), such as supplies used to clean up spills.*	
#8 Special Precautions for Animal Use (if applicable)	> See Figure 6-1.	
Particularly hazardous substance involved?	_X_ YES:	Blocks #9 to #11 are Mandatory
	___ NO:	Blocks #9 to #11 are Optional.
#9 Approval Required	> *Indicate if the process/chemical procedure requires prior approval. Describe the approval process.*	
#10 Decontamination	> *Describe decontamination procedures for equipment and glassware. Include glove boxes, restricted access hoods, perchloric acid fume hoods, etc.*	
#11 Designated Area	> *Indicate where the "designated area" is for the particularly hazardous chemical(s) being used. The entire laboratory, a fume hood, or a portion of the laboratory can be labeled as a "designated area".*	
Name:	Title:	
Signature:	Date:	

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Section 7
Safety Training

Section 7
Safety Training

Contents

A. Training Requirements

1. Employee Safety Training

According to state/federal laws and University of Washington policy, Principal Investigators and laboratory supervisors are responsible for ensuring that all employees receive adequate training to understand the hazards present in their work area. Training must occur prior to assignments involving new exposure situations. The laboratory should have a formal method for tracking that new employees receive training before working with hazardous chemicals. All visitors must receive sufficient training to assure that they too are aware of the hazards and how to protect themselves while in the work area.

The University of Washington takes the responsibility of safety for employees very seriously. *"Faculty and staff shall be directly responsible for their own safety, for the safety of students and employees under their supervision; and for the safety of their fellow employees. This responsibility can neither be transferred nor delegated."* University Handbook, Vol.4; Part VI; Chapter 4, University Safety Programs; Section 1, Statement of Policy and Responsibilities. (Executive Order No. 55 of the President, last revision April 1994). See http://www.washington.edu/faculty/facsenate/handbook/Volume4.html for more information.

2. EH&S Safety Training

EH&S provides initial training for most categories of hazards in the laboratory. EH&S strongly encourages and in some cases requires that employees take these classes since they cover topics that are specific to the University of Washington and Washington state, such as resources available through EH&S and specific administrative policies. Some of these classes are required by regulation. However, additional laboratory or worksite specific training is required.

B. Laboratory-Specific Safety Training Contents

Principal Investigators or laboratory supervisors must ensure that additional training on safety topics specific are given to each laboratory employee. This training must be provided by someone knowledgeable about the laboratory-specific procedures, be provided before workers start using a hazardous substance, and be documented. Changes in the process, equipment, or chemicals may require additional training. Training can be formal or informal but must include the following:

1. Laboratory Safety Manual/Chemical Hygiene Plan

Personnel must be informed that the laboratory's safety manual including laboratory-specific information combine to form the laboratory's Chemical Hygiene Plan (CHP) required by regulations, and shown the location of the laboratory's official CHP if multiple manuals are kept by different lab personnel. Personnel must be informed about the general contents of a laboratory safety manual. Additionally, personnel must be shown the location of the Hazardous Chemicals in Laboratories regulation (WAC 296-828), in Appendix A of each manual.

2. Permissible Exposure Limits

Methods for finding the Permissible Exposure Limits (PELs) or recommended exposure limits for chemicals used in the laboratory must be brought to the attention of laboratory staff. This information is described in Section 5.A of this manual.

3. Material Safety Data Sheets

Procedures used in the laboratory as to how to access and interpret Material Safety Data Sheets (MSDSs) and other safety references present in the laboratory must be taught to all staff who use chemicals or work around the chemicals within the laboratory. (This could include administrative support staff if they frequently work in the laboratory.) All personnel must demonstrate that they can retrieve an MSDS for a chemical within 5 minutes, whether it is from a file of paper copies of the laboratories MSDSs, or by accessing an electronic copy of the MSDS – whichever procedure is to be used in the laboratory.

4. Emergency Response

Emergency response steps that should be taken if a spill or accident happens must be taught and should be occasionally exercised. Include how to summon emergency assistance by dialing 911 or activating the fire alarm pull station. Identify the location of safety equipment (eyewash, shower, spill kits, fire alarm pull stations, fire extinguishers, first aid kits, etc.). During the training session, it is frequently beneficial to actually walk through the area and physically check the presence of the safety equipment and point out possible problems with access or use.

Review the building, department, or laboratory emergency evacuation plan, including any lab specific shutdown procedures. Walk the evacuation routes and go to the emergency assembly point.

Additional information about emergency response is located in Section 9.

5. Standard Operating Procedures

The SOPs written for the laboratory must be used as training aids. Point out specific safety aspects such as how to check that a chemical fume hood is operating, before using it. Additional information about SOPs is located in Section 6 and the SOPs themselves should be located either in the front of the Chemical Hygiene Plan/Laboratory Safety Manual or noted with a cross-reference as to where they are in the laboratory.

6. Personal Protective Equipment

Laboratory requirements for personal protective equipment (PPE) must be described. Staff must be informed about selecting, donning, doffing, and if re-usable, cleaning and maintaining personal protective equipment. Personnel should demonstrate correct doffing procedures showing that it can be removed without spreading contamination. Additional information about PPE is located in Section 5.B.

7. Laboratory Waste

The proper way to dispose of all laboratory waste must be explained. Training should emphasize precautions to avoid mixing incompatible wastes, the need to select containers appropriate for the wastes, the need to keep containers closed except when chemicals are actively being added to the container, and documents to properly keep track of the wastes. Additional information about laboratory waste is located in Section 3.

8. Chemical Storage and Labeling

Provide information on how to segregate and safely store chemicals in the laboratory. Secondary container labeling methods used in the laboratory also must be described. Additional information about storage is located in Section 2.D and labeling is located in Section 2.E.

9. Hazardous Chemicals

Staff must be informed about ways to detect the presence or release of hazardous chemicals in the laboratory (odor, automatic alarms, unexpected release of vapors during a chemical reaction, monitoring badges which may be worn to measure exposures to certain contaminants, etc.) and the basic signs and symptoms of chemical overexposure. Also, describe ways to observe if potentially hazardous situations are developing, such as peroxide solutions becoming aged.

Staff using hazardous chemicals or potentially exposed to the hazards must be taught about the physical and health hazards in the work area. The PI/Supervisor is responsible for ensuring effective training is completed, but it is recommended that all personnel help teach some aspects. It's also recommended that all chemicals having the same hazard be lumped together during the training. For example, all chemicals and solutions that have the hazard of being corrosive to the skin, eyes, mucous membranes, and respiratory tract (acids, alkalies, etc.), be discussed in one training session, along with the use of proper personal protective equipment and safety response equipment (safety eyewash, safety shower, and spill kit). Additional information on the safe use of special hazardous chemicals can be found in Section 2.G.

C. EH&S Classes

A quarterly training schedule that includes course descriptions of classes offered on a regular basis is available at the EH&S webs site *http://www.ehs.washington.edu/psotrain/index.shtm* or by calling 206-543-7201.

1. Required Training

a. Animal Biological Safety Level-2 / Biological Safety Level-2 Laboratory Training

ABSL/BSL-2 training is required for all laboratory staff working in ABSL-2 or BSL-2 Biological Laboratories

b. Bloodborne Pathogens for Researchers

Initial and annual training is required for personnel working with human cells, tissue, or body fluids. This class covers requirements of the Washington Administrative Code (WAC) 296-62-08001 and a review of epidemiology and the exposure control plan. Annual refresher required.

c. Bloodborne Pathogens for Human Subject Research and UW Off-site Clinical Facilities

(For research staff who give injections or draw blood only) This is a new class with emphasis on the clinical setting. Field clinic work will be covered as well. Please call JoAnn Kauffman, Occupational Health Nurse, to arrange this training, 206-221-3025. Annual training is required.

d. Fire Extinguisher Training

Any employee who is expected to use a fire extinguisher in the event of an emergency is required to have this training. Fire prevention, emergency and evacuation procedures, hands-on fire extinguisher training. Annual training is required.

e. Laboratory Safety Standard Compliance

This is required training for supervisors, PIs, and others responsible for chemical laboratory safety compliance. It covers how to comply with the requirements of the standard, how to complete the Chemical Hygiene Plan (found in the UW Laboratory Safety Manual), Hazard Communication for laboratory workers, and conducting and keeping records of staff training.

f. Managing Hazardous Chemicals in the Laboratory

University employees are required to receive information and training about chemical hazards in their workplace and proper hazardous chemical waste management procedures. This class provides information on risk assessment, personal protection, storage, MSDSs, chemical safety resources, and the proper procedures for managing and disposing of chemical wastes. It also covers spill prevention, clean-up procedures, and supplies for small spills of chemicals (such as acidic, caustic, flammable solvents, mercury, and toxic materials). Attending this course partially fulfills the training requirements of the State Occupational Health Standard relating to hazardous chemical exposures in labs.

g. Radiation Safety Training

This eight hour course is offered 10 times per year. It is required for all personnel being authorized to use radioactive material. Pre-registration required. Call 206-543-0463 for a schedule or to pre-register or see http://www.ehs.washington.edu/rsotrain/index.shtm

h. Respiratory Protection Training and Fit-Testing

Employees who need to wear respirators on the job are required to attend this training prior to using respirators. It covers the selection, care, maintenance, and proper procedures for use. Individual fit-testing is performed after training (typically on the same day). The Respirator Request Form and Respirator Medical Evaluation are required prior to training and fit-testing. The Respirator Request form is the first step and can be downloaded at:

http://www.ehs.washington.edu/ohsresp/index.shtm. Refer to the EH&S web site and contact the Respiratory Protection Program Administrator if you have additional questions. Annual completion of the Respirator Request Form, Respirator Medical Evaluation form, respirator training, and fit-testing is required.

i. Shipping and Transporting Hazardous Materials

Shippers and transporters of hazardous materials or infectious substances are required to have this training. It covers DOT and IATA requirements for packaging and labeling, terminology, and preparation of documentation. Attendance in the Managing Hazardous Chemicals in the Laboratory training before attending this class is recommended. Biennial training is required.

2. Recommended Training

a. Compressed Gas Safety

This class covers practical, safe handling and use of cylinders containing hazardous, toxic, and/or flammable compressed gases.

b. First Aid & CPR Certification Training

Completion of the course provides a State Department of Labor and Industries approved certificate that is valid for two years. Heart attacks, fractures, respiratory failure, CPR, environmental emergencies (heat stroke, hypothermia, bites and stings, etc.) shock, scene management, and the Good Samaritan law are discussed. Training is $35.00 per person: budget number or check must be in our office before the training begins.

c. MyChem Training

The MYCHEM chemical inventory and MSDS database replaces the Laboratory Safety System (LSS) course. This hands-on computer class teaches you how to access this web database, maintain chemical inventories, view and print the Material Safety Data Sheets (MSDSs), and locate surplus chemicals in the campus chemical exchange. Call 206-543-0467 to obtain access to MyChem.

D. Safety Training Records

The laboratory PI or supervisor must ensure records of all laboratory-specific chemical safety training are maintained, either within the laboratory or at a central location if that is required by the department. The location of the training records should be noted in the Laboratory-Specific Information section of the Chemical Hygiene Plan. See Appendix C for a sample training log.

Along with formal training, it is wise to record any safety training or topics covered during staff meetings. You may also want to keep a copy of any training materials generated for safety training, such as a lesson outline, to help in training new employees.

The EH&S Training Office maintains training records for all of their classes. Departments or units may request a copy of their training records by calling 206-543-7201 or by email at ehstrain@u.washington.edu. Telephone is the best contact method for a successful data search.

Section 8
Record Keeping

Section 8
Record Keeping

Contents

A. Current Records Maintained in the Laboratory/Department

1. Laboratory Safety Manual / Chemical Hygiene Plan

The Laboratory Safety Manual is augmented with laboratory-specific information to form the laboratory's Chemical Hygiene Plan, which must be accessible to all employees in the laboratory at all times that they are working. The laboratory-specific information is typically filed in the front of the Laboratory Safety Manual binder. The latest edition of the Laboratory Safety Manual can be ordered on-line from the University of Washington Copy Centers by placing an electronic order at http://www.ehs.washington.edu/forms/fso/plmcsform.php.

The latest edition of the Laboratory Safety Manual is also always available electronically for viewing individual sections in the manual, on the EH&S website at http://www.ehs.washington.edu/manuals/lsmanual/index.shtm. If you have any questions about obtaining the manual, please contact EH&S at 206-543-7388 or at uwcho@u.washington.edu.

Laboratory-specific information consisting of such information as Standard Operating Procedures, laboratory floor plans, chemical spill kit locations, and emergency procedures filed at the beginning of the manual should be updated annually or whenever there are changes. The entire manual must be reviewed and **updated at least annually** by the PI or laboratory supervisor, and the review should be recorded in the laboratory-specific information area.

2. Chemical Inventory

Current chemical inventories must be maintained on MyChem for each laboratory. A copy should be printed annually for easy reference. The current inventory could be filed in the laboratory-specific information area or in another location. All workers must know where the inventory is maintained. (EH&S also recommends that the PI or laboratory manager have a current copy available at home in case of emergencies.)

3. Material Safety Data Sheets (MSDSs)

Material Safety Data Sheets must be maintained for hazardous products. Departments are encouraged to maintain accessible copies of MSDSs for immediate reference in case of emergencies and for training purposes. The master file of MSDSs for all known chemicals used on campus is maintained by EH&S, and electronic copies of individual MSDSs are immediately available on MyChem. See also the MSDS section in Section 2.B.3 of this manual.

4. Incident/Accident Reports

Employee incident/accident report records are maintained at EH&S (206-543-7388). Industrial insurance records are maintained in the UW Office of Risk Management (206-543-0183). The Principal Investigators or laboratory supervisors should keep copies of all incident/accident reports filed pertaining to the laboratory or involving laboratory staff.

5. Safety Training Records

Laboratories must maintain records of all work-related safety and health training. An example training log sheet is available in Appendix C. (Also, see Section 7 for information on what to include in your laboratory training.)

EH&S maintains records of employee attendance at their classes. Copies of these records are available to departments upon request (call 206-543-7201 or email ehstrain@u.washington.edu).

6. Shipping Papers (Bills of Lading)

If chemical-containing items are mailed or moved on or off campus and require shipping papers, these papers should be kept for one year.

7. Sewer Discharge Logs

A Sewer Discharge Log is used to record the wastes discharged to the sewer from a sink or drain as described in Section 3. Keep these logs for three years. The logs must be available for review by county or state inspectors.

8. Exposure Monitoring Records

Departments frequently maintain copies of employee exposure monitoring, to provide immediate information to their workers if questions arise. These records can be kept in the laboratory or in the department. EH&S maintains records for all exposure monitoring conducted by EH&S. In some cases, laboratories conduct their own employee monitoring. If this occurs, please forward a copy of the monitoring results to the Occupational Health and Safety Office in EH&S, Box 354400. Exposure monitoring records must be maintained for at least 30 years after the exposure.

B. Obsolete and Superseded Records from the Laboratory

Changes in laboratory operations may cause records to become obsolete or superseded.

1. Obsolete Exposure Information

Obsolete and superseded information concerning the chemicals in use in a laboratory should be archived and disposed after 30 years when no longer current. These documents include chemical inventories, MSDSs, SOPs, records of spills and accidents, and exposure monitoring records.

2. Other Obsolete Documents

Records not directly pertaining to potential chemical exposures can be discarded a year after they are no longer current. These records typically include shipping / receiving documents and training documents for individuals who have left the department.

3. Records from Decommissioned Laboratories

The department should archive any records pertaining to possible employee exposures for 30 years after decommissioning a laboratory.

C. EH&S Records

EH&S maintains records for particular areas of responsibility.

1. Records Concerning Individuals

a. Occupational Exposure Monitoring

EH&S maintains records for all exposure monitoring conducted by EH&S and any results of monitoring conducted by others that is reported to EH&S.

b. Medical Records

Occupational health medical records for employees are maintained for Environmental Health and Safety in the Hall Health Center Medical Records Division. Confidentiality of medical records is maintained.

2. Centralized Records

EH&S is the central repository for chemical inventory records, Accident/Incident Reports, and training performed by EH&S.

Section 9
Emergencies

Section 9
Emergency Preparedness and Response

Contents

Tables

A. Before an Emergency

This section on Emergency Preparedness describes emergency guidelines and requirements that are unique or particular to laboratory operations. This section is intended to supplement emergency preparation and response procedures as described in other documents, including your Departmental Health and Safety Plan, your Emergency Evacuation and Operations Plan, and the UW Emergency Response Management Plan. These other documents describe emergency preparedness and response for departments, buildings, and in the case of a campus-wide emergency, the entire campus. Additionally, instructors teaching laboratory classes must follow university and departmental rules for instructors during emergencies, as augmented by the guidance in this section.

Principal Investigators must prepare laboratory personnel for unexpected events such as accidents, fires or explosions, chemical spills, floods, power failures and earthquakes. To adequately prepare for an emergency, laboratory personnel should plan, obtain materials, modify facilities, train, and practice responses. Staff should also be encouraged to prepare for emergencies outside of their workplace.

1. Departmental Plans and Policies

As part of their new employee orientation, employees need to be informed of evacuation procedures and the Emergency Assembly Point(s) as described in the building or department's Emergency Evacuation Operations Plan (EEOP). Personnel should also practice these procedures periodically. Visitors, visiting researchers, volunteers, and temporary employees must also be informed of these procedures and assembly points. Generally, the department that is the primary occupant in a building will write the EEOP with technical assistance from EH&S (206-543-0465).

Another plan, which may affect emergency response procedures, is the department's Health and Safety Plan, especially if the plan addresses first aid training policies and lists trained personnel.

Some departments have an annex to the UW Emergency Response Management Plan, which may describe who is responsible for conducting essential services. If the department has an annex, personnel in the laboratory must be familiar with the plan and keep information current, such as telephone numbers on the departmental phone tree.

Employees must also be informed and periodically reminded of departmental policies, such as policies concerning security, and any policies that forbid working alone.

2. Planning and Prevention

Emergency response on the Seattle campus is provided by the University of Washington Police Department (who are CPR-trained and carry automated external defibrillators), and the Seattle Fire Department. Other UW campuses and off-site locations need to ensure they have the correct response agencies identified prior to making their emergency response plans.

a. Accident Prevention

General laboratory actions to prevent and minimize emergencies include the following actions by the PI/supervisor and all personnel:

1) Follow general lab safety rules, and enforce compliance if necessary
2) Post emergency phone numbers, contact names/numbers, and a floor plan
3) Know locations of shutoffs for utilities including electrical, laboratory gas, water, etc.
4) Train personnel to retrieve MSDSs for laboratory chemicals
5) Assure adequate chemical storage is available for separation of incompatible chemicals, and for storage of particularly hazardous substances in protective (secondary) containers
6) Frequently dispose of chemical wastes and periodically surplus un-necessary chemicals and equipment
7) Ensure electrical wires and equipment are in good condition
8) Review incidents, near misses and previous accidents to anticipate and prevent possible future accidents
9) Complete the laboratory inspection checklist periodically to guard against bad habits
10) Discuss safety topics periodically in staff meetings

b. Hazards Assessment /Risk Minimization

When a new experiment or process is in development, the laboratory supervisor and staff must assess experimental procedures for possible hazards and identify ways to reduce risks and avoid emergency situations. This is the responsibility of the Principal Investigator (with assistance from the Chemical Hygiene Officer if other than the Principal Investigator), however, laboratory personnel are more likely to comply with the experimental procedures if all of the staff conducting the experiment are involved with the hazards assessment.

The identified hazards should suggest ways to minimize the risks. For example, use of flammable chemicals would suggest the controls listed in the next section (Section 9.A.2.c. Fire and Explosion Prevention). Personnel must be trained about the hazards and controls (see Section 7 Training) before their first use of a chemical. Additionally, personnel need authorization prior to the first time independently performing a procedure using reactive, explosive, and particularly hazardous substances, as described in the process' standard operating procedure (See Section 6.B.1.g Authorizations).

Advice and information about hazards and controls are available in product literature including MSDSs, from individuals' experiences, and from EH&S (phone number 206-543-7388 or email to uwcho@u.washington.edu)

c. Fire and Explosion Prevention

To prevent fires and explosions and to reduce the effects if they were to occur, laboratory staff should:

1) Determine if non-flammable substitutes are available
2) Use a minimum amount at any one time
3) Maintain proper clearances for floor aisles and underneath sprinklers
4) Have a habit of closing fume hood sashes when not in use
5) Keep containers closed
6) Maintain good housekeeping practices, such as quickly removing unnecessary combustibles such as broken down cardboard boxes from the lab and disposing of unnecessary or outdated chemicals
7) Have the appropriate fire extinguisher available for the materials in use – for example, obtain a Special Extinguisher (D) if using combustible metals (and ensure laboratory staff are trained in its use)
8) Ensure personnel wear appropriate PPE such as cotton rather than plastic lab coats
9) Use chemicals in a ventilated enclosure such as a fume hood
10) Design procedures to reduce or eliminate open flames and possible spark-producing equipment when flammable or explosive chemicals are in use
11) Pay special attention to containment of flammable chemicals – how they are used and the integrity of containers and systems that contain them
12) Obtain a refrigerator/freezer specifically designed and built to hold flammable materials if refrigerating volatile, flammable chemicals
13) Obtain portable barriers which will provide adequate protection from an explosion that may occur if using reactive or explosive materials
14) Consider whether the process will go out of control if utility outages occur
15) Anticipate that intermediates, wastes, spill residue, etc., could also be flammable or explosive, and need controls, etc.

16) Ensure there are appropriate containers in adequate amounts to hold the different wastes generated

d. Chemical Spill Prevention

Laboratory supervisors should identify chemicals likely to be spilled during common laboratory procedures as well as during emergency events, such as earthquakes and fires. The treatment procedures for cleaning frequent spills in a laboratory should be included in the SOPs developed for each of the laboratory's processes (see Section 6, Standard Operating Procedures). If more than one spill clean-up procedure could be used, the procedure that minimizes clean-up hazards and minimizes the generation of hazardous wastes is the preferred choice.

Chemicals should be acquired in small quantities and small containers to increase ease of handling and limit the amount spilled if an entire container ruptures.

Chemicals should only be transported between rooms in a tub or bottle carriers designed to prevent breakage and to hold the contents in case of breakage. Carts used to transport chemicals should have large wheels to minimize chances of a sudden stop if it hits a small projection on the floor.

All laboratories should have a chemical spill clean-up kit containing materials matched with chemicals likely to be spilled. For example, there are specific materials for cleaning up a mercury spill.

To protect high value equipment from overhead leaks, have quick access to large plastic bags such as garbage bags or plastic sheets to cover the equipment

Spills of a non-hazardous nature, such as water and coffee, should be cleaned promptly by laboratory staff to avoid slips and to prevent damaging other materials or spreading contamination if another material were to also spill.

e. Earthquake

Laboratory personnel should be familiar with actions to take during an earthquake. In addition to general procedures such as DROP, COVER, and HOLD ON, personnel should know the proper procedures for laboratory evacuation, chemical spills cleanup, and accessing MSDSs for emergency response personnel. To address laboratory specific concerns, a checklist on earthquake preparation for laboratory personnel is available in Appendix E and the EH&S web site http://www.ehs.washington.edu/). Also, refer to the department's EEOP for departmental procedures during and after earthquakes. Questions about earthquake preparedness can be answered by telephoning EH&S at 206-543-7388.

f. Gas Leaks and Unknown Odors

All staff need to know what gases and volatile chemicals are normally found in the laboratory which may produce an odor. Identify contents of pipes, hoses or gas lines with labels. Staff should know the location of control valves used to shut off gas flow. Knowledge of previous incidents with odors as well as possible odors from adjacent laboratories should be discussed during staff meetings.

g. Utility Outages: Pre-planning and Mitigation

1) To pre-plan for utility failure, consider the different utilities the lab is dependent upon and determine if any interruptions would degrade operations. Utility outages that can affect laboratory operations include:

- Electrical power systems (both for loss of specific circuit(s) and for widespread failure)
- Backup power system or switching systems
- Compressed-air systems
- Ventilation systems (including fume hoods, biological safety cabinets, etc.)
- Natural gas system
- Supplied gas systems (medical air, O2, N2O, N2, EtO, etc.)
- Vacuum systems
- Potable water systems (complete loss or contamination)
- Non-potable water systems (complete loss or contamination)
- Sewage systems
- Heating systems
- Fire protection systems
- Refrigeration systems (cold rooms, walk-in freezers, etc.)
- Elevators
- Telephone systems
- Detection and alarm systems (fire alarms, low airflow alarms, etc.)

2) Actions that can be taken beforehand to mitigate the effects on laboratory operations include:

- Maintain backup (split) samples and specimens at another geographic location.
- Maintain backup computer or paper records at another geographic location.
- Assess requirements for emergency power. If emergency power circuits are available, only use them for emergency-use devices.
- Consider installing devices to improve the utility service provided, such as: water filters on potable water connections and surge protectors or Uninterruptible Power Systems for electrical power
- Assess whether operations could present a problem if they were to start up again automatically after the utility outage is over. Pre-plan the steps needed to be taken to safely shut the process(es) down.
- If processes operate at increased/reduced temperature or pressure, pre-plan possible actions to take to prevent uncontrolled reactions in case of utility failure
- Contract for emergency supplies and services as a contingency. For example, if refrigerators or freezers are used for high value specimens, locate a source for dry ice and liquid nitrogen freezers in case of electrical failure – some departments have contingency contracts already in case of emergency.
- Consider connecting incubators, refrigerators or freezers to battery powered automatic phone dialing systems or alarm monitoring services which will detect power interruptions and alert the designated contact person. Being alerted to an outage does not solve the problem, but it does gives employees critical time to take action.
- Card reader doors and other security systems typically have a four-hour battery backup. If such a system is used in the lab, document procedures for utility failures in excess of four hours. Also, if documented procedures change normal access or exit routes for the facility, develop procedures to communicate the routes to all staff.
- Maintain flashlights in work areas that do not have emergency lighting.
- Be aware of the various alarm systems in the laboratory and the appropriate responses if an alarm activates. (These could include such things as fire alarms, ventilation system alarms, fume hood low flow alarms, gas leak detection systems, etc.).

- Consider advising staff that communication channels set up for other disaster situations (adverse weather) will be used during long-term power outages.
- Develop good daily habits – such as routinely closing containers as soon as possible.
- Periodically remind staff of the correct response actions, and conduct drills or exercises.

h. Unattended Operations and Floods

Unattended operations or experiments should be avoided whenever possible. If an operation needs to continue unattended, the door to the room must be labeled with the name and phone number where the person responsible for the reaction can be reached. At the experimental apparatus, identify the chemicals in use and post clear directions for an untrained person to shut down the operation during an emergency.

Flooding may be a serious hazard when an operation is unattended. Water should never be left running unless it is for a specific purpose. Water spilled on the floor can readily flood into the room below, endangering equipment. If it is absolutely necessary to have water running while the laboratory is unattended, install a commercially available water flow device that alarms if a leak develops.

If an experiment is to run unattended with running water, it is best to use copper tubing with proper fittings. If you must use a hose in the system, use Tygon tubing. Tygon tubing is less likely to become brittle and fail than rubber tubing, but it still requires regular inspection. Connect hoses to glass tubing with ribbed ends. Secure tubing to glass with clamp or copper wire using at least two loops around the hose and twist ends fairly tightly.

Outlet hoses into sinks or drains should be anchored to prevent variations in water pressure from ejecting them from the drain. Do not place rags or other such material in sinks to avoid splattering, particularly where water aspirators are used. Use a small plastic bottle with the bottom removed.

Unattended cooling or heating apparatus including flame burners also present serious challenges to ensuring no out-of-control conditions develop. Different equipment for a similar purpose may have different control challenges. The PI should approve any unattended applications requiring cooling or heating.

Electrical and mechanical equipment failures during unattended operations and experiments have also resulted in the destruction or damage to facilities and years of research. Equipment must be maintained and operated properly. Replace damaged equipment and damaged electrical cords before starting experiments. Do not permanently use extension cords for hooking up to electrical power; use strip outlets instead or plug directly into electrical outlets. Plan to check equipment periodically during long duration runs to specifically look, listen, and smell for unexpected conditions.

i. Inclement Weather

Pre-planning for inclement weather affecting laboratories is similar to the campus community. Staff must have an emergency kit when on campus, and should have emergency kits at home. Laboratory-specific planning should include determining how communications between separated staff will occur and determining what procedures may be affected by the expected weather.

If an essential service must continue on a daily basis, such as caring for research animals or monitoring an experiment in progress on campus, the PI and staff should devise a contingency plan for inclement weather operations. Consider who could travel to the laboratory and provide the necessary service. Realize that that access may be difficult; roads and building entrances that normally provide access may not be available.

University laboratories may be at risk from unusual weather conditions such as lightning, heavy snow, hail or ice storms, high winds, heavy rainfall, flooding, and even high heat loads, depending on the laboratory's location. Laboratories may also be at locations subject to tsunamis, volcanic eruptions and falls of ash from volcanic eruptions that would require similar planning. Pre-plan for these events by considering the following beforehand:

1) How to safeguard personnel.
2) Procedures to shut down experiments in progress in a timely manner.
3) Alternatively, procedures to continue experiments, taking into account the expected conditions.
4) Means to safeguard experimental results and essential materials.

5) How to safeguard equipment and supplies from the weather taking into account the time available before the event is expected to occur (lowest priority).

j. Security Issues

Pre-planning for violence, vandalism, un-authorized entrants, and packages or contaminants deliberately placed at the laboratory is similar to that performed in other areas of the campus. Information is available on the EH&S and the Office of Emergency Management web sites for planning for such contingencies. One of the main impacts on laboratories is that the laboratory may be a deliberate target for such activities.

Laboratory security can be improved if all staff:

1) Are aware of entry points
2) Keep doors closed and locked when the lab is unoccupied
3) Wear identification badges
4) Never allow a stranger to enter the lab
5) Are alert to the status of materials which may be attractive to thieves
6) Properly dispose of hazardous agents which are no longer needed, as soon as possible

Call EH&S at 206-221-7770 with questions about biological agent disposal and at 206-616-5835 with questions about chemical agent disposal. Use of MyChem to track your chemicals can improve the ability of personnel to manage the chemical inventory and will aid Police and Fire Department response in case of emergency.

Depending on the materials in use in the laboratory, higher levels of controls may need to be implemented. These controls may include using codes to identify certain materials and securing them inside the laboratory with access by only designated personnel.

The PI with the assistance of the department should determine the level of protection and the policies to be implemented, such as whether incoming mail from unknown sources will be accepted. All staff must be periodically reminded of these policies and controls.

k. Field Operations

If remote operations are conducted, planning should address emergencies which may occur when conducting activities away from the base laboratory. The planning needs to take into account the remoteness of the operation and the activities that will occur on the site. Minimum considerations include:

1) Access to first aid and CPR trained help,
2) First aid kit availability,
3) Communications to be used in case of emergency,
4) Guidelines concerning inclement weather limits, and,
5) Checklists to ensure proper tools and equipment go with the field team.

3. Spill, First Aid, and Emergency Kits

Laboratories need to maintain response kits for possible use. Personnel should inspect them routinely (*i.e*, semi-annually and after use) to make sure they are complete and ready for response. A specific individual by individual name or on a rotating roster should be assigned to inspect the kits on a periodic basis.

a. Chemical Spill Clean-Up Kits

Chemical spill kit contents vary with the chemicals in use. General kits may contain the items listed in Table 9-1 (stock numbers included if available at University Stores).

Table 9-1 Chemical Spill Kit Contents

Item	Description	Stock #
Spill Kit	Complete spill kit containing items listed below	7600-100
Absorbent	5 spill pads, universal for all acid, base, oil, solvents	7600-220
Neutralizer	One box baking soda	7600-240
Brush and dustpan	One snap together dust pan and whisk broom	7600-260
Plastic bag	Four 20 x 30, heavy duty (6mm)	7600-280
Plastic drum	One 5-gallon re-useable screw top plastic drum. Good to store all kit supplies and later use to hold bagged plastic spill waste for pickup.	7600-200
Goggles	One chemical splash protection goggles	0737-120
Heavy duty gloves	One pair nitrile gloves, Ansel Edmont	0737-080
Other gloves	Eight pairs of Microgrip powder free nitrile gloves for increased dexterity, chemical resistant, various sizes	
Forms	Chemical Collection Request & hazardous waste labels	

b. Biological Spill Kits

Information on biological spill kits is located at the EH&S website: http://www.ehs.washington.edu/rbsbiosafe/spillbiokit.shtm.

c. First Aid Kits

First aid supplies must be readily accessible to employees. The size and contents of a first aid kit depends upon the number of people who may use the kit or station. UW Stores stocks first aid kits and replacement supplies. The following table (Table 9-2, First Aid Kit Sizes) indicates the sizes of the first aid kit available that serve various numbers of laboratory personnel.

Table 9-2 First Aid Kit Sizes

# People	Size of Kit	UW Stores Stock #
1 – 5	10 package	0727-090
6 – 15	16 package	0727-082
16 – 30	24 package	0727-084

The kit contents may vary depending on particular laboratory situations. For example, laboratories using hydrofluoric acid must stock calcium gluconate gel in case of skin contact with the hydrofluoric acid. Each laboratory must also establish procedures to assure that supplies in first aid kits are maintained and restocked to the required levels. The table on the following page, Table 9-3, First Aid Kit Contents, lists contents of the typical first aid kit.

Table 9-3 First Aid Kit Contents

Required Items	UW Stores Stock #	# People		
		1 - 5	6 – 15	16 -30
Absorbent gauze 2'x6'	0727-075	0 pk	1 pk	2 pk
Adhesive bandages 1"	0727-020	1 bx	1 bx	2 bx
Bandage compress 4"	0727-038	1 pk	2 pk	2 pk
Eye dressing	0727-080	0 pk	1 pk	1 pk
Scissors and tweezers	0727-095	1 pk	1 pk	1 pk
Triangle bandages	0727-150	1 pk	2 pk	6 pk
Antiseptic soap/pads	0717-055	1 pk	1 pk	1 pk
Kling bandage 4"	0050-380	1 dz	1 dz	1 dz
Surgipad dressing	0727-152	2 ea	2 ea	3 ea
Adhesive tape	0727-127	1 pk	1 pk	1 pk
Multi-trauma dressing	0727-078	0 ea	1 ea	1 ea
Kerlix dressing 3"	0727-037	0 pk	1 pk	1 pk

NOTE: Medicines, even analgesics, are not included. These are considered personal items.

d. Emergency Kits

Departmental emergency disaster kit information is available from the University of Washington Office of Emergency Management web site at http://www.washington.edu/admin/business/oem/prepare/disaster_kit.html

4. Fire Extinguishers, Eyewash Stations, and Safety Showers

a. Fire Extinguishers

Portable fire extinguishers are provided in University buildings and are available for use by trained personnel. All laboratory personnel should be trained to use the type(s) of fire extinguishers that are present in the laboratory. These types of extinguishers are based on the types of combustible and flammable materials in the lab (see Table 9-4). Training classes are available through EH&S, with registration available on-line at http://www.ehs.washington.edu/. Individuals who have been trained in the principles of fire extinguisher use and the hazards involved may attempt to extinguish small (trash can or smaller) and incipient (early stage) fires if there is an escape route. Individuals not trained in the proper use of extinguishers should not attempt to use one during a fire. Doing so could put them and others in danger.

University laboratories using hazardous chemicals should have an ABC rated, dry chemical fire extinguisher within 50 feet of the hazard, either along the exit path from the laboratory or in the hallway adjacent to the laboratory. Many fire extinguishers on campus are the multipurpose type, or ABC, which perform well on most fires with one major exception, combustible metal fires. Combustible metal (Class D) extinguishers are not typically provided for laboratories unless the need has been identified. Laboratories may request the addition of a CO_2 extinguisher (Class BC). It is not as effective as a dry chemical extinguisher, but will require less clean up after use. Some pressurized water fire extinguishers (Class A) are still found in hallways but they are only suitable for use on ordinary combustible materials (paper, wood, plastic, etc.). Fire extinguishers should be conspicuously located, wall mounted, and easily accessible.

Table 9-4 Classes of Fires and Proper Fire Extinguishers

Class of Fire	Description	Proper Extinguisher
A	Ordinary combustibles such as wood, cloth, and paper.	Dry Chemical (ABC) or water
B	Flammable liquids such as gasoline, oil, and oil-based paint.	Carbon Dioxide (BC) or Dry Chemical (ABC)
C	Energized electrical equipment including wiring, fuse boxes, circuit breakers, machinery, and appliances.	Carbon Dioxide (BC) or Dry Chemical (ABC)
D	Combustible metals such as magnesium or sodium	Special Extinguisher (D)

Extinguishers are certified annually by Facilities Services. All buildings that are non-chargeable receive this service as part of the routine building maintenance and will not be charged to departmental budgets. If an extinguisher needs to be refilled contact Facilities Services at 206-685-1411. If additional or alternative extinguishers are wanted for an area, contact EH&S at 206-543-0465 for recommendations and requirements.

Automatic fire suppression systems may be found in a decreasing number of fume hoods and are being removed as equipment is replaced. Fire hoses may only be used by fire department personnel. Fire blankets are not recommended for laboratory use because they may trap heat in when a victim has burning clothes and cause more injury than would otherwise occur.

b. Eyewash Stations

If chemicals in use can cause eye damage or irritation and are used in such a way that they may splash into eyes, an eyewash station is required. Laboratory personnel must be able to reach eyewash stations within ten seconds. The eyewash should be within 50 feet of chemical use locations, although this distance may be less if doorways interfere with access. Chemical splashes can cause temporary or permanent blindness, which can make it very difficult for someone to find the eyewash on their own in an emergency.

Laboratory personnel should know the location and operation of the eyewash stations in their area. It is recommended that staff practice locating the eyewash station while keeping their eyes closed. Always maintain a clear path to an eyewash station. Eyewashes must be flushed weekly by the laboratory staff to ensure the eyewash is operating correctly.

Refer to Section 4 for additional information on eyewash stations.

c. Safety Showers

Laboratory personnel should know the location and use of the emergency showers in their area. Laboratory personnel must be able to reach showers within ten seconds. Always keep the area underneath the shower and the path to the emergency shower clear. Safety showers are tested annually by Facilities Services to ensure they operate properly.

Refer to Section 4 for additional information on safety showers.

d. Deluge Hoses

Deluge hoses have been replaced with dual eyewash stations. However, deluge hoses remain in some labs because the near proximity of a dual eyewash station. Deluge hoses are not acceptable alternatives to a dual emergency eyewash or safety shower. If the lab already has one, it can be used for washing glassware and other materials. Deluge hoses should not be routinely requested to be installed in a lab. Contact EH&S (206-543-0465) if the lab staff or PI is unsure if there is an acceptable dual eyewash station for their laboratory.

5. Securing Equipment and Supplies

a. Attaching Equipment to Walls or Supports

Heavy or hazardous items that could topple over and create a hazard or block emergency exits must be secured to the walls or floor by Facilities Services. These items include shelving units, equipment racks, and file cabinets taller than 4 feet, distillation units, gas cylinders (attach at two heights, approximately one third and two thirds of the cylinder height), and cryogenic dewars which are taller than two and a half times their base diameters.

Any new apparatus should be constructed robustly and secured to supporting fixtures. If you need to route gas lines between apparatus mounted to different supports, the lines should either be made of a compatible material that is flexible, or have flexing joints if made of solid lines.

b. Modifying Shelves and Cabinets

Shelves holding chemical containers must have a two-inch tall lip or protective restraint devices to prevent chemical containers from being shaken off the shelf.

Shelves higher than 4 feet above the floor should have anti-earthquake matting or protective restraint device if used to hold heavy manuals, books, or equipment.

Cabinets used to store chemical containers should have a closure device to prevent the door from being shaken open.

6. Protective Procedures

Staff should be in the habit of:

- Ensuring there is clear access to exits, fire extinguishers, eyewash stations, and safety showers.
- Closing containers when not in use.
- Closing fume hood sashes when not in use.
- Maintaining good housekeeping, including not placing chemical containers on the floor.
- Not storing boxes or large items within 18” of the ceiling if the room has fire sprinklers.

7. Training Staff for Emergencies

Not all staff may need training in each subject and the extent of training may vary depending on departmental decisions, such as whether all staff must be trained to use fire extinguishers. Periodic drills and exercises, including “table top” discussions, are encouraged to keep knowledge and interest current and fresh.

a. All Staff

Staff frequently entering the lab must be trained in emergency evacuation (including use of kick-out panels if build into the lab), how to retrieve MSDSs for all chemicals in the laboratory, and the meaning of all alarms and the proper responses to them.

b. Training as Determined by the Department or PI

The department or PI may have specific policies concerning whether all staff or select staff will be current in First Aid/CPR Certification and Fire Extinguisher Training. EH&S recommends all laboratory staff be trained in First Aid/CPR and Fire Extinguisher Use.

c. Evacuation Wardens

Personnel who serve as evacuation wardens require specific training as to their duties. Their duties and responsibilities are described in the EEOP.

B. Response to Specific Incidents/Accidents

1. Accidents Resulting in Personal Injury or Contamination

For any accident involving personal injury, seek medical attention immediately from the nearest emergency room.

a. Involving Human Contamination by a Hazardous Chemical

If a chemical splash into the eye is causing irritation, pain, or concern, flush eyes for at least 15 minutes holding both eyelids open. Prompt medical attention is important regardless of the severity of the injury. Call 911 (on campus) if necessary.

If a chemical splash onto the skin involves a corrosive or irritating chemical, flush area affected for at least 15 minutes while removing contaminated apparel under a safety shower. (One exception is the case of contamination with hydrofluoric acid when calcium gluconate treatment is available, in which case flush the skin for five minutes and immediately apply the calcium gluconate.) Prompt medical attention is important regardless of the severity of the injury. Call 911 if necessary.

All personnel in the laboratory should be able to retrieve a MSDS for any hazardous chemical in the laboratory, to aid in treatment of the injured. Call the Occupational Health Nurse at UW Campus Health Services (206-685-1026) if there is a concern about possible health effects from a spilled hazardous material.

b. Reporting

All faculty, staff, students, or visitors are required to complete the University incident/accident report form available on the EH&S web site (OARS – On-Line Accident Reporting System) within 24 hours following an incident or accident. Also report to your supervisor any accident, injury, work-related illness, or on-the-job incident that could have caused an injury or illness.

If the accident results in a fatality, or hospitalization of two or more persons, the accident must be reported immediately to EH&S, at 206-543-7262. The report can be made after routine office hours through the UW Police Department at 206-543-9331.

If the accident involves a University vehicle, it must be reported immediately to the UW Police Department, at 911 or 206-543-9331.

c. Medical Treatment Reports

Employees, who seek medical treatment for a work related injury or illness, need to submit a State of Washington Accident Report Form, which is available from your health care provider. Then notify UW Risk Management (206-543-0183) of the injury or illness.

2. Fires and Explosions

Activate the alarm system (or call 9-1-1) and evacuate as soon as possible unless the fire is easily extinguished (fire smaller than a trashcan) or has already been extinguished by self-limiting features or an automatic extinguishing system. If a person's hair or clothing is on fire, smother the flames with a coat or by having the person roll on the floor. Assist the victim to medical treatment. Assist others to evacuate as needed. Remain at a location known to the on-scene emergency responders to provide any details they may need.

Report all fires and explosions immediately. Even if the fire was small, contained and readily extinguished by laboratory personnel, and you did not call 9-1-1, immediately report the incident to the University Police on the main campus at 206-543-9331. At UW Bothell, call the UW Bothell Public Safety Department at 425-352-5222. At UW Tacoma, call the Campus Safety Services at 253-692-4416.

If you are uncertain about calling 9-1-1, the best course of action is to call 9-1-1 and let the dispatch operator assist in deciding a proper response.

Submit an accident report on OARS (On-line Accident Reporting System) on the EH&S web site at http://www.ehs.washington.edu/ohsoars/index.shtm.

3. Chemical Spills

Before taking action when a chemical is spilled, you should decide whether the spill has minor or major property or personal risk to yourself and others.

a. Minor Risk

Spills that are stable, contained, isolated from public areas, and not posing an immediate health or environmental threat may be cleaned up by laboratory workers who have been trained and are properly equipped to handle the situation. Spill kits (see paragraph A.3.a above) are available from University Stores during business hours.

When you notice a spill, if you think that it may be hard to find it again if you were to leave to get a spill clean-up kit, you may want to put an absorbent towel or lab coat over the spill so as to identify its location. Do not do this when the chemical spilled is likely to react with the towel or coat. Leave a warning sign or let co-workers know of the spill before you leave.

Spill clean-up procedures should be described in the Standard Operating Procedures (SOP). Incorporate into the SOP any improvements to the spill cleanup procedures, following an actual spill.

If the spill injured someone or damaged equipment or facilities, submit an accident report on OARS (On-line Accident Reporting System) on the EH&S web site at http://www.ehs.washington.edu/ohsoars/index.shtm.

b. Major Risk

For spills that present an immediate or significant physical, health or environmental risk, do the following:

1) Evacuate all personnel from the area. If there is a risk to surrounding labs, pull the fire alarm to evacuate the area. Attend to injured personnel to the best of your training and experience.

2) Report the incident to the following numbers, depending on your location:

All campuses	911
Harborview Medical Center	3000

3) When placing an emergency call, give the following information.

   Name
   Location (room and building)
   Phone number you are using
   Description of the emergency/injuries

4) If possible, remain at a safe location in the vicinity to assist emergency responders. Do not hang up until directed to do so.

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5) The UW Police will notify the Seattle Fire Department (SFD) who will respond, stabilize, and contain the chemical spill. EH&S will assist the SFD and advise departments on proper cleaning, packaging, and removal of any hazardous waste left behind. For some spills, departments may need to bear the cost of clean up by an outside contractor.

6) Submit an accident report on OARS (On-line Accident Reporting System) online at http://www.ehs.washington.edu/ohsoars/index.shtm.

c. Mercury Spills

Mercury spills are one of the most common spill calls received by EH&S. All departments using mercury should replace their mercury devices if at all feasible. The following discussion primarily pertains to metallic mercury (such as is in a mercury thermometer). Spills of other compounds of mercury which may be easily absorbed through skin can be cleaned up by lab personnel also, but more care needs to be taken to avoid contact exposures.

Mercury may enter the body through skin or eye contact, but inhalation is the more serious exposure route, especially if the spill involves heated mercury. Because metallic mercury vaporizes very slowly at room temperatures, mercury exposure will probably not be a health concern as long as the mercury is completely cleaned up. Spills on soft surfaces such as carpeting and shoes may continue to pose a health hazard and such items may need to be disposed as hazardous waste.

While cleaning the spill, extreme care must be taken to prevent personnel from stepping on spilled mercury or spreading the spill to un-contaminated areas. Personnel must be trained in spill clean-up and use appropriate techniques and materials. Advice about spill clean-up can be obtained from EH&S at 206-543-0467. Laboratories which use mercury or mercury-containing equipment should have a mercury clean-up kit immediately accessible. Follow-up monitoring after the clean-up has been completed should be done by EH&S to assure that there is no residual mercury. This monitoring can be requested by phoning 206-543-7388. Personnel should stay out of the area and routine operations should not take place until after the area has been shown to be clean.

Mercury spills at elevated temperatures may cause significant exposure and require immediate actions to turn off the heating apparatus if possible and to evacuate the room until the surfaces involved in the spill have cooled.

Submit an accident report on OARS (On-line Accident Reporting System) on the EH&S web site at http://www.ehs.washington.edu/ohsoars/index.shtm.

d. Spill Clean-Up Waste

Waste generated from a spill clean-up should be placed in a container with a screw top closure or double bagged. Attach a chemical waste label that lists all of the items in the package and complete a Chemical Collection Request form. For more information, see Section 3 of this manual.

e. Use of Respirators

If respirators will be used for spill clean up, all users must have prior medical evaluation, training and fit testing. Fit testing will determine which respirator a user is certified to use. Consult EH&S at 206-543-7388 before making any purchases. Additional information about respirators is located in Section 5 of this manual.

Prior to using respirators in spill clean up, call EH&S at 206-543-7388 to verify that the correct respirator and cartridges will be used.

4. Earthquake Response

Drop, Cover, and Hold! Take shelter under a workbench or other protective cover until the earth movement stops. Afterwards, if safe to do so, shut down any procedures which may be underway and cap any open containers. Aid injured if you are able. Determine if you need to evacuate the work area. When evacuating, take keys, emergency kits, etc. because you may not be allowed to re-enter until the building has been assessed for hazards. Try to note the extent of building damage while evacuating. Assemble at the Emergency Assembly Point. Await further instructions. Do not re-enter the building until after it has been assessed for structural damage by trained personnel and re-entry is authorized by University officials. For further information about earthquake safety, see guidelines on the EH&S web page: http://www.ehs.washington.edu/fsoemerprep/earthquake.shtm.

5. Gas Leaks or Other Odors

a. Natural Gas Leaks

1) Natural gas leaks are a potential cause of explosions. Natural gas contains an odorant that is easily detected by smell. If a weak odor is smelled inside a building, do the following:

   - Check laboratory gas outlets for open valves.
   - Call Facilities Services (3-3010 in South Campus or 5-1411 on Upper Campus) to have the location of the gas leak identified.

2) For strong, widespread (in many rooms), and/or quickly worsening odor:

   - Pull the emergency alarm at a pull station.
   - Close the emergency gas valve for your floor or area if one exists.

- Evacuate the building immediately, following your building evacuation plan.
- If your assembly area is downwind of the building, move to an alternate assembly area up wind at least 300 feet from the building.
- Do not return to an evacuated building unless told to do so by the on-scene authority (fire department, police department or other personnel).
- Submit an accident report on OARS (On-line Accident Reporting System) on the EH&S web site at http://www.ehs.washington.edu/ohsoars/index.shtm.

b. Leaking Gas Cylinders

Do not over-tighten the valve in an attempt to stop the leak. If the valve continues to leak, consider whether room evacuation and building evacuation is necessary. Take the following actions:

1) Flammable, Oxidizing or Inert Gases – Wear PPE as necessary. If possible, allow the cylinder to exhaust into a well ventilated area (such as a fume hood) with few or no combustible absorbent materials in the vicinity (such as cardboard). Post a sign warning of the leaking cylinder. Avoid sparks and open flames.

2) Toxic or Corrosive Gases – Wear PPE as necessary. Exhaust cylinder into an absorbent or neutralizer if possible. If no absorbent or neutralizing system is available, exhaust the cylinder into an operating fume hood. Post a sign warning of the leaking cylinder.

c. Unknown Odors

Check with co-workers to determine if they are doing something to produce an odor. If not, check adjacent labs to determine if the odor is widespread or if the source is obvious. Try to relate the odor to possible causes – such as whether it smells like a sewer, or rotting food, or over-heating electronics, or a distinct chemical. If the source is obvious, take action if possible to eliminate the cause or control the odor, such as taking a chemical reaction off the benchtop and putting it into a working fume hood.

If the odor isn't immediately found but appears to be appreciably stronger in one location, there is likely a source nearby, which can be a dried sink drain or floor drain (if a sewer-like or chemical-like odor), a chemical process gone wrong (if a rotting or unknown chemical odor), over-heating electronics (if devices are over-heating), or a chemical spill or a leaking process (if a distinct chemical). There are an unlimited number of potential sources, but familiarity with the lab's activities should help narrow the possibilities.

Additional general information about indoor air quality is available on the EH&S web site at http://www.ehs.washington.edu/ohsshoptrade/iaq.shtm.

6. Utility Outage

Safety and protection of you and your fellow area occupants is the first consideration. Remain calm; assess the situation and if conditions appear dangerous, evacuate the area while assisting others to evacuate. Once you evacuate, do not re-enter the building until competent authority has determined it is safe to do so.

If you cannot conduct work but your exit can be safely delayed, notify your supervisor or the building coordinator of the failure, shut off work in progress that could cause hazards, close containers, close fume hood/biosafety cabinet sashes, and return hazardous material containers to their proper storage locations. Some utility failures may have insignificant impact on your operations, and you can safely continue work as determined by you and your department/supervisor. Note: Emergency lighting systems are meant to provide light for exiting and are not to be used to continue routine work.

If the failure appears likely to last for a long period, follow your health and safety plan and directions of your department/supervisor. Keep refrigerator and freezer doors closed for as long as possible and implement backup procedures as necessary, such as obtaining dry ice to keep specimen refrigerators cold. When systems return to normal operation, immediately assess the work area (even on weekends if that is when service is restored) for any hazards that may be present, such as electric devices (heaters, ovens, centrifuges, etc.) left on when the outage occurred.

a. Electrical Failure

1) Assess the extent of the outage in your area.

2) If on the Seattle campus, report the outage to Facilities Services at 206-685-1411 or 206-543-3010. If in a leased facility off-campus, report the outage to the servicing electrical utility and to the building owner.
3) Help co-workers in darkened work areas move to safe locations.
4) Implement pre-planned response actions, as necessary. Do not treat the outage as "business as usual."
5) If practical, secure current experimental work, then move it to a safe location.
6) Close any open containers of hazardous materials.
7) Close sashes on fume hoods and biological safety cabinets.
8) If you move chemicals on carts between floors, get assistance. Hazardous spills are a significant risk during transport.
9) Keep lab refrigerators or freezers closed throughout the outage.
10) Unplug personal computers, non-essential electrical equipment, and appliances.
11) Open windows for additional light and ventilation (during mild weather).
12) If you are asked to evacuate your building, secure any hazardous materials work and leave the building.
13) To obtain information about a prolonged outage, listen to service announcements in the local media or call the service provider.
14) Release personnel during an extended outage if directed to do so by the department director.
15) When power is restored, immediately assess the affected area for potentially hazardous situations, such as devices left "on." This is also required if power is restored at a time that the facility would be normally unoccupied.

b. HVAC/Fume Hood Fan Failure

1) Notify other occupants of the situation.
2) If necessary (*e.g.*, because smoke is coming into the room), evacuate area (and pull fire alarm if the situation is widespread)
3) Notify your supervisor or building coordinator of the situation.
4) Shut down work in progress if safe to do so:
   - Shut off equipment and supplied gases and liquids;
   - Close open containers.
   - Close sashes on fume hoods, biological safety cabinets, *etc.*
   - Note the step in the process when work was stopped.
   - Return specimens to freezer, storage containers, *etc.*

5) Open windows if staff are to remain in the workplace.
6) If staff remain in the workplace, periodically check on their well being and evacuate if anyone is adversely affected.
7) Prior to re-starting work in the area, review work to identify possible hazards.
8) If the outage caused damage, submit an accident report on OARS (On-line Accident Reporting System) on the EH&S web site at http://www.ehs.washington.edu/ohsoars/index.shtm .

7. Laboratory Floods

If your laboratory is affected by flooding, do the following.

a. Identifying Source

Find the source of the water. If safe, shut the water off.

b. Protecting Yourself and Equipment

If safe, shut down any equipment that could cause a dangerous electrical situation during a flood and use plastic film for covering equipment and desks if water or sewage is dripping onto them.

c. Obtaining Help

Get help quickly. During work hours, contact your building coordinator. After hours, call UW Police at 911 if on the UW Seattle Campus or senior departmental personnel if at other locations.

Notify the student, supervisor, or principal investigator in charge of the flooding laboratory as soon as possible. He/she will assume responsibility as soon as he/she arrives.

d. Flood Cleanup

If foreign materials such as sewage, ceiling tiles, or leaking chemicals have contaminated the flood water, the situation should be assessed by hazardous material staff who can be contacted through Facilities Services. The best method to clean up uncontaminated water is by using one water vacuum on the scene of the flood and another on the affected area below. Saturated materials (fabrics and cardboard, for example) need to be dried within 48 hours or will need to be discarded to prevent mold growth.

After the cleanup, submit an accident report on OARS (On-line Accident Reporting System) on the EH&S web site at http://www.ehs.washington.edu/ohsoars/index.shtm.

8. Inclement Weather

During thunderstorms, shut off electrical equipment that may be sensitive to voltage fluctuations. For other anticipated weather conditions, which may affect your lab's operations, take response actions as indicated in your pre-emergency plans.

Do not drive through flooded areas to get to your laboratory if there is a possibility of getting swept off the roadway. Minimize your driving and your lab staff's driving during heavy snow, ice storms and extreme icing conditions. Listen to the radio (KIRO 710AM or other more current radio station as listed on the Office of Emergency Management web page) for instructions pertaining to University operations and use email and telephones to maintain contact with your department and laboratory staff.

9. Intruders, Suspicious Packages, and Demonstrators

Contact your servicing police department immediately to report a suspicious intruder or there is something missing. If a person is acting in a way that indicates he or she may become violent, follow protocols for handling potentially violent situations as set up by the University and department (such as using code words and maintaining an exit pathway if possible).

If you find a suspicious package, do not handle it. If you suspect that a package could be explosive, evacuate the area and call 911 from a safe location. If you see wiring, or hear noise coming from the package, the weight of the package is odd for its size, there is liquid or powder leaking from the package, a chemical odor is present, there are odd stains on the package, or there is excessive packaging, this should alert you that it could be explosive.

If you find a suspicious letter, do not handle it. If you receive a suspicious letter, evacuate the area and call 911 from a safe location. If you see wiring, the weight of the letter is odd for its size or lopsided, the envelope is stained, there is powder or liquid leaking from the envelope, a chemical odor is present, a foreign return address, or no return address, this should alert you that the letter may contain dangerous materials.

If the letter or package has already been opened, and a powder or other substance has spilled from the package or letter, do not clean it up**.** Leave it where it is, advise others in the immediate area of the situation, evacuate the area, wash your hands with soap and water, and call 911 from any Campus phone.

For more information, see the US Postal Service Poster on Suspicious Packages online at http://www.usps.com/cpim/ftp/posters/pos84.pdf.

In case of a demonstration adjacent to your laboratory, do not provoke, obstruct, or get into a verbal altercation with the demonstrators. If necessary, simply agree to disagree and move on. Demonstrators are prohibited from blocking free entry to, and exit from, buildings and free movement in public spaces, and disrupting or causing obstacles to regular University activities. When you leave your office or lab, be sure the door is closed and locked, even if you are just going down the hall "for a minute," do not leave items unattended, and if you see anything suspicious or criminal in nature, report it to the police (dial 911). If a disturbance seems threatening, immediately report it to the police (dial 911), alert other personnel in the area of the situation, lock doors and windows, and evacuate if necessary, under direction of the police or your evacuation warden (and submit an OARS report).

In all cases, submit an accident report on OARS (On-line Accident Reporting System) at http://www.ehs.washington.edu/ohsoars/index.shtm.

10. Emergencies During Field Operations

Do the best you can to stabilize injuries. Call for aid. After the emergency response, submit an accident report into OARS (On-line Accident Reporting System) at http://www.ehs.washington.edu/ohsoars/index.shtm.

Section 10
Move In / Moving Out

Section 10
Moving In / Moving Out

Contents

A. Moving In: Occupying a New or Remodeled Laboratory

Occupants moving into new or remodeled laboratory space must comply with many health and safety regulations designed to keep workers safe. See the EH&S Moving In Checklist (Appendix E) for a comprehensive list of requirements and recommendations for moving into a new laboratory.

1. Before the Move

a. Clearing of laboratory by previous occupants

If possible, visit your space in advance to ensure that it has been completely decontaminated and cleared for reuse. See the Moving Out Checklist in Appendix E for more details. If you believe that the space is still contaminated or has not been properly cleared out, contact your Building Coordinator immediately.

b. Laboratory design

If you are modifying an existing laboratory or constructing a new one, refer to the University of Washington Laboratory Safety Design Guide, online at http://www.ehs.washington.edu/fsodesignrev/labsafdesign.shtm. The Guide outlines requirements and recommendations for new laboratories. For further information about laboratory equipment installation, testing and approvals, contact the Facility Safety Office at 206-543-0465.

Facilities Services Maintenance and Alterations Shops must be hired for certain physical work involved with the installation of equipment. This may include but is not limited to bolting items to walls or floors and electrical and plumbing work. To request work, use their online form at http://www.washington.edu/admin/facserv/maintalt.html.

Ensure that any physical modifications are complete before you begin to handle hazardous materials. This includes electrical work, plumbing, air balancing in the building, and other considerations. Also ensure that any fume hoods and biosafety cabinets have been certified by EH&S.

If your laboratory does not meet your needs, consider obtaining access to another laboratory's equipment or space. For example, you may want to share a fume hood with another group.

c. Ordering specialized equipment

Order specialized equipment such as flammable liquid storage cabinets, acid and base storage cabinets, flammable material or explosion proof refrigerators, fume hoods and biosafety cabinets in advance. Many of these items require approval; see Section 4, Equipment and Facilities, for more information about equipment approved for purchase at the University of Washington. New fume hoods and biosafety cabinets must be tested and certified by the EH&S Facility Safety Office before use.

d. Transporting and storing hazardous materials

Plan ahead about how and where you will transport and store your materials and equipment so that you can pack and unpack most efficiently. You must not block hallways, doorways or emergency equipment while packing or unpacking. Special arrangements must be made with a hazardous materials mover for chemicals, gasses, and other hazardous materials. Call the EH&S Environmental Programs Office at 206-616-5835 for assistance with moving arrangements for hazardous materials. Call the Radiation Safety Office at 206-543-0463 for assistance with moving radioactive materials.

Finally, refer to the Moving In Checklist in Appendix E of this manual. Many items in that checklist can or must be completed before you move in.

2. After the Move

Use the Moving In/New Laboratory Checklist in Appendix E of this manual to help you fulfill all health and safety requirements. Start filling out this checklist as early as possible; some items should be completed weeks or even months in advance of your move.

Once you have moved in and completed the checklist, consider regularly using the more detailed Annual Laboratory Self –Assessment Checklist, also in Appendix E, to evaluate overall conditions and practices in the laboratory.

3. Checklist for Moving Into a Laboratory

A comprehensive checklist for moving in is in Appendix E of this manual.

B. Moving Out: Vacating a Laboratory

Whether a laboratory is being completely vacated or partially vacated due to remodeling, you must leave the laboratory in a clean and safe condition for the new occupants or construction crews. Prior to vacating a laboratory, you must remove all chemicals, biological materials, radiological materials, and any other hazardous materials and you must decontaminate all work surfaces. You must also remove all equipment (unless arrangements have been otherwise) and any garbage or other items that will not be wanted by the new occupants. EH&S is available to assist with the clearance of your laboratory. It is helpful to contact EH&S a month or two before you move.

Use our Moving Out Checklist in Appendix E as a tool for making sure that all requirements associated with moving out are completed. Thorough planning of a laboratory move is essential. EH&S recommends that each laboratory or department develop a list of all the tasks and which people are assigned to each task.

The responsibilities of the Principal Investigator, Department, Project Manager (if there is one) and EH&S are listed below.

1. Responsibilities

a. Principal Investigator

The Principal Investigator is responsible for managing the safe removal of hazardous materials and decontamination of the laboratory and equipment when leaving, moving, or closing a laboratory. The PI is required to remove the hazards associated with his/her work and to provide information about potential hazards (or lack thereof) remaining in the space. The PI is responsible for ensuring the removal of all chemical, biological, and radioactive materials and their residues from the labs in which their work was conducted. The PI may delegate tasks to lab staff and colleagues appropriate to their level of training, knowledge, and ability to address them; however, in all cases, it remains the PIs responsibility to assure tasks are completed satisfactorily according to the guidelines and specified protocols.

b. Project Manager

The Project Manager is responsible for ensuring that all steps of a construction or remodeling project are completed. For department-managed projects, this person may be a department employee, and for Facilities Services projects, this person may be a Facilities Services employee. Either entity may contract for project management services; if they do, then it is the contracted individual who assumes responsibility for assuring project tasks are completed according to plan and schedule.

c. Department

The department is responsible for ensuring that principal investigators and designated Project Managers manage laboratory closures or moves responsibly. In the event a PI is no longer available to fulfill his or her duties, then the department must ensure the completion of tasks ordinarily assigned to PIs. If hazardous materials are not responsibly managed and require removal by EH&S or by an outside contractor, the department will be responsible for incurred costs. Any regulatory action or fines resulting from improper management or disposal of chemical waste will be the responsibility of the department.

Departments also retain records about chemical exposure and other chemical safety issues. Records retention is discussed in Section 8 - Record Keeping.

d. EH&S

EH&S is responsible for advising a Department, PI or Project Manager on EH&S related aspects of laboratory deactivations and moves. EH&S can perform an advisory inspection of the work area before the laboratory is vacated. The EH&S inspection should be arranged by the PI, Department or Project Manager.

For radioactive materials, please refer to the Radiation Safety Manual and the Moving Out Checklist in Appendix E of this manual for additional EH&S roles in laboratory closures. For biological materials, please refer to the Biological Safety Manual and the Moving Out Checklist in Appendix E of this manual for additional EH&S roles in laboratory closures.

2. Transportation Requirements and Logistics

a. Moving Equipment and Non-Hazardous Items

You may choose to hire an outside moving company or UW Property & Transportation Services to pack and/or move equipment and non-hazardous materials such as glassware, books and computers. Moving companies and UW Property & Transport Services are not authorized to move hazardous substances (see next subsection for information about moving hazardous substances).

Moving companies are also not authorized to remove materials/equipment that are attached to the building (*e.g.* removing a laboratory bench from a wall) or would impact the building materials (*e.g.* removing a cork board that is glued to the wall). Facilities Services Maintenance and Alterations Shops must be hired for these tasks as well as tasks such as removal of materials and equipment attached to the walls and floors and electrical and plumbing work. To request these types of jobs, use their online form at http://www.washington.edu/admin/facserv/maintalt.html.

Lab equipment must be decontaminated before it is moved. Information on decontamination is in Sections 4.G. and 4.H of this manual and online at http://www.ehs.washington.edu/forms/fso/lab_equip.pdf.

b. Moving Hazardous Materials

Investigators have the options of moving their hazardous chemicals themselves with the guidance of EH&S or of hiring through EH&S a hazardous materials contractor.

If you choose to move your chemicals yourself, you can use a cart (if transporting them on campus) or a vehicle under certain strict conditions. If you use a cart, refer to the requirements (*e.g.* spill kits, spill training, PPE) under Transporting Chemicals in Section 2.F of this manual. If you choose to use a vehicle, the requirements in Section 2.F mentioned above apply along with four addition conditions:

1) The driver must be a UW employee,
2) The vehicle must be a UW-owned vehicle (either owned by the department or rented from UW Motor Pool)
3) The trip must be business-related only, and
4) You must let EH&S know what you will be moving.

The chemicals must be in DOT-approved containers. EHS will loan you DOT-approved containers upon request.

EH&S can also arrange for a hazardous material contractor to pack and/or transport your chemicals for you. The contractor will not move any hazardous wastes.

Again, anyone deciding to move hazardous chemicals without the assistance of movers must contact EH&S for guidance before attempting the move. Call 206-616-5835 or email chmwaste@u.washington.edu for more information.

c. Moving Radioactive Materials

For short moves of radioactive materials between locations on the contiguous UW Seattle campus, an investigator may choose to "hand carry" these materials to a new location. Radioactive materials transported in this manner shall be in a closed container and contain diatomaceous earth or similar absorbent in order to mitigate any possible spill.

For any move of radioactive materials over public roads or long enough distances to require the use of a vehicle, contact the Radiation Safety Office to complete the move (206-543-0463). Radioactive materials must never be transported by laboratory personnel in either private vehicles or university vehicles. All vehicular transport of radioactive materials must be performed by Radiation Safety staff.

d. Moving Biological Materials

When transporting biological materials, follow the instructions in Appendix B of the UW Biosafety Manual, online at http://www.ehs.washington.edu/rbsbiosafe/appendixb.pdf.

e. Moving Freezers

The moving company cannot move any freezers containing materials that would be considered infectious, including viral stocks, human or primate diagnostic specimens or liquid nitrogen freezers or dewar flasks. Special arrangements must be made with EH&S to move freezers and dewars containing infectious items. Specialized moving companies can move freezers and dewars that do not contain infectious materials. Call 206-616-5835 or email chmwaste@u.washington.edu for more information.

3. Checklist for Laboratory Moveouts

The four major areas to address when vacating a laboratory are chemical safety, radiation safety, biological safety, and general safety, which includes sharps and broken glass. A moving out checklist has been developed to facilitate this process and is in Appendix E of this manual. The *Notice of Laboratory Moveout* (UoW 1800) must be completed, signed and posted on the inside of one of the laboratory doors.

Appendix A
WAC 296-828 Hazardous Chemicals in Laboratories

Washington Industrial Safety & Health Act (WISHA)
Department of Labor & Industries
April 2006

WISHA Department of Labor & Industries

Hazardous Chemicals in Laboratories

Chapter 296-828 WAC

April 2006 Edition

Washington Industrial Safety & Health Act

Department of LABOR AND INDUSTRIES

F414-135-000

04/06 printing

Other Rules that may apply to your workplace

- The WISHA Safety and Health Core Rules, Chapter 296-800 WAC, contain the basic requirements that apply to most employers in Washington. They also contain:
  - An Introduction that lists important information you should know, including a section on building, fire and electrical codes.
  - A Resource section that includes a complete list of all WISHA rules and a directory of the Labor and Industries (L&I) offices.
- Other WISHA rules may apply to you, depending on the activities and operations of your workplace. Contact your local L&I office if you're uncertain about which WISHA requirements apply to you.
- To go online to access all the Safety and Health Rules: http://www.lni.wa.gov/wisha
- If you would like to receive e-mail notification of rule updates, please register for the Standards Listserv on the WISHA web site at http://www.lni.wa.gov/home/listservs.htm
- For a CD or paper copy contact us by:

Mail: Department of Labor and Industries
P.O. Box 44620
Olympia, WA 98504-4620

Telephone: 1-800-4BE-SAFE (1-800-423-7233)

Hazardous Chemicals in Laboratories

Chapter 296-828 WAC

Quick Reference

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Notes

Hazardous Chemicals in Laboratories

Chapter 296-828 WAC

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Notes

Hazardous Chemicals in Laboratories

WAC 296-828-100

Scope

This Chapter applies to the laboratory use of hazardous chemicals. To determine if this Chapter applies to your workplace, use Table 1.

Table 1
Chapter Application

Are “Hazardous Chemicals” used? **Definition:** *Hazardous chemicals* are any chemicals that have been shown (in at least one scientific study) to cause acute or chronic health effects in exposed employees. 296-839 WAC contains information that can be used to determine if a chemical is considered hazardous for this rule	YES	NO
Are the hazardous chemicals used in “laboratory scale operations”? **Note:** Laboratory scale operations use containers that have been designed to be easily and safely handled by one person for reactions, transfers and other handling of the hazardous chemicals. Laboratory scale operations **are not:** - Capable of producing commercial quantities of materials - Part of a production process or simulate a production process - Part of a quality control process that directs how a process operates. - A simulation of a production process such as a pilot plant	YES	NO *If any one of your answers brought you here, the Laboratory Standard **does not apply**, but other WISHA rules still apply.*
Are multiple chemicals or multiple procedures used?	YES	NO
Are protective practices or protective equipment generally available for employee protection? **Note:** Protective practices and equipment are those procedures, practices, or equipment accepted by laboratory health and safety experts as effective at controlling employee exposures to hazardous chemicals. For example laboratory fume hoods, chemical splash goggles, protective gloves, etc. **or** Those practices, procedures or equipment the employer can show are effective at controlling employee exposures to hazardous chemicals.	YES	NO
If your answers brought you here, the Laboratory Standard **applies** to your workplace.		

– Continued–

Hazardous Chemicals in Laboratories

Scope

WAC 296-828-100
Scope (Continued)

IMPORTANT:

- When your laboratory operation is covered by this Chapter, and you use any of the substances in Table 2, the following applies:
  - The exposure limits and any requirement protecting employees from skin and eye contact in the rules listed in Table 2 will still apply.
  - Where the action level (or where no action level exists, the permissible exposure limit) is exceeded for a substance listed in Table 2, the exposure evaluation and medical surveillance requirements in the substance rule will still apply.
  - You aren't required to meet other requirements of the substance rule.
- To get the permissible exposure limits (PELs) for hazardous chemicals used in your laboratory, see Chapter 296-841 WAC, Respiratory Hazards.

– Continued–

WAC 296-828-100

Scope (Continued)

Table 2
WISHA Regulated Hazardous Chemicals

2-Acetylaminofluorene
Acrylonitrile
Alpha-Naphthylamine
4-Aminodiphenyl
Arsenic (inorganic)
Asbestos
Benzene
Beta-Naphthylamine benzidine
Beta-Propiolactone
Bis-Chloromethyl ether
Butadiene
Cadmium
Coke ovens
Cotton dust
1, 2-Dibromo-3-chloropropane
3,3'-Dichlorobenzidine (and its salts)
4-Dimethylaminoazobenzene
Ethylene oxide
Ethyleneimine
Formaldehyde
Ionizing radiation
Lead
Methyl chloromethyl ether
4,4' Methylene bis (2 - chloroaniline)
Methylene chloride
Methylenedianiline
4-Nitrobiphenyl
N-Nitrosodimethylamine
Vinyl chloride

Notes

Using Hazardous Chemicals in Laboratories

WAC 296-828-200

Section Contents

YOUR RESPONSIBILITY:

To protect employees from laboratory use of hazardous chemicals

Rule

WAC 296-828-20005

Chemical Hygiene Plan

You must

- Develop and carry out a written chemical hygiene plan (CHP) that will protect your employees from hazardous substances in the laboratory and keep exposure levels below those listed in Respiratory Hazards, Chapter 296-841 WAC.
- Make sure the written plan is readily available to employees and their representatives.
- Include the following elements in your written CHP:
  - The names or job titles of the chemical hygiene officer, other personnel responsible for implementing the CHP, or when appropriate, the members of a chemical hygiene committee
  - Standard operating procedures that provide employee protection when working with hazardous substances
  - Criteria for how you will select and use control measures to reduce employee exposures to hazardous chemicals, especially chemicals known to be extremely hazardous
  - Additional employee protection for select carcinogens, reproductive toxins, and chemicals with high degree of acute toxicity. The following will be considered, when appropriate:
    - The establishment of exposure control areas
    - Containment devices, such as fume hoods or glove boxes
    - The safe removal of contaminated waste
    - Procedures for decontamination
  - Specific measures to make sure fume hoods and other protective equipment provide proper and adequate performance and are properly functioning

– Continued–

WAC 296-828-20005
Chemical Hygiene Plan (Continued)

  - The circumstances when specific laboratory operation, activity, or procedure requires prior approval from the employer or their designated representative before implementation
  - A description of how you are going to train and inform your employees about laboratory use of hazardous chemicals
  - A description of your provisions for medical consultations and medical examinations
- Review and evaluate the effectiveness of your written CHP at least annually and update as necessary.

Reference:

This publication can provide you with additional information to help you with your written chemical hygiene plan:

- National Research Council, Prudent Practices for Disposal of Chemicals from Laboratories, National Academy Press, Washington, DC, 1995.

Using Hazardous Chemicals in Laboratories

WAC 296-828-200

Rule

WAC 296-828-20010

Exposure Evaluation

IMPORTANT:

For any of the specific substances listed in Table 2 of the scope of this Chapter, you need to follow the exposure evaluation procedures found in the Chapters regulating those substances if employee exposure routinely exceeds the AL or PEL. For all other employee exposures follow this section to determine exposure evaluation procedures.

You must

- Determine if you could have a respiratory hazard as described in Chapter 296-841 WAC, Respiratory Hazards.

Reference:

For additional requirements relating to respiratory hazards, see:

– Chapter 296-841 WAC, Respiratory Hazards
– Chapter 296-842 WAC, Respirators
– The specific rule for your chemical

– Continued–

WAC 296-828-20010
Exposure Evaluation (Continued)

You must

- Provide written notification of exposure monitoring results to employees represented by your exposure evaluation, within 5 business days after the results become known to you.

Note:

- ➢ You can notify employees either individually or by posting the notification in areas readily accessible to all affected employees.
- ➢ Posted notifications may need information that allows affected employees to determine which monitoring results apply to them.
- ➢ Notification may be:
  - – In any written form, such as hand-written or e-mail.
  - – Limited to the required information, such as exposure monitoring results.

Reference:

For additional requirements relating to employee exposure records, go to Employee Medical and Exposure Records, Chapter 296-802 WAC.

Using Hazardous Chemicals in Laboratories

WAC 296-828-200

Rule

WAC 296-828-20015

Training

You must

- Inform employees about the presence of hazardous chemicals at the following times:
  - At the time of initial assignment to a work area where hazardous chemicals are present
  - Prior to situations involving a new exposure to hazardous chemicals
- Train employees on all of the following:
  - Methods and observations for detecting the presence or release of hazardous substances. Examples of these methods and observations may include:
    - Monitoring conducted by you
    - Continuous monitoring devices
    - Visual appearance or odor of hazardous chemicals when being released.
  - The physical and health hazards of chemicals in the work area
  - The procedures and measures employees can use to protect themselves from hazardous substances. Examples of these include:
    - Appropriate work practices
    - Emergency procedures
    - Personal protective equipment
- Provide refresher training to fit your needs

– Continued–

WAC 296-828-20015

Training (Continued)

- Provide information to employees on all of the following:
  - The contents of this Chapter and where to find a copy
  - Permissible exposure limits found in Chapter 296-841 WAC, Respiratory Hazards
  - Any recommended exposure levels for compounds without an exposure limit in the WISHA rules. Examples include:
    - The PELs found in the National Institute for Occupational Safety and Health (NIOSH) NIOSH Pocket Guide to Chemical Hazards 2004

      or
    - The American Conference of Governmental Industrial Hygienists (ACGIH®) Documentation of the Threshold Limit Values (TLVs) and Biological Exposure Indices (BEIs), 7th Edition.
  - Signs and symptoms associated with exposures to hazardous chemicals used in the laboratory.
  - Where to find a copy of:
    - Your chemical hygiene plan
    - Material safety data sheets (MSDSs), including those received from the chemical suppliers
    - Reference material on the hazards, safe handling, storage, and disposal of hazardous chemicals found in the laboratory.

Using Hazardous Chemicals in Laboratories

WAC 296-828-200

Rule

WAC 296-828-20020

Labeling and Material Safety Data Sheets (MSDSs)

You must

- Make sure labels on incoming containers aren't removed or defaced.
- Keep and make available to employees any MSDS received with an incoming container of hazardous chemicals.

WAC 296-828-20025

Chemicals Produced in Laboratories

You must

- Follow Table 3 for chemical substances produced in your laboratory.

Table 3
Lab Produced Chemical Substance Requirements

If	Then
The chemical is a hazardous chemical	Follow all appropriate requirements of this Chapter
A chemical by-product is produced and its composition is unknown	Assume it's a hazardous chemical **and** Follow your chemical hygiene plan to protect employees
You produce chemicals in your laboratory for users outside the laboratory	Follow Chapter 296-839 WAC, MSDS and Label Preparation

WAC 296-828-20030

Medical Evaluations

IMPORTANT:

For any of the specific substances listed in Table 2 of the scope of this chapter, you need to follow the medical evaluation procedures found in the chapters regulating those substances if employee exposure routinely exceeds the AL or PEL. For all other employee exposures follow this section to determine medical evaluation procedures.

You must

1) Make medical evaluations available when:
   - An employee develops signs or symptoms associated with a hazardous substance from laboratory exposure.
   - Any emergency situation that could cause a hazardous exposure, such as a spill, leak, or explosion, occurs.
   - A medical provider recommends a follow-up evaluation.
   - Exposure monitoring for any of the substances found in Table 2 reveals exposures routinely over the action level (AL) or in the absence of an AL the permissible exposure level (PEL).
2) Make sure medical evaluations are provided at reasonable times and places, and at no cost to employees.

Note:

This includes travel costs and wages associated with any time spent obtaining the medical evaluation.

– Continued–

WAC 296-828-20030

Medical Evaluations (Continued)

You must

- Provide the LHCP the following information before the medical evaluation is performed:
  - The name of the hazardous chemicals the employee may have been exposed to
  - Any signs or symptoms of exposure the employee has.
  - A description of the conditions under which the exposure occurred.
  - The exposure monitoring results for the conditions, if available.
- Obtain the LHCP's written opinion for each medical evaluation that includes the following:
  - Recommendations for medical follow-up
  - Any medical conditions found that would increase the employee's risk for impairment from exposure to a hazardous chemical
  - A statement that the employee has been informed of exposure-related medical results and conditions that require further examination or treatment
  - A written opinion that doesn't contain any medical information unrelated to the employee's occupational exposures
- If the written opinion contains any medical information unrelated to occupational exposures, return it to the LHCP and obtain a revised version without the additional medical information

Reference:

For additional requirements relating to employee medical records, go to Employee Medical and Exposure Records, Chapter 296-802 WAC.

Definitions

Action level

An airborne concentration of a hazardous substance that's calculated as an 8-hour time-weighted average, and initiates certain requirements to be followed such as exposure monitoring or medical surveillance.

Carcinogens

See "Select carcinogen"

Chemical hygiene officer

An employee designated by the employer who is qualified by training or experience to provide technical guidance in the development and implementation of the chemical hygiene plan. This definition isn't intended to place limitations on the designated employee's position description or job classification within the employer's organization.

Chemical hygiene plan

A written program developed and implemented by the employer that establishes procedures, equipment, personal protective equipment, and work practices to protect employees from the health hazards of the chemicals used in the laboratory.

Container

Any container, except for pipes or piping systems that contains a hazardous substance. For example, it can be any of the following:

– Barrel

– Bottle

– Can

– Cylinder

– Drum

– Reaction vessel

– Storage tank

– Continued–

Hazardous Chemicals in Laboratories

WAC 296-828-300

Definitions

Day

Any part of a calendar day.

Designated representative

Any one of the following:

- Any individual or organization to which an employee gives written authorization
- A recognized or certified collective bargaining agent without regard to written employee authorization
- The legal representative of a deceased or legally incapacitated employee.

Emergency

Any event that could or does result in the unexpected, significant release of a hazardous substance. Examples of emergencies include equipment failure, container rupture, or control equipment failure.

Exposure

The contact an employee has with a hazardous substance, whether or not protection is provided by respirators or other personal protective equipment (PPE). Exposure can occur through various routes of entry such as inhalation, ingestion, skin contact, or skin absorption.

Hazardous chemical

A chemical for which there is statistically significant evidence based on at least one study conducted in accordance with established scientific principles that acute or chronic health effects may occur in exposed employees. The term "health hazard" includes chemicals which are carcinogens, toxic or highly toxic agents, reproductive toxins, irritants, corrosives, sensitizers, hepatotoxins, nephrotoxins, neurotoxins, agents which act on the hematopoietic systems, and agents which damage the lungs, skin, eyes, or mucous membranes.

Laboratory

A facility where the "laboratory use of hazardous substances" takes place. A workplace where relatively small amounts of hazardous substances are used on a nonproduction basis.

– Continued–

Definitions

Laboratory-type hood

A device located in a laboratory, enclosure on 5 sides with a moveable sash or fixed partial enclosed on the remaining side, constructed and maintained to draw air from the laboratory and to prevent or minimize the escape of air contaminants into the laboratory, and allows chemical manipulations to be conducted in the enclosure without insertion of any portion of the employee's body other than hands and arms.

Note:

Walk-in hoods with adjustable sashes meet the above definition provided that the sashes are adjusted during use so that the airflow and the exhaust of air contaminants aren't compromised and employees don't work inside the enclosure during the release of airborne hazardous substances.

Laboratory scale

Work with substances in which the containers used for reactions, transfers and other handling of the substances are designed to be easily and safely manipulated by one person. "Laboratory scale" **does not** include workplaces producing commercial quantities of materials.

Laboratory use

The handling or use of hazardous substances that includes **all** the following:

- Chemical manipulations conducted on a "laboratory scale"
- Multiple chemical procedures or chemicals are used
- The procedures aren't part of a production process, nor in any way simulate a production process.
- "Protective laboratory practices and equipment" are available and are commonly used to minimize the potential for employee exposures to hazardous substances.

– Continued–

Definitions

Licensed healthcare professional (LHCP)

An individual whose legally permitted scope of practice allows him or her to provide some or all of the healthcare services required for medical evaluations

Material safety data sheet (MSDS)

Written, printed, or electronic information (on paper, microfiche, or on-screen) that informs manufacturers, distributors, employers or employees about a hazardous substance, its hazards, and protective measures as required by Material Safety Data Sheet and Label Preparation, Chapter 296-839 WAC.

Permissible exposure limits (PELs)

PELs are employee exposures to toxic substances or harmful physical agents that must not be exceeded. PELs are also specified in WISHA rules found in other chapters.

Physical hazard

As used in Employer chemical hazard communication, WAC 296-800-170 means a chemical that has scientifically valid evidence to show it's one of the following:

– Combustible liquid

– Compressed gas

– Explosive

– Flammable

– Organic peroxide

– Oxidizer

– Pyrophoric

– Unstable (reactive)

– Water reactive

– Continued–

Definitions

Protective laboratory practices and equipment

Laboratory procedures, practices, and equipment accepted by laboratory health and safety experts as effective, that can be shown to be effective, in minimizing the potential for employee exposure to hazardous substances.

Reproductive toxin

Chemicals that affect reproductive capabilities including chromosomal damage (mutations) and effects on fetuses (teratogenesis)

Select carcinogen

Any substance meeting one of the following criteria:

– Regulated by WISHA as a carcinogen

– Listed in the "known to be carcinogens" category in the latest edition of the Annual Report on Carcinogens by the National Toxicity Program (NTP).

– Listed in Group I (carcinogenic to humans) in the latest editions of the International Agency for Research on Cancer (IARC) Monographs.

– Listed in either group 2A or 2B by IARC or in the category "reasonably anticipated to be carcinogens" by the NTP, and causes statistically significant tumor incidence in experimental animals in accordance with any of the following criteria:

- After an inhalation exposure of 6 to 7 hours a day, 5 days a week, for a significant portion of a lifetime to dosages of less than 10 mg/m^3

  or

- After repeated skin application of less than 300 mg/kg of body weight per week

  or

- After oral dosages of less than 50 mg/kg of body weight per day.

Time-weighted average (TWA_8)

An exposure limit averaged over an 8-hour period that must not be exceeded during an employee's workday.

Notes

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Statutory Authority

296-828-100 Scope.

[Statutory Authority: RCW 49.17.010, .040, .050, and .060. 06-02-060 (Order 05-19), § 296-828-100, filed 01/03/06, effective 04/01/06]

296-828-200 Using hazardous chemicals in laboratories.

[Statutory Authority: RCW 49.17.010, .040, .050, and .060. 06-02-060 (Order 05-19), § 296-828-200, filed 01/03/06, effective 04/01/06]

296-828-20005 Chemical hygiene plan.

[Statutory Authority: RCW 49.17.010, .040, .050, and .060. 06-02-060 (Order 05-19), § 296-828-20005, filed 01/03/06, effective 04/01/06]

296-828-20010 Exposure evaluation.

[Statutory Authority: RCW 49.17.010, .040, .050, and .060. 06-02-060 (Order 05-19), § 296-828-20010, filed 01/03/06, effective 04/01/06]

296-828-20015 Training.

[Statutory Authority: RCW 49.17.010, .040, .050, and .060. 06-02-060 (Order 05-19), § 296-828-20015, filed 01/03/06, effective 04/01/06]

296-828-20020 Labeling and material safety data sheets (MSDSs).

[Statutory Authority: RCW 49.17.010, .040, .050, and .060. 06-02-060 (Order 05-19), § 296-828-20020, filed 01/03/06, effective 04/01/06]

296-828-20025 Chemicals produced in laboratories .

[Statutory Authority: RCW 49.17.010, .040, .050, and .060. 06-02-060 (Order 05-19), § 296-828-20025, filed 01/03/06, effective 04/01/06]

296-828-20030 Medical evaluations .

[Statutory Authority: RCW 49.17.010, .040, .050, and .060. 06-02-060 (Order 05-19), § 296-828-20030, filed 01/03/06, effective 04/01/06]

296-828-300 Definitions.

[Statutory Authority: RCW 49.17.010, .040, .050, and .060. 06-02-060 (Order 05-19), § 296-828-300, filed filed 01/03/06, effective 04/01/06]

Notes

Appendix B
Glossary

This glossary contains common terms found in the Laboratory Safety Manual and on Material Safety Data Sheets. Another valuable source for information about MSDS entries can be found at the web site http://www.ilpi.com/msds/ref/index.html.

absolute — A chemical substance that is not mixed; pure. For example Absolute Alcohol, ethyl alcohol, containing not more than one percent by weight of water.

ACGIH — American Conference of Governmental Industrial Hygienists, Incorporated. An organization of professional personnel in governmental agencies or educational institutions engaged in occupational safety and health programs. ACGIH develops and publishes recommended occupational exposure limits (see "TLV") for hundreds of chemical substances and physical agents annually. (ACGIH, 1330 Kemper Meadow Drive, Cincinnati, OH 45240-1634; 513-742-2020, http://www.acgih.org/home.htm)

acids — Any chemical which undergoes dissociation in water with the formation of hydrogen ions. Acids have a sour taste and may cause severe skin burns. Acids turn litmus paper red and have pH values of 0 to 6. Segregate acids from active metals such as sodium, potassium, magnesium, etc. Segregate oxidizing acids from organic acids, flammable and combustible materials. Segregate acids from chemicals that could generate toxic or flammable gases upon contact, such as sodium cyanide, iron sulfide, calcium carbide, etc. Segregate acids from bases.

action level — An exposure limit designated in a WAC, generally derived as an 8-hour time-weighted average, which requires the employer to initiate certain required activities such as exposure monitoring and medical surveillance.

acute health effect — An adverse effect on a human or animal body, with severe symptoms developing rapidly and coming quickly to a crisis. Also, see "chronic health effect."

acute toxicity	The adverse (acute) effects resulting from a single dose of, or exposure to, a substance. Ordinarily used to denote effects in experimental animals.
acutely hazardous waste	A dangerous material as identified with a dangerous waste number beginning with "P" in WAC 173-303-9903. Contact EH&S at 206-685-2848 for current information.
alkali	Any chemical substances which forms soluble soaps with fatty acids. Alkalis are also referred to as bases. They may cause severe burns to skin. Alkalis turn litmus paper blue and pH values range from 8 to 14. Segregate bases from acids, metals, explosives, organic peroxides and easily ignitable materials.
alopecia	Loss of hair.
analgesia	Loss of sensitivity to pain.
anesthesia	Loss of sensation or feeling.
anhydride	An oxide or compound that when combined with water gives an acid or base.
anhydrous	Free of water.
anorexia	Loss of appetite.
anosmia	Loss of the sense of smell.
anoxia	A lack of oxygen from inspired air (literally without oxygen). Also, see "hypoxia."
ANSI	American National Standards Institute. A privately funded, voluntary membership organization that identifies industrial and public needs for national consensus standards and coordinates development of such standards. Many ANSI standards relate to safe design/performance of equipment such as safety shoes, eyeglasses, smoke detectors, fire pumps, and household appliances; and safe practices of procedures such as noise measurement, testing of fire extinguishers and flame arresters, industrial lighting practices, use of abrasive wheels, etc. (ANSI, 1819 L Street NW, Suite 600, Washington DC 20036, 202-293-8020, http://www.ansi.org)
aqueous	A water-based solution.

aquatic toxicity — The adverse effects to marine life that result from being exposed to a toxic substance.

argyria — Local or generalized impregnation (gray-blue color) of the body tissues with silver.

asphyxia — Lack of oxygen and thus interference with the oxygenation of the blood. Can lead to unconsciousness.

asphyxiant — A vapor or gas that can cause unconsciousness or death by suffocation (lack of oxygen). Most simple asphyxiants are harmful to the body only when they become so concentrated that they reduce oxygen in the air (normally about 21%) to dangerous levels (18% or lower). Asphyxiation is one of the principal potential hazards of working in confined spaces.

asthma — A disease characterized by recurrent attacks of dyspnea, wheezing, and perhaps coughing due to spasmodic contraction of the bronchioles.

ASTM — American Society for Testing and Materials. A voluntary membership organization whose members devise consensus standards for materials characterization and use. (ASTM, 1916 Race Street, Philadelphia, PA 19103, 215-299-5400.)

asymptomatic — Neither causing nor exhibiting symptoms.

ataxia — A loss of muscular coordination.

atrophy — A wasting or diminution in the size of tissues, organs, or the entire body.

autoignition temperature — The minimum temperature to which a substance must be heated without application of a flame or spark in order to cause that substance to ignite.

bases — See "alkali."

boiling point — The temperature at which a liquid changes to a vapor state, at a given pressure. Flammable materials with low boiling points generally present special fire hazards (below 100 °F).

bradycardia — A slow heartbeat. Pulse rate below 60 beats per minute.

bronchitis — Inflammation of the bronchial tubes in the lungs.

buffer — A substance capable in solution of neutralizing both acids and bases.

CAA — Clean Air Act. The federal law enacted to regulate/reduce air pollution. Administered by the EPA.

C *or* **ceiling** — The maximum allowable human exposure limit for an airborne substance; not to be exceeded even momentarily. Also, see "STEL" and "TWA."

carcinogen — A substance that causes cancer. Also, see "select carcinogen."

CAS number — An assigned number that identifies the material. CAS stands for Chemical Abstracts Service, a Columbus, Ohio, organization that indexes information published in Chemical Abstracts by the American Chemical Society and provides index guides by which information about particular substances may be located in the Abstracts when needed. CAS numbers identify specific chemicals and are assigned sequentially. (Chemical Abstracts Service, Division of American Chemical Society, Box 3012, Columbus, OH 43210, 614-447-3600, http://www.cas.org)

Fun Fact: The CAS number takes the form of xxxxxx-yy-z, where the "x" series can be any number of 50 or greater up to 6 digits long, and "z" is a digital check derived by multiplying each "y" and "x" digit by a factor (the number of places away from the "z"), and summing these results. Then "z" should be the units digit in the sum. For example, CAS number 591-78-7 is incorrect, because (8 x 1) + (7 x 2) + (1 x 3) + (9 x 4) + (5 x 5) equals 8 + 14 + 3 + 36 + 25 which equals 86. So the "z" should have been "6." The number "591-78-6" is a correct CAS number and is assigned to methyl-n-butyl ketone. (Note: Perhaps the "z" number was actually "7," and a mistake was made at a different part of the number? Perhaps "591-79-7" or "591-87-7" was the number they meant to write down.)

caustic — See "alkali."

central nervous system — The brain and spinal cord.

CERCLA — Comprehensive Environmental Response, Compensation, and Liability Act of 1980. Provides for a fund, Superfund, to be used for the cleanup of abandoned hazardous waste disposal sites.

CFR Code of Federal Regulations. A collection of the regulations that have been promulgated under US law.

CHAC Chemical Hazards Advisory Committee. A University of Washington committee composed of personnel from various departments throughout the University, to provide guidance on policies and procedures concerning chemical use.

chemical family A group of single elements or compounds with a common general name. Example: Acetone, methyl ethyl ketone (MEK), and methyl isobutyl ketone (MIBK) are of the ketone family; acrolein, furfural, and acetaldehyde are of the aldehyde family.

Chemical Hygiene Officer See "CHO."

Chemical Hygiene Plan See "CHP."

CHEMTREC Chemical Transportation Emergency Center. The national center established by the Chemical Manufacturers Association (CMA) in Washington, DC, in 1971, to relay pertinent emergency information concerning specific chemicals on request. CHEMTREC has a 24-four toll free telephone number (800-424-9300), intended primarily for use by those who respond to chemical transportation emergencies. (http://www.chemtrec.org/Chemtrec/)

CHO Chemical Hygiene Officer. An employee who is designated by the employer, and who is qualified by training or experience, to provide technical guidance in the development and implementation of the provisions of the Chemical Hygiene Plan. This definition is not intended to place limitations on the position description or job classification that the designated individual shall hold within the employer's organizational structure. At the University of Washington, the "CHO" is designated for each laboratory as an individual familiar with the rules, processes and required personal protective equipment and has the authority to enforce proper procedures in that lab. The University CHO (UW CHO) provides guidance and advises concerning policies university-wide.

CHP Chemical Hygiene Plan. The written guidance document required to meet the laboratory safety standard, WAC 296-828, Hazardous Chemicals in Laboratories. It must address all potential exposures to health hazards from the chemicals in the laboratory and is achieved at the University of Washington by adding laboratory-specific information to a generalized manual.

chronic health effect An adverse effect on a human or animal body, with symptoms that develop slowly over a long period of time or that recur frequently. Also, see "acute health effect."

chronic toxicity Effects resulting from repeated doses of or exposures to a substance over a relatively prolonged period of time. Ordinarily used to denote effects in experimental animals.

CO Carbon monoxide. A colorless, odorless, flammable and very toxic gas produced by the incomplete combustion of carbon; also a by-product of many chemical processes.

CO_2 Carbon dioxide. A heavy, colorless gas produced by the combustion and decomposition of organic substances and as a by-product of many chemical processes. CO_2 will not burn and is relatively nontoxic (although high concentrations, especially in confined spaces, can create hazardous atmospheres and breathing difficulties).

COC Cleveland Open Cup. A flash point test method.

combustible A term used by NFPA, DOT, and others to classify certain liquids that will burn, on the basis of flash points. Both NFPA and DOT generally define combustible liquids as having a flash point of 100 °F (37.8 °C) or higher. Non-liquid substances such as wood and paper are classified as ordinary combustibles by NFPA. Also, see "flammable."

common name A designation for a material other than its chemical name, such as code name, code number, trade name, brand name, or generic name.

concentration The relative amount of a substance when combined or mixed with other substances. Examples: 2 ppm hydrogen sulfide in air, or a 50 percent caustic solution.

conjunctivitis Inflammation of the conjunctiva, the delicate membrane that lines the eyelids and covers the eyeballs.

cornea Transparent structure of the external layer of the eyeball.

corrosive A chemical that causes visible destruction of, or irreversible alterations in living tissue by chemical action at the site of contact; or in the case of leakage from its packaging, a liquid that has a severe corrosion rate on steel. A solid or liquid

	waste that exhibits a "characteristic of corrosivity," as defined by RCRA, may be regulated (by EPA) as a hazardous waste.
corrosivity	One of the characteristics of hazardous waste, it refers to the pH of an acid or base or its ability to corrode steel.
CPSC	Consumer Products Safety Commission. The federal agency with responsibility for regulating hazardous materials when they appear in consumer goods. For CPSC purposes, hazards are defined in the Hazardous Substances Act and the Poison Prevention Packaging Act of 1970.
cutaneous	Pertaining to the skin.
CWA	Clean Water Act. The federal law enacted to regulate/reduce water pollution. Administered by the EPA.
cyanides	Any of various salts or esters of hydrogen cyanide containing a CN group, including the extremely poisonous compounds potassium cyanide and sodium cyanide. Segregate from acids and oxidizers.
cyanosis (cyanotic)	A dark purplish coloration of the skin and the mucous membrane due to deficient oxygenation of the blood.
decomposition	Breakdown of a material or substance (by heat, chemical reaction, electrolysis, decay, or other processes) into parts or elements or simpler compounds.
dermal	Used on or applied to the skin.
dermal toxicity	Adverse effects resulting from the skin's exposure to a substance. Ordinarily used to denote effects in experimental animals.
dermatitis	Inflammation of the skin.
designated area	An area which may be used for work with "select carcinogens," reproductive toxins or chemicals which have a high degree of acute toxicity. A designated area may be the entire laboratory, an area of a laboratory or a device such as a laboratory hood.
DHHS	U.S. Department of Health and Human Services. A federal agency created in 1980 to replace the Department of Health, Education, and Welfare (DHEW) as "parent" for NIOSH, Public Health Service, and other agencies related to health and safety.

diaphoresis Perspiration.

disposal The discharge, deposit or placing of waste into the environment, usually by incineration or burial in landfills.

DOT U.S. Department of Transportation. A federal agency which regulates transportation of chemicals and other substances to aid in the protection of the public as well as fire, law enforcement, and other emergency response personnel, particularly when transportation incidents occur involving hazardous materials. Detailed DOT classification lists specify appropriate warnings such as “Oxidizing Agent” or “Flammable Liquid” that must be used for various substances.

DOT numbers Identification numbers that are four-digit numbers, preceded by “UN” or “NA” and are used to identify particular substances for regulation of their transportation. See the DOT publications that describe the regulations.

dyspnea A sense of difficulty in breathing; shortness of breath.

edema An abnormal accumulation of clear, watery fluid in the tissues.

EH&S Department of Environmental Health and Safety. Box 354400, 201 Hall Health, Seattle, Washington 98195, 206-543-7262.

The mission of EH&S is: To support University of Washington’s teaching, research, and service missions, the Environmental Health and Safety Department assists organizational units in meeting their responsibility to protect the environment and to provide a safe and healthful place of employment and learning..

electrolyte Any substance that conducts an electric current in solution.

embolism Obstruction of a blood vessel by a transported clot, a mass of bacteria, or other foreign material.

emphysema A swelling or inflation due to presence of air in the connective tissues of the lungs.

employee An individual employed in a laboratory workplace who may be exposed to hazardous chemicals in the course of his or her assignments.

EPA U.S. Environmental Protection Agency. The federal agency with environmental protection regulatory and enforcement authority. Administers the CAA, CWA, FIFRA, RCRA, TSCA, and other Federal environmental laws.

epidemiology The science which deals with the study of disease in a general population. Determination of the incidence (rate of occurrence) and distribution of a particular disease (as by age, sex, or occupation) may provide information about the causes of the disease.

epistaxis Nosebleed; hemorrhage from the nose.

evaporation rate The rate at which a particular material will vaporize (evaporate) when compared to the rate of vaporization of a known material. The evaporation rate can be useful in evaluating the health and fire hazards of a material. The known material is usually normal butyl acetate (NBUAC or n-BuAc), with a vaporization rate designated as 1.0. Vaporization rates of other solvents or materials are then classified as fast, medium or slow, as compared to n-butyl acetate, with examples shown in Table B-1:

Table B-1 Evaporation Rate Examples

	Evaporation Rate	Examples
Fast	> 3.0	Hexane - 8.3 Acetone - 5.6 Methyl ethyl ketone (MEK) - 3.8
Medium	0.8 to 3.0	Methyl isobutyl ketone (MIBK) - 1.6 190-proof (95%) Ethyl alcohol-1.4 VM&P naphtha - 1.4
Slow	< 0.8	Xylene - 0.6 Water - 0.3 Mineral spirits - 0.1

explosive A material that causes a sudden, almost instantaneous release of pressure, gas, and heat when subjected to sudden shock, pressure, or high temperature.

extinguishing media The type of fire extinguisher or extinguishing method appropriate for use on a specific chemical. For example, some chemicals react violently in the presence of water, so other types of extinguishing media would be necessary to control a fire.

FDA U.S. Food and Drug Administration. The federal agency which, under the provisions of the Food, Drug and Cosmetic Act, establishes requirements for the labeling of foods and drugs to protect consumers from misbranded, unwholesome, ineffective, and hazardous products. The FDA also regulates materials for food contact service and the conditions under which such materials are approved.

fibrosis Formation of fibrous tissue, as in a reparative or reactive process, in excess of amounts normally present.

FIFRA Federal Insecticide, Fungicide, and Rodenticide Act. The federal legislation administered by EPA concerning control of chemicals designed to kill organisms. Part of the legislation requires that certain useful poisons sold to the public, such as chemical pesticides, contain labels that carry health hazard warnings to protect users.

flammable Describes any solid, liquid, vapor, or gas that will ignite easily and burn rapidly. A flammable liquid is defined by NFPA and DOT as a liquid with a flash point below 100 °F (37.8 °C). Store in approved safety cans or cabinets. Segregate from oxidizing acids and oxidizers. Keep away from any source of ignition: heat, sparks, or open flames.

flammable limits The minimum and maximum concentrations of a flammable gas or vapor between which ignition can occur. Concentrations below the lower flammable limit (LFL) are too lean to burn, while concentrations above the upper flammable limit (UFL) are too rich. All concentrations between LFL and UFL are in the flammable range, and special precautions are needed to prevent ignition or explosion.

flash point The temperature at which a liquid will give off enough flammable vapor to ignite. There are several flash point test methods and flash points may vary for the same material depending on the method used, so the test method is indicated when the flash point is given.

formula The conventional scientific designation for a material (water is H_2O, sulfuric acid is H_2SO_4, sulfur dioxide is SO_2, etc.).

fume hood (Laboratory type): A device located in a laboratory, enclosed on five sides with a moveable or fixed partial sash enclosing on the remaining side; constructed and maintained to draw air from the laboratory and to prevent or minimize the escape of air contaminants into the laboratory; and allows chemical manipulations to be conducted in the enclosure without insertion of any portion of the employee's body other than hands and arms.

Note: Walk-in hoods with adjustable sashes meet the above definition provided that the sashes are adjusted during use so that the airflow and the exhaust of air contaminants are not compromised and employees do not work inside the enclosure during the release of airborne hazardous chemicals.

gangrene Death of tissue combined with putrefaction.

gastroenteritis Inflammation of the stomach and intestines.

general exhaust A system for exhausting air containing contaminants from a general work area. Also, see "local exhaust."

generic name A designation or identification such as code name, code number, trade name, or brand name used to identify a chemical other than by its chemical name.

gingivitis Inflammation of the gums.

GHS Globally Harmonized System for the Classification and Labeling of Chemicals (GHS). An international agreement to classify chemicals into certain categories that have specific hazards and warnings, and to use a consistent label format and a consistent "Safety Data Sheet (SDS)" to provide information to those who use the chemical. The classification scheme is at http://www.unece.org/trans/danger/publi/ghw/ghs_rev01/01files_e.html .

hazardous chemical A chemical for which there is statistically significant evidence based on at least one study conducted in accordance with established scientific principles that acute or chronic health effects may occur in exposed employees. See "health hazard" and "physical hazard."

Note: The Hazard Communication Standard at WAC 296-839-20005 provides further guidance in defining the scope of health hazards and determining whether or not a chemical is to be considered hazardous for purposes of this standard.

hazardous waste — Any substance that (a) has a characteristic of hazardous waste (i.e., ignitability, corrosivity, etc.), or (b) is included by name in hazardous waste regulations.

health hazard — A chemical which can cause measurable adverse effects on a human upon being absorbed into the body, such as irritants, corrosives, carcinogens, sensitizers, hepatotoxicants, nephrotoxicants, neurotoxicants, reproductive toxicants, toxic or highly toxic agents, agents which act on the hematopoietic systems, and agents which damage the lungs, skin, eyes, or mucous membranes.

hematuria — The presence of blood in the urine.

hepatic — Pertaining to the liver.

high degree of acute toxicity — The following criteria identify acutely toxic chemicals based on data from mammalian testing, as a minimum:

a. Oral route: the median lethal dose (LD_{50}) is less than or equal to 25 mg/kg.

b. Dermal route: the median lethal dose (LD_{50}) is less than or equal to 50 mg/kg.

c. Inhalation route: the median lethal concentration (LC_{50}) is less than or equal to 0.5 mg/1 where time of exposure is any time up to 8 hours.

highly toxic — The following criteria identify highly toxic chemicals based on data from mammalian testing:

a. Oral route: LD_{50} of 50 mg/kg or less when administered to albino rats weighing 200-300 grams each.

b. Dermal route: LD_{50} of 200 mg/kg or less when administered by continuous contact for 24 hours with the bare skin of albino rabbits weighing 2-3 kilograms.

c. Inhalation route: LC_{50} in air of 200 ppm or less (gas or vapor) or 2 mg/l or less (mist, fume, or dust) when administered by continuous inhalation for one hour to albino rats weighing 200-300 grams each.

hygroscopic	Readily absorbs moisture from the air.
hypergolic	Describing rocket fuel or propellant that consists of combinations of fuels and oxidizers that ignites spontaneously on contact.
hypoxia	Insufficient oxygen especially applied to body cells.
IARC	International Agency for Research on Cancer. One of the sources that OSHA refers to for data on whether a material is a carcinogen. (http://www.iarc.fr/) (A subsidiary agency of the World Health Organization, with US offices at 525 23rd Street NW, Washington DC 20037, 202-974-3000, http://www.who.int/en/ .)
IFC	International Fire Code. Adopted in 2003 by the Seattle Fire Department as the fire code for the City of Seattle, replacing the Uniform Fire Code.
ignitability	One of the characteristics of a hazardous waste, it refers to the waste's ability to burn.
incompatible	A combination of chemicals which could cause dangerous reactions after direct contact with one another.
inflammation	A series of reactions produced in the tissues by an irritant, injury, or infection characterized by redness and swelling caused by an influx of blood and fluids.
ingestion	The taking in of a substance through the mouth.
inhalation	The breathing in of a substance in the form of a gas, vapor, fume, mist, or dust.
inhibitor	A chemical that is added to another substance to prevent an unwanted chemical change from occurring.
irritant	Chemicals that causes a reversible inflammatory effect on living tissue by chemical action at the site of contact.
isomers	In chemistry, chemical compounds that have the same molecular weight and atomic composition but differ in molecular structure (e.g., 1-propanol and 2-propanol are isomers).

jaundice Yellowish discoloration of the skin, whites of eyes, and bodily fluids with bile pigment (bilirubin) caused by any of several pathological conditions that interrupt liver function.

L&I Department of Labor and Industries. The State of Washington agency that is responsible for administering worker safety and health regulations in Washington (*www.wa.gov/lni*).

laboratory An area where chemical manipulations are done for either research, educational, or clinical purposes.

Laboratory Safety System The precursor to MyChem. See "MyChem."

lacrimation Secretion and discharge of tears.

lavage A washing of a hollow organ, such as the stomach.

LC_{50} (lethal concentration 50) The concentration of a material in air that on the basis of laboratory tests is expected to kill 50% of a group of test animals when administered as a single exposure (usually 1 or 4 hours). The LC_{50} is expressed as parts of material per million parts of air by volume (ppm) for gases and vapors, or as micrograms of material per liter of air (ug/l) or milligrams of material per cubic meter of air (mg/m^3) for dusts, mists, gases or vapors.

LD_{50} (lethal dose 50) A single dose of a material that on the basis of laboratory tests is expected to kill 50% of a group of test animals. The LD_{50} dose is usually expressed as milligrams or grams of material per kilogram of animal weight (mg/kg or g/kg).

LEL *or* LFL Lower Explosive Limit or Lower Limit. For a vapor or gas; the lowest concentration (lowest percentage of the substance in air) that will produce a flash of fire when an ignition source (heat, arc, or flame) is present. At concentrations lower than the LEL, the mixture is too "lean" to burn. Also, see "UEL or UFL."

lesion Abnormal change, injury, or damage to tissue or to an organ.

leukemia A progressive, malignant disease of the blood-forming organs.

LFL Lower Flammable Limit. See "LEL or LFL."

light sensitive chemicals Chemicals that may react violently or degrade in the presence of light. Store in amber bottles in a cool, dry, dark place.

local exhaust — A system for capturing and exhausting contaminants from the air at the point where the contaminants are produced (welding, grinding, sanding, other processes or operations). Also, see "general exhaust."

LSS — Laboratory Safety System. The name of the computer network database which has been upgraded and is now the MyChem system. See "MyChem."

malaise — A feeling of general discomfort, distress, or uneasiness; an out-of-sorts feeling.

mechanical exhaust — A powered device, such as a motor-driven fan or air/stream venturi tube, for exhausting contaminants from a workplace, vessel, or enclosure.

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

melting point — The temperature at which a solid substance changes to a liquid state. For mixtures, the melting range may be given.

mil — Generally, one one-thousandth of something. With respect to protective gloves, a unit of thickness equal to one thousandth of an inch. Thin, surgical gloves may be five to seven mils thick. Many industrial gloves are 20 to 35 mils thick.

MSDS — Material Safety Data Sheet. A document describing a chemical's known hazards, which is produced by the chemical manufacturer and provided to the chemical user as required by OSHA.

mutagen — A substance or agent capable of altering the genetic material in a living cell.

MyChem — A computer network database established to give access to MSDSs, to surplus chemical exchange, and to site-specific chemical information including chemical inventories.

narcosis — Stupor or unconsciousness produced by some narcotic drug.

nausea — Tendency to vomit, feeling of sickness at the stomach.

necrosis Local death of tissue.

neoplasm A new or abnormal growth of tissue in which the growth is uncontrollable and progressive.

negative pressure The environmental condition when the air pressure inside a room or containment device is less than the air pressure outside the area of interest. When a fume hood is running, it should be at "negative pressure" to the rest of the room. This is desirable because hazardous chemicals inside the area of interest will be less likely to escape, because air leaks will be into the area. Also, see "positive pressure."

neutralization A method of chemically treating corrosive hazardous waste by the addition of an acid or base to make the waste neutral.

NFPA National Fire Protection Association. An international voluntary membership organization to promote/improve fire protection and prevention and establish safeguards against loss of life and property by fire. Best known on the industrial scene for the National Fire Codes, 16 volumes of codes, standards, recommended practices, and manuals developed (and periodically updated) by NFPA technical committees. Among these is NFPA 704. It contains the code for showing hazards of materials using the familiar diamond-shaped label or placard with appropriate numbers or symbols.

NIOSH National Institute for Occupational Safety and Health. A research agency within the Public Health Service, U.S. Department of Health and Human Services (DHHS) which--among other activities--tests and certifies respiratory protective devices, recommends occupational exposure limits for various substances, and assists OSHA in occupational safety and health investigations and research. (http://www.cdc.gov/Niosh/homepage.html)

NTP National Toxicology Program. A group within the U.S. Department of Health and Human Services which produces the Annual Report on Carcinogens.

nystagmus Spastic, involuntary motion of the eyeballs in a horizontal, rotary, or vertical direction.

olfactory Relating to the sense of smell.

oliguria Scanty or low volume of urine.

opaque Impervious to light rays.

oral Used in or taken into the body through the mouth.

OSHA Occupational Safety and Health Administration. The federal agency charged with developing and enforcing regulations to protect workers. http://www.osha.gov/ . Alternatively, the Occupational Safety and Health Act (1970), the federal act requiring worker protection programs.

oxidation In a literal sense, oxidation is a reaction in which a substance combines with the oxygen provided by an oxidizer or oxidizing agent. An oxidizer or oxidizing material is a substance that yields oxygen readily to stimulate the combustion of organic matter such as ozone or chlorinated trisodium phosphate.

oxidizers Chemicals, other than a blasting agents or explosives, that initiate or promote combustion in other materials, thereby causing fire either of itself or through the release of oxygen or other gases (e.g. chlorate, permanganate, and nitrate compounds). Store in a cool, dry place. Keep away from combustible and flammable materials. Keep away from reducing agents such as zinc, alkali metals, and formic acid.

palpitation Irregular, rapid heartbeat.

particularly hazardous substances Chemicals that have a “high degree of acute toxicity,” are “select carcinogens” or are “reproductive toxins.” A partial list is provided in Appendix H.

PEL Permissible Exposure Limit. The exposure limit established in accordance with the Washington Industrial Safety and Health Act (WISHA). The PEL may be a time-weighted average (TWA) limit of average exposures throughout the work day, or an exposure limit for a shorter period of time. Additional information about Washington State’s PELs is provided in the Employee Health Section of this manual.

percent volatile by volume The percentage of a liquid or solid (by volume) that will evaporate at an ambient temperature of 70 °F (unless some other temperature is stated). Examples: butane, gasoline, and paint thinner (mineral spirits) are 100% volatile; their individual evaporation rates vary, but over a period of time each will evaporate completely.

peroxidizable chemicals Chemicals that may become shock sensitive or explosive when they oxidize to form an appreciable concentration of peroxides.

Store in airtight containers in a dark, cool, and dry place. Label containers with receiving, opening, and disposal dates. Periodically test for the presence of peroxides.

pH The value that represents the acidity or alkalinity of an aqueous solution. The number is the logarithm, to the base 10, of the reciprocal of the hydrogen-ion concentration of a solution. Pure water has a pH of 7. The substance in an aqueous solution will ionize to various extents giving different concentrations of H+ and OH- ions. For example, the strongest acids have an excess of H+ ions and a pH of 1 to 3 (HCl, pH=1). The strongest bases have an excess of OH- ions and a pH of 11 to 13 (NaOH, pH = 12). The pH scale is logarithmic and the intervals are exponential, so the progression of values represents far greater concentrations than one would suspect (i.e., pH of 3=10,000 to 1 ratio of H+ ions, while a pH of 4=1000 to 1, pH of 5=100 to 1).

phlegm Thick mucous from the respiratory passages.

physical hazard According to the Laboratory Safety Standard (WAC 296-828), a chemical for which there is scientifically valid evidence that it is a combustible liquid, a compressed gas, explosive, flammable, an organic peroxide, an oxidizer, pyrophoric, unstable (reactive) or water-reactive. More generally, an environmental condition that can cause a mechanical injury to a human or acts from a distance (such as radiation or noise).

PI Principal Investigator. The senior researcher who has control over a laboratory's spaces and processes.

PMCC Pensky-Martens Closed Cup. A flash point test method.

pneumoconiosis Respiratory tract and lung condition caused by inhalation and retention of respirable material.

polymerization A chemical reaction in which one or more small molecules combines to form larger molecules. A hazardous polymerization is such a reaction that takes place at a rate that releases large amounts of energy.

positive pressure An environmental condition when the air pressure inside a containment device or a room is higher than the outside air pressure. Air contaminants outside the glove box or room will be less likely to enter and contaminate the device or room,

	because air leaks and currents will tend to blow them out. Also, see “negative pressure.”
PPE	Personal Protective Equipment. Items worn by an individual such as an apron, faceshield, gloves, respirator or hearing protective devices, to prevent illness or injury.
ppm	Parts per million. A measure of the concentration of a gas or vapor in air; the number of molecules of vapor or gas per million molecules of air.
precipitation	A method of chemically treating hazardous wastes in which a substance is separated from solution or suspension by a chemical or physical change.
prostration	Physical exhaustion and incapacitation.
pulmonary edema	Fluid in the lungs.
pyrophoric	Chemicals that will ignite spontaneously in air below 130 °F (54 °C). (e.g., white phosphorus.) Store in a cool dry place, making provisions for an airtight seal.
RCRA	Resource Conservation and Recovery Act. The federal legislation that requires controls be placed upon disposal of hazardous waste materials, administered by the EPA.
reactivity	A description of the tendency of a substance to undergo chemical reaction with the release of energy. Undesirable effects such as pressure buildup; temperature increase; or formation of noxious, toxic, or corrosive byproducts may occur because of the reactivity of a substance to heating, burning, direct contact with other materials, or other conditions in use or in storage.
recycling	A general term for the reuse of wastes, it includes reclamation and recovery.
reproductive toxicants	Chemicals that affect the reproductive capabilities including chromosomal damage (mutations) and effects on fetuses (teratogenesis).
respiratory system	The breathing system, includes the lungs and air passages (trachea or “windpipe,” larynx, mouth, and nose), as well as the associated nervous and circulatory supply.

S *or* "Skin" A notation found in MSDSs or regulatory standards that is used to indicate possible significant contribution to overall exposure to a chemical by way of absorption through the skin, mucous membranes, and eyes by direct or airborne contact.

Safety Data Sheet See "SDS."

SARA Title III Superfund Amendments and Reauthorization Act, Title III: Also known as the Emergency Planning and Community Right-to-Know Act of 1986, administered by EPA, which requires notification of local emergency response agencies as to the amounts of hazardous materials stored by an employer.

satellite generator A collection area near a hazardous waste's point of generation that is under the control of the person generating the waste.

sclerae The tough, white, fibrous covering of the eyeball.

SDS Safety Data Sheet. A document similar to a Material Safety Data Sheet and prepared in accordance with the internationally coordinated Globally Harmonized System for Classifying and Labeling Chemicals (GHS).

select agent Highly toxic organisms and toxins regulated by the U.S. Department of Health and Human Services. Also, see "select toxin."

select carcinogen Any chemical that meets one of the following criteria:

a) It is regulated under WISHA as a carcinogen;

b) It is listed under the category, "known to be carcinogens," in the Annual Report on Carcinogens published by the National Toxicology Program (NTP)(latest edition);

c) It is listed under Group I ("carcinogenic to humans") by the International Agency for Research on Cancer (IARC) Monographs (latest editions); or

d) It is listed in either Group 2A or 2B by IARC or under the category, "reasonably anticipated to be carcinogens" by NTP, and causes statistically significant tumor incidence in experimental animals in accordance with any of the following criteria:

1) After inhalation exposure of 6-7 hours per day, 5 days per week, for a significant portion of a lifetime to dosages of less than 10 mg/m^3;

2) After repeated skin application of less than 300 mg/kg of body weight per week; or

3) After oral dosages of less than 50 mg/kg of body weight per day.

select toxin A highly toxic "select agent" chemical regulated by the U.S. Department of Health and Human Services. If a select toxin has its LD_{50} greater than 0.1 micrograms per kilogram when tested using vertebrates, it is exempt from additional requirements for select agents when it is being used in biomedical research.

sensitization An immune response reaction states in which further exposure elicits an immune or allergic response. A person previously exposed to a certain material is more sensitive when further contact with this material is encountered.

sensitizer A substance that on first exposure causes little or no reaction in man or test animals, but which on subsequent exposure may cause a marked response not necessarily limited to the contact site. Skin sensitization is the most common form of sensitization in the industrial setting, although respiratory sensitization to a few chemicals is also known to occur.

SFC Seattle Fire Code. Based on the 2003 International Fire Code with some amendments specific to the City of Seattle.

SFD Seattle Fire Department.

SETA Setaflash Closed Tester. A flash point test method.

"skin" See "S."

solid waste With respect to chemical substances, a non-hazardous chemical waste. A solid waste may be a liquid, gas, or solid.

solubility in water A term expressing the percentage of a material (by weight) that will dissolve in water at ambient temperature. Solubility information can be useful in determining spill cleanup methods and fire-extinguishing agents and methods for a material. Terms used to express solubility are:

Negligible	=	Less than 0.1 percent;
Slight	=	0.1 to 1.0 percent;
Moderate	=	1 to 10 percent;
Appreciable	=	More than 10 percent;
Complete	=	Soluble in all proportions.

solvent A material that can dissolve other materials to form a uniform mixture. Water is a solvent for many chemicals.

SOP Standard Operating Procedure. A document that lists specific work practices for a process or operation.

spasm An involuntary, convulsive muscular contraction.

species A biological type; on MSDSs, species refers to the test animals (usually rats, mice, or rabbits) which were used to obtain the toxicity test data reported.

specific gravity An expression of the density (or heaviness) of a material. Ratio of the mass of a body to the mass of an equal volume of water at 4 °C or other specified temperature. If a volume of a material weighs 8 pounds, and an equal volume of water weighs 10 pounds, the material is said to have a specific gravity of 0.8 (8 divided by 10 = 0.8). Insoluble materials with specific gravity of less than 1.0 will float in (or on) water. Insoluble materials with specific gravity greater than 1.0 will sink (or go to the bottom) in water. Most (but not all) flammable liquids have specific gravity less than 1.0 and, if not soluble, will float on water - an important consideration for fire suppression and spill cleanup.

stability An expression of the ability of a material to remain unchanged. For MSDS purposes, a material is stable if it remains in the same form under expected and reasonable conditions of storage or use. Conditions such as temperatures above 150 °F or shock from being dropped that may cause instability (dangerous change) are stated on the MSDS's.

STEL Short-Term Exposure Limit. The maximum allowable average exposure level for a short period of time, usually 15 minutes. Also, see “PEL.”

stupor	Partial or nearly complete unconsciousness.
subcutaneous	Beneath the skin.
synonym	Another name or names by which a material is known. Methyl alcohol, for example, is also known as methanol and wood alcohol.
systemic	Affecting the entire body.
tachycardia	Excessively rapid heartbeat. Pulse rate above 100.
TAG	Tagliabue Closed Tester. A flash point test method.
target organ effects	Chemically caused effects upon organs and systems such as the liver, kidneys, nervous system, lungs, skin, and eyes from exposure to a material.
teratogen	An agent or substance that causes physical defects in the developing embryo.
tinnitus	A ringing or singing sound in the ears.
TLV	Threshold Limit Value. A term used by ACGIH to express the airborne concentration of a material to which nearly all persons can be exposed day after day without permanent adverse effects. Since it is updated annually, this guideline level is often more current than the PELs listed in regulations.
TLV - C	TLV – Ceiling. The concentration that should not be exceeded even instantaneously.
TLV - STEL	TLV – Short - Term Exposure Limit. The average concentration over a short period, such as during peak or maximum generation of an airborne contaminant. The guideline limits such peaks to a maximum of four such periods per day, with at least 60 minutes between exposure periods, and provided that the daily TLV -TWA is not exceeded.
TLV - TWA	TLV – Time Weighted Average. The recommended guideline time-weighted average exposure limit for a normal 8-hour workday or 40-hour week. Also, see "TWA."
toxic	Having (a) an LD_{50} of 50-500 mg/kg when administered orally to albino rats weighing 200-300 grams each, (b) an LD_{50} of 200-1000 mg/kg when administered by continuous contact for 24

hours with the bare skin of albino rabbits weighing 2-3 kilograms each, or (c) an LC_{50} of 200-2000 ppm (gas or vapor) or 2-20 mg/l (mist, fume or dust) when administered by continuous inhalation for one hour to albino rats weighing 200-300 grams each. Store according to the nature of the chemical, using appropriate security where necessary.

toxicity
The sum of adverse effects resulting from exposure to a material, generally by the mouth, skin, or respiratory tract. For RCRA purposes, EPA may regulate solid or liquid wastes that exhibit certain specified "characteristics of toxicity" as hazardous wastes.

treatment
A chemical or physical process that makes the waste less hazardous or non-hazardous, or recovers materials.

TSCA
Toxic Substances Control Act. The federal environmental legislation, administered by EPA, for regulating the manufacture, handling, and use of materials classified as "toxic substances."

TWA
Time-Weighted Average. The method of averaging exposures to airborne concentrations of a material when levels vary, based on duration of exposures to those levels. For example, an exposure of some chemical at 100 parts per million for 2 hours and 0 parts per million for 6 hours for an 8-hour work day would be the first level times duration plus the second level times duration, divided by total work shift, i.e., (100x2+0x6) divided by 8 hours, or 25 parts per million. This is normally for an 8 hour work day, but other durations may apply as necessary. Used in conjunction with "PEL" and "TLV."

UEL *or* UFL
Upper Explosive Limit or Upper Flammable Limit. The highest concentration of a material in air that will produce an explosion or fire when it contacts an ignition source (high heat, electric arc, spark, or flame). A higher concentration of the material with a smaller percentage of oxygen or air may be too rich to be ignited. Care must be taken if using air or oxygen to dilute a high concentration too rich to burn, since at some point the mixture will fall within the explosive or flammable range and may be very hazardous. Also, see "LEL or LFL."

unstable
Tending toward decomposition or other unwanted chemical change during normal handling or storage.

urticaria Nettle-rash; hives; elevated, itching, white patches.

UW APS University of Washington Administrative Policy Statements. Official University of Washington policies, available at http://www.washington.edu/admin/rules/APS/APSIndex.html .

vapor density The weight of a vapor or gas compared to the weight of an equal volume of air: an expression of the density of the vapor or gas. Materials lighter than air have vapor densities less than 1.0. Materials heavier than air have vapor densities greater than 1.0. All vapors and gases will mix with air, but the lighter materials will tend to rise and dissipate (unless confined). Heavier vapors and gases are likely to concentrate in low places (along or under floors; in dumps, sewers, and manholes; in trenches and ditches), where they may create fire, explosion, or health hazards.

vapor pressure The pressure exerted by a saturated vapor above its own liquid in a closed container. Vapor pressures reported on MSDS's are in millimeters of mercury (mm Hg) at 68 °F (20 °C), unless stated otherwise. (Typically, chemicals with lower boiling points will have higher vapor pressures; e.g., hexane with a boiling point of 69 °C has a vapor pressure of 100 mm Hg, while 1,3-xylene with a boiling point of 139 °C has a vapor pressure of 10 mm Hg

ventilation Circulation of air.

vertigo A feeling of revolving in space; dizziness, giddiness.

viscosity Measurement of the flow properties of material.

WAC Washington Administrative Code. The compilation of regulations written by State of Washington regulatory agencies. WACs can be reviewed online at http://apps.leg.wa.gov/wac/ . Regulations about safety and health are written by L&I, put into Title 296 and are also available at http://www.lni.wa.gov/Safety/Rules/Find/WACNumber/default.htm .

water reactive chemicals A chemical that reacts with water to release a gas that is either flammable or presents a health hazard. Store in a cool, dry place away from any water source. Have a Class D fire extinguisher available in case of fire.

WISHA

Washington Industrial Safety and Health Act. The legislative act that requires a state agency (L&I) to be responsible for drafting and monitoring compliance with safety and health regulations affecting employers and workers in Washington.

Appendix C
Templates for Lab Specific Information

Contents

Figures

A. Laboratory-Specific Data

The following pages contain templates that can be used to note laboratory-specific information that is required for your Chemical Hygiene Plan. File these pages in the front of the safety manual for easy reference.

Figure C-1 Laboratory Data

(Begins on next sheet)

Laboratory-Specific Information

This Laboratory Safety Manual/Chemical Hygiene Plan Belongs To:

Laboratory Name:	
Chemical Hygiene Officer*:	
Department:	
Phone:	
Date:	

* The Chemical Hygiene Officer is the Principal Investigator, Faculty Member, or Supervisor who is responsible for the Chemical Hygiene Plan in the unit or laboratory.

This Laboratory Safety Manual Covers the Following Laboratory Spaces:

This Laboratory Safety Manual Was Reviewed and Updated:
On: By:

The items listed below identify the laboratory-specific information which applies to this laboratory. Check marks indicate that the material is available on the following sheets or at a noted location:

✓	Laboratory-specific information cover sheet (*i.e.*, these pages)
	Laboratory floor plan(s)
	General laboratory safety rules, applicable throughout the laboratory
	Designations of individuals performing particular tasks (e.g., checking first aid supplies, maintaining chemical inventories, etc.)
	Authorizations for individuals to use specific hazardous/controlled substances
	Any special instructions for receiving and storing hazardous materials
	Contents of chemical spill kit(s)
	Any special instructions for labeling containers
	Training records, or location if filed separately from this Safety Manual
	Standard Operating Procedures (SOPs), or location if filed separately
	MyChem Chemical Inventory Report, or location if filed separately
	Locations of MSDSs, other reference materials, equipment maintenance manuals and other documents filed separately from this Safety Manual
	Location of building evacuation plan, departmental health and safety plan, and any other pertinent documents

B. Laboratory Floor Plans

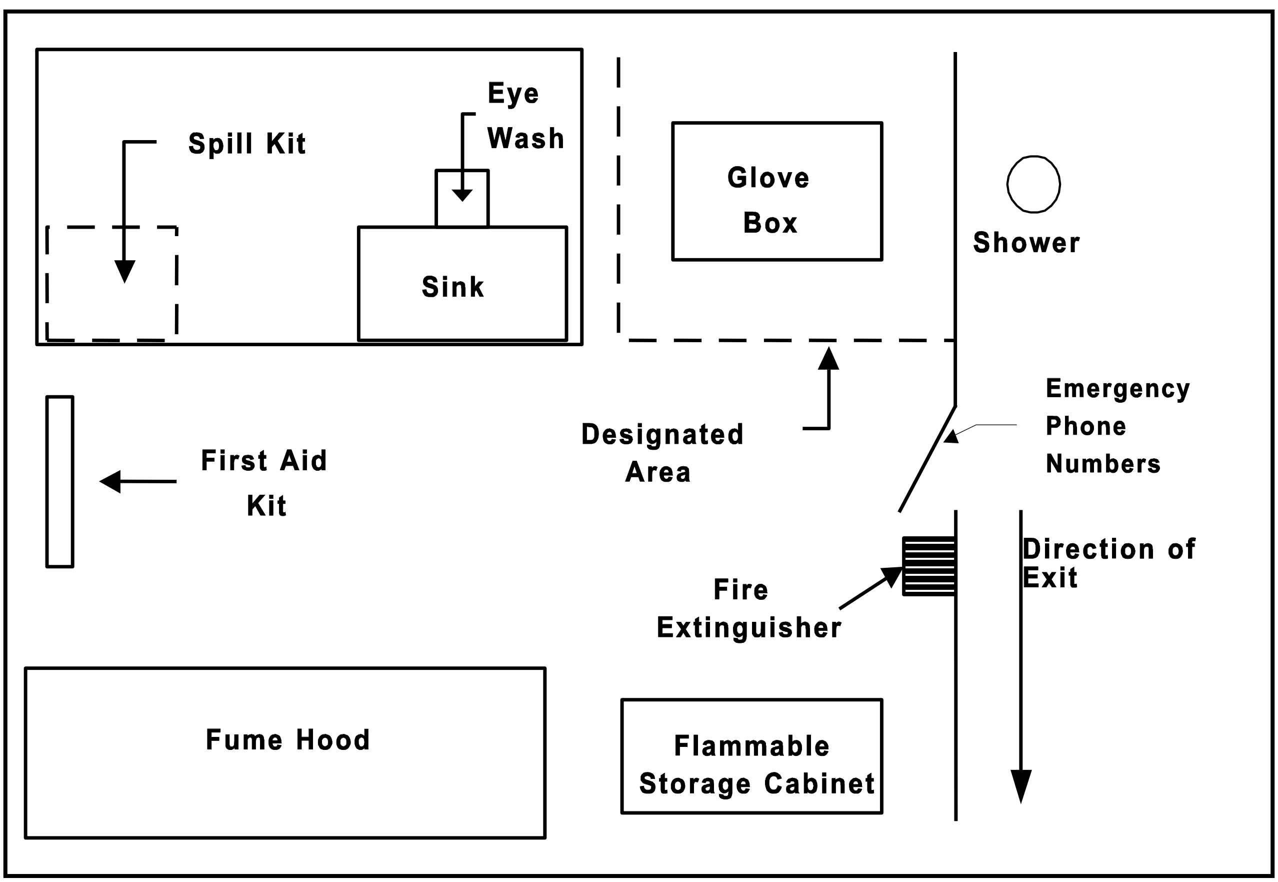
Draw a floor plan for each room that is covered by this manual. Place it/them in the My Lab Specific section at the front of this manual. Note the locations of any signs, safety equipment and process-related equipment that may be present. Please see the examples of such equipment, and an example floor plan, on the following page.

Eyewash Stations	**Emergency Phone Number Signs**
Emergency Showers	**Direction of Exit**
Fire Extinguishers	**Gas Shut-Off Valves for Benches**
First Aid Kits	**Ventilation Systems**
Flammable Liquid Storage Cabinets	**Spill Kits**
Glove Boxes	**Electrical Panels/Circuit Boxes**

Any other specialized equipment or operation with safety implications.

(If select carcinogens, reproductive toxicants, select agents, chemicals with a high degree of acute toxicity are in use, a "designated area" must be specified. This area can be the entire laboratory, a fume hood, or portion of the laboratory.)

Figure C-2 Example Floor Plan



C. Training Documentation Form

The following page shows an example form which could be used to document training. After being filled out to describe a training session, this form could be filed in the laboratory-specific information section or in a department's filing scheme. If filed separately from the laboratory-specific information section, the filing location should be noted in the laboratory-specific information section.

Figure C-3 Example Chemical Safety Training Log

Chemical Safety Training Log			
PI/Supervisor:			
Department:			
Documentation should include formal and informal safety discussions, including any internal meetings when the agenda includes any safety discussions. Log discussions on Personal Protective Equipment, ventilation systems, glove box requirements, specific chemical hazards, MSDS access, chemical storage plans, etc.			
Date	**Trainer**	**Trainees**	**Description of Safety Training**
Ex. 1/21/05	*Roberta Rosen*	*Tim Hansen, John Peil*	*Protective glove selection, use, disposal when handling solvents*
Ex. 2/12/05	*Dr. Albert Jones*	*Jerry Marshall, Roberta Rosen, April Shen*	*Hazards of new Montrose Model 550 GLC – outline attached*

Appendix D
Example Standard Operating Procedures

Contents

Figures

A. Standard Operating Procedure (SOP) Forms

A blank Standard Operating Procedure (SOP) form is shown in Figure D-1.

An electronic copy of this blank form is available in Word format at http://www.ehs.washington.edu/forms/epo/sopchemform.doc.

The following pages contain example SOPs. They contain general safety information. Please customize them to your unique situations.

We are looking to expand our collection of example SOPs. If you have an SOP that you think other departments in the university would like to refer to, please send an electronic copy to the UW Chemical Hygiene Officer at uwcho@u.washington.edu.

Figure D-1 Blank Standard Operating Procedure (SOP) Form

University of Washington

<table>
<tr><th colspan="4">Standard Operating Procedures for Chemicals or Processes</th></tr>
<tr><td>#1 Process
(if applicable)</td><td colspan="3"></td></tr>
<tr><td>#2 Chemicals</td><td colspan="3"></td></tr>
<tr><td>#3 Personal Protective Equipment (PPE)</td><td colspan="3"></td></tr>
<tr><td>#4 Environmental / Ventilation Controls</td><td colspan="3"></td></tr>
<tr><td>#5 Special Handling Procedures & Storage Requirements</td><td colspan="3"></td></tr>
<tr><td>#6 Spill and Accident Procedures</td><td colspan="3"></td></tr>
<tr><td>#7 Waste Disposal</td><td colspan="3"></td></tr>
<tr><td>#8 Special Precautions for Animal Use
(if applicable)</td><td colspan="3"></td></tr>
<tr><td colspan="2" rowspan="2">Particularly hazardous substance involved?</td><td>__ YES:</td><td>Blocks #9 to #11 are Mandatory</td></tr>
<tr><td>__ NO:</td><td>Blocks #9 to #11 are Optional.</td></tr>
<tr><td>#9 Approval Required</td><td colspan="3"></td></tr>
<tr><td>#10 Decontamination</td><td colspan="3"></td></tr>
<tr><td>#11 Designated Area</td><td colspan="3"></td></tr>
<tr><td colspan="2">Name:</td><td colspan="2">Title:</td></tr>
<tr><td colspan="2">Signature:</td><td colspan="2">Date:</td></tr>
</table>

Environmental Health and Safety, Box 354400 **to be filled in by PI or Supervisor*

Figure D-2 Example SOP for a Process

University of Washington

Standard Operating Procedures for Chemicals or Processes			
#1 Process (if applicable)	Solvent distillation (for recycling).		
#2 Chemicals	Ethanol, xylene, paraffin wax. Ethanol is flammable and a reproductive toxicant. Xylene is flammable, toxic and a suspected reproductive toxicant. Paraffin wax is not hazardous.		
#3 Personal Protective Equipment (PPE)	Standard PPE: Lab coat, goggles, closed toe shoes.		
#4 Environmental / Ventilation Controls	Xylene and ethanol are volatile. Xylene distillation unit is vented to atmosphere. Nearby walk-in fume hood can be used for chemical handling. Any other chemical handling is done in the fume hood in the wet lab room (room 114). Limit any handling of xylene and ethanol outside of the fume hood.		
#5 Special Handling Procedures & Storage Requirements	Chemicals are stored in 5 gallon HDPE carboys in a specially designed and designated flammables storage room. No more than 10 gallons (two carboys) may be stored out this storage room, even temporarily.		
#6 Spill and Accident Procedures	Spill kit is in cabinet next to distillation unit. Spill kit contains spill pads, gloves, bags. In the event of a spill, remove any source of spark or flame. Try to move spill toward walk in fume hood to ease cleanup. If spill is large and fumes are in the air, leave the room and call the UW EH&S Spills Line at 206-543-0467. If exposed, remove clothing and use the emergency shower located directly outside of room. If someone is incapacitated, call 911 and initiate first aid if possible.		
#7 Waste Disposal	This process produces a mixture of ethanol and paraffin wax that is hazardous waste. This haz waste has the EH&S waste routine #4444. Use the online form at http://www.ehs.washington.edu/forms/epo/routinepickup.php to request pickup of waste. Do not accumulate more than 55 gallons of this waste.		
#8 Special Precautions for Animal Use (if applicable)	N/A		
Particularly hazardous substance involved?		_x_ YES:	Blocks #9 to #11 are Mandatory
		__ NO:	Blocks #9 to #11 are Optional.
#9 Approval Required	Supervisor training required on this SOP and supporting materials, as well as basic lab emergency procedures.		
#10 Decontamination	Decontaminate surfaces with soapy water as necessary.		
#11 Designated Area	Flammables storage room, fume hood next to distillation unit, and fume hood in room 114.		
Name: Megan Kogut	Title: Supervisor		
Signature:	Date: 10.13.06		

Environmental Health and Safety, Box 354400 *to be filled in by PI or Supervisor*

Figure D-3 Example SOP for Acrylamide Use

University of Washington

Standard Operating Procedures for Chemicals or Processes			
#1 Process (if applicable)	Use of Acrylamide. Use in polyacrylamide gels.		
#2 Chemicals	Un-polymerized acrylamide is toxic (neurotoxin) and suspect carcinogen.		
#3 Personal Protective Equipment (PPE)	Double layers of nitrile gloves, lab coat, and goggles required when handling the solid powder. Use diapers when pouring gels.		
#4 Environmental / Ventilation Controls	Handle powder inside the designated fume hood located in *		
#5 Special Handling Procedures & Storage Requirements	Avoid getting the unpolymerized acrylamide on skin, gloves, clothing, etc.		
#6 Spill and Accident Procedures	If skin contact is made, wash copiously with water. Call Poison Control Center if necessary. Absorb spill with diatomaceous earth and call EH&S at 543-0467 for further information.		
#7 Waste Disposal	Polymerized acrylamide is non-toxic and can be disposed in the trash. Unpolymerized liquid is hazardous waste. Label with Hazardous Waste Label, accumulate according to requirements, and send in Chemical Collection Request or Routine Pickup request, both available online at http://www.ehs.washington.edu/epowaste/chemwaste.shtm.		
#8 Special Precautions for Animal Use (if applicable)	N/A		
Particularly hazardous substance involved?		_X_ YES:	Blocks #9 to #11 are Mandatory
		__ NO:	Blocks #9 to #11 are Optional.
#9 Approval Required	Users must receive specific process training and information about acrylamide from their supervisor before being authorized to perform procedures.		
#10 Decontamination	Double nitrile gloves. Use copious amounts of soap and water.		
#11 Designated Area	Inside fume hood between microscope and water bath.		
Name:		Title:	
Signature:		Date:	

Environmental Health and Safety, Box 354400 **to be filled in by PI or Supervisor*

Figure D-4 Example SOP for Benzene Use

University of Washington

Standard Operating Procedures for Chemicals or Processes	
#1 Process (if applicable)	Injections of Benzene Standards for Gas Chromatograph Calibrations and Sample Analyses (Note: *All use of benzene is strictly regulated by occupational health regulation WAC 296-849.)*
#2 Chemicals	Benzene, at known and unknown concentrations.
#3 Personal Protective Equipment (PPE)	Chemical splash goggles, butyl or natural rubber gloves, and a lab coat or apron is required.
#4 Environmental / Ventilation Controls	Benzene-containing solutions should be dispensed and used only in a properly operating fume hood. Syringe purging should also be done in the fume hood.
#5 Special Handling Procedures & Storage Requirements	Mixing and dispensing done in an operating fume hood with all sources of ignition turned off (hot plates, burners, etc.). Benzene stored in metal safety cans or glass bottles (1 liter maximum) as much as possible. Transported in spill-proof carriers. Benzene is stored in a flammable cabinet, separate from acids, bases, and oxidizers. The flammable cabinet is located _______________.
#6 Spill and Accident Procedures	Try to stop the spill if it is on-going. Remove all sources of ignition from the spill area. If splash on skin occurs, wash immediately with soap and water and remove any contaminated apparel while washing. Call 911 in the event of a spill beyond lab staff capabilities. Use absorbent pads or vermiculite to clean up small fume hood spills or to dike larger spills. Absorbent pads are stored in ________________. If a spill of more than ___ ml of benzene occurs outside the fume hood, vacate the room, close the door and call 911. If the quantity of benzene is in solution and does not easily evaporate, a spill cleanup by a contractor could be obtained by calling EH&S at 206-543-0467. Otherwise, the benzene could be allowed to evaporate. After clean-up or evaporation, room air must be monitored by EH&S prior to re-occupancy.
#7 Waste Disposal	For spills: place used absorbent in metal can with leak-proof lid. Over-pack with additional absorbent. Seal can. For all waste, label with Hazardous Waste Label, accumulate according to requirements, and send in Chemical Collection Request or Routine Pickup request, both available online at http://www.ehs.washington.edu/epowaste/chemwaste.shtm.
#8 Special Precautions for Animal Use (if applicable)	*

Particularly hazardous substance involved?		
	_X_ YES:	Blocks #9 to #11 are Mandatory
	___ NO:	Blocks #9 to #11 are Optional.

#9 Approval Required	Users must receive specific physical and health hazard information and safe laboratory work practices training from their supervisor. Representative breathing zone air sampling shall be taken to ensure that exposures do not exceed regulated levels. (Contact EH&S for additional information.)
#10 Decontamination	Immediately wash with soap and water.
#11 Designated Area	Room _______________ . Special signage may be required depending on air sampling results.

Name:	Title:
Signature:	Date:

Environmental Health and Safety, Box 354400 **to be filled in by PI or Supervisor*

Additional Information about Benzene

Exposure Limits as Set by the Washington State Department of Labor & Industries (at WAC 296-849):

8-hour Permissible Exposure Limit (PEL):	1.0 ppm
15-minute Short Term Exposure Limit (STEL):	5.0 ppm
8-hour Action Level (AL):	0.5 ppm

Hazards:

Benzene liquid is highly flammable. It should be stored in tightly closed containers in a cool, well ventilated area. Benzene vapor may form explosive mixtures in air. All sources of ignition must be controlled. Use non-sparking tools when opening or closing benzene containers. Fire extinguishers, where provided, must be readily available. Know where they are located and how to operate them. Smoking is prohibited in areas where benzene is used or stored.

Benzene can affect your health if inhaled, if it contacts skin or eyes, or if ingested. The most frequent work place route of entry is by inhalation, but benzene can be absorbed through the intact skin and will be absorbed faster through abraded skin.

High, short-term (acute) exposures may result in feelings of breathlessness, irritability, euphoria, giddiness, or irritation of the eyes, nose or respiratory tract. Also, headache, dizziness and feelings of nausea or intoxication may occur. Severe exposures may lead to convulsions and loss of consciousness.

Periodic exposures at lower levels (chronic exposures) may result in various blood disorders, ranging from anemia to leukemia (an irreversible, fatal disease). Many blood disorders associated with benzene exposure may occur without symptoms.

Exposure Monitoring

The supervisor must determine by breathing zone air monitoring if employees are over the AL or STEL. If levels are below the AL and STEL, no further air sampling is required unless procedures change. Affected employees must be informed of air monitoring results within 15 days of the supervisor receiving the results.

Training Requirements:

The Principal Investigator or supervisor must provide initial training to all personnel using benzene. If airborne levels reach or exceed the AL, annual benzene training is required. The training content must include the hazards of benzene, safety information, regulatory requirements, signs and symptoms of possible exposures to benzene, and medical surveillance requirements.

Medical Surveillance

Any employee who is exposed to benzene above the AL for more than 30 days per year, or exposed to benzene above the PEL for more than 10 days per year, must be evaluated by the Occupational Health Nurse. Based on the evaluation results, the nurse may recommend further evaluation, exposure restrictions, or job reassignment. Contact EH&S at 206-543-7388 for safety information, guidance for air monitoring strategies, equipment and analytical result interpretation.

Last revised on 09/06

Figure D-5 Example SOP for Ethidium Bromide Use

University of Washington

Standard Operating Procedures for Chemicals or Processes	
#1 Process (if applicable)	Ethidium bromide, used in staining DNA.
#2 Chemicals	Ethidium bromide (CAS Registry Number 1239-45-8). The material fluoresces a red-orange color under ultraviolet light, with increased fluorescence when the material is bound to double-stranded DNA. Ethidium bromide is typically purchased in powder or solution form and is soluble in water. The crystal or powder form is odorless and appears dark red in color. The powder form is considered an irritant to the upper respiratory track, eyes and skin. Ethidium bromide is strongly mutagenic, causing living cell mutations. Even though there is no evidence at this time of human carcinogenicity or teratogenicity, this material should be considered a possible carcinogen or teratogen. SybrSafe is a safer alternative to ethidium bromide. While it should be handled and disposed of as ethidium bromide, it is somewhat less mutagenic and therefore safer to handle.
#3 Personal Protective Equipment (PPE)	Lab coat, chemical splash goggles and nitrile gloves are required. Leave lab coats in the lab when your work is complete to prevent the spread of this or other chemicals outside of the lab. When an ultraviolet light source is used in your work with ethidium bromide, added caution is required. As a general rule, avoid exposing unprotected skin and eyes to intense UV sources. If the UV light is aimed upwards, wear a UV protective face shield when you are standing near the source. For prolonged work close to UV light boxes or other intense sources, it may be useful to wrap the end of the lab coat sleeves loosely with masking tape to prevent gaps where the wrist could be exposed. For low-intensity UV sources, the requirement for UV protection can be waived if the exposure to personnel has been measured and shown to be within permissible exposure levels. Contact Radiation Safety at 206-543-0463 if you need measurements of the UV levels in your facility.
#4 Environmental / Ventilation Controls	All operations involving powder or mists of ethidium bromide must be done in a fume hood. Check for proper operation of the fume hood prior to use.
#5 Special Handling Procedures & Storage Requirements	Liquid: Store in the dark and the cold, preferably in a plastic container. Solid: Store at the designated area.
#6 Spill and Accident Procedures	When working with ethidium bromide, try to minimize the potential for spills. Where practical, purchase ready-made stock solutions from chemical manufacturers in lieu of mixing your own solutions. If you prefer to mix your own solutions of ethidium bromide, protect yourself by doing this process in a fume hood. Perform all processes that generate ethidium bromide dusts or mists inside the fume hood to minimize inhalation exposures. Prevent accidents by transporting small quantities of ethidium bromide in a secondary container instead of carrying large quantities. Spills of ethidium bromide solutions should be absorbed and decontaminated with soap and water. Avoid raising dust when cleaning up solid spills by mixing with water and then absorbing the solution. All spill cleanup materials and absorbents should be bagged or placed in a sealed container with a hazardous waste label.

	Some facilities use a hand held UV lamp to check for residual ethidium bromide contamination following spill cleanup. A reddish-orange fluorescence can be detected under both "long" and "short" UV wavelengths. Users of the hand held lamps should be aware that their ability to detect small spills is not guaranteed. The ease of detection depends upon a variety of factors including the chemical composition of the sample, the wavelength of the UV lamp, and the intensity of the lamp. Use of a hand held UV lamp to detect traces of ethidium bromide may serve as an occasional check of laboratory practices, but it cannot substitute for good cleanliness and careful contamination control.
#7 Waste Disposal	EH&S recommends that ethidium bromide waste be treated using special filters. These filters use ion-exchange resins and activated charcoal to remove the ethidium bromide from solution. There are effective chemical treatments to destroy ethidium bromide, but filtering is an easier and safer choice. See http://www.ehs.washington.edu/epohazreduce/index.shtm for more information. Powders, concentrated solutions, and grossly contaminated items are hazardous waste. Label with Hazardous Waste Label, accumulate according to requirements, and send in Chemical Collection Request or Routine Pickup request, both available online at http://www.ehs.washington.edu/epowaste/chemwaste.shtm.
#8 Special Precautions for Animal Use (if applicable)	*

Particularly hazardous substance involved?	_X_ YES:	Blocks #9 to #11 are Mandatory
	__ NO:	Blocks #9 to #11 are Optional.

#9 Approval Required	Approval from PI prior to first use.
#10 Decontamination	Use copious amounts of soap and water.
#11 Designated Area	Fume hood at __________________. Check that the fume hood is operating properly before starting the procedure.

Name:	Title:
Signature:	Date:

Environmental Health and Safety, Box 354400 *to be filled in by PI or Supervisor

Figure D-6 Example SOP for Flammable Solvents Use

University of Washington

Standard Operating Procedures for Chemicals or Processes			
#1 Process (if applicable)	**Flammable Solvents**- use and storage - including the following:*		
#2 Chemicals	Flammable solvent vapors can travel and can produce fire and explosion if an ignition source is contacted. Some flammable solvents are more hazardous than others. Many solvents also have an effect on the central nervous system and at high concentrations cause sedation, coma and death. Contact with solvents can de-fat skin and cause irritation of skin and mucous membranes.		
#3 Personal Protective Equipment (PPE)	Wear chemical splash goggles, consult Appendix C for proper glove selection. Call EH&S (3-7388) for further information. A lab coat or apron is recommended for personal protection and is required when dispensing or cleaning up spill quantities greater than 1 liter.		
#4 Environmental / Ventilation Controls	Solvents should be dispensed only in a fume hood or in a well-ventilated space which has been approved and permitted by the Seattle Fire Department.		
#5 Special Handling Procedures & Storage Requirements	Mixing or dispensing should be done in a hood with all sources of ignition eliminated (hot plates, burners, etc.). Store in metal safety cans whenever possible. Solvents should be stored in appropriate flammable cabinets, separate from acids, bases, and oxidizers. Flammable cabinets located ____________________.		
#6 Spill and Accident Procedures	Remove all sources of ignition from the spill area if it is safe to do it. Small fires may be extinguished if it is safe and the operator is trained to use the fire extinguisher. Wipe down spill area with solvent absorbent pads. Solvent absorption pads are stored in _____________________________.		
#7 Waste Disposal	Label with Hazardous Waste Label, accumulate according to requirements, and send in Chemical Collection Request or Routine Pickup request, both available online at http://www.ehs.washington.edu/epowaste/chemwaste.shtm. Do not evaporate flammable solvents in the fume hood.		
#8 Special Precautions for Animal Use (if applicable)	*		
Particularly hazardous substance involved?		__ YES:	Blocks #9 to #11 are Mandatory
		_X_ NO:	Blocks #9 to #11 are Optional.
#9 Approval Required	N/A		
#10 Decontamination	N/A		
#11 Designated Area	N/A		
Name:	Title:		
Signature:	Date:		

Environmental Health and Safety, Box 354400 **to be filled in by PI or Supervisor*

Figure D-7 Example SOP for Formaldehyde Use

University of Washington

Standard Operating Procedures for Chemicals or Processes	
#1 Process (if applicable)	**Formaldehyde**-All use of formaldehyde and formaldehyde-containing solutions is regulated under Occupational Health regulation WAC 296-62-07540.
#2 Chemicals	Formaldehyde: Flammable liquid, irritant, sensitizer and potential human carcinogen. Permissible exposure limit (PEL) (8hrs.): 0.75 ppm, short term exposure limit (STEL) (15 min.) 2 ppm, action level (8hrs.): 0.5 ppm. Any product capable of releasing formaldehyde vapor of 0.1 to 0.5 ppm must be labeled that it contains formaldehyde, the availability of physical and health hazard information, and the name and address of the responsible party. For products capable of releasing formaldehyde vapor at levels of 0.5 ppm or above, the label must include the physical and health hazards as well as the warnings "respiratory sensitizer" and "potential cancer hazard".
#3 Personal Protective Equipment (PPE)	Chemical splash goggles and nitrile gloves must be worn to prevent eye contact and limit dermal exposure. A lab coat or apron is also required.
#4 Environmental / Ventilation Controls	Formaldehyde-containing solutions and preserved samples should be dispensed and used only in a properly operating fume hood. Routine use outside of a fume hood is acceptable only when formaldehyde levels are monitored and are below 0.5 ppm. Employers must determine by breathing zone air monitoring if employees are over exposed to formaldehyde. If the result of 8 hour monitoring is below the action level and the 15 minute monitoring is below the STEL, then no further air monitoring is required. However, if the work procedure changes, then monitoring must be repeated to ensure acceptable exposure levels. Affected employees must be informed of the formaldehyde exposure levels within 15 days of receiving the monitoring results. An employee reporting significant eye, nose, throat or dermal irritation or sensitization which might be a result of occupational exposure to formaldehyde shall be evaluated by the University's Occupational Health Professional. Based on the medical evaluation results, the Occupational Health Professional may recommend further evaluation, workplace exposure restrictions or reassignment.
#5 Special Handling Procedures & Storage Requirements	Mixing or dispensing should be done in a hood. Store in a cool dry well ventilated flammable liquid storage area or cabinet. Do not store with strong oxidizing or reducing agents, strong acids or bases, alkalies, alkali metals, amines, ammonia or phenol. Storage cabinet is located*
#6 Spill and Accident Procedures	If skin is exposed, wash immediately with soap and water. Flush mucus membranes with large amounts of water. Use drench shower in case of extensive contamination. Remove all sources of ignition from the spill area. Spills in fume hood - use absorbent pads or vermiculite to clean up small fume hood spills or to dike spill area. Clean up spill area with additional pads or paper towels. Absorbent pads can be found in ___________________. Spills in room - respiratory protection is required to clean up spills of formaldehyde greater than ___ ml outside an operating fume hood. If you are not certified to wear a respirator, call 206-543-0467 for the EH&S spill hotline for assistance in contacting a spill cleanup contractor. If it is an emergency (risk of fire or exposure to others) call 911. After cleanup, room air must be monitored by EH&S prior to occupancy.

#7 Waste Disposal	EH&S has a treatment program for formaldehyde; for more information see http://www.ehs.washington.edu/epohazreduce/index.shtm. If disposing of as hazardous waste, label with Hazardous Waste Label, accumulate according to requirements, and send in Chemical Collection Request or Routine Pickup request, both available online at http://www.ehs.washington.edu/epowaste/chemwaste.shtm.
#8 Special Precautions for Animal Use (if applicable)	Disposal of sample tissues or material soaked in formaldehyde should be disposed of by *___________________________________.
Particularly hazardous substance involved?	_X_ YES: Blocks #9 to #11 are Mandatory __ NO: Blocks #9 to #11 are Optional.
#9 Approval Required	Users must receive specified physical and health hazard information and safe laboratory work practices training from their supervisor. Lab supervisors must ensure that at least two representative breathing zone air samples have been taken for evaluation. Personnel using respirators must be enrolled in University's Respiratory Protection Program. For further information, air sampling guidelines, or a copy of the formaldehyde regulations contact EH&S at (206-543-7388).
#10 Decontamination	Wash affected area with soap and water.
#11 Designated Area	Room # *________. Special signage may be required depending on air sampling results (see #4 above). Contact EH&S (3-7388) for further information.

Name:	Title:
Signature:	Date:

Environmental Health and Safety, Box 354400 *to be filled in by PI or Supervisor*

Figure D-8 Example SOP for Gas Cylinder Use

University of Washington

Standard Operating Procedures for Chemicals or Processes	
#1 Process (if applicable)	**Gas cylinders** (Inert) Use of compressed gas cylinders (See CHP Sec **)
#2 Chemicals	Compressed gas cylinder present hazards because of the volume of gas and the pressures involved. Leaking or vented inert gas can displace breathing air. This SOP is for N2, Ar, Air, CO2, SF6, and _________________________________.
#3 Personal Protective Equipment (PPE)	Wear goggles. Gloves, face shield, lab coat or apron and/or respirator may be required for personal protection depending on the gas and use.
#4 Environmental / Ventilation Controls	Fittings and connections must be properly tested for leaks using a soapy water, 'Snoop' or other appropriate test system or meter. Do not use an open flame.
#5 Special Handling Procedures & Storage Requirements	All cylinders should be properly identified and the specific hazards of each cylinder should be known. Cylinders must be fastened securely at all times whether in use, transit, or storage. Cylinder safety caps must be in place whenever cylinders are not in use for an extended period of time or during transport. Proper valves and/or regulators for the specific gas must be used. Store and use cylinders in ventilated areas away from heat or ignition sources. When not in use, separate flammables and oxidizers. Transport large cylinders only on an approved dolly or cart. A dolly or cart is located ______________________.
#6 Spill and Accident Procedures	If safe, turn the gas valve off. For cylinders that continue to leak, refer to th e Laboratory Safety Manual section 9 or contact EH&S at 206-543-0467.
#7 Waste Disposal	Empty nontoxic or non-corrosive gas cylinders should be marked 'empty' and returned to ________________. Empty gas cylinders that contained toxic or corrosive gases must be stored in a fume hood or well ventilated space for pickup by the supplier. For more information, see the Laboratory Safety Manual, section 3 Waste Management.
#8 Special Precautions for Animal Use (if applicable)	*

Particularly hazardous substance involved?	__ YES:	Blocks #9 to #11 are Mandatory
	_X_ NO:	Blocks #9 to #11 are Optional.

#9 Approval Required	N/A
#10 Decontamination	N/A
#11 Designated Area	N/A

Name:	Title:
Signature:	Date:

Environmental Health and Safety, Box 354400 **to be filled in by PI or Supervisor*

Figure D-9 Example SOP for Inorganic Acid Use

University of Washington

Standard Operating Procedures for Chemicals or Processes	
#1 Process (if applicable)	**Inorganic Acids** - handling, dispensing, and diluting acids including: *____.
#2 Chemicals	Acids cause burns to skin and eyes upon contact and to mucous membranes if inhaled or ingested.
#3 Personal Protective Equipment (PPE)	Wear chemical splash goggles and heavy-duty neoprene gloves for concentrated acids. For diluted acids greater than pH 2, use nitrile gloves. A lab coat or apron is recommended for personal protection.
#4 Environmental / Ventilation Controls	Concentrated acids should be dispensed in a fume hood.
#5 Special Handling Procedures & Storage Requirements	When diluting acids, small amounts should be added gradually to water and mixed thoroughly to dissipate any heat generated. Inorganic and organic acids should be stored in separate bins in the acid storage cabinets. Acids should be stored separately from bases, oxidizers and flammable solvents. Acids in glass bottles over 1 liter should be transported in spill proof carriers. Acids are stored *____.
#6 Spill and Accident Procedures	In case of skin contact, flush affected areas with copious amounts of water for 15 minutes. Obtain medical attention. Neutralize any spilled acids with sodium bicarbonate or spill pads to clean up. Spill kit can be found*_________________.
#7 Waste Disposal	EH&S has a treatment program for acids and bases; for more information see http://www.ehs.washington.edu/epohazreduce/index.shtm. If disposing of as hazardous waste, label with Hazardous Waste Label, accumulate according to requirements, and send in Chemical Collection Request or Routine Pickup request, both available online at http://www.ehs.washington.edu/epowaste/chemwaste.shtm.
#8 Special Precautions for Animal Use (if applicable)	*
Particularly hazardous substance involved?	__ YES: Blocks #9 to #11 are Mandatory _X_ NO: Blocks #9 to #11 are Optional.
#9 Approval Required	N/A
#10 Decontamination	N/A
#11 Designated Area	N/A
Name:	Title:
Signature:	Date:

Environmental Health and Safety, Box 354400 *to be filled in by PI or Supervisor*

Figure D-10 Example SOP for Inorganic Base Use

University of Washington

Standard Operating Procedures for Chemicals or Processes			
#1 Process (if applicable)	**Inorganic Bases** - handling, dispensing, and diluting including: ___________.		
#2 Chemicals	Bases cause burns to skin and eyes upon contact and to mucous membranes if inhaled or ingested.		
#3 Personal Protective Equipment (PPE)	Wear chemical splash goggles. For concentrated bases use heavy duty neoprene gloves or natural rubber gloves. A lab coat or apron is recommended for personal protection and is required when dispensing quantities greater than 1 liter or when cleaning up a spill of a quantity greater than 1 liter.		
#4 Environmental / Ventilation Controls	Concentrated bases should be dispensed in a fume hood.		
#5 Special Handling Procedures & Storage Requirements	When diluting bases, small amounts should be added gradually to water and mixed thoroughly to dissipate any heat generated. Bases should be stored separately from acids, oxidizers, and flammable solvents. Bases in glass bottles over 1 liter should be transported in spill proof carriers. Bases are stored __________________.		
#6 Spill and Accident Procedures	In case of skin contact, flush affected areas with copious amounts of water for 15 minutes. Obtain medical attention. Neutralize any spilled base with citric acid. Spill kit can be found ___________________.		
#7 Waste Disposal	EH&S has a treatment program for acids and bases; for more information see http://www.ehs.washington.edu/epohazreduce/index.shtm. If disposing of as hazardous waste, label with Hazardous Waste Label, accumulate according to requirements, and send in Chemical Collection Request or Routine Pickup request, both available online at http://www.ehs.washington.edu/epowaste/chemwaste.shtm.		
#8 Special Precautions for Animal Use (if applicable)	*		
Particularly hazardous substance involved?		__ YES:	Blocks #9 to #11 are Mandatory
		_X_ NO:	Blocks #9 to #11 are Optional.
#9 Approval Required	N/A		
#10 Decontamination	N/A		
#11 Designated Area	N/A		
Name:		Title:	
Signature:		Date:	

Environmental Health and Safety, Box 354400 **to be filled in by PI or Supervisor*

Figure D-11 Example SOP for Mercury Use

University of Washington

Standard Operating Procedures for Chemicals or Processes			
#1 Process (if applicable)	**Mercury** - handling (lab use, thermometers, etc) including: ___________________ (The state of Washington has a ban on mercury products as described at http://www.ehs.washington.edu/eporecycle/hg.shtm. All mercury thermometers should be replaced with alcohol thermometers as soon as possible).		
#2 Chemicals	Metallic mercury at elevated temperatures (*e.g.*, drying ovens, water baths, incubators) will vaporize and may reach concentrations which will adversely affect worker health.		
#3 Personal Protective Equipment (PPE)	Safety glasses, gloves and a lab coat or apron are recommended for personal protection and are required during dispensing and spill cleanup activities.		
#4 Environmental / Ventilation Controls	If working with elemental mercury, the mercury should be in an enclosed vessel.		
#5 Special Handling Procedures & Storage Requirements	Use an unbreakable container when transporting thermometers or other mercury containing equipment. Dispense mercury in a pan with raised edges to contain spills. If possible place a plastic tub under equipment containing large amounts of mercury.		
#6 Spill and Accident Procedures	Prevent others from entering the area of the spill. Do not allow any mercury to contact shoes or be tracked into a wider area. Spills less than 5 ml (e.g. thermometer) should be cleaned up according to the instructions in the mercury spill cleanup kit which is located ____________________. A mercury vacuum may also be used. User instructions should be attached to the machine. Users should receive specialized training regarding proper use of the unit prior to their first use. The mercury vacuum is located ________________________. or borrow a mercury vacuum from EH&S. For more information about mercury spills, see http://www.ehs.washington.edu/epo/spills/hgspills.shtm. Call EH&S at 206-543-0467 for help with mercury spills.		
#7 Waste Disposal	Place mercury and contaminated materials, such as broken glass, into a screw capped plastic container. Label with Hazardous Waste Label, accumulate according to requirements, and send in Chemical Collection Request or Routine Pickup request, both available online at http://www.ehs.washington.edu/epowaste/chemwaste.shtm.		
#8 Special Precautions for Animal Use (if applicable)	*		
Particularly hazardous substance involved?		_X_ YES:	Blocks #9 to #11 are Mandatory
		___ NO:	Blocks #9 to #11 are Optional.
#9 Approval Required	The PI must train staff on procedures and observe the first procedure of a new employee prior to allowing independent work.		
#10 Decontamination	Request EH&S monitor the area for mercury after clean-up and before allowing un-restricted access to the area.		
#11 Designated Area	Mercury which is not in an enclosed device (such as a thermometer) can only be used in the fume hood in room ____. Check to ensure it's operating before starting the procedure.		
Name:		Title:	
Signature:		Date:	

Environmental Health and Safety, Box 354400 *to be filled in by PI or Supervisor

Figure D-12 Example SOP for Oxidizer Use

University of Washington

Standard Operating Procedures for Chemicals or Processes			
#1 Process (if applicable)	**Oxidizers** - use and storage - including the following: (*This SOP is not suitable for Perchlorate acid or HF acid*.) *___________________________ ___________________________		
#2 Chemicals	Oxidizers such as dichromates, permanganates, sulfurics, or perchlorates may cause skin irritation or sensitization. Besides these hazardous properties, many oxidizers may present fire and explosion hazards.		
#3 Personal Protective Equipment (PPE)	Wear chemical splash gloves and heavy duty nitrile or neoprene gloves. Call EH&S (3-0467) for further information if needed. A lab coat or apron is recommended for personal protection and is required when dispensing or cleaning up a spill of a quantity greater than 1 liter of liquid or 0.5 kg of a solid.		
#4 Environmental / Ventilation Controls	Volatile oxidizers should be dispensed in a fume hood.		
#5 Special Handling Procedures & Storage Requirements	Store separate from organic compounds, flammable materials, metals, and other easily oxidizable materials; do not use metal containers. Do not use metal containers for oxidizer storage. Storage location * ___________________ ___________________________.		
#6 Spill and Accident Procedures	Absorb a liquid spill with suitable diatomaceous earth or universal spill pads, except for concentrated nitric acid. Neutralize concentrated nitric acid with copious amounts of baking soda. Place used absorbent materials in plastic containers.		
#7 Waste Disposal	Label with Hazardous Waste Label, accumulate according to requirements, and send in Chemical Collection Request or Routine Pickup request, both available online at http://www.ehs.washington.edu/epowaste/chemwaste.shtm.		
#8 Special Precautions for Animal Use (if applicable)	*		
Particularly hazardous substance involved?		__ YES:	Blocks #9 to #11 are Mandatory
		_X_ NO:	Blocks #9 to #11 are Optional.
#9 Approval Required	N/A		
#10 Decontamination	N/A		
#11 Designated Area	N/A		
Name:	Title:		
Signature:	Date:		

Environmental Health and Safety, Box 354400 **to be filled in by PI or Supervisor*

Figure D-13 Example SOP for Peroxide-Forming Chemicals Use

University of Washington

Standard Operating Procedures for Chemicals or Processes	
#1 Process (if applicable)	Peroxide forming chemicals - use and storage including: ______________________ ____.
#2 Chemicals	These chemicals can form highly explosive peroxide compounds as impurities when exposed to air over a period of time. Peroxide formation is prevented by strict inventory control of opened peroxidizable chemicals. Most compounds are also flammable and toxic.
#3 Personal Protective Equipment (PPE)	Wear goggles and butyl gloves unless other hazards indicate another selection. A lab coat or apron is recommended for personal protection.
#4 Environmental / Ventilation Controls	Peroxidizable compounds should be dispensed in a fume hood.
#5 Special Handling Procedures & Storage Requirements	Store separate from acids, bases, and oxidizers. Store in metal safety cans if possible. Label all containers with the date the original container was opened. If transferred to another container, label with the date the original container was opened. Discard any remaining chemical at the end of the time limit. Do not open jars that show any sign of aging or crystal formation8. Peroxidizable chemicals are stored __________________. For more information, please refer to the Peroxide Forming Chemicals Management and Assessment Guidelines, online at http://www.ehs.washington.edu/forms/epo/peroxideguidelines.pdf.
#6 Spill and Accident Procedures	Remove all sources of ignition from the spill area. Wipe down spill area with solvent absorbent pads.
#7 Waste Disposal	Label with Hazardous Waste Label, accumulate according to requirements, and send in Chemical Collection Request or Routine Pickup request, both available online at http://www.ehs.washington.edu/epowaste/chemwaste.shtm.
#8 Special Precautions for Animal Use (if applicable)	*
Particularly hazardous substance involved?	__ YES: Blocks #9 to #11 are Mandatory _X_ NO: Blocks #9 to #11 are Optional.
#9 Approval Required	N/A
#10 Decontamination	N/A
#11 Designated Area	N/A
Name:	Title:
Signature:	Date:

Environmental Health and Safety, Box 354400 *to be filled in by PI or Supervisor*

Figure D-14 Example SOP for Phenol Use

University of Washington

Standard Operating Procedures for Chemicals or Processes			
#1 Process (if applicable)	**Phenol** Use in molecular biology.		
#2 Chemicals	Causes severe burns, toxic if inhaled or skin contact, poison, readily absorbed by skin.		
#3 Personal Protective Equipment (PPE)	Neoprene or natural rubber gloves, double gloves; lab coat: chemical goggles. A rubber or neoprene apron must be worn when pouring liquids and splashes may occur.		
#4 Environmental / Ventilation Controls	A protective shield is required around all pressurized systems handling phenol. Use phenol only in the fume hood at*		
#5 Special Handling Procedures & Storage Requirements	Store saturated phenol in the cold (4ºC)		
#6 Spill and Accident Procedures	Use drench shower or eyewash immediately if any contact with skin/eyes, and seek medical attention. Personnel in this lab are only allowed to clean up spills inside the fume hood of _______ ml or less using absorbent. For spills outside the fume hood or larger spills, evacuate the laboratory, prevent re-entry by un-authorized personnel, and call the EH&S spills line at 206-543-0467 for help.		
#7 Waste Disposal	Label with Hazardous Waste Label, accumulate according to requirements, and send in Chemical Collection Request or Routine Pickup request, both available online at http://www.ehs.washington.edu/epowaste/chemwaste.shtm.		
#8 Special Precautions for Animal Use (if applicable)	*		
Particularly hazardous substance involved?		_X_ YES:	Blocks #9 to #11 are Mandatory
		__ NO:	Blocks #9 to #11 are Optional.
#9 Approval Required	Approval by PI before first use.		
#10 Decontamination	Wear face shied to protect face and eyes from splatters, rubber gloves, boots and apron. Flood area with water and cover with caustic soda ash to neutralize any un-absorbed phenol.		
#11 Designated Area	Inside fume hood only.		
Name:		Title:	
Signature:			Date:

Environmental Health and Safety, Box 354400 **to be filled in by PI or Supervisor*

Appendix E
Checklists

Appendix E
Checklists

Contents

A. Earthquake Preparation Checklist for Laboratory Personnel

The following checklist is designed to help Department Chairs, Principal Investigators, and laboratory supervisors and personnel perform earthquake self-assessments. Use this list of questions to help identify situations that may pose a problem in an earthquake.

For free informational handouts on earthquake preparedness (including for home/family), call EH&S Training at 543-7201. Also check the Office of Emergency Management webpage for more earthquake preparedness information: http://www.washington.edu/admin/business/oem/hazards/earthquake.html

Preparing For A Major Earthquake

- If an earthquake occurred right now, where would you go for protection?
  - ❑ Locate safe and danger spots in your area. Decide if you would go under a desk or table, in a safe corner, or out of the lab against a corridor wall.
  - ❑ Consider flying glass hazards from windows and glass and falling hazards from light fixtures, books, pictures, and equipment when selecting safe spots.
- Do you know the evacuation routes from your building?
  - ❑ If you're unfamiliar with your evacuation route(s), refer to your department's Emergency Evacuation and Operations Plan (EEOP) or contact your evacuation warden or evacuation director. For further information on evacuation routes from your building, contact EH&S Facility Safety at 543-0465.
  - ❑ Post a lab floor plan near laboratory exits that shows exit routes.
  - ❑ Do not leave the building until the tremors have stopped.
- Where is the primary evacuation assembly point (EAP) for your building, department, or work unit? Where is an alternate EAP in case your primary EAP happens to be downwind of a chemical or gas release or otherwise unusable?
  - ❑ Check your departmental health and safety plan or EEOP for location(s) of EAPs.
- Are gas cylinders well secured in an upright position?
  - ❑ Are pressure regulators removed and cylinder caps in place on cylinders not in use?
  - ❑ Are two cylinder straps or chains fastened to the lab wall for each cylinder?
- Are chemicals stored properly?
  - ❑ Are chemicals recapped and returned to their storage cabinets immediately after use?
  - ❑ Are chemical storage cabinets closed and latched?
  - ❑ Are chemical storage cabinets secured to prevent tipping or movement?
  - ❑ Are storage shelves equipped with lips or restraints to keep chemicals and glassware in place?
  - ❑ Are waste and unwanted chemicals removed in a timely fashion?
  - ❑ Are chemicals stored in secondary containment trays or tubs?
  - ❑ Are non-compatible chemicals stored separately?

- Are fume hood sashes closed as far as possible to contain spills while still maintaining adequate ventilation rates?

- Are heavy pieces of equipment and furniture that might block exit routes secured? Are exits and aisle ways maintained free and clear of obstructions?

- Do you have equipment and/or processes that could be damaged or pose a fire or health hazard if the power goes out? What contingency plans have been made to provide backup or emergency power to maintain critical systems?

- Are safety systems (*e.g.*, fire extinguishers, safety showers, eyewashes) accessible and in proper operating condition? Does everyone in the lab know how to operate them?

- Are chemical and biological spill kits available?

- Is extra food, water, flashlight, radios and batteries available?

Operations after a Major Earthquake

- After the shaking stops:
  - ❑ check for injured or physically limited people who might have trouble evacuating the building
  - ❑ turn off gas burners
  - ❑ check quickly for fires, fire hazards, or spilled chemicals
  - ❑ close the lab door as you leave
  - ❑ bring emergency supplies (first aid kit, flashlights, etc.) to the evacuation assembly point
  - ❑ report crucial items or hazards to the appropriate official at the evacuation assembly point
  - ❑ do not reenter the building until the building has been declared safe for entry by trained emergency personnel

- Depending on the time and circumstances of the earthquake, you may be asked to stay out of the building for a few minutes to a few days--or indefinitely. Develop long-term plans in case you cannot get back into your laboratory. Contact UW Office of Emergency Management for assistance in developing Business Continuity Plans. Here are some items to consider:
  - ❑ Which experiments and data are your first priorities?
  - ❑ Do you have plans for routine necessary tasks such as taking care of lab animals or making sure that you have enough liquid nitrogen for freezers? (Remember that normal distribution systems may not work, so you should have your own supply.)
  - ❑ Do you have backup copies of important data?

Conclusion

Each of these items could be critical for the health and safety of laboratory occupants. While this checklist is directed toward earthquakes, building fires and other natural or man made disasters could have a similar impact on your laboratory and staff. We encourage you to discuss these plans and take whatever action is necessary to see that all items are addressed. Practice your disaster plans periodically to assure that the plans meet the requirements of current laboratory operations, that all staff are familiar with both the overall plan and their specific role, and that the plan is successful in accounting for staff and in reporting staff and laboratory conditions to key department administrators.

B. Annual Laboratory Safety Survey Checklist

University of Washington Environmental Health and Safety Annual Laboratory Survey Checklist			
Principal Investigator: Date:			
Lab Contact:			
Room Number: Lab Name/Function:			
Building: Department:			
Please check "YES," "NO," or "NOT APPLICABLE" for each item. Comments may be written next to the question or at the end of the survey. Questions answered "NO" require follow-up.			
Y	**N**	**N A**	**Laboratory Self-Assessment**
			A. Written Laboratory Safety Policies/Procedures/Programs
			1. Do you have a current version of the UW Laboratory Safety Manual and is it accessible to every worker in the laboratory?
			a. Has laboratory-specific information been added to the Manual?
			b. Are Standard Operating Procedures (SOPs) addressing all hazardous processes/chemicals up-to-date and in (or referenced in) the Manual?
			2. Does your laboratory or department have written procedures for:
			a. Describing any revised procedures necessary due to laboratory work outside usual work hours (such as first aid/emergency response)?
			b. Chemical, biohazard and radioactive material spills (as applicable)?
			c. Emergencies such as sudden loss of power, fire, severe weather; earthquake;.?
			d. Planned shutdown of gas, water, or electricity?
			3. Are records kept of safety inspection results and corrective actions?
			4. Are safety procedures/issues discussed at staff, department, or other committee meetings, and are the discussions documented as records of safety training?
			B. Employee and Visitor Training
			1. Do laboratory personnel working with hazardous materials receive training in the following subjects:
			a. Chemical safety including personal protective equipment, chemical storage, and emergency procedures, fume hood use, chemical waste disposal?
			c. Biohazard waste disposal, as applicable?
			d. Radioactive waste disposal, as applicable?
			e. Fire extinguisher training?
			f. Location and use of safety/deluge showers and eye washes?
			j. Bloodborne pathogen exposure control, as applicable?
			k. Shipping/transporting hazardous materials, if needed?
			2. Does your research supervisor or department keep records of what training was provided, detailing the instructor's name, date, who attended, and scope of training?
			3. Have employees been instructed in the following:
			a. What phone number to call for emergency assistance?
			b. Where the nearest fire alarm is located?

			c. Where the nearest fire extinguisher is located? (Employees must be trained how to use if it they plan on using it in an emergency.)
			d. How to evacuate upon hearing an alarm or other warning?
			4. Are employees aware that they should call EH&S to arrange for a hazmat contractor to clean up or contain spills of any unknown hazardous substances or other spills that cannot be cleaned up safely by laboratory personnel due to risk of exposure or lack of spill cleanup equipment?
			5. Are faculty, staff and students aware of the meaning of all laboratory warning labels and signs used in the lab?
			6. Are records kept of new employee and visitor safety orientations?
			7. Are records kept of employee safety training (required and refresher training)?
			C. General Emergency Preparedness
			1. Are the following posted:
			a. Emergency phone numbers?
			b. Emergency instructions addressing fire, medical and chemical emergencies, and biohazard and radiation emergencies as needed?
			2. Do employees know:
			a. The location of safety showers and eyewashes?
			a. The location of the nearest fire alarm pull box?
			b. The number of exits (doors) in the laboratory? _______
			c. The number of escape “kick-out” panels in laboratory? _______
			d. That fire codes prohibit the use of any door wedges?
			e. The location of the fire extinguisher(s) in this laboratory?
			f. Location(s) of chemical spill kits?
			g. Location(s) of complete/up-to-date first-aid kits and supplies?
			h. The posted location of the Washington State Labor & Industries poster entitled "Job Safety & Health Protection”? (Available from EH&S)
			3. Have employees been provided information about the importance of personal emergency preparedness? ??
			4. If the lab has an emergency preparedness kit or supplies, have it/they been checked in the last 6 months?
			5. Is a First Aid and CPR – certified responder available on all shifts that employees are working?
			a. Do all workers know who these people are, or how to contact the responding agency?
			b. Are instructions for contacting the responding agency posted, or are these responders listed by name on a sign or in a document (such as department Safety and Health Plan or Lab. Safety Manual)?
			D. Laboratory Conditions
			1. Does this lab use proper housekeeping practices which include:
			a. Removal of spills and residues on floor/bench tops?
			b. Uncluttered benchtops and hoods?
			c. Clear (3 foot) pathways to eyewashes and safety showers?
			d. Clear (3 foot) pathways to exits, both inside and outside the laboratory?
			e. Easy access to electrical panels?
			2. Electrical Equipment

			a. Is equipment plugged into permanent outlets (not extension cords)?
			b. Are multi plug fused power strips used if permanent wiring outlets are not available?
			c. If electrical equipment or power strip has frayed/damaged cords or damaged plugs, has it been removed from service until repaired?
			3. General Lab Equipment
			a. Are belts, pulleys, and other exposed moving equipment parts guarded?
			b. For reduced pressure processes, is there a filter or trap between the experimental setup and the evacuating equipment?
			c. If a research pressurized vessel or a similar high-pressure system is in use, has it been pressure tested? (Do not include compressed gas cylinders or lab bench gases.)
			d. If a pressurized vessel or system is in use and if the vessel or system should have an over pressure device, does it have one?
			e. Are explosion shields available if they are needed?
			f. Is equipment serviced to ensure that it functions safely?
			g. Are equipment service and inspection records kept?
			4. Safety Equipment
			a. Is a first-aid kit available which is appropriate for the size of the lab and located in an easily accessible spot?
			b. Is the lab first-aid kit fully stocked with non-expired materials?
			c. If corrosive, irritating or substances toxic by eye contact are being used, can an eye wash be reached within 10 seconds (approximately 50 feet)?
			d. If corrosive, irritating or substances toxic by skin contact are being used, can a safety shower be reached within 10 seconds (approximately 50 feet)?
			e. If a fume hood is available, does it have a valid EH&S certification sticker that marks the sash height for 100 feet per minute airflow?
			f. If a fume hood is available, are the electrical receptacles (sockets) outside the hood?
			5. If the room has ceiling sprinklers, is the lab maintaining an 18 inch clearance below the sprinklers?
			6. Is the general room ventilation adequate (temperature and odors controlled, etc.)?
			E. Hazardous Material Safety *(Materials considered potentially hazardous include cleaners, solvents, laboratory chemicals, grease, disinfectants, dental products, etc.)*
			1. Is a current inventory of hazardous materials on MyChem?
			2. Do all lab personnel have access to Material Safety Data Sheets (MSDSs) during all hours of operation?
			a. If the method is to download MSDSs from MyChem, can all employees prove they know how to get an MSDS?
			b. If the method is to maintain a file of hard copy MSDSs, can all employees prove they know where the file is located?
			c. Are MSDSs available for all hazardous chemicals used in the laboratory?
			3. Are all containers labeled, showing chemical contents and appropriate hazard warning labels?
			4. Are incompatible hazardous materials isolated from each other (*i.e.*, stored according to chemical class)?
			5. If hazardous materials are stored in this laboratory, are they stored in:
			a. A mechanically ventilated storage area?
			b. Chemically-resistant containers?

			c. Designated areas such as placarded cabinets, shelves, etc.?
			6. Are chemical storage shelves:
			a. Protected with a lip or barrier?
			b. Designed and installed to carry the current load?
			7. If present, are refrigerators containing hazardous materials placarded to identify contents and restrictions (*e.g.*, "NO FOOD")?
			8. If a refrigerator is used to store flammable materials, is it explosion-proof and labeled as explosion proof?
			9. If ten (10) gallons or more of flammable liquids are in a room:
			a. Are the flammable liquids stored in a storage cabinet designed for storing flammables?
			b. Are flammable liquids storage areas located away from open flames or sparks, and labeled (*e.g.*, with signs reading "Flammable")?
			10. Are ethers and peroxide-forming compounds (*e.g.*, aldehydes, ethers, benzylic hydrogen compounds, allylic compounds, vinyl compounds) dated when received by the department and when opened in the lab?
			11. Are the dated containers of ethers and peroxide-forming compounds checked to ensure they do not exceed allowable storage times?
			12. Are all staff familiar with storage, handling, and testing of peroxide-forming chemicals prior to performing procedures that can increase potential for peroxide development (e.g., distillations)?
			13. Are piping (tubing), valves, and fittings compatible with the hazardous materials for which they are used and checked periodically for integrity?
			14. If compressed gas cylinders are located in the lab:
			a. Are the cylinders secured with chains/straps at two levels when used in a permanent location, or secured on an approved cart?
			b. Are the cylinders capped when not in use?
			c. Are the cylinders stored away from heat sources?
			15. Are staff aware that state safety regulations protect worker's exposure for many specific hazardous materials (such as, but not limited to benzene, formaldehyde, lead, vinyl chloride, and chemicals considered particularly hazardous; *i.e*. carcinogens, highly acute, and reproductive toxicants)?
			16. Are there designated and labeled areas for handling particularly hazardous substances? (These particularly hazardous substances include but are not limited to select carcinogens, reproductive toxicants, select agents, and materials with high acute toxicity.)
			17. Are the designated and labeled areas (# 16 above) supplied with local exhaust, such as a fume hood?
			18. Is an external container like a Rubbermaid tub always used when carrying particularly hazardous materials and multiple containers, and whenever possible when carrying less hazardous materials?
			19. Are all hazardous procedures and processes using hazardous materials conducted in a fume hood?
			20. Are unnecessary materials removed from the hood so that procedures can be performed at least six inches inside the face of the hood?
			21. Has the laboratory replaced their reagents, procedures or equipment with less hazardous materials (such as mercury-containing thermometers) when possible?
			22. Are chemical spill cleanup supplies (*e.g.*, absorbents like spill pads and diatomaceous earth, neutralizers like citric acid) readily available in the lab and selected based on materials likely to spill (*e.g.*, if mercury is used, is a mercury spill kit available)?
			F. Biological Safety
			1. If laboratory operations involve potential biohazard exposures, is a copy of the current UW Biosafety Manual available?
			2. If the Bloodborne Pathogen Standard applies, have all of the staff:
			a. Received the required training?

			b. Received the Hepatitis B immunization or signed a declination?
			3. Has the Principal Investigator submitted a "Research Project Hazard Assessment Form" for all research ongoing in the laboratory?
			4. If the laboratory's activities involve recombinant DNA, does it have a current project registration with the UW Institutional Biosafety Committee?
			5. Is a biosafety cabinet used for procedures where the manipulation of potentially infectious material could create aerosols or splashes?
			6. Are sharps placed in sharps containers at point of generation and autoclaved prior to disposal?
			7. Are biohazardous liquid wastes decontaminated by autoclaving, bleaching, or other methods before disposal via the sewer?
			8. Are biohazardous solid wastes autoclaved before disposal?
			G. Radiation Safety
			1. Are radiation safety inspections periodically performed?
			H. Hazardous Chemical Wastes *Anyone generating wastes (such as labs, shops, stores, etc.) bears the responsibility for handling the waste according to all Federal, State, County, and University regulations. Waste reduction and minimization are important in reducing hazards and/or quantities of wastes.)*
			1. Do people responsible for purchasing chemicals review reference materials (such as MSDSs available in MyChem) to evaluate materials before purchase to select the least toxic materials possible and to identify possible waste streams?
			4. Are employees familiar with the procedure for requesting chemical or radioactive waste pickup by EH&S?
			5. Are glass and sharp plastic waste segregated and disposed of separately from general trash?
			6. Is glass waste properly packaged and labeled?
			7. Are empty containers originally containing acutely-hazardous chemicals triple rinsed prior to being discarded?
			8. A limited number of chemicals can be disposed of in the sink. If any of these chemicals are disposed of in the sink:
			a. Is the required Sewer Discharge Log maintained?
			I. Personal Protective Equipment (PPE)
			1. Have potential exposure hazards been assessed?
			2. If PPE (e.g., gloves, goggles, face shields, lab coats, safety glasses with side-shields, etc.) is required, have the requirements been noted in SOPs, health and safety plans, or other guidance used by all laboratory workers?
			3. Is required PPE available and in good condition?
			4. Are all laboratory personnel:
			a. Instructed as to general departmental rules for PPE (such as rules to remove and store lab coats in the laboratory before leaving) and any process specific requirements for additional PPE?
			b. Informed as to where these rules are posted or filed?
			c. Trained in the correct procedures for selecting the appropriate PPE, inspecting for damaged PPE prior to wear, correctly donning and adjusting for proper fit (if required), doffing without spreading contamination, and maintaining and disposing of the PPE?
			5. When selecting the type of protective gloves(s) required, does the staff use all glove selection resources available (e.g., MSDSs, Laboratory Safety Manual Appendix G, vendor catalogs and laboratory staff experience that the glove provides adequate dexterity)?

			6. If respirators (half face, full face, SCBA, Air Line) are being used:
			a. Has EH&S been contacted to assess the exposure?
			b. Have users received medical evaluation, training and fit testing in accordance with the EH&S Respiratory Protection Program?
			c. Are respirators properly inspected, cleaned, serviced and stored?
			d. If cartridges are used, are they the correct ones for each hazard exposure?
			J. Occupational Health
			1. Do all personnel know that following an incident or accident they must complete the appropriate UW Incident / Accident / Quality Improvement Report form?
			2. Do staff know that there is an occupational health nurse available for consultation at 685-1026? (Note: In case of a medical emergency, staff should go to the nearest emergency room for care.)

Comments:

Corrective Action Items:

Laboratory Survey Conducted By: (Print)

PI or Supervisor Signature: Date:

C. “Top 25” Laboratory Self-Audit Checklist Instructions

This “Top-25” self-audit checklist is one of many tools provided by EH&S for laboratory PIs and researchers to assess environmental, health, and safety conditions in their labs. This checklist focuses on unsafe practices and conditions most frequently observed by the EH&S Prevention and Assessment Team. The practices and conditions identified on this form are prohibited by state laws or campus policies, or are not generally accepted as safe laboratory practices.

The procedures for completing this form are as follows:

1. Designate a qualified[1] individual to audit each laboratory using this form, or an equivalent.
2. Send a photocopy of the completed form to your Department Administrator.
3. Share the completed form with the Principal Investigator (PI) and other laboratory users. Discuss the findings and corrective actions in a laboratory meeting and encourage others to voice their safety concerns.
4. Correct each identified deficiency as soon as possible and document corrections on the original form.
5. Keep the original audit form on file in the laboratory for at least one year, so that it will be available to the Washington State Department of Labor and Industries, granting agencies, campus research oversight groups, or EH&S, if requested.
6. If you need assistance correcting conditions identified during the self-inspection or have any questions or concerns about laboratory safety, whether they pertain to this inspection or not, contact the Facility Safety Office of Environment Health & Safety at (206) 543-0465.

> This form was designed to help ensure compliance with WISHA, Department of Ecology, Seattle Fire Department, International Fire Code, and other codes and regulations. **This form *is not a comprehensive checklist* otherwise available from EH&S (like the Annual Laboratory Safety Survey Checklist in Appendix E in Lab Safety Manual) and should not be considered a substitute for a comprehensive survey or audit of regulatory requirements and code compliance.** Completion of this form and correction of any findings noted herein does not guarantee that these agencies will not issue citations.
>
> The EH&S Prevention and Assessment Team routinely conducts laboratory surveys. Prior to these surveys, the team plans to spot check many of the forms, comparing notations with actual conditions in the laboratory. This action is done to ensure that questions are not misinterpreted and that this program remains effective.

***Please note*:** This form does not address specific activities involving research animals, biohazardous agents, lasers, radioactive materials or radiation-producing machines, which have separate and unique inspection requirements that are part of their approval process.

D. “Top 25” Laboratory Self-Audit Checklist

Please print.

Department: ____________________ Date of Inspection: ____________________

PI Name: ____________________ Inspector Name: ____________________

Room and Bldg.: ____________________ Inspector E-mail: ____________________

Please check the boxes indicating Yes (satisfactory), No (needs correction), or N/A (not applicable).

Written Laboratory Safety Policies And Procedures

1. Does each laboratory have a copy of the latest (2006) UW Laboratory Safety Manual or is it accessible to every worker whenever work is done in the lab (online or from other digital media)?

1 ☐ Yes ☐ No ☐ N/A

Corrective Action: Obtain a UW Laboratory Safety Manual through EH&S and make it readily available to laboratory workers.

Online: http://www.ehs.washington.edu/manuals/lsmanual/index.shtm

Completion Date: ____________________

2. Do you have up-to-date written Standard Operating Procedures (SOPs) addressing laboratory specific processes for hazardous substances (chemicals, pressurized cylinders, etc) used or stored in lab?

2 ☐ Yes ☐ No ☐ N/A

Corrective Action: Develop written SOPs for any hazardous substances used or stored in lab, as directed in Section 6 of the UW Laboratory Safety Manual (examples are in Appendix D of the Laboratory Safety Manual and a blank template is available on the EH&S website.)

Online: http://www.ehs.washington.edu/manuals/lsmanual/lsmsectx6b.pdf

http://www.ehs.washington.edu/forms/epo/soptemplate.doc

Completion Date: ____________________

3. Is there an up-to-date laboratory floor plan, showing the location of signs, safety equipment, process equipment, and exit routes, and is it posted in the laboratory?

3 ☐ Yes ☐ No ☐ N/A

Corrective Action: Develop a laboratory floor plan in accordance with Appendix C of the UW Laboratory Safety Manual.

Online: http://www.ehs.washington.edu/manuals/lsmanual/lsmxappcb.pdf

Completion Date: ____________________

Employee and Visitor Training

4 ☐ Yes ☐ No ☐ N/A

4. Have all laboratory employees, including those handling and generating hazardous chemical wastes, attended chemical safety training for laboratory workers? Have supervisors, PIs, and others responsible for laboratory safety compliance attended laboratory safety compliance training?

Corrective Action: Staff must attend the two-hour class *Managing Hazardous Chemicals in the Workplace* or the fall *Laboratory Safety Seminar* intended for new students. Supervisors and PI must attend *Laboratory Safety Standard Compliance*. Register through EH&S website. Additional chemical and process specific training, such as spill response and chemical storage, should occur in the lab as needed.

Online: http://www.ehs.washington.edu/psotrain/corsdesc.shtm

Completion Date: ______________________

General Emergency Preparedness

5 ☐ Yes ☐ No ☐ N/A

5. Does the laboratory have a first aid kit, appropriate chemical spill kit (s), and a biological spill kit (as necessary), and do employees know where the kit(s) are located and how to use them?

Corrective Action: Obtain first aid kit and/or chemical spill kits, which are available through University Stores and other vendors. Assemble and store biological spill kit in lab. Train laboratory staff in kit storage location and correct kit use.

Online: http://www.ehs.washington.edu/ohshsplans/firstaidkit.shtm

http://www.ehs.washington.edu/epo/spills/chemspills.shtm#kits

http://www.ehs.washington.edu/epo/spills/hgspills.shtm

http://www.ehs.washington.edu/rbsbiosafe/spillsbio.shtm

Completion Date: ______________________

Laboratory Conditions

6 ☐ Yes ☐ No ☐ N/A

6. Are aisles, exits, and adjoining hallways maintained free of obstructions that would hinder emergency access or exiting?

Corrective Action: Remove obstructions from aisles, exits, and adjoining hallways.

Online: http://www.ehs.washington.edu/fsofire/fireprevention.shtm

Completion Date: ______________________

7 ☐ Yes ☐ No ☐ N/A

7. Are fire extinguishers located so that they are easily accessible and not blocked by stored materials?

Corrective Action: Remove any stored materials blocking clear access to fire extinguishers. Relocate extinguishers if necessary by contacting Facilities Services.

Online: http://www.ehs.washington.edu/fsohazmat/eyewash.shtm

Completion Date: ______________________

8 ☐ Yes ☐ No ☐ N/A

8. Are all emergency eyewash and shower stations free of obstructions and located such that they can be accessed within 10 seconds (approx 50 ft)?

Corrective Action: Remove all obstructions from emergency eyewashes and showers.

Online: http://www.ehs.washington.edu/fsohazmat/eyewash.shtm

Completion Date: ______________________

9. Are there at least 18 inches of vertical clearance between all stored items and the ceiling mounted fire sprinklers? Do suspended ceilings have all of their ceiling tiles in place?

9 ☐ Yes ☐ No ☐ N/A

Corrective Action: Relocate stored items to maintain at least 18 inches of clearance under fire sprinklers. Contact Facilities Services to replace ceiling tiles.

Online: http://www.ehs.washington.edu/fsofire/fireprevention.shtm

Completion Date: ____________________

10. Are extension cords used only as temporary wiring and not connected in a series (daisy-chained) with other extension cords or power strips? (Cords must be in good condition with no breaks or exposed wiring.)

10 ☐ Yes ☐ No ☐ N/A

Corrective Action: Dispose of, or repair, all electrical cords that are not in good condition. Remove all daisy-chained and permanent extension cords. Contact Facilities Services for installation of additional outlets where needed.

Online: http://www.ehs.washington.edu/fsofire/fireprevention.shtm

Completion Date: ____________________

11. Are bookcases, filing cabinets, and furnishings over 4 feet tall near doorways and other emergency exits secured to keep from tipping over?

11 ☐ Yes ☐ No ☐ N/A

Corrective Action: Contact Facilities Services to install devices to secure furnishings.

Online: http://www.ehs.washington.edu/fsoemerprep/earthquake.shtm

Completion Date: ____________________

Hazardous Material Safety

12. Do employees have ready access to MSDSs?

12 ☐ Yes ☐ No ☐ N/A

Corrective Action: Make MSDSs available to employees through UW's MyChem program or keep current hard copies in lab. All laboratory personnel must know how to access MSDSs for chemicals with which they are working.

Online: http://www.ehs.washington.edu/epomychem/index.shtm

Completion Date: ____________________

13. Are all containers (including squirt bottles and unwanted hazardous materials containers) clearly labeled with their chemical contents and primary hazard(s) and are they in good condition (not corroded or leaking)?

13 ☐ Yes ☐ No ☐ N/A

Corrective Action: Label all secondary chemical containers using UW Hazard Label (or equivalent) available at UW stores. Replace corroded or leaking containers. Reduce inventory of expired, surplus, and unnecessary chemicals via MyChem Chemical Exchange or as hazardous waste.

Online: http://www.ehs.washington.edu/manuals/lsmanual/lsmsectx2b.pdf
http://www.ehs.washington.edu/eporecycle/chemex.shtm
http://www.ehs.washington.edu/epowaste/chemwaste.shtm

Completion Date: ____________________

14. Are incompatible hazardous materials segregated and stored separately?

14 ☐ Yes ☐ No ☐ N/A

Corrective Action: Separate acids from bases. Store flammables in approved safety cans or cabinets and away from acids and oxidizers. See Table 2-1 in Lab Safety Manual for further information on segregating other chemicals.

Online: http://www.ehs.washington.edu/manuals/lsmanual/lsmsectx2b.pdf

Completion Date: ____________________

15. Are excess flammable and combustible liquids (only 10 gallons allowed outside of cabinets) kept in approved storage cabinets?

15 ☐Yes ☐ No ☐ N/A

Corrective Action: Keep excess flammable and combustible liquids in approved storage cabinets marked, "FLAMMABLE KEEP FIRE AWAY."

Online: http://www.ehs.washington.edu/manuals/lsmanual/lsmsectx4b.pdf

Completion Date: ______________________

16. Are peroxide formers (such as isopropyl ether, diethyl ether, and THF) stored away from light and heat and labeled with the date they were opened and the expiration date?

16 ☐Yes ☐ No ☐ N/A

Corrective Action: Label all peroxide formers with opening and expiration dates. These chemicals may become explosive after prolonged storage. If any of these chemicals are present and have not been used for a long time, do not handle. Conduct assessment of outdated ether following the EH&S peroxide guidelines. For technical support, contact Chemical Waste at 616-5835.

Online: http://www.ehs.washington.edu/forms/epo/peroxideguidelines.pdf

Completion Date: ______________________

17. Are chemical fume hoods kept uncluttered so that air flows properly (e.g., is storage minimized and are adequate work areas provided)? Can ALL chemical work be done more than six inches into hood? (Note: Chemical fume hood sashes must be in good condition and be used at the proper setting.)

17 ☐Yes ☐ No ☐ N/A

Corrective Action: Train laboratory users to minimize hood clutter and place sashes to maintain good airflow and provide splash protection. Contact Facilities Services for repairs.

Online: http://www.ehs.washington.edu/fsofumehoods/fume.shtm

Completion Date: ______________________

18. Are compressed gas cylinders secured with chain(s), strap(s) or bracket(s) to prevent them from falling or tipping? Are incompatible compressed gas cylinders stored separately?

18 ☐Yes ☐ No ☐ N/A

Corrective Action: Provide a chain, strap or bracket to secure the compressed gas cylinder(s) to prevent them from falling or tipping. Secure cylinders taller than 26 inches at two locations: 1/3 and 2/3 height to protect from tipping over in an earthquake. Separate incompatible compressed gas cylinders by 20 feet or a 30-minute fire rated partition.

Online: http://www.ehs.washington.edu/fsohazmat/gascylinders.shtm

Completion Date: ______________________

Biological Safety

19. Do you have EH&S approval for your research if your research involves hazardous materials in animal studies, biohazards, recombinant DNA, or clinical trials involving human gene therapy?

19 ☐Yes ☐ No ☐ N/A

Corrective Action: To initiate the approval process, submit a Research Project Hazard Assessment (RPHA) Form to the EH&S Research and Biological Safety Office (see online link below). This process also initiates the Institutional Biosafety Committee (IBC) approval process. If your research requires work at Biosafety Level 3 containment, notify EH&S at (206) 221-7770 for approval as soon as possible because of limited availability of facilities. An Animal Use Medical Screening Form and Occupational Health Hazard Questionnaire are also required for animal research (see online links below).

Online: RPHA: http://www.ehs.Washington.edu/rbsresplan/index.shtm

Animal Use Medical Screening Form: http://www.ehs.washington.edu/rbs/aums.shtm

Occupational Health Hazard Questionnaire Form:

http://depts.washington.edu/iacuc/iacucforms/OHreview.doc

Completion Date: ______________________

20. Do lab personnel promptly dispose of blades, needles and other sharps in sharps containers and do not recap needles?

20 ☐Yes ☐ No ☐ N/A

Corrective Action: Procure a sharps container, if needed. Discontinue recapping needles to prevent needle sticks.

Online: http://www.ehs.washington.edu/rbsresplan/sharp.shtm

Completion Date: ____________________

Radiation Safety

21. Do lab personnel secure all radioactive material stock solutions inside a locked container/cabinet when the materials are not in use?

21 ☐Yes ☐ No ☐ N/A

Corrective Action: Promptly return to a locked container and/or cabinet any radioactive stock solutions not actively in use.

Online: http://www.ehs.washington.edu/rsolabauth/rad_auth.shtm

Completion Date: ____________________

22. Are surveys done regularly in areas where radioactive material is used or stored using a calibrated instrument capable of detecting the radionuclides in question?

22 ☐Yes ☐ No ☐ N/A

Corrective Action: Use a calibrated instrument that can detect the radionuclide you are using. Survey work spaces, well traveled areas of the floor, and places where people commonly put their hands. Keep a record of your survey results.

Online: http://www.ehs.washington.edu/rsolabauth/rad_surveys.shtm

Completion Date: ____________________

Hazardous Chemical Wastes

23. Are chemical waste containers appropriate for the waste, securely capped, segregated by hazard class and labeled with a completed UW Hazardous Waste label (UoW 1157)?

23 ☐Yes ☐ No ☐ N/A

Corrective Action: Use appropriate containers, securely cap the containers, segregate waste by hazard class (e.g., flammables separated from oxidizers). Label all waste containers with completed UW Hazardous Waste Labels available online and at several locations on campus. Take our online hazardous waste training for more information.

Online: http://www.ehs.washington.edu/epowaste/chemwaste.shtm

http://www.ehs.washington.edu/epowaste/hazwastelabel.shtm

http://www.ehs.washington.edu/psotrain/hazwaste/index.shtm

Completion Date: ____________________

24. If you discharge chemicals or treated chemicals in the sink, do you follow all applicable requirements (heeding discharge limits, keeping a Sewer Discharge Log, not allowing acetone to go down the sink)?

24 ☐Yes ☐ No ☐ N/A

Corrective Action: Ensure that your chemicals meet discharge limits listed in EH&S website listed below. Keep a Sewer Discharge Log and post it near the point of discharge.

Online: http://www.ehs.washington.edu/epowaste/sink.shtm

Completion Date: ____________________

Personal Protective Equipment

25. Is Personal Protective Equipment (PPE) identified in the laboratory Standard Operating Procedures (SOP) available to laboratory personnel and in good condition? Identify additional PPE needs on the right side of this form.

Corrective Action: Work with your PI or lab manager to ensure proper PPE for the work done in your laboratory is available including: safety glasses, goggles, face shields, protective gloves (chemical, thermal, etc), laboratory coats, aprons, and other PPE specific to the work done in your laboratory.

Online: http://www.ehs.washington.edu/rbsresplan/ppe.shtm

Completion Date: ____________________

25 ☐ **Yes** ☐ **No** ☐ **N/A**

Additional PPE needed for this laboratory (quantity)
___safety glasses
___goggles
___face shields
___respirators
___laser safety eyewear
___gloves for:
  ____chemical hazards
  ____thermal hazards
  ____physical hazards
____laboratory coats
____aprons
___other safety equipment (specify)

OTHER HAZARDS

List any other hazardous conditions in need of correction that are not covered on this general laboratory self-audit form. Assign and document correction of each hazardous condition or concern.

1. ____
2. ____
3. ____

OTHER COMMENTS

The space provided below can be used to comment on any conditions described in the above questions.

____

____

____

____

____

____

____

____

Date_____________Signature of PI/Researcher ___________________________

E. Moving In/New Laboratory Checklist

Use this checklist as a tool to help you get started with health and safety requirements. Refer to the Laboratory Safety Manual Section 10 - Moving In/Moving Out for more details.

General Safety

- ❑ If possible, visit the laboratory to determine if it will meet your needs, has been cleaned and is in good condition. If the lab had prior tenants, it should have a *Notice of Laboratory Moveout* (UoW 1800) posted inside one of the doors. If it does not, contact your Building Coordinator.
- ❑ Reserve an accessible area for storage of health and safety related documents, including Material Safety Data Sheets (MSDS), training records and your Chemical Hygiene Plan (the UW Laboratory Safety Manual and accompanying Laboratory-Specific Information.)
- ❑ Keep areas uncluttered, reserving three feet of space in all aisles.
- ❑ Do not block exits or safety equipment such as showers and eyewash stations.

Emergency Planning

- ❑ Know locations of emergency showers and eye washes.
- ❑ Know the emergency escape routes. Contact your Building Coordinator for more information.
- ❑ Prepare and post a floor plan which includes locations of signs, safety equipment, and process-related equipment. Show direction of exit from the laboratory.
- ❑ Post emergency phone numbers next to telephone.
- ❑ Obtain chemical spill kit, biohazard spill kit (as needed), and first aid kit. University Stores carries chemical spill and first aid kits.
- ❑ Reserve an accessible area for spill kits and other emergency equipment.
- ❑ Keep tall cabinets, filing cabinets, and other furnishings away from doorways or secure them to the wall.

Facilities/Equipment

- ❑ Check test dates on the fume hoods, biosafety cabinets, fire extinguishers, and safety showers. These should all be current within the past year. To update fume hoods and biosafety cabinets, contact Facility Safety Office at 206-543-0465. To update fire extinguishers and safety showers, enter work order through FSWorks at **http://www.washington.edu/admin/facserv/maintalt.html**
- ❑ To relocate or purchase a new biological safety cabinet (BSC), submit a Request to Purchase or Relocate a Biological Safety Cabinet Form to EH&S at **http://www.ehs.washington.edu/rbsbiosafe/approvedlist.shtm**
- ❑ Any new fume hoods and BSCs are required to be tested and certified by EH&S before research can start. Contact the Facility Safety Office at 206-543-0465 to schedule a test.
- ❑ If this is a newly constructed laboratory or if you have purchased new laboratory equipment, ensure that equipment has been certified for function before using chemicals, radioactive materials, or biological agents.
- ❑ If research involves work at BSL-3/ABSL-3 containment, contact the Research and Biological Safety Office at 206-221-7770 as soon as possible for facility authorization.

- ❑ If lab does not have fire extinguisher, request one through Facilities Services. **http://www.washington.edu/admin/facserv/**
- ❑ Ensure that gas cylinders are secured to walls or bench tops with two chains or straps. Complete a Facilities Services work order request to secure cylinders. **http://www.washington.edu/admin/facserv/maintalt.html**

Chemical Safety

- ❑ Assess storage capacity for hazardous materials. Obtain approved storage cabinets as needed for flammable liquids (including flammable liquid wastes) so that amount of flammable liquid outside a cabinet is always less than ten gallons. Obtain storage cabinets for acids and/or bases.
- ❑ Apply for a new hazardous materials permit through the Seattle Fire Department if one has not already been obtained by the department for the lab. Contact the Fire Marshal's Office Permit Section at 206-386-1450 to obtain the application form. If the lab is already covered under an existing SFD permit, contact permit holder with the department and arrange for SFD to conduct an inspection of the lab. Contact Facility Safety Office 206-543-0465 for technical assistance.

  Fill out or update the Laboratory Specific Information in this Manual, including

  - ❑ Laboratory floor plans
  - ❑ General laboratory safety rules

    Designations of individuals performing the following tasks

    - ❑ Chemical Hygiene Officer
    - ❑ Maintaining first aid supplies
    - ❑ Maintaining chemical inventories
    - ❑ Performing certain safety protocols
  - ❑ Any special instructions for receiving and storing hazardous materials
  - ❑ Locations and contents of chemical spill kits
  - ❑ Location of Emergency Plans
  - ❑ Location of MSDS and other safety reference materials if stored separately from the Laboratory Safety Manual
  - ❑ Operating procedures for equipment
  - ❑ Training records or location of same if stored separately from the Laboratory Safety Manual
  - ❑ Standard Operating Procedures for hazardous materials
- ❑ Segregate and store your chemicals correctly. Refer to this manual and our website for more information.

  Make sure your chemical inventory is entered in the UW MyChem system.

  - ❑ Call 206-543-0467 to obtain a MyChem account (training is available through EH&S) or call 206-543-0467 to update your contact information and location if you are an existing PI.
  - ❑ Call the Facility Safety Office at 206-543-0465 to let them know that your inventory is new in MyChem or has been updated in MyChem. If necessary, the Facility Safety Office will request building use and fire department permits, which must be applied for before occupancy.

For questions or assistance call the EH&S Environmental Programs Office at 206-616-5835.

Biological Safety and Animal Research

- ❑ Register and obtain approval for your research with the EH&S Research and Biological Safety Office (RBSO) if your research involves hazardous materials in animal studies, biohazards, recombinant DNA, or clinical trials involving human gene therapy. To initiate this process, submit a Research Project Hazard Assessment (RPHA) Form online at **http://www.ehs.washington.edu/rbsresplan/index.shtm**. This process also initiates the Institutional Biosafety Committee (IBC) approval process.

  Additional requirements for animal research:

  - ❑ Submit an Animal Use Medical Screening Form: **http://www.ehs.washington.edu/rbs/aums.shtm**
  - ❑ Submit an Occupational Health Hazard Questionnaire Form for each IACUC protocol submitted. **http://depts.washington.edu/iacuc/iacucforms/OHreview.doc**

- ❑ If your research requires work at Biosafety Level 3 (BSL-3) containment, notify the EH&S RBSO at 206- 221-7770 for approval as soon as possible because of limited availability of facilities.
- ❑ If your research involves work with select agents, notify the EH&S RBSO at 206- 221-7770 for authorization instructions.
- ❑ Maintain a Biosafety Manual with laboratory specific information included in Appendix D of the Biosafety Manual. See link. **http://www.ehs.washington.edu/rbsbiosafe/bsmanualindex.shtm**

  If you are working with blood or other potentially infectious materials, you must be included in the University's Bloodborne Pathogens Program. This requires a site specific Exposure Control Plan, annual training, and offering of hepatitis B vaccination. The UW core Exposure Control Plan is in the Biosafety Manual, Section IX.

  - ❑ Complete the Supplemental Form for Bloodborne Pathogens to complete your site specific ECP, online at http://www.ehs.washington.edu/forms/rbs/researchlaboratorysupplementalform.pdf

  *For questions or assistance, contact the EH&S Research and Biological Safety Office at 206-221-*7770.

Radiation Safety

- ❑ **New Principal Investigators:** Obtain an authorization to use radioactive materials. If this is a new location, contact the Radiation Safety Office as soon as possible to evaluate any special needs and potential for air emissions.
- ❑ Amend an existing authorization when adding workers or a changing a radionuclide use.
- ❑ **Human Subjects:** Submit an application with EH&S to use radiation with human subjects.
- ❑ Make sure you have a way to keep radioactive stock solutions locked when not in use.
- ❑ Using radioactive materials may require additional constraints than those stated above (*e.g.* using iodine for labeling requires radioiodine hood and using large quantities of material may require dosimeters.)
- ❑ Using Lasers, non-ionizing radiation, EMF, RFR, etc requires that you contact RSO for registration, surveys, and evaluation.

  For questions or assistance, contact the Radiation Safety Office at 206-543-0463.

Hazardous Waste

- ❑ Reserve areas in your laboratory for safe hazardous waste accumulation as appropriate.

- ❑ If you have hazardous waste "routines", update the contact information and location. Email **chmwaste@u.washington.edu** with your routine numbers and new information.
- ❑ **New Principal Investigators:** Consider obtaining hazardous waste "routines" for specific waste streams that you generate on a regular basis. Fill in the New Routine Collection request form online: **http://www.ehs.washington.edu/forms/epo/1471.pdf**. For more information about "routines", see **http://www.ehs.washington.edu/epowaste/chemwaste.shtm.**

  For questions or assistance call the EH&S Environmental Programs Office at 206-616-5835.

EH&S Training

- ❑ Chemical Training
  - ❑ Managing Hazardous Chemicals in the Workplace: for staff working with chemicals
  - ❑ Laboratory Safety Standard Compliance: for PIs, Lab Managers and Supervisors to learn your responsibilities for health and safety of your employees.
  - ❑ MyChem training: optional for staff assigned to update chemical inventories and others who use MyChem
- ❑ Biological Safety Training
  - ❑ BSL-2/ABSL-2: for staff who work in BSL-2/ABSL-2 laboratories
  - ❑ Bloodborne Pathogens: for staff who work with bloodborne pathogens or other potentially infectious materials
- ❑ Radiation safety training for new workers
- ❑ Other EH&S courses that may apply to your work
  - ❑ Earthquake disaster preparedness
  - ❑ CPR certification
  - ❑ First Aid and CPR
  - ❑ Back Protection
  - ❑ Compressed Gas Safety
  - ❑ Fire extinguisher
  - ❑ Forklift Safety, Pallet Jack, and Narrow Aisle Lifters
  - ❑ Respiratory Protection and Fit testing
- ❑ Provide additional documented laboratory specific training as needed. PIs are responsible for providing additional documented laboratory specific safety training to staff.

  For additional information about training, and to sign up for classes, see the EH&S training webpage at http://www.ehs.washington.edu/psotrain/index.shtm.

F. Laboratory Moving Out Checklist

Use this checklist as a tool to help you relocate or shut down your laboratory, or to temporarily relocate for remodels and renovations. Refer to the Laboratory Safety Manual Section 10 - Moving In/Moving Out for more details, including your responsibilities.

Laboratory Decontamination and Cleanout

- ❑ If you are partially or completely vacating your laboratory for remodeling, relocation or closure, you must leave it clean, empty and safe for Facilities Services staff or the next occupants. Follow all applicable instructions on the *Notice of Laboratory Moveout* (UoW 1800) online at http://ehs.washington.edu/forms/epo/1800.pdf. The Principal Investigator or laboratory manager/Chemical Hygiene Officer must sign the checklist to verify that all instructions were followed. **A copy of the *Notice for Laboratory Moveout* must be posted inside the door near one or more exits of your laboratory for Facilities Services or the next occupants.**

Chemical Safety

- ❑ Arrange for disposal of all hazardous waste and unwanted chemicals. (Attach a completed UW Hazardous Waste Label to any waste not in its original manufacturer's container, and complete and send a Chemical Collection Request form (UoW 1470) at least one month before you vacate.)
- ❑ Properly manage unwanted gas cylinders. (Contact University Stores to arrange for pickup, or return gas cylinders to whom you are leasing them from. If you cannot do either, email chmwaste@u.washington.edu for assistance.)

For questions or assistance call the EH&S Environmental Programs Office at 206-616-5835.

Biological Safety

- ❑ If your laboratory is relocating or shutting down, contact the EH&S Research and Biological Safety Office (RBSO) at 206-221-7770 to update your Research Project Hazard Assessment (RPHA) Form and/or laboratory spaces.
- ❑ If you are relocating or ending research involving select agents, contact the EH&S RBSO at 206-221-7770 for instructions.
- ❑ If you intend to relocate a biological safety cabinet, call 206-543-9510 or complete and submit a "Request to Purchase or Relocate a Biological Safety Cabinet" at http://www.ehs.washington.edu/forms/rbs/bsc_cabinets.doc.
- ❑ If applicable, submit written plans for the decommissioning of a Biosafety Level 3 (BSL-3) area to the EH&S Research & Biological Safety Office Manager (Box 357165).

For questions or assistance call EH&S Research & Biological Safety Office at 206-221-7770.

Radiation Safety

- ❑ Notify the EH&S Radiation Safety Office in writing as soon as the intent to vacate is known. Mail correspondence to EH&S Radiation Safety, Box 354400 or e-mail radsaf@u.washington.edu. Inform Radiation Safety of your new laboratory location if known.
- ❑ Discuss arrangements with Radiation Safety to assure removal of all radioactive waste and to coordinate relocation or transfer of ownership for remaining radioactive materials (206-543-0463).

If the Principal Investigator is leaving the University of Washington, these additional steps must be followed with the Radiation Safety Office:

- ❑ Usage records, including Radiation Survey Records, must be updated, finalized and submitted to Radiation Safety.
- ❑ Waste disposal records must be finalized and turned in to the Radiation Safety Office.
- ❑ All radioactive material waste containers must be picked up by the Radiation Safety Office.
- ❑ Personnel dosimeters must be returned to Radiation Safety.
- ❑ Termination bioassays must be performed if necessary.

For questions or assistance call the EH&S Radiation Safety Office at 206-543-0463.

Transportation

- ❑ Biological Materials: follow the instructions in Appendix B of the UW Biosafety Manual, online at http://www.ehs.washington.edu/rbsbiosafe/appendixb.pdf.
- ❑ Chemicals: follow the instructions in Section 10 Moving In/Moving Out and in Section 2 Chemical Management in your UW Laboratory Safety Manual. Under certain conditions, you can transport the chemicals yourself on campus. You can also arrange for a hazardous material contractor to pack and/or transport your chemicals for you.
- ❑ Radioactive Materials: For short moves of radioactive materials between locations on the contiguous UW Seattle campus, “hand carrying” is an option. For transport of radioactive materials over public roads, call the Radiation Safety Office.
- ❑ Equipment and Non-Hazardous Items: you may choose to hire an outside moving company or UW Property & Transport Services to move equipment. Either way, do these two items first:
  - ❑ Schedule for Facilities Services Maintenance and Alterations Shops to remove materials or equipment that are attached to the building or would impact building materials. To request these jobs, use their online form at http://www.washington.edu/admin/facserv/maintalt.html.
  - ❑ Decontaminate your laboratory equipment if it has or may have come into contact with hazardous materials. Follow the instructions and fill out Form UoW 1017 Notice of Laboratory Equipment Decontamination and attach it to the equipment. For more details, see the form at http://ehs.washington.edu/forms/epo/1017.pdf. To schedule pickup or dropoff of surplus equipment, see http://www.washington.edu/admin/surplus/started.html.
- ❑ Freezers: special arrangement must be made with EH&S to move freezers and Dewar flasks that contain infectious materials. Specialized moving companies can move other materials. See Section 10 of this manual for more details.

General

- ❑ Inform vendors and on-campus suppliers of your new box number and physical delivery address. Update your own information on www.myuw.washington.edu. Follow guidelines on records retention in Section 7 of this manual and also on the Records Management website at http://www.washington.edu/admin/recmgt/index.php. Box and label sensitive files (data, patent files, *etc*.) for personal transport.

- ❑ If your laboratory is relocating, take your Laboratory Safety Manual and all laboratory-specific information (chemical inventory, standard operating procedures, training records, etc.) which will pertain to the new laboratory.
- ❑ If your laboratory is closing down permanently, give to your departmental administrator your copy of the Laboratory Safety Manual, a printout of your chemical inventory and your training records.
- ❑ If your laboratory is relocating or shutting down permanently, email mychem@u.washington.edu with your contact information to change your inventory location or eliminate your chemical inventory on MyChem.
- ❑ If you are leaving a leased or rented space, contact the UW Real Estate Office. Their website is at http://www.washington.edu/admin/reo.
- ❑ Notify your Building Coordinator that you are vacating your laboratory.
- ❑ Your department may have additional requirements for relocation and closure; check with your administrator.

Appendix F
Resources

Appendix F
Resources for Laboratory Personnel

Contents

A. Calling for Assistance

If you need more information or assistance, please review the following list for a number to call. This is not a complete list, but does cover most types of health and safety concerns on campus. The underlined topics include web links in the electronic versions of this manual.

IN AN EMERGENCY: *DIAL 9 1 1*

Topic	*Phone*
Accident/Incident Reports	206.543.7388
Air Pollution	206.616.5835
Animals (sick/injured)	206.543.7388
Asbestos Safety	206.543.7388
Autoclave, Sharps and Biological Waste	206.616.3331
Biological Safety Cabinets	206.543.0465
Biological Safety	206.221.7770
Bloodborne Pathogens Program	206.221.7770
Bloodborne Pathogens Exposures	206.685.1026
Building Evacuation Planning	206.543.0465

Topic	Phone
Building Repairs/Maintenance (Facilities Services)	
North East Zone	206.685.8815
Central Zone	206.685.8814
South West Zone (includes Housing & Food Services)	206.543.5677
Health Sciences Zone	206.543.3010
Outside Zone	206.616.5042
Calibrations for Radiation Detection Instruments	206.543.0463
Chemical Hazards (Worker Right-to-Know)	206.543.7388
Chemical Inventories	206.616.5835
Chemical Spills	206.616.5835
Confined Spaces	206.543.7388
Cranes and Hoists	206.543.7388
Diving Safety (Research)	206.221-7770
Dosimetry Services	206.543.0463
Drug Testing	206.543.7388
Earthquakes	206.543.0465
Electrical Safety	206.543.7388
Emergencies	9-1-1
Campus	9-1-1
UW Medical Center	9-1-1
Fire	9-1-1
Harborview Medical Center	3000 or 9-1-1
Electromagnetic Radiation	206.543.0463
Ergonomics	206.543.7388
Explosion	206.543.0465
Fall Prevention	206.543.7388
Fire Safety	206.543.0465
Fire Safety Equipment Repair	206.685.1411
Fire/Building Code Consultations	206.543.0465

Topic	***Phone***
Food Poisoning	206.543.7388
Food Service Area	206.543.7388
Forklift Safety	206.543.7388
Freezer Purchase	206.543.0465
Fume Hood Monitoring and Use	206.543.0465
Fume Hood Maint/Repair (Physical Plant)	
Upper Campus	206.685.1411
South Campus	206.543.3010
UW Medical Center	206.598.4645
Harborview Medical Center	206.731.3191
Gas Cylinder Leaks	206.616.5835
General Health and Safety Information	206.543.7388
Hall Health Primary Care Center	206.685.1011
Hazardous Materials Storage	206.543.0465
Hazardous Material	206.543.0465
Health/Safety Plans	206.543.7388
Hospital Health and Safety:	
UW Medical Center	206.598.4645
Harborview Medical Center	206.731.8742
Hospital Radiation Safety	206.543.0463
Indoor Air Quality (Odors)	206.543.7388
Industrial Hygiene	206.543.7388
Industrial Insurance Claim (Worker's Compensation)—Risk Management	206.543.0183
Labor and Industry Inspections	206.543.7388
Laboratory Safety: General	206.543.7388
Lasers	206.543.0463
Lead Safety	206.543.7388
Lockout/Tag Out	206.543.7388
Medical Surveillance	206.543.7388
MyChem	206.616.5835

Topic	*Phone*
Material Safety Data Sheets (MSDSs)/Inventory	206.543.7388
Noise/Hearing Conservation	206.543.7388
Occupational Health Nurse (medical surveillance/consultation)	206.543.7388
Occupational Health Nurse (Clinical)	206.598.4848
Odors: Indoor Air Quality	206.543.7388
Personal Protective Equipment	206.543.7388
Pest Control	206.543.7388
Physical Plant / Facilities Services:	
NE Maintenance Zone	206.685.8815
Central Maintenance Zone	206.685.8814
SW Maintenance Zone	206.543.5677
Health Sciences Maintenance Zone	206.543.3010
Outside Maintenance Zone	206.685.8818
Emergency Call	206.685.1411
Pressure Systems (vessels, cylinders, sterilizers, etc.)	206.543.7388
Radiation Safety	206.543.0463
Radioactive Orders/Deliveries	206.543.0463
Recycle Chemicals	206.616.5835
Respirator Selection, Training, and Fit Testing	206.543.7388
Safety	
General Campus, Health Sciences	206.543.7388
UW Medical Center	206.598.4645
Harborview Medical Center	206.731.8742
Sanitation	206.543.7388
Scaffold	206.543.7388
Seattle Fire Department (Administrative)	206.386.1400
Sharps Disposal	206.543.7388
Shipping & Transporting	

Topic	Phone
Biological/Infectious Waste	206.543.7388
Hazardous Materials	206.616.5835
Radioactive Materials	206.543.0463
Spills-Hazardous	
Biological	206.221.7770
Chemical - Advice	206.616.5835
Emergency Assistance	911
Laboratory Spills	206.616.5835
Radioactive	206.543.0463
Swimming Pools	206.543.7388
Surplus Chemical Exchange	206.616.5835
Surveys	206.543.6328
Radiation	206.543.0463
Prevention Team	206.543.0465
Training	
Health and Safety	206.543.7262
Radiation Safety	206.543.0463
Ultraviolet Light	206.543.0463
Waste Disposal – Hazardous	
Biological/Infectious	206.221.7770
Chemical Waste	206.616.5835
Mixed Waste	206.616.5835
Radioactive	206.543.0463
Sewer Disposal	206.616-5835
Sharps/Needles	206.543.7388
UW Info Line	206.UWS.INFO 1.866.897.INFO
Water Quality	206.543.7388
Workplace Violence	
Human Resources: Upper Campus	206.685.1516
Human Resources: Health Sciences/Medical Centers	206.731.3366

B. Web Resources

Resource	Web Address
EH&S Offices	
Environmental Programs	www.ehs.washington.edu/epo/
Facility Safety Office	www.ehs.washington.edu/fso/
Occupational Health & Safety	www.ehs.washington.edu/ohs/
Radiation Safety	www.ehs.washington.edu/rso/
Research & Biological Safety	www.ehs.washington.edu/rbs/
EH&S General Resources	
Accident Reporting (OARS)	www.ehs.washington.edu/ohsoars/
Forms	www.ehs.washington.edu/forms/
MyChem	www.ehs.washington.edu/epomychem/
Posters (workplace)	www.ehs.washington.edu/manuals/
Research Planning	www.ehs.washington.edu/rbsresplan/
Respiratory Protection	http://www.ehs.washington.edu/ohsresp/index.shtm
Safety Committees	www.ehs.washington.edu/ohssafcom/
Training	www.ehs.washington.edu/psotrain/
Waste Management	www.ehs.washington.edu/epowaste/
EH&S Manuals/Plans	www.ehs.washington.edu/manuals/
Biosafety Manual	www.ehs.washington.edu/rbsbiosafe/bsmanualindex.shtm
Emergency Evacuation & Operations Plan	www.ehs.washington.edu/fsoemerprep/modevacplans.shtm
Lab Safety Manual	www.ehs.washington.edu/manuals/lsmanual/
Radiation Safety Manual	www.ehs.washington.edu/manuals/rsmanual/
Other UW	
Facilities Services	www.washington.edu/admin/facserv/
Office of Emergency Management	www.washington.edu/admin/business/oem/
Regulatory Agencies	
EPA	www.epa.gov
OSHA	www.osha.gov
WA Dept. of Ecology	www.ecy.wa.gov
WA Dept. of Labor & Indus	www.lni.wa.gov

Government Resources	
Centers for Disease Control and Prevention	www.cdc.gov
Department of Homeland Security	www.ready.gov
Federal Emergency Management Agency (FEMA)	www.fema.gov
King County	www.metrokc.gov
National Institute for Occupational Safety & Health	www.cdc.gov/niosh/homepage.html
National Weather Service	www.wrh.noaa.gov/sew/
WA Dept. of Health	www.doh.wa.gov
WA Dept. of Labor and Industries	www.lni.wa.gov/
WA State Emergency Management	http://emd.wa.gov
Non-Governmental Organizations (NGOs)	
American Conference of Governmental Industrial Hygienists	www.acgih.org
American Industrial Hygiene Association	www.aiha.org
American Red Cross	www.redcross.org
Howard Hughes Medical Institute	www.practicingsafescience.org

Appendix G
Gloves

Contents

Tables

A. Choosing Gloves

1. Primary Concern

The primary concern for gloves used to protect the skin from chemical contact is that they provide adequate worker safety. (This appendix only addresses chemical protective gloves and does not address protection from cuts, burns, electricity, etc.)

After ensuring that a glove provides adequate chemical protection, the gloves should be tested while performing the laboratory procedure, to ensure the glove provides enough dexterity that the work can be done. If a glove is too slippery to allow gripping the work, a different type glove can be worn over the chemical protective glove to improve dexterity.

Sometimes, workers do not want to wear effective gloves because they are not comfortable. A big factor frequently in worker comfort is that the right size glove is available. In other cases, worker comfort can be improved is some cases by wearing cotton inserts within the chemical protective glove or by purchasing gloves designed to be more comfortable.

2. Glove Weaknesses

Either degradation or permeation may affect gloving material.

a. Degradation

This is when glove material breaks down due to chemical contact. Exposed gloves may get harder, softer, expand, contract, stiffen, weaken or become brittle.

b. Permeation

This means leaking through the glove material even if the glove material is not susceptible to chemical attack. Permeation can occur even if there is no visible damage to the gloves being worn. Thicker gloves usually resist permeation better than thin gloves.

The information in Table G-4, Glove Guide for Specific Chemicals, is based primarily on permeation information for thick (20 mil) gloves.

B. Glove Materials

Different gloving materials offer different kinds of protection. The following will help you understand the various glove-related terms used.

1. Natural Rubber

A naturally produced rubber (commonly called latex) that is highly elastic and flexible. This type material resists bases, acids, alcohols and diluted water solutions of most types of chemicals, especially when it is thick (18 mils or more). **Latex (natural rubber) exam gloves and thin latex gloves do not provide chemical protection.**

The primary concern from latex gloves is that the proteins in latex can produce allergic reactions in some people (as described later in Appendix G in paragraph C, page G-4). All latex gloves are not alike. Powder-free gloves transfer less protein to the skin and respiratory tract. Hypoallergenic gloves have lower protein levels because of additional washing after manufacture. Because of these differences, there is over a 500-fold difference in protein levels between different style gloves from different manufacturers.

2. Neoprene

A synthetic rubber developed as an oil-resistant substitute for natural rubber. Neoprene has excellent resistance to all straight-chain hydrocarbons, all aliphatic hydroxy compounds such as methyl and ethyl alcohols and ethylene glycol, animal and vegetable fats and oils, and fluorinated hydrocarbons such as Freon refrigerants.

3. Nitrile

Nitrile is a synthetic rubber with chemical protection as well as superior puncture, cut, snag, and abrasion resistance. Nitrile is often available in thin and heavy gauges and offers excellent protection against alkaline solutions, saturated salt solutions and aliphatic hydrocarbons, both saturated and unsaturated. It is little affected little by fatty acids found in vegetable fats and oils or by aliphatic alcohols, glycols, glycerols. Nitrile is not recommended for use in the presence of strong oxidizing agents, ketones, acetates, and a few other chemicals.

4. PVC

Polyvinyl chloride (PVC) or vinyl is a plastic material that resists amines, aromatics, inorganic acids, bases, and salts but not aldehydes, ketones, halogen compounds, and petroleum products.

5. Viton

A specialty fluoroelastomer which is the most chemical resistant of all rubbers. It protects against oils, fuels, and lubricants, most mineral acids, hydraulic fluids and aliphatic and aromatic hydrocarbons.

6. PVA

Polyvinyl Alcohol, PVA is a plastic material that protects against aromatics, ketones and chlorinated solvents. PVA coating is water soluble. ***Do not use in water or water based solution.***

7. Butyl

Butyl rubber provides superior resistance to highly corrosive acids and is excellent against ketones and esters. It should not be worn with halogen compounds.

8. Plastic Film

Special, multiple laminated layers of different type plastics make these gloves resistant and impervious to the vast majority of common chemicals. Examples are 4H and SilverShield gloves. These gloves have very poor dexterity and most workers wear latex gloves over the plastic film gloves to improve the dexterity.

C. Latex Allergic Reactions

Since 1988, allergies to natural rubber latex have become a serious concern to workers in frequent contact with latex derived products. For laboratory and health care personnel this chronic exposure comes from the frequent use of disposable latex gloves.

Glove related chemical sensitizers are found in both latex and synthetic gloves as residue from the glove manufacturing process. Powder, used to make the gloves easier to put on, absorbs these chemicals and unbound latex proteins. The powder works as an abrasive, accelerating the individual's sensitivity to the chemicals/proteins it has absorbed. **Environmental Health and Safety (EH&S) Department recommends purchasing powder-free latex or synthetic gloves.**

Three types of reactions are associated with latex gloves: irritation, delayed hypersensitivity reaction, and immediate hypersensitivity reaction.

1. Irritation

All individuals are susceptible to irritation caused by direct cell injury. The abrasive nature of powder particles may initiate or aggravate irritating symptoms.

a. Symptoms

The first symptoms are redness with associated burning or itching. It appears where the glove is tighter on knuckles, the back of the hands or on the wrists.

b. Prevention

Wear larger gloves to reduce pressure areas and increase air circulation. Use powder free gloves. After removing gloves, wash your hands with mild soap and water and keep your hands conditioned with hand lotions and creams. Water-based lotions are more compatible with latex than oil-based lotions.

c. Reactions

People who are genetically predisposed to develop sensitivity to the powders, chemicals, and/or proteins found in the latex gloves can have either a delayed or immediate hypersensitivity reaction.

2. Delayed Hypersensitivity Reaction

a. Symptoms

The skin in the gloved area becomes red and painful with small blisters appearing. This reaction often spreads beyond the border of the glove. The skin reaction will recur and will be more severe with every exposure to latex.

b. Prevention

An option is to use a powder free synthetic rubber with less allergic potential such as vinyl, nitrile, or neoprene gloves. You should also see your health care provider for evaluation. A prescription strength steroid cream is often required to calm the allergic reaction.

It is important to know that people with this delayed skin sensitivity reaction do not go on to develop the Immediate Hypersensitivity Reaction.

3. Immediate Hypersensitivity Reaction

a. Symptoms

A very small exposure to latex can trigger an extreme reaction in some sensitized individuals. These people may have the reactions simply by being in a room with someone using powdered latex gloves. The symptoms include hives, itching all over, nasal congestion, swelling of lips, eyelids, and face, shortness of breath, rapid heartbeat, abnormally low blood pressure, and shock.

b. Prevention

People with this reaction must avoid all products containing latex (balloons, condoms, dental dams, etc.). Wear a medic alert bracelet, showing an allergy to latex. Remember that the emergency responders will be wearing latex gloves.

c. First Aid

First Aid for individuals with immediate hypersensitivity reaction to latex - Carry an Epi Pen or Anakit for self-injection with epinephrine at the first sign of symptoms. Seek medical treatment immediately. These reactions can be medical emergencies.

D. Glove Sizes

Determine your proper size by using a tape measure to find the circumference of your hand around the palm. This measurement in inches is closest to your actual glove size. For example 7 inches is equal to a size 7 glove. Sizes may vary among styles and manufacturers. Most often gloves are sized according to men’s hands.

Table G-1 Glove Sizes

	Extra Small (XS)	Small (S)	Medium (M)	Large (L)	Extra Large (XL)
Hand Size (Inches)	6-7	7-8	8-9	9-10	10-11

E. Gloves Stocked by University Stores

Gloves commonly stocked at University Stores are listed on the following table.

Table G-2 Available Gloves

Stores Order #	Material	Size	Powder	Thickness (mils)	Beaded Cuff?	Cuff Length (inch)	Manufacturer's Description
0052-396	Nitrile	S	Light Powder	4.5	No	9.5	N-Dex
0052-397	Nitrile	M	Light Powder	4.5	No	9.5	N-Dex
0052-398	Nitrile	L	Light Powder	4.5	No	9.5	N-Dex
0052-399	Nitrile	XL	Light Powder	4.5	No		N-Dex 7005
0052-871	Vinyl	M	Powderfree	8	Yes	3	American Healthcare
0052-881	Vinyl	L	Powderfree	8	Yes	3	American Healthcare
0052-882	Vinyl	XL	Powderfree	8	Yes	3	American Healthcare
0052-830	Neoprene-natural blend	S	Unlined	17	No	12	Utility, Ansell-EDM 3908
0052-840	Neoprene-natural blend	M	Unlined	17	No	12	Utility, Ansell-EDM 3908
0052-850	Neoprene-natural blend	L	Unlined	17	No	12	Utility, Ansell-EDM 3908
0052-855	Neoprene-natural blend	XL	Unlined	17	No	12	Utility, Ansell-EDM 3908
0052-987	Nitrile	L			Yes		VWR 40101-348, Microgrip, Purple
0061-964	Neoprene	M				10.5-12	Pioneer 334028
0061-965	Neoprene	L				10.5-12	Pioneer 334036
0061-966	Polyethylene	M		1.25			VWR 32915-246
0061-967	Polyethylene	L		1.25			VWR 32915-268
7600-300	Nitrile	S	Powderfree	4	Yes	10	Microgrip, Purple
7600-320	Nitrile	M	Powderfree	4	Yes	10	Microgrip, Purple
7600-340	Nitrile	L	Powderfree	4	Yes	10	Microgrip, Purple
7600-360	Nitrile	XL	Powderfree	4	Yes	10	Microgrip, Purple

F. Off Campus Sources for Gloves

Table G-3 Glove Suppliers

	Natural rubber	Neo-prene	Nitrile	PVC	Viton	PVA	Butyl	4H	Silver Shield
VWR Scientific Products 1-800-932-5000 www.vwrsp.com	X	X	X	X	X	X	X		
Lab Safety Supply 1-800-356-0783 www.labsafety.com		X	X	X	X	X	X	X	X
Best Mfg. Company 1-800-241-0323	X	X	X	X	X		X		
Ansell Edmont Industrial 1-800-800-0444	X	X	X	X		X			
Guardian Mfg. Company 1-800-243-7379		X					X		

G. Glove Selection for Specific Chemicals Chart

The following chart is to be used only as a *general* guide to the type of glove to be worn as protection against accidental splashes and spills. Each glove manufacturer uses their own formulations to produce gloves. No two-glove manufacturers produce gloves exactly alike. Manufacturers will often make several types of glove from the same material, e.g., nitrile. Each of these gloves has specific uses specified by the manufacturer.

If your gloved hands will be immersed in a chemical or they will be in contact with a chemical for more than a few minutes, then contact a manufacturer. Manufacturers can send you glove guides/charts or provide recommendations. You can also contact EH&S, 206-543-7388, for recommendations on the best glove to use.

Latex exam gloves are not intended for use with chemicals.

The following chart was compiled using the glove guides provided by the manufacturers listed in the footnotes.

Table G-4 Glove Guide for Specific Chemicals

Chemical	Excellent	Very Good
Acetaldehyde[3&5]	Butyl[3], 4H[5], SilverShield[5]	
Acetamide[1]	Butyl, Nitrile	
Acetic Acid, Anhydride[1]	Neoprene	Butyl
Acetic Acid, 30%[1]	Neoprene	
Acetic Acid, 50%[5]	Nitrile, Neoprene	
Acetic Acid, 84%[4]	Neoprene, Nitrile, Butyl, Viton	
Acetic Acid, Glacial[2&5]	Neoprene[2], 4H[5]	Natural Rubber
Acetone[3&5]	Butyl[3], 4H[5], SilverShield[5]	Neoprene[3]
Acetonitrile[2,4&5]	Neoprene[2], Butyl[4], 4H[5], SilverShield[5]	
Acetophenone[1]	Butyl	
Acrylic Acid[2]	Natural Rubber	
Acetyl Chloride[1]	Viton	
Acetylene[1]	Butyl, PVC, Viton	
Acrylamide, 50%[4]	Butyl, Viton, Neoprene, Nitrile	
Acrylonitrile[4]	Butyl	Neoprene
Adipic Acid[1]	Viton, Butyl, Nitrile, Neoprene,PVC	
Alkazene[1]		Viton
Allyl Alchol[1]	Viton, Butyl, Nitrile, Neoprene, PVC	
Alum-NH3-Cr-K[1]	Butyl, Nitrile, Neoprene	
Aluminum Acetate[1]	Viton, Butyl, PVC	
Aluminum Chloride[1]	Viton, Butyl, Nitrile, Neoprene	PVC
Aluminum Fluoride[1]	Viton, Butyl, Nitrile, Neoprene	PVC
Aluminum Hydroxide[1]	Viton, Nitrile, Neoprene	PVC, Butyl
Aluminum Nitrate[1]	Viton, Butyl, Nitrile, Neoprene, PVC	
Aluminum Phosphate[1]	Viton, Butyl, Nitrile, Neoprene, PVC	
Aluminum Sulfate[1]	Viton, Butyl, Nitrile, Neoprene, PVC	
Ammonia, Anhydrous[4]	Butyl, Viton, Nitrile	Neoprene
Ammonia[3]	Butyl, Neoprene	
Ammonium Carbonate[1]	Viton, Butyl, Neoprene, PVC	
Ammonium Chloride[1]	Viton, Butyl, Nitrile, Neoprene	PVC
Ammonium Fluoride, 40%[2]	Nitrile, Neoprene, PVC, Natural Rubber	
Ammonium Hydroxide, Conc.[2]	Nitrile, Neoprene, PVC, Natural Rubber	
Ammonium Hydroxide[3]	Butyl, Neoprene	
Ammonium Hydroxide, 29%[4&5]	Neoprene[4], Butyl[4], Viton[4], 4H[5]	
Ammonium Nitrate[1]	Viton, Butyl, Nitrile, PVC	Neoprene
Ammonium Persulfate[1]	Viton, Butyl, Neoprene, PVC	
Ammonium Phosphate[1]	Viton, Butyl, Nitrile, Neoprene, PVC	
Ammonium Salts[1]	Viton, Butyl, Nitrile, Neoprene, PVC	
Ammonium Sulfate[1]	Viton, Butyl, Nitrile, Neoprene, PVC	
Amyl Acetate[2]	Nitrile[2]	
Amyl Alcohol[4]	Butyl, Nitrile, Neoprene, Natural Rubber	
Amyl Borate[1]	Viton, Nitrile, Neoprene	

Chemical	Excellent	Very Good
Amyl Chloronapthalene[1]	Viton	
Aniline[3&5]	Butyl[3], 4H[5], SilverShield[5]	Neoprene[3]
Aniline Dyes[1]		Viton, Butyl, Neoprene
Aniline Hydrochloride[1]	PVC	Viton, Butyl, Nitrile
Ansul Ether[1]		Butyl
Aqua Regia [4]	Natural Rubber, Butyl, Viton, Neoprene, Nitrile	
Arochlor(s)[1]	Viton	
Arsenic Acid[1]	Viton, Butyl, Nitrile, Neoprene, PVC	
Arsenic Trichloride[1]	Viton, Nitrile, Neoprene	PVC
Askarel[1]	Viton	PVC, Nitrile
Asphalt[1]	Viton	PVC, Nitrile
Barium Chloride[1]	Viton, Butyl, Nitrile, Neoprene, PVC	
Barium Hydroxide[1]	Viton, Butyl, Nitrile, Neoprene, PVC	
Barium Sulfide[1]	Viton, Butyl, Nitrile, Neoprene, PVC	
Battery Acid [4]	Neoprene, Nitrile, Butyl, Viton	
Benzaldehyde [4]	Butyl, Viton	
Benzene[3,4&5]	Butyl[3], Natural Rubber[4], Viton[4], 4H[5], SilverShield[5]	
Benzoic Acid[1]	Viton	PVC
Benzyl Chloride[1]		
Benzyl Alcohol[1]	Viton	Butyl, Neoprene
Benzyl Benzoate[1]	Viton, PVC	Butyl
Benzyl Chloride[1]	Viton	
Berrylium[1]	Viton, Butyl, Nitrile, Neoprene, PVC	
Black Sulfur Liquor[1]	Viton, PVC	Butyl, Nitrile, Neoprene
Blast Furnace Gas[1]	Viton, PVC	
Bleach Solutions[1]	Viton, Butyl, PVC	
Borax[1]	Viton, Butyl, Neoprene, PVC	Nitrile
Bordeaux Mixture[1]	Viton, Butyl, PVC	Nitrile, Neoprene
Boric Acid[1]	Viton, Butyl, Nitrile, Neoprene, PVC	
Boron Trifluoride[1]		PVC
Bromine[1]	Viton, PVC	
Bromoform[4]	Viton	
Bromopropionic Acid[2]	Natural Rubber	
1,3-Butadiene[4]	Viton, Nitrile	Butyl
Butane[1]	Viton, Nitrile, Neoprene	PVC
Butoxypropanol[4]	Neoprene, Nitrile, PVC, Butyl, Viton	Natural Rubber
Butoxytriglycol[4]	PVC, Butyl, Viton, Neoprene, Nitrile	
Butyl Acetate[3&5]	4H[5], SilverShield[5]	Butyl[3]
Butyl Acetyl Ricinoleate[1]	Viton, Butyl, PVC	Neoprene
Butyl Alcohol, Butanol[4]	Viton, Butyl, Neoprene, Nitrile, Natural Rubber	PVC
Butyl Amine[4]		Natural Rubber, Butyl, Viton
Butyl Benzoate[1]	Viton	Butyl, PVC
Butyl Carbitol Solvent[4]	Neoprene, Nitrile, PVC, Viton, Butyl	

Chemical	Excellent	Very Good
Butyl Cellosolve[2&4]	Nitrile[2], Neoprene[2], PVC [4]	
Butyl Dipropasol Solvent[4]	Neoprene, Nitrile, PVC, Butyl, Viton	
Butyl Ethylene	Viton, Nitrile	
Butyl Oleate[1]	Viton, PVC	Butyl
Butyl Propasol Solvent[4]	Neoprene, Nitrile, PVC, Butyl, Viton	Natural Rubber
Butyl Stearate[1]	Viton	Viton, Butyl, Nitrile, PVC
p-tert-Butyl Toluene[3,4&5]	Butyl[3], Nitrile[4], PVC[4], Viton[4], 4H[5], SilverShield[5]	
-Butyrolactone[2]	PVA, Natural Rubber	Neoprene
Butyraldehyde[1]		Butyl
Butyric Acid[1]	Viton, PVC	Butyl
Calcium Acetate[1]	Butyl, PVC	Nitrile, Neoprene
Calcium Bisulfite[1]	Viton, Nitrile, Neoprene, PVC	
Calcium Chloride[1]	Viton, Butyl, Nitrile, Neoprene, PVC	
Calcium Hydroxide[1]	Viton, Butyl, Nitrile, Neoprene, PVC	
Calcium Hypochlorite[1]	Viton, Butyl, PVC	
Calcium Nitrate[1]	Viton, Butyl, Nitrile, Neoprene, PVC	
Calcium Sulfide[1]	Viton, Butyl, Neoprene, PVC	
Carbamate[1]	Viton, PVC	Butyl, Neoprene
Carbinol[3]	Butyl	
Carbitol[1]		Viton, Butyl, Nitrile, Neoprene, PVC
Carbolic Acid[4]	Viton, Butyl	
Carbon Bisulfide[1]	Viton	
Carbon Dioxide[1]	Viton, Nitrile, PVC	Butyl, Neoprene
Carbon Disulfide[2,4&5]	PVA[2], Viton[4], 4H[5], SilverShield[5]	
Carbonic Acid[1]	Viton, Butyl, Neoprene, PVC	Nitrile
Carbon Monoxide[1]	Viton, Butyl, Nitrile, Neoprene, PVC	
Carbon Tetrachloride [2,4&5]	Viton[4], PVA[2], Nitrile[4], 4H[5], SilverShield[5]	
Caustic Soda 50%[4]	Neoprene, Nitrile, PVC, Butyl, Viton	Natural Rubber
Cellosolve[1]		Butyl, Vinyl
Cellosolve Acetate[2&4]	Butyl[4]	Natural Rubber[2]
Cellosolve Solvent[2]	Neoprene, Natural Rubber	
Cellulube[1]	Viton, Butyl	PVC
Chlorine (Dry)[1]	Viton	PVC
Chlorine (Wet)[3]	Butyl	
Chlorine Dioxide[1]	Viton, PVC	
Chlorine Trifluoride[1]	Vinyl	
Choroacetic Acid[1]	Viton, PVC	Butyl
Chloroacetone[1]		Butyl, Neoprene
Chlorobenzene[2&4]	Viton[4], PVA[2]	
Chlorobromomethane[1]		Butyl
Chlorobutadiene[1]	Viton	
Chlorododecane[1]	Viton	
Chloroform[2&5]	PVA[2], 4H[5]	

Chemical	Excellent	Very Good
Cloromethane[3]	Butyl, Neoprene	
O-Chloronaphthalene[2&5]	SilverShield[5]	PVA[2]
1-Chloro 1-Nitro Ethane[1]		
Chlorox Solution[1]	Viton, Neoprene	Butyl, Nitrile, PVC
Chlorosulfonic Acid[1]	Vinyl	
Chlorothene[3]	Butyl, Neoprene	
Chlorothene VG[2]		PVA
Chlorotoluene[1]	Viton	PVC
Chrome Plating Solutions[1]	Viton, PVC	
Chromic Acid , 50%[4]	Neoprene, Nitrile, Natural Rubber, PVC, Butyl, Viton	
Chromium Trioxide[4]	Neoprene, Nitrile, Natural Rubber, PVC, Butyl, Viton	
Citric Acid[1]	Viton, Butyl, Nitrile, Neoprene, PVC	
Citric Acid, 10%[2]	Nitrile, Neoprene, PVC, Natural Rubber	
Citric Acid, 30% [4]	Neoprene, Nitrile, Natural Rubber, PVC, Butyl, Viton	
Coal Tar Products[1]	Nitrile	
Cobalt Chloride[1]	Viton, Butyl, Nitrile, Neoprene, PVC	
Copper Acetate[1]	Viton, Butyl, PVC	Nitrile, Neoprene
Copper Chloride[1]	Viton, Butyl, Nitrile, Neoprene, PVC	
Copper Cyanide[1]	Viton, Butyl, Nitrile, Neoprene, PVC	
Copper Sulfate[1]	Viton, Nitrile, Neoprene, PVC	Butyl
Creosote[1]	Viton	Nitrile
Cresol[4]	Neoprene, PVC, Butyl, Viton	Natural Rubber
Cresylic Acid[4]	Neoprene, PVC, Butyl, Viton	Natural Rubber
Cumene[1]	Viton	PVC
Cyclohexane[5]	Viton, Nitrile, Neoprene, Butyl, 4H	Silver Shield
Cyclohexanol[4&5]	Neoprene[4], Nitrile[4], Natural Rubber[4], PVC[4], Butyl[4], Viton[4], 4H[5], SilverShield[5]	
Cyclohexanone[3&5]	Butyl[3], 4H[5], SilverShield[5]	
P-Cymene[1]	Viton	
Decalin[1]	Viton	
Decane[1]	Viton	Nitrile, Neoprene
Denatured Alcohol[1]	Viton, Butyl, Nitrile, Neoprene	PVC
Developing Fluids[1]	Viton, PVC, Nitrile, Neoprene	Butyl
Diacetone Alcohol[4]	Neoprene, Natural Rubber, PVC, Butyl, Viton	
Dibenzyl Ether[1]		Butyl
Dibenzyl Sebecate[1]		Viton, Butyl
Dibutyl Amine[1]		PVC, Nitrile, neoprene
Dibutyl Phthalate1[2,3&5]	PVA[2], Butyl[3],4H[5], SilverShield[5]	
Dibutyl Sebacate[1]		Viton, Butyl
O-Dichlorobenzene[4]	Viton	
Dichloromethane[3]	Butyl	
1,2-Dichloroethane[5]	Viton, 4H[5], SilverShield[5]	

Chemical	Excellent	Very Good
Dichlorotrifluoroethane		Neoprene
Diesel Oil[4]	Viton, Nitrile, PVC, Neoprene	
Diethanolamine[4]	Neoprene, Nitrile, Natural Rubber, PVC, Butyl, Viton	
Diethylamine[3]	Butyl[3]	
Diethyl Ether[1]		
Diethylene Glycol[1]	Viton, Butyl, Nitrile, Neoprene	PVC
Diethylene Glycol Monobutyl Ether[4]	Natural Rubber, PVC, Butyl, Viton, Neoprene, Nitrile	
Diethylene Glycol Monohexyl Ether[4]	Natural Rubber, PVC, Butyl, Viton, Neoprene, Nitrile	
Diethylene Glycol Monomethyl Ether[4]	Natural Rubber, PVC, Butyl, Viton, Neoprene, Nitrile	
Diethylene Glycol Monopropyl Ether[4]	Natural Rubber, PVC, Butyl, Viton, Neoprene, Nitrile	
Diethylene Oxide[4]	Butyl	
Diethyl Sebacate[1]		Viton, Butyl
Diisobutylene[1]	Viton	Nitrile
Di-Isobutyl Ketone, DIBK[5]	Silver Shield, Butyl, Nitrile, Viton, 4H	
Diisopropyl Benzene[1]	Viton	
Diisopropyl Ketone[1]	Butyl	
n,n-Dimethyl Acetamide, DMAC[2]		Natural, Rubber
Dimethyl Aniline[1]		
Dimethyl Formamide, DMF[2,3&5]	Butyl[3], Nitrile[3], 4H[5], SilverShield[5]	Natural Rubber[2]
Dimethyl Phthalate[1]		Viton, Butyl, PVC
Dimethyl Mercury	Silver Shield or 4H worn under long-cuffed, unsupported neoprene, nitrile or other heavy duty gloves[6]	
Dimethyl Sulfoxide, DMSO[2]	Nitrile, Neoprene, Natural Rubber	
2,6-Dimethyl-4-Heptanone[4]	Nitrile, Neoprene, Natural Rubber, PVC, Butyl, Viton	
2,4-Dinitrotoluene, 40% in ROH[4]	Butyl	Natural Rubber, Neoprene
Dioctyl Phthalate, DOP[1&2]		Viton[1], Butyl[1], PVA[2]
Dioctyl Sebacate[1]		Viton, Butyl
1,4-Dioxane[3&5]	Butyl[3], 4H[5], SilverShield[5]	
Dipropasol Glycol Monobutyl Ether[4]	Neoprene, Nitrile, Natural Rubber, PVC, Butyl, Viton	
Dipropylene Glycol Monopropyl Ether[4]	Neoprene, Nitrile, Natural Rubber, PVC, Butyl, Viton	
Divinyl Benzene[3,4&5]	Butyl[3], Viton[4], SilverShield[5]	
Dowtherm Oil[1]	Viton	
Electroless Copper (MacDermid 9048)[2]	Nitrile, Neoprene, PVC, Natural Rubber	
Electroless Nickel MacDermid J60/61)[2]	Nitrile, Neoprene, PVC, Natural Rubber	
Epichlorohydrin[1 &2]	PVA[2]	Butyl[1]
Ethanal[3]	Butyl	
Ethane[1]	Viton, Nitrile	Neoprene, PVC

Chemical	Excellent	Very Good
Ethanol[4]	Neoprene, Nitrile, Natural Rubber, Butyl, Viton	PVC
Ethanolamine[4]	Neoprene, Nitrile, Natural Rubber, PVC, Butyl, Viton	
Ethanamine[3]	Butyl	
2-Ethoxyethanol[4]	Butyl, Viton	
Ethoxytriglycol[4]	Neoprene, Nitrile, Natural Rubber, PVC, Butyl, Viton	
Ethylamine, 70% in water[5]	Silver Shield, Butyl	
Ethylene[1]	Viton, Nitrile, PVC	Butyl
Ethylene Chloride[1]	Viton	
Ethylene Chlorohydrin[1]	Viton	Butyl, Neoprene
Ethylene Diamine[1]	Butyl, Nitrile, Neoprene	PVC
Ethylene Dichloride[1&2]	Viton[1], PVA[2]	
Ethylene Glycol[2]	PVC, Nitrile, Neoprene, Natural Rubber	
Ethylene Glycol Ether[4]	Butyl	
Ethylene Glycol Monobutyl Ether	Neoprene, Nitrile, PVC, Butyl, Viton	Natural Rubber
Ethylene Glycol Monhexyl Ether	Neoprene, Nitrile, PVC, Butyl, Viton, Natural Rubber	
Ethylene Glycol Monopropyl Ether	Viton, Neoprene, Nitrile	Butyl
Ethylene Oxide[3]	Butyl, Neoprene	
Ethylene Trichloride[1]	Viton	
n-Ethylethaneamine[3]	Butyl, Neoprene	
Ethyl Acetate[3&5]	Butyl[3], Neoprene[3], 4H[5], SilverShield[5]	
Ethyl Acetoacetate[1]	PVC	Butyl
Ethyl Acrylate[1]		Butyl
Ethyl Alcohol[1,2&5]	Viton[1], Butyl[1], Nitrile[2], Neoprene[2], 4H[5]	PVC[1]
Ethyl Aldehyde[3]	Butyl	
Ethyl Benzene[3]	Butyl	
Ethyl Benzoate[1]	Viton	Butyl
Ethyl Bromide[1]		Nitrile
Ethyl Butanol[4]	Neoprene, Nitrile, Natural Rubber, PVC, Butyl, Viton	
Ethyl Chloride[1]	Viton, Butyl, Nitrile	Neoprene
Ethyl Ether[2&5]	Nitrile[2], SilverShield[5]	
Ethyl Formate[1]	Viton	Butyl, Neoprene, PVC
Ethyl Glycol Ether[2]	Neoprene	Natural Rubber
Ethyl Mercaptan[1]	Viton	PVC
Ethyl Oxalate[1]	Viton, Butyl	PVC
Ethyl Silicate[1]	Viton, Butyl, PVC, Nitrile, Neoprene	
Fatty Acids	Viton, PVC	Nitrile, Neoprene
Ferric Chloride	Viton, Butyl, PVC, Nitrile, Neoprene	
Ferric Nitrate[1]	Viton, Butyl, PVC, Nitrile, Neoprene	
Ferric Sulfate[1]	Viton, Butyl, PVC, Nitrile, Neoprene	
Fluohydric Acid[3]	Butyl	
Fluoroboric Acid[1]	Viton, Butyl, PVC, Nitrile, Neoprene	

Chemical	Excellent	Very Good
Fluorine (Liquid)[1]		Viton
Fluorocarbon Oils[1]	Butyl, Nitrile, PVC	Viton, Neoprene
Fluorolube[1]	Butyl, PVC, Nitrile, Neoprene	Viton
Fluorosilicic Acid[1]	Nitrile, Neoprene	Viton, Butyl
Formaldehyde, 37%[2&5]	Viton[5], Butyl[5], PVC[5], Nitrile[2], 4H [5]	Silver Shield [5]
Formic Acid 90%[2]	Neoprene, PVC, Natural Rubber	
Freon 11[1]	Viton	Nitrile
Freon 12[1]	PVC, Nitrile, Neoprene	Viton, Butyl
Freon 13[1]	Viton, Butyl, PVC, Nitrile, Neoprene	
Freon 21[1]	Nitrile	
Freon 22[1]	Butyl, PVC, Neoprene	
Freon 31[1]	Butyl, Neoprene	
Freon 32[1]	Butyl, Nitrile, Neoprene	
Freon 112[1]	Viton	Nitrile
Freon 113[4]	Butyl, Nitrile, Neoprene	
Freon 114[1]	Butyl, Nitrile, Neoprene	Viton, PVC
Freon 115[1]	Butyl, Nitrile, Neoprene	Viton, PVC
Freon 142B[1]	Butyl, Nitrile, Neoprene	
Freon 152A[1]	Butyl, Nitrile, Neoprene	
Freon 218[1]	Viton, Butyl, Nitrile, Neoprene	PVC
Freon C316[1]	Viton, Butyl, Nitrile, Neoprene	PVC
Freon C318[1]	Viton, Butyl, Nitrile, Neoprene	PVC
Freon 114B2[1]		Viton, Nitrile, neoprene
Freon 502[1]	Butyl, Neoprene	Viton, Nitrile
Freon TA[1]	Butyl, Nitrile, Neoprene	Viton, PVC
Freon TC[1]	Butyl, Nitrile, Neoprene	Viton, PVC
Freon TF[1&2]	Viton[1], Nitrile[2], Neoprene[2]	
Freon TMC[1]	Viton	Butyl, Nitrile, Neoprene
Freon T-P35[1]	Viton, Butyl, Nitrile, Neoprene	PVC
Freon T-WD602[1]	Viton, Butyl	PVC, Nitrile, Neoprene
Freon BF[1]		Nitrile, Neoprene
Freon MF[1]	Nitrile	
Fuel Oil[1]	Viton, Nitrile	PVC, Neoprene
Fumaric Acid[1]	Viton, PVC, Nitrile	Neoprene
Furan[1]	PVC	
Furfural[4]	Natural Rubber, Butyl	Neoprene
Gallic Acid[1]	Viton	Butyl, PVC, Nitrile, Neoprene
Gasoline, Unleaded[4]	Viton, Nitrile	
Gasoline (White)[2]	Nitrile	
Glucose[1]	Viton, Butyl, PVC, Nitrile, Neoprene	
Glutaraldehyde, 50%[4]	Neoprene, Nitrile, Natural Rubber, Butyl, Viton	PVC

Chemical	Excellent	Very Good
Glycerine[1]	Viton, Butyl, PVC, Nitrile, Neoprene	
Glycols[1]	Viton, Butyl, PVC, Nitrile, Neoprene	
Glyphosate Roundup(TM)	Butyl, Viton, Nitrile	
Green Sulfate Liquor[1]	Viton, Butyl, PVC	Nitrile, Neoprene
Halowax Oil[1]	Viton, PVC	
Heptane[4]	Neoprene, Nitrile, Viton	
N-Hexaldehyde[1]	Neoprene	Butyl
Hexamethyldisilazane[2]	Nitrile, Neoprene	
n-Hexane[5]	Viton, Silver Shield, 4H, PVA, Nitrile	
n-Hexene[4]	Viton, Nitrile	
Hexyl Carbitol Solvent[4]	Neoprene, Nitrile, Natural rubber, PVC, Butyl, Viton	
Hexyl Cellosolve Solvent[4]	Neoprene, Nitrile, Natural rubber, PVC, Butyl, Viton	
Hexyl Alcohol[1]	Viton, Nitrile	PVC, Neoprene
Hexylene Glycol[1]	Viton, Butyl	PVC, Nitrile, Neoprene
Hydraulic Oil[1]	Viton, Nitrile	Neoprene
Hydrazine Hydrate, 85%[4]	Neoprene, Nitrile, Natural rubber, PVC, Butyl, Viton	
Hydrazine, 70%[5]	Silver Shield, 4H, Butyl, Neoprene, PVC, Nitrile	
Hydrazine 65%[2]	Nitrile, Neoprene, PVC, Natural Rubber	
Hydrobromic Acid[1]	Viton, Butyl, PVC	Neoprene
Hydrochloric Acid, Conc.[2]	Nitrile, Neoprene, PVC, Natural Rubber	
Hydrochloric Acid, 10%[4]	Nitrile, Neoprene, PVC, Natural Rubber, Viton, Butyl	
Hydrochloric Acid 37%[2&5]	Viton[2], PVC[2], Butyl[2], 4H[5], SilverShield[5]	Nitrile[2], Neoprene[2]
Hydrocyanic Acid[1]	Viton, Butyl	PVC, Nitrile, Neoprene
Hydrofluoric Acid, 48%[4&5]	Butyl[4], Neoprene[4], 4H[5], SilverShield[5]	Nitrile[4], Viton[4], PVC[4]
Hydrogen Chloride (gas)[3]	Butyl, Neoprene	
Hydrogen Fluoride[4]	Butyl	Neoprene, Natural Rubber
Hydrogen Peroxide (90%)[1]	PVC	Viton
Hydrogen Peroxide (30%)[2]	Nitrile, PVC, Natural Rubber	
Hydrogen Sulfide[1]	Butyl, PVC, Neoprene	
Hydroquinone[2]	Nitrile, Neoprene, PVC	
Hydroquinone, Saturated	Nitrile, Neoprene, PVC	
Iodine[1]	Viton, PVC	Butyl, Nitrile
Iodomethane[4]	Viton,	
Isoamyl Acetate[4]		Nitrile
Isoamyl Alcohol[4]	Natural Rubber, Butyl, Viton, Neoprene, Nitrile	PVC
Isobutyl Alcohol, Isobutanol [4]	Viton, Butyl, Neoprene, Nitrile, Natural Rubber	PVC
Isooctane[2]	Neoprene, Nitrile, PVA	
Isophorone[1]	Butyl	
Isopropyl Acetate[1]		Butyl

Chemical	Excellent	Very Good
Isopropyl Alcohol, Isopropanol[4]	Nitrile, Neoprene, Butyl, Viton, Natural Rubber	
Isopropyl Chloride[1]	Viton, PVC	
Isopropyl Ether[1]	PVC	Nitrile
JP3[1]	Viton, Nitrile	
JP4[1]	Viton, Nitrile	
Kerosene[2&4]	Nitrile[4], Neoprene[4], PVC[4], Viton[4]	PVA[2]
Lactic Acid[1]	Viton, Butyl, PVC, Nitrile, Neoprene	
Lauric Acid, 36%/ EtOH[2]	Nitrile, Neoprene, Natural Rubber	
Lead Acetate[1]	Viton, Butyl, PVC	Nitrile, Neoprene
Lead Nitrate[1]	Viton, Butyl, PVC, Nitrile, Neoprene	
Lead Sulfamate[1]	Viton, Butyl, PVC, Neoprene	Nitrile
Lime Bleach[1]	Viton, Butyl, PVC, Nitrile	Neoprene
Lime Sulfur[1]	Viton, Butyl, PVC, Neoprene	
dl-Limonene[4]	Nitrile, Viton	Neoprene, PVC
Lindol[1]	Butyl	Viton
Linoleic Acid[1]	PVC	Viton, Nitrile
Linseed Oil[1]	Viton, Nitrile	PVC, Neoprene
Liquified Petroleum Gas[1]	Viton, PVC, Nitrile	Neoprene
Lubricating Oils[1]	Viton, Nitrile	PVC, Neoprene
Lye[1]	Buytl, PVC	Viton, Nitrile, Neoprene
Magnesium Chloride[1]	Viton, Butyl, PVC, Nitrile, Neoprene	
Magnesium Hydroxide[1]	Viton, Butyl, PVC, Neoprene	Nitrile
Magnesium Sulfate[1]	Viton, Butyl, PVC, Nitrile, Neoprene	
Malathion[1]		PVC, Nitrile, Neoprene
Maleic Acid[1]	Nitrile, Neoprene, Natural Rubber	
Maleic Anhydride[1]	Viton, PVC	
Mercuric Chloride[1]	Viton, Butyl, Nitrile, Neoprene	
Mercury[1]	Viton, Butyl, PVC, Nitrile, Neoprene	
Mesityl Oxide[1]		Butyl
Methane[1]	Viton, PVC, Nitrile	Neoprene
Methoxytriglycol[4]	Neoprene, Nitrile, Natural Rubber, PVC, Butyl, Viton	
Methyl Acetate[2]	Neoprene	Nitrile, Natural Rubber
Methyl Alcohol, Methanol[1&3]	Butyl[3], PVC[1], Nitrile[1], Neoprene[3]	
Methylamine[2]	PVC, Natural Rubber, Nitrile	
Methyl Acrylate[1]		Butyl, Neoprene
Methylacrylic Acid[1]		Viton, Butyl, PVC, Neoprene
Methyl Bromide[1&2]	Viton [1]	PVA[2], Nitrile[1]
Methyl Butyl Ketone[1]	Butyl	
Methyl Carbitol Solvent[4]	Neoprene, Nitrile, Natural Rubber, PVC, Butyl, Viton	
Methyl Cellosolve[4]	Neoprene, Natural Rubber, PVC, Butyl, Viton	
Methyl Chloride[2&4]	Viton [4], Neoprene[4], Nitrile[4], PVC[4], Butyl[4]	PVA[2], Natural

Chemical	Excellent	Very Good
		Rubber[4]
Methylchloroform[3]	Butyl, Neoprene	
Methylene Chloride[5]	Silver Shield, 4H, PVA	
Methyl Ethyl Ketone, MEK[3&5]	Butyl[3], Silver Shield[5], 4H[5]	
Methyl Formate[1]		Butyl, PVC, Neoprene
Methyl Iodide[4]	Viton	
Methyl Isobutyl Ketone, MIBK[3]	Butyl	
Methyl Methacrylate[2]		PVA
Methyl Oleate[1]	Viton, PVC	Butyl
Methyl Propasol Solvent[4]	Natural Rubber, Butyl, Neoprene, Nitrile	
N-Methyl-2-Pyrrolidone, NMP[2&4]	Natural Rubber[2], Neoprene[4], Butyl[4]	
Methyl Salicylate[1]	Butyl	
Methyl t-Butyl Ether, MTBE[2]	Nitrile	PVA
Mineral Oil[1]	Viton, PVC, Nitrile	Neoprene
Mineral Spirits[4]	Neoprene, Nitrile, Viton	PVC
Mineral Spirits, Rule 66[2]	Nitrile, PVA	
Monochlorobenzene[1]	Viton	
Monoethanolamine[2]	Nitrile, Neoprene, PVC, Natural Rubber	
Monomethyl Ether[1]	Butyl, Nitrile, Neoprene	Viton, PVC
Monovinyl Acetylene[1]	Viton, Butyl, Nitrile	Neoprene
Morpholine[5]	Butyl, Neoprene, Silver shield, 4H	PVA
Muriatic Acid[2]	Nitrile, Neoprene, PVC, Natural Rubber	
Naphtha VM&P[2]	Nitrile, PVA	Neoprene
Naphthalene[1]	Viton	
Neville Acid[1]	Viton, PVC	Butyl
Nickel Acetate[1]	Butyl, PVC	Nitrile, Neoprene
Nickel Chloride[1]	Viton, Butyl, PVC, Nitrile, Neoprene	
Nickel Sulfate[1]	Viton, Butyl, PVC, Nitrile, Neoprene	
Nitric Acid, 10%[2]	Nitrile, Neoprene	PVC, Natural Rubber
Nitric Acid, 23%[4]	Neoprene, Nitrile, Natural Rubber, PVC, Butyl, Viton	
Nitric Acid, 70%[2]		Neoprene
Nitric Acid, conc.[3]	Butyl	
Nitric Acid-Dilute[1]	Viton, Neoprene	Butyl, PVC
Nitrobenzene[2,3&5]	Butyl[3], Neoprene[3], 4H[5], SilverShield[5]	PVA[2]
Nitroethane[1]		Butyl
Nitromethane[2]	Neoprene,	PVA
2-Nitropropane[2,3&5]	PVA[2], Butyl[3], 4H[5], SilverShield[5]	Neoprene[2]
Octadecane[1]	Viton, Nitrile	Neoprene
N-Octane[1]	Viton, Nitrile	Neoprene
Octachlorotoluene[1]	Viton	
Octyl Alcohol, n-Octanol[2&4]	Nitrile[2], Neoprene[2], Natural Rubber[4], PVC[4], Butyl[4], Viton[4]	PVA[2]
Oleic Acid[2]	Nitrile, Neoprene	PVA
Oleum Spirits[1&3]	Viton [1], PVC [1], Butyl [3], Neoprene [3]	Nitrile [1]

Chemical	Excellent	Very Good
Oxalic Acid[2]	PVC, Nitrile, Neoprene, Natural Rubber	
Palmitic Acid[2]	Neoprene	PVC
PCBs 50% (Aroclor 1254/TCB)[4]	Nitrile, Butyl, Viton	PVC
Pentachlorophenol[3]	Neoprene	
n-Pentane[5]	Viton, Silver Shield, 4H, Nitrile	
Perchloric Acid, 60%[2]	Nitrile, Neoprene, PVC	
Perchloroethylene[2]	PVA	Nitrile
Pentane[3]	Neoprene	
Pentachlorophenol, 1% in Kerosene[5]	Viton, Silver Shield, Neoprene, PVC, Nitrile	
Petroleum Ether[4]	Nitrile, Viton	Neoprene
Phenol[2&5]	Neoprene[2], Natural Rubber[2], 4H[5], SilverShield[5]	PVC[2]
Phenyl Benzene[1]	Viton	PVC
Phenyl Ethyl Ether[1]		Viton, PVC
Phorone[1]		Butyl
Phosphoric Acid, Conc.[2]	Nitrile, Neoprene	PVC
Phosphoric Acid (20%)[1]	Viton, PVC	Butyl, Nitrile, Neoprene
Phosphoric Acid (45%)[1]	Viton, PVC	Butyl, Neoprene
Phosphoric Acid (85%)[4]	Neoprene, Nitrile, Natural Rubber, PVC, Butyl, Viton	
Phosphorous Trichloride[1]	Viton, Butyl, PVC	
Phthalic Acid Dibutyl Ester[4]	Neoprene, Nitrile, Natural Rubber, PVC, Butyl, Viton	
Picric Acid[1]	Viton, PVC, Neoprene	Butyl, Nitrile
Picric Acid, Sat. /EtOH[2]	Nitrile, Neoprene, PVC	
Pinene[1]	Viton	PVC, Nitrile
Pine Oil[1]	Viton	PVC, Nitrile
Piperidene[1]		
Polyvinyl Acetate Emulsion[1]	Viton, Butyl, PVC, Nitrile	Neoprene
Potash 45%[4]	Neoprene, Nitrile, PVC, Butyl, Viton	Natural Rubber
Potassium Acetate[1]	Butyl, PVC	Nitrile, Neoprene
Potassium Chloride[1]	Viton, Butyl, PVC, Nitrile, Neoprene	
Potassium Cupro Cyanide[1]	Viton, Butyl, PVC, Nitrile, Neoprene	
Potassium Cyanide[1]	Viton, Butyl, PVC, Nitrile, Neoprene	
Potassium Dichromate[1]	Viton, Butyl, PVC, Nitrile, Neoprene	
Potassium Hydroxide[3]	Butyl, Neoprene	
Potassium Hydroxide, KOH, 45%[4]	Neoprene, Nitrile, Natural Rubber. Butyl, Viton, PVC	
Potassium Hydroxide, 50%[2]	Nitrile, Neoprene, PVC, Natural Rubber	
Potassium Nitrate[1]	Viton, Butyl, PVC, Nitrile, Neoprene	
Potassium Sulfate[1]	Viton, Butyl, PVC, Nitrile, Neoprene	
2-Propanol[4]	Viton, Butyl, Nitrile, Neoprene, Natural Rubber	
Propetamphos 50% in ROH[4]	Neoprene, Nitrile, Natural Rubber, Butyl, PVC, Viton	
Propoxy Diethylene Glycol[4]	Neoprene, Nitrile, Natural Rubber, Butyl, PVC, Viton	

Chemical	Excellent	Very Good
Propoxypropanol[4]	Neoprene, Nitrile, Natural Rubber, Butyl, Viton	
Propyl Acetate[2&3]	Butyl[3], Neoprene[3]	PVA[2]
N-Propyl Acetate[1&5]	Butyl[3], 4H[5], SilverShield[5]	PVC
Propyl Acetone[1]	Butyl	PVC
n-Propyl Alcohol, Propanol[4]	Viton, Butyl, Nitrile, Neoprene	PVC
Propyl Carbitol Solvent[4]	Neoprene, Nitrile, Natural Rubber, Butyl, Viton	
n-Propyl Cellosolve[4]	Neoprene, Nitrile, Viton	Butyl
Propyl Cellosolve Solvent[4]	Neoprene, Nitrile, Viton	Butyl
Propyl Dipropasol Solvent[4]	Neoprene, Nitrile, Natural Rubber, Butyl, Viton, PVC	
Propyl Nitrate[1]		Butyl
Propylene[1]	Viton, PVC	
Propylene Glycol Monobutyl Ether[4]	Neoprene, Nitrile, PVC, Butyl, Viton	Natural Rubber
Propylene Glycol Monomethyl Ether[4]	Neoprene, Nitrile, Natural Rubber, Butyl, Viton	
Propylene Glycol Monopropyl Ether[4]	Neoprene, Nitrile, Natural Rubber, Butyl, Viton	
Propylene Oxide[2]		Butyl, PVA
Propyl Propasol Solvent[4]	Neoprene, Nitrile, Natural Rubber, Butyl, Viton	
Pyranol[1]	Viton, Nitrile	
Pyridine[2]		Butyl, PVA
Red Oil[1]	Viton, Nitrile	PVC, Neoprene
Rubber Solvent[2]	Nitrile, PVA	Neoprene
Safrotin 50% in ROH[4]	Neoprene, Nitrile, Natural Rubber, Butyl, Viton, PVC	
Sal Ammoniac[1]	Viton, Butyl, PVC, Nitrile, Neoprene	
Salicylic Acid[1]	Viton, Butyl, PVC, Neoprene	Nitrile
Silicate Esters[1]	Viton, Neoprene	Nitrile
Silicone Greases[1]	Viton, Butyl, PVC, Nitrile, Neoprene	
Silicone Oils[1]	Viton, Butyl, PVC, Nitrile, Neoprene	
Silver Nitrate[1]	Viton, Butyl, PVC, Neoprene	Nitrile
Skydrol 500[1]		Butyl
Skydrol 7000[1]	Butyl	Viton
Soda Ash[1]	Viton, Butyl, PVC, Nitrile, Neoprene	
Sodium Bicarbonate[1]	Viton, Butyl, PVC, Nitrile, Neoprene	
Sodium Acetate[1]	Butyl, PVC	Nitrile, Neoprene
Sodium Bisulfite[1]	Viton, Butyl, PVC, Nitrile, Neoprene	
Sodium Borate[1]	Viton, Butyl, PVC, Nitrile, Neoprene	
Sodium Carbonate[1]	Viton, Butyl, PVC, Nitrile, Neoprene	
Sodium Chloride[1]	Viton, Butyl, PVC, Nitrile, Neoprene	
Sodium Cyanide[1]	Viton, Butyl, PVC, Nitrile, Neoprene	
Sodium Hydroxide[3]	Butyl, Neoprene	
Sodium Hydroxide, 50%[2&5]	Nitrile[2], Neoprene[2], Natural Rubber[2], 4H[5], SilverShield[5]	PVC[2]
Sodium Hypochlorite 4-6%[4]	Neoprene, Nitrile, Natural Rubber, PVC, Butyl, Viton	
Sodium Metaphosphate[1]	Viton, Butyl, PVC, Nitrile	Neoprene

Chemical	Excellent	Very Good
Sodium Nitrate[1]	Viton, Butyl, PVC	Nitrile, Neoprene
Sodium Perborate[1]	Viton, Butyl, PVC	Nitrile, Neoprene
Sodium Peroxide[1]	Viton, Butyl, PVC	Nitrile, Neoprene
Sodium Phosphate[1]	Viton, Butyl, PVC, Nitrile, Neoprene	
Sodium Silicate[1]	Viton, Butyl, PVC, Nitrile, Neoprene	
Sodium Sulfate[1]	Viton, Butyl, PVC, Nitrile, Neoprene	
Sodium Sulfide[1]	Viton, Butyl, PVC, Nitrile, Neoprene	
Sodium Sulfite[1]	Viton, Butyl, PVC, Nitrile, Neoprene	
Sodium Thiosulfate[1]	Viton, Butyl, PVC, Neoprene	Nitrile
Stannic Chloride	Viton, PVC, Nitrile, Neoprene	
Stearic Acid[1]	Viton, PVC	Butyl, Nitrile, Neoprene
Stoddard Solvent[2]	Nitrile, Neoprene, PVA	
Styrene[2&4]	Viton[4]	PVA
Sulfite Liquors[1]	Viton, PVC	Butyl, Nitrile, Neoprene
Sulfur[1]	Viton, Butyl, PVC, Neoprene	
Sulfur Chloride[1]	Viton, PVC	
Sulfur Dioxide[1]	Viton, PVC	Butyl
Sulfur Hexafluoride[1]	Viton, Butyl, PVC, Neoprene	Nitrile
Sulfur Trioxide[1]	Viton, PVC	Butyl
Sulfuric Acid (20% Oleum)[1]	Viton, PVC	
Sulfuric Acid 47% (battery acid)[2]	Neoprene, Natural Rubber	PVC
Sulfuric Acid, 25%[5]	Silver Shield, 4H, Butyl, Neoprene, Nitrile	
Sulfuric Acid, Fuming[3]	Butyl, Neoprene	
Sulfuric Acid, Conc[3]	Butyl, Neoprene	
Sulfurous Acid[1]	Viton	Butyl, PVC, Nitrile, Neoprene
Tannic Acid[2]	PVC, Nitrile, Neoprene, Natural Rubber	
Tar, Bituminous[1]	Viton, PVC	Nitrile
Tartaric Acid[1]	Viton, PVC, Nitrile	Butyl, Neoprene
Terpineol[1]	Viton, PVC	Nitrile
Tertiary Butyl Alcohol[1]	Viton	Butyl, PVC, Nitrile, Neoprene
Tertiary Butyl Catechol[1]	Viton, PVC	Butyl, Neoprene
Tertiary Butyl Mercaptan[1]	Viton	PVC
Tetrabromamethane[1]	Viton	
Tetrabuty Titanate[1]	Viton, PVC	Butyl, Nitrile, Neoprene
Tetrachloroethylene[2&5]	PVA[2], 4H[5], SilverShield[5]	Nitrile[2]
Tetrahydrofuran, THF[3]	Butyl	
Tetralin[1]	Viton	PVC
Thionyl Chloride[1]	Viton, PVC	
Titanium Tetrachloride[1]	Viton, PVC	
Toluene, Toluol[2,3&5]	Butyl[3], 4H[5], SilverShield[5]	PVA[2]
Toluene Diisocyanate, TDI[3&5]	Butyl[3], 4H[5], SilverShield[5]	

Chemical	Excellent	Very Good
o-Toluidine[4]	Butyl, Viton	Natural Rubber, Neoprene
Transformer Oil[1]	Viton, Nitrile	Neoprene
Transmission Fluid A[1]	Viton, Nitrile	Neoprene
Triacetin[1]	Butyl, PVC	Nitrile, Neoprene
Tributoxy Ethyl Phosphate[1]	Viton, Butyl	
Tributy Phosphate[1]	Butyl	
Tributy Mercaptan[1]	Viton	
Trichloroacetic Acid[1]	PVC	Butyl, Nitrile
1,2,4-Trichlorobenzene[4]	PVC, Viton	
1,1,1-Trichloroethane[5]	Viton, Silver Shield, 4H, PVA	
Trichloroethylene, TCE[2&5]	PVA[2], 4H[5]	
Trichlorotrifluoroethane[4]	Neoprene, Nitrile, Butyl, Viton	
Tricresyl Phosphate, TCP[2]	Nitrile, Natural Rubber	PVA
Triethanolamine 85%, TEA[2]	Neoprene, Nitrile, PVC	PVA, Natural Rubber
Triethyl Aluminum[1]	PVC	Viton
Triethyl Borane[1]	Viton, PVC	
Trinitrotoluene[1]		Viton, Neoprene
Trioctyl Phosphate[1]	Butyl	Viton
Triaryl Phosphate[1]	Viton, Butyl	
Tung Oil[1]	Viton, Nitrile	Neoprene
Turbine Oil[1]	Viton	Nitrile
Turpentine[2]	Nitrile	PVA
Urea[1]	Viton, Butyl, PVC, Nitrile, Neoprene	
UDMH[1]	Butyl	Nitrile, Neoprene
Varnish[1]	Viton	Nitrile
Versilube[1]	Viton, Butyl, Nitrile, Neoprene	
Vinyl Acetate[1]	Viton, Nitrile, Neoprene	
Vinyl Chloride[5]	Viton, Silver Shield, Nitrile	
Vinyl Ethylene[3]	Butyl, Neoprene	
Vinyl Styrene[4]	Viton	
Wagner 21B Fluid[1]		Butyl, Neoprene
White Pine Oil[1]	Viton	Nitrile
White Oil[1]	Viton, Nitrile	PVC, Neoprene
Xylene, Xylol[5]	Viton, Silver Shield, 4H, PVA, Nitrile	
Zeolites[1]	Viton, Butyl, PVC, Nitrile, Neoprene	
Zinc Acetate[1]	Butyl, PVC	Nitrile, Neoprene
Zinc Chloride[1]	Viton, Butyl, PVC, Nitrile, Neoprene	
Zinc Oxide[1]	Viton, Butyl, PVC, Nitrile, Neoprene	
Zinc Sulfate[1]	Viton, Butyl, PVC, Nitrile, Neoprene	

1 ILC Dover, a division of ILC Industries, P. O. Box 266, Frederica, DE 19946, #302-335-3911
2 Ansell Edmont Industrial, 1300 Walnut Street, P.O. Box 6000, Coshocton, OH 43812, #800-800-0444
3 Guardian Manufacturing Company, 302 Conwell Avenue, Willard, OH 44890, #800-243-7379

[4] Best Manufacturing Company, 4615 East 48th Street, Los Angles, CA 90058, #213-583-9951 / 800-862-2660

[5] Lab Safety Supply Inc, P. O. Box 1368 Janesville, WI 53547-1368, #1-800-356-0783

[6] Chemical & Engineering News, May 12, 1997, p. 7

Appendix H
Particularly Hazardous Substances

Contents

Tables

A. Hazardous Chemicals

"Hazardous chemicals" is a broad category that is defined as having statistically significant evidence based on a least one study conducted in accordance with established scientific principles that acute or chronic health effects may occur in exposed employees. It also includes chemicals that are known to present a physical hazard (e.g., combustible liquids, compressed gases, explosive materials, flammable materials, organic peroxides, oxidizers, pyrophoric materials, water-reactive, and unstable reactive materials).

Although a list of hazardous chemicals provides some guidance for laboratory staff, it is important to consider risk factors such as exposure and potency when determining precautions to be followed. For example, a hazardous chemical that has completely reacted to form a gel will no longer cause significant exposure, and one chemical may present much less hazard than a second chemical due to a relatively lower toxicity.

B. Particularly Hazardous Substances

A subset of hazardous chemicals is a group of chemicals that require additional handling provisions. This group is referred to in the Laboratory Safety Standard as "particularly hazardous substances" and includes chemicals that meet any of the following criteria:

1. High Degree of Acute Toxicity

The Environmental Protection Agency (EPA) has adopted the following criteria to identify acutely toxic chemicals based on data from mammalian testing.

For reference, LD_{50} is a single dose of a material expected to kill 50% of a group of test animals. LC_{50} is a calculated concentration of a material in air, exposure to which for a specified length of time is expected to cause death of 50% of a defined experimental animal population.

a. Dermal Route

The median lethal dose (LD_{50}) for dermal route is less than or equal to 50 milligrams per kilogram (mg/kg).

b. Oral Route

For an oral route, the median lethal dose (LD_{50}) is less than or equal to 25 mg/kg.

c. Inhalation Route

The median lethal concentration (LC_{50}) for an inhalation route is less than or equal to 0.5 milligrams per liter of air (mg/l) where time of exposure is any time up to 8 hours.

The EPA definition should be considered as the minimum "floor" for consideration as "high degree of acute toxicity." Other gases and vapors which may present an acute toxic affect and may be generated in large quantities in a laboratory setting should be included. Examples of such substances cited in the background documentation for the federal law included hydrogen cyanide (0.35 mg/l for mice), hydrogen sulfide (0.62 mg/l for mice), and nitrogen dioxide (0.06 mg/l for guinea pigs).

2. Select Carcinogens

Various peer group agencies have researched data and compiled lists of known, suspected, and/or regulated carcinogens. A select carcinogen is any chemical that meets one of the following criteria:

It is regulated by WISHA as a carcinogen;

OR

It is listed as “known to be carcinogens” in the Annual Report on Carcinogens published by the National Toxicology Program (NTP) (latest edition);

OR

It is listed as “carcinogenic to humans” by the International Agency for Research on Cancer (IARC) Monographs (latest edition);

OR

It is listed in either Group 2A (“Probably carcinogenic to humans”) or 2B (“Possibly carcinogenic to humans”) by IARC or in the category of “Reasonably anticipated to be human carcinogens” by NTP, and it causes statistically significant tumor incidence in experimental animals in accordance with any of the following criteria:

After inhalation exposure of 6-7 hours per day, 5 days per week, for a significant portion of a lifetime to dosages of less than 10 mg/m^3;

OR

After repeated skin application of less than 300 mg/kg of body weight per week;

OR

After oral dosages of less than 50 mg/kg of body weight per day.

3. Reproductive Toxicants

Reproductive toxicants are those known to affect human reproductive capabilities including chromosomal damage (mutations) and effects on fetuses (teratogenesis). Tables H-1 and H-2 include those human reproductive toxicants listed as “A+” through “A–” in “Workplace Hazards to Reproduction and Development: A

Resource for Workers, Employers, Health Care Providers, and Health & Safety Personnel," 1999, by Sharon L. Drozdowsky and Stephen G. Whittaker, Technical Report Number 21-3-1999, Washington State Department of Labor and Industries, Safety and Health Assessment and Research for Prevention (SHARP) Program. Chemicals rated "A+" and "A" are listed as "Reproductive Toxicants, and those rated "A–" are listed as "Suspected Reproductive Toxicants."

4. Select Toxins

Some chemicals with high toxicity are managed as potential terrorist weapons. These chemicals are listed in the Code of Federal Regulations at 42 CFR 72.6. However, the select toxins may be exempted from the regulatory requirements if the LD_{50} is greater than 100 nanograms per kilogram and the toxin is used for medical purposes or biomedical research. Any select toxin that is not exempted is noted in the tables as a "Select Toxin." If used on the University of Washington campus, additional requirements for registration, handling and disposal are mandatory. Contact EH&S at 206-543-7388.

C. Particularly Hazardous Substance List

The following list (Table H-1) is a list of the known chemicals that are select carcinogens, reproductive toxicants, select toxins, or meet the definitions for a high degree of acute toxicity and are believed to have been used on the campus in the past few years. Table H-2 lists the substances by Chemical Abstracts Service (CAS) Registry Number.

This list is not complete. Until a definitive list of these substances is developed by a regulatory agency, it is up to the user to determine what chemicals being used or generated during a laboratory protocol are considered particularly hazardous. All chemicals in this category require pre-planned storage and handling practices that minimize exposures, and written standard operating procedures that identify these safe practices.

Table H-1 Minimum List of Known Particularly Hazardous Substances

Particularly Hazardous Substances	CAS Number[1]	Hazard
Acetaldehyde	75-07-0	Suspected Carcinogen / Susp. Reproductive T.
Acetone	67-64-1	Susp. Reproductive T.
Acetone cyanohydrin	75-86-5	Highly Toxic

Particularly Hazardous Substances	CAS Number[1]	Hazard
2-Acetylaminofluorene	53-96-3	Regulated Carcinogen
1-Acetyl-2-thiourea	591-08-2	Highly Toxic
Acrolein	107-02-8	Highly Toxic
Acrylamide	79-06-1	Suspected Carcinogen
Acrylic Acid	79-10-7	Highly Toxic
Acrylonitrile	107-13-1	Regulated Carcinogen / Susp. Reproductive T.
Acryloyl chloride	814-68-6	Highly Toxic
Actinomycin D	50-76-0	Highly Toxic
Aflatoxins	1402-68-2	Known Carcinogen / Highly Toxic
Aflatoxin B1	1162-65-8	Known Carcinogen / Highly Toxic
Aldrin Pestanal®		Highly Toxic
Aluminum	7429-90-5	Susp. Reproductive T.
Amanita Muscaria		Highly Toxic
d-Amethopterin hydrate		Highly Toxic
dl-Amethopterin hydrate		Highly Toxic
o-Aminoazotoluene	97-56-3	Suspected Carcinogen
4-Aminobiphenyl (4-Aminodiphenyl)	92-67-1	Known Carcinogen
1-Amino-2-methylanthraquinone	82-28-0	Suspected Carcinogen
Aminopteridine (Aminopterin)	54-62-6	Highly Toxic
4-Aminopyridine	504-24-5	Highly Toxic
Amitrole	61-82-5	Suspected Carcinogen
Ammonia	7664-41-7	Susp. Reproductive T.
d-Amphetamine sulfate		Highly Toxic
Analgesic Mixtures Containing Phenacetin	N/A	Known Carcinogen
Aniline	65-53-3	Reproductive Toxicant
o-Anisidine hydrochloride	134-29-2	Suspected Carcinogen
Antimony	7440-36-0	Susp. Reproductive T.
Antimony potassium tartrate	28300-74-5	Susp. Reproductive T.
Antimycin A	1397-94-0	Highly Toxic
Arsenic	7440-38-2	Susp. Reproductive T.

Particularly Hazardous Substances	CAS Number[1]	Hazard
Arsenic Compounds, Inorganic	N/A	Known Carcinogen / Susp. Reproductive T.
Arsenic pentoxide	1303-28-2	Highly Toxic
Arsenic trioxide	1327-53-3	Highly Toxic
Arsine (Hydrogen arsenide)	7784-42-1	Highly Toxic
Asbestos	1332-21-4	Known Carcinogen
Atrazine	1912-24-9	Susp. Reproductive T.
Avidin FITC Conjugate		Highly Toxic
Azathioprine	446-86-6	Known Carcinogen
Azinphos-ethyl (Ethyl guthion)	2642-71-9	Highly Toxic
Benomyl	17804-35-2	Susp. Reproductive T.
Benzene	71-43-2	Known Carcinogen / Susp. Reproductive T.
Benzidine	92-87-5	Known Carcinogen
Benzotrichloride	98-07-7	Suspected Carcinogen
Beryllium and Certain Beryllium Compounds	N/A	Known Carcinogen
N,N-Bis(2-chloroethyl)-2-naphthylamine (Chlornaphazine)	494-03-1	Known Carcinogen
Bis(chloromethyl) ether	542-88-1	Known Carcinogen
Bischloroethyl nitrosourea (BCNU) (Carmustine)	154-93-8	Suspected Carcinogen
2,2-Bis(4-chlorophenyl)-1,1-dichloroethylene, DDT -		Suspected Carcinogen
Boric acid	10043-35-3	Susp. Reproductive T.
Boron oxide	1303-86-2	Susp. Reproductive T.
Botulinum toxins	N/A	Highly Toxic, Select Toxin
Botulinum toxin A	93384-43-1	Highly Toxic, Select Toxin
Bromine	7726-95-6	Susp. Reproductive T.
Bromodichloromethane	75-27-4	Suspected Carcinogen
α-Bungarotoxin		Highly Toxic
1,3-Butadiene	106-99-0	Regulated Carcinogen
1,4-Butanediol dimethylsulfonate (Myleran®; Busulfan)	55-98-1	Known Carcinogen / Reproductive Toxicant
3-Buten-2-one (Methyl vinyl ketone)	78-94-4	Highly Toxic
Butylated hydroxyanisole (BHA)	25013-16-5	Suspected Carcinogen
n-Butyronitrile	109-74-0	Highly Toxic
Cadmium and Certain Cadmium Compounds	N/A	Regulated Carcinogen

Particularly Hazardous Substances	CAS Number[1]	Hazard
Carbachol (Carbamylcholine chloride)	51-83-2	Highly Toxic
Carbolic acid (See Phenol)		
Carbon disulfide	75-15-0	Reproductive Toxicant
Carbon monoxide	630-08-0	Reproductive Toxicant
Carbon tetrachloride	56-23-5	Suspected Carcinogen
Carmustine (See Bischloroethyl nitrosourea)		
Ceramic Fibers	N/A	Suspected Carcinogen
Chloecalciferol		Highly Toxic
Chlorambucil	305-03-3	Known Carcinogen / Reproductive Toxicant
Chlorendic Acid	115-28-6	Suspected Carcinogen
Chlorinated Paraffins	108171-26-2	Suspected Carcinogen
Chloroacetoaldehyde		Highly Toxic
2-Chloroacetophenone		Highly Toxic
Chlorobiphenyls	N/A	Reproductive Toxicant
2-Chloroethyl ether		Highly Toxic
1-(2-Chloroethyl)-3-cyclohexyl-1-nitrosourea (CCNU)	13010-47-4	Suspected Carcinogen
1-(2-Chloroethyl)-3-(4-methylcyclohexyl)-1-nitrosourea (MeCCNU) (Semustine)	13909-09-6	Known Carcinogen
Chloroform	67-66-3	Suspected Carcinogen / Susp. Reproductive T.
Chloromethyl methyl ether (technical grade)	107-30-2	Known Carcinogen
3-Chloro-2-methylpropene	563-47-3	Suspected Carcinogen
4-Chloro-o-phenylenediamine	95-83-0	Suspected Carcinogen
Chlorpyrifos	2921-88-2	Susp. Reproductive T.
Chromium, Hexavalent, and Certain Chromium Compounds	N/A	Known Carcinogen
Chromomycin A3	7059-24-7	Highly Toxic
C. I. Basic Red 9 Monohydrochloride	569-61-9	Suspected Carcinogen
Cisplatin	15663-27-1	Suspected Carcinogen
Ciclosporin (See Cyclosporin A)	79217-60-0	
Clostridium perfringens epsilon toxin		Highly Toxic, Select Toxin
Colchicine	64-86-8	Highly Toxic
Copper	7440-47-3	Susp. Reproductive T.
Coumarin Anticoagulants (e.g., Warfarin)	N/A	Reproductive Toxicant

Particularly Hazardous Substances	CAS Number[1]	Hazard
p-Cresidine	120-71-8	Suspected Carcinogen
Cupferron	135-20-6	Suspected Carcinogen
Cycloheximide	66-81-9	Highly Toxic
Cyclophosphamide (Cytoxan, Neosar)	50-18-0	Known Carcinogen / Reproductive Toxicant
Cyclosporin A (Cyclosporine A) (Ciclosporin)	59865-13-3	Known Carcinogen
Decaborane	17702-41-9	Highly Toxic
Di(2-ethylhexyl) phthalate (DEHP)	117-81-7	Suspected Carcinogen
Diacetoxydibutyltin	1067-33-0	Highly Toxic
2,4-Diaminoanisole sulfate	39156-41-7	Suspected Carcinogen
2,4-Diaminotoluene	95-80-7	Suspected Carcinogen
Diazinon	333-41-5	Susp. Reproductive T.
1,2-Dibromo-3-chloropropane (DBCP)	96-12-8	Regulated Carcinogen / Susp. Reproductive T.
1,2-Dibromoethane (Ethylene dibromide)	106-93-4	Suspected Carcinogen
Dibutyltin diacetate (See Diacetoxydibutyltin)		
Dibutyltin oxide	818-08-6	Highly Toxic
o-Dichlorobenzene	95-50-1	Susp. Reproductive T.
1,4-Dichlorobenzene	106-46-7	Suspected Carcinogen
3,3'-Dichlorobenzidine	91-94-1	Regulated Carcinogen
3,3'-Dichlorobenzidine 2HCL	612-83-9	Regulated Carcinogen
Dichlorodiphenyltrichloroethane (DDT)	50-29-3	Susp. Reproductive T.
1,2-Dichloroethane	107-06-2	Suspected Carcinogen
Dichloromethane (See Methylene chloride)		
2,4-Dichlorophenoxyacetic acid (2,4-D)	94-75-7	Susp. Reproductive T.
1,3-Dichloropropene (technical grade)	542-75-6	Suspected Carcinogen
Dichlorvos Pestanal ®		Highly Toxic
Dieldrin	60-57-1	Highly Toxic
Diepoxybutane	1464-53-5	Suspected Carcinogen
Diethyl sulfate	64-67-5	Suspected Carcinogen
Diethyl chlorophosphate	814-49-3	Highly Toxic
Diethylstilbestrol (DES)	56-53-1	Known Carcinogen / Reproductive Toxicant
Diglycidyl resorcinol ether	101-90-6	Suspected Carcinogen

Particularly Hazardous Substances	CAS Number[1]	Hazard
Diisopropyl fluorophosphate	55-91-4	Highly Toxic
Dimethoate	60-51-5	Susp. Reproductive T.
Dimethyl sulfate	77-78-1	Suspected Carcinogen
Dimethyl vinyl chloride	513-37-1	Suspected Carcinogen
4-Dimethylaminoazobenzene	60-11-7	Regulated Carcinogen
4,4-(Dimethylamino)benzophenone (See Michler′s Ketone)		
3,3'-Dimethylbenzidine	119-93-7	Suspected Carcinogen
Dimethylcarbamoyl chloride	79-44-7	Suspected Carcinogen
Dimethylformamide (DMF)	68-12-2	Susp. Reproductive T.
1,1-Dimethylhydrazine (UDMH)	57-14-7	Suspected Carcinogen
4,6,-Dinitro-o-cresol	534-52-1	Highly Toxic
Dinitrotoluene (DNT)	25321-14-6	Reproductive Toxicant
1,4-Dioxane	123-91-1	Suspected Carcinogen
Diphenylhydantonin (Phenytoin)	57-41-0	Suspected Carcinogen
Direct Black 38	1937-37-7	Suspected Carcinogen
Direct Blue 6	2602-46-2	Suspected Carcinogen
Drabkins Reagent		Highly Toxic
Emetine dihydrochloride	316-42-7	Highly Toxic
Endrin Pestanal®		Highly Toxic
Epichlorohydrin	106-89-8	Suspected Carcinogen
Ergocalciferol (Vitamin D2)	50-14-6	Highly Toxic
Erionite	66733-21-9	Known Carcinogen
Estrogens, Conjugated	N/A	Known Carcinogen
Estrogens (Not Conjugated):Estradiol-17beta	50-28-2	Suspected Carcinogen
Estrogens (Not Conjugated) Estrone	53-16-7	Suspected Carcinogen
Estrogens (Not Conjugated): Mestranol	72-33-3	Suspected Carcinogen
Ethidium bromide	1239-45-8	Suspected Mutagen
Ethyl acrylate	140-88-5	Suspected Carcinogen
Ethyl alcohol (when evaporating from large surface areas)	64-17-5	Reproductive Toxicant
Ethyl mercuric chloride (Chloroethyl mercury)	107-27-7	Highly Toxic
Ethyl methanesulfonate	62-50-0	Suspected Carcinogen
Ethylene dibromide (See 1,2-Dibromoethane)		

Particularly Hazardous Substances	CAS Number[1]	Hazard
Ethylene glycol monoethyl ether (EGEE)	110-80-5	Susp. Reproductive T.
Ethylene glycol monomethyl ether (EGME)	109-86-4	Susp. Reproductive T.
Ethylene oxide	75-21-8	Regulated Carcinogen / Susp. Reproductive T.
Ethylene thiourea	96-45-7	Suspected Carcinogen
Ethyleneimine	151-56-4	Regulated Carcinogen
Fentanyl	437-38-7	Highly Toxic
Fentanyl citrate	990-73-8	Highly Toxic
Fluocinolone acetonide (Synsac)	67-73-2	Highly Toxic
Fluorescein mercuric acetate	3570-80-7	Highly Toxic
Fluoroacetamide	640-19-7	Highly Toxic
Fluoroacetic acid	144-49-0	Highly Toxic
dl-Fluorocitric acid		Highly Toxic
2-Fluoroethanol	371-62-0	Highly Toxic
Formaldehyde (Gas)	50-00-0	Suspected Carcinogen / Susp. Reproductive T.
Gasoline	8006-61-9	Susp. Reproductive T.
Glasswool	N/A	Suspected Carcinogen
Glycidol	556-52-5	Suspected Carcinogen
Heptachlor	76-44-8	Highly Toxic
Hexachloro-epoxy-octahydro-		Highly Toxic
Hexachlorobenzene	118-74-1	Suspected Carcinogen
Hexachloroethane	67-72-1	Suspected Carcinogen
Hexamethyl phosphoramide	680-31-9	Suspected Carcinogen
Hexamethylditin	661-69-8	Highly Toxic
Hydrazine	302-01-2	Suspected Carcinogen
Hydrazine sulfate	10034-93-2	Suspected Carcinogen
Hydrazobenzene	122-66-7	Suspected Carcinogen
Hydrogen cyanide	74-90-8	Highly Toxic
Hydrogen sulfide	7783-06-4	Highly Toxic
2-Idioethanol		Highly Toxic
Indomethacin	53-86-1	Highly Toxic
Iron Dextran Complex	9004-66-4	Suspected Carcinogen
Iron pentacarbonyl	13463-40-6	Highly Toxic

Particularly Hazardous Substances	CAS Number[1]	Hazard
Isobutyronitrile	78-82-0	Highly Toxic
Kepone® (Chlordecone)	143-50-0	Suspected Carcinogen
Lead	7439-92-1	Reproductive Toxicant
Lead acetate	301-04-2	Suspected Carcinogen
Lead chromate	7758-97-6	Known Carcinogen
Lead phosphate	7446-27-7	Suspected Carcinogen
Lindane	58-89-9	Suspected Carcinogen / Susp. Reproductive T.
Lithium	7439-93-2	Susp. Reproductive T.
Manganese	7439-96-5	Susp. Reproductive T.
Melphalan	148-82-3	Known Carcinogen
Mercury, Metallic and Salts	7439-97-6	Susp. Reproductive T.
Mercury, Organic and Methyl	N/A	Reproductive Toxicant
Methotrexate (Methylaminopterin)	59-05-2	Highly Toxic / Reproductive Toxicant
Methyl alcohol	67-56-1	Susp. Reproductive T.
Methyl chloromethyl ether	107-30-2	Regulated Carcinogen
Methyl ethyl ketone (MEK)	78-93-3	Susp. Reproductive T.
Methyl methanesulfonate	66-27-3	Suspected Carcinogen
Methyl parathion	298-00-0	Susp. Reproductive T.
2-Methyl propionitrile (See Isobutyronitrile)		
N-Methyl-*N*-nitro-*N*-nitrosoguanidine	70-25-7	Suspected Carcinogen
2-Methylaziridine (Propyleneimine)	75-55-8	Suspected Carcinogen / Highly Toxic
4,4'-Methylene-bis-(2-chloroaniline) (MBOCA)	101-14-4	Regulated Carcinogen
4,4'-Methylene-bis-(*N,N*-dimethylbenzenamine)	101-61-1	Suspected Carcinogen
Methylene chloride (Dichloromethane)	75-09-2	Regulated Carcinogen / Reproductive Toxicant
4,4'-Methylenedianiline (MDA)	101-77-9	Suspected Carcinogen
4,4'-Methylenedianiline Dihydrochloride	13552-44-8	Suspected Carcinogen
Metronidazole	443-48-1	Suspected Carcinogen
Michler′s Ketone	90-94-8	Suspected Carcinogen
Mirex	2385-85-5	Suspected Carcinogen
Mustard Gas (Sulfur mustard)	505-60-2	Known Carcinogen

Particularly Hazardous Substances	CAS Number[1]	Hazard
1-Naphthylamine (α-Naphthylamine) (1-Aminonaphthalene)	134-32-7	Regulated Carcinogen
2-Naphthylamine (β-Naphthylamine) (2-Aminonaphthalene)	91-59-8	Known Carcinogen
Nickel and Certain Nickel Compounds	N/A	Known Carcinogen
Nitrilotriacetic Acid	139-13-9	Suspected Carcinogen
4-Nitrobiphenyl	92-93-3	Regulated Carcinogen
Nitrofen	1836-75-5	Suspected Carcinogen
Nitrogen dioxide	10102-44-0	Highly Toxic
Nitrogen Mustard Hydrochloride	55-86-7	Suspected Carcinogen
2-Nitropropane	79-46-9	Suspected Carcinogen
N-Nitrosodi-*n*-butylamine	924-16-3	Suspected Carcinogen
N-Nitrosodiethanolamine	1116-54-7	Suspected Carcinogen
N-Nitrosodiethylamine	55-18-5	Suspected Carcinogen
N-Nitrosodimethylamine	62-75-9	Regulated Carcinogen
N-Nitrosodi-*n*-propylamine	621-64-7	Suspected Carcinogen
N-Nitroso-*N*-ethylurea	759-73-9	Suspected Carcinogen
4-(*N*-Nitrosomethylamino)-1-(3-pyridyl)-1-butanone (NNK)	64091-91-4	Suspected Carcinogen
N-Nitroso-*N*-methylurea	684-93-5	Suspected Carcinogen
N-Nitrosomethylvinylamine	4549-40-0	Suspected Carcinogen
N-Nitrosomorpholine	59-89-2	Suspected Carcinogen
N-Nitrosonornicotine	16543-55-8	Suspected Carcinogen
N-Nitrosopiperidine	100-75-4	Suspected Carcinogen
N-Nitrosopyrrolidine	930-55-2	Suspected Carcinogen
N-Nitrososarcosine	13256-22-9	Suspected Carcinogen
Nitrous oxide	10024-97-2	Susp. Reproductive T.
Norethisterone	68-22-4	Suspected Carcinogen
Ochratoxin A	303-47-9	Suspected Carcinogen
4,4'-Oxydianiline	101-80-4	Suspected Carcinogen
Oxymetholone	434-07-1	Suspected Carcinogen
Phenacetin	62-44-2	Suspected Carcinogen
Phenazopyridine hydrochloride	136-40-3	Suspected Carcinogen
Phenol (Carbolic acid)	108-95-2	Reproductive Toxicant

Particularly Hazardous Substances	CAS Number[1]	Hazard
Phenoxybenzamine hydrochloride	63-92-3	Suspected Carcinogen
1-Phenyl-2-thiourea	103-85-5	Highly Toxic
Phenytoin	57-41-0	Suspected Carcinogen
Piperazine estrone sulfate	7280-37-7	Known Carcinogen
Polychlorinated biphenyls (PCBs)	1336-36-3	Reproductive Toxicant
Polyvinyl chloride (PVC resin)	9002-86-2	Susp. Reproductive T.
Potassium silver cyanide	506-61-6	Susp. Reproductive T.
Procarbazine	671-16-9	Reproductive Toxicant
β-Propiolactone	57-57-8	Regulated Carcinogen
Propyleneimine (See 2-Methylaziridine)		
Radon	10043-92-2	Known Carcinogen
Selenium	7782-49-2	Susp. Reproductive T.
Silica, Crystalline	14808-60-7	Known Carcinogen
Sodium equilin sulfate	16680-47-0	Known Carcinogen
Sodium estrone sulfate	438-67-5	Known Carcinogen
Strontium Chromate	7789-06-2	Known Carcinogen
Styrene (Vinyl benzene)	100-42-5	Susp. Reproductive T.
Sulfur dioxide	7446-09-5	Susp. Reproductive T.
Talc, containing asbestiform fibers	14807-96-6	Known Carcinogen
Tamoxifen	10540-29-1	Known Carcinogen
2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	1746-01-6	Known Carcinogen / Susp. Reproductive T.
Tetrachloroethylene	127-18-4	Susp. Reproductive T.
Tetrodotoxin	4368-28-9	Highly Toxic
Thiotepa (See Tris (1-aziridinyl) phosphine sulfate)		
Thorium dioxide	1314-20-1	Known Carcinogen
Toluene	108-88-3	Reproductive Toxicant
Treosulfan	299-75-2	Known Carcinogen
Trichloroethylene (TCE)	79-01-6	Susp. Reproductive T.
Trinitrotoluene (TNT)	118-96-7	Susp. Reproductive T.
Triple super phosphate, granular (TSP)	7758-23-8	Susp. Reproductive T.
Tris (1-aziridinyl) phosphine sulfate (Thiotepa)	52-24-4	Known Carcinogen
d-Tubocurarine chloride	57-94-3	Highly Toxic

Particularly Hazardous Substances	CAS Number[1]	Hazard
Vinyl Chloride	75-01-4	Known Carcinogen / Susp. Reproductive T.
Warfarin	81-81-2	Reproductive Toxicant
Xylene	1330-20-7	Susp. Reproductive T.
Zinc chromate	13530-65-9	Known Carcinogen

[1]CAS Number indicates the Chemical Abstracts Service registry number.

Table H-2 Particularly Hazardous Substances Listed by CAS Number

CAS Number[1]	Particularly Hazardous Substance	Hazard
	Aldrin Pestanal®	Highly Toxic
	Amanita Muscaria	Highly Toxic
	d-Amethopterin hydrate	Highly Toxic
	dl-Amethopterin hydrate	Highly Toxic
	d-Amphetamine sulfate	Highly Toxic
	Avidin FITC Conjugate	Highly Toxic
	2,2-Bis(4-chlorophenyl)-1,1-dichloroethylene, DDT -	Suspected Carcinogen
	α-Bungarotoxin	Highly Toxic
	Chloecalciferol	Highly Toxic
	Chloroacetoaldehyde	Highly Toxic
	2-Chloroacetophenone	Highly Toxic
	2-Chloroethyl ether	Highly Toxic
	Dichlorvos Pestanal ®	Highly Toxic
	Drabkins Reagent	Highly Toxic
	Endrin Pestanal®	Highly Toxic
	dl-Fluorocitric acid	Highly Toxic
	Hexachloro-epoxy-octahydro-	Highly Toxic
	2-Idioethanol	Highly Toxic
N/A	Analgesic Mixtures Containing Phenacetin	Known Carcinogen
N/A	Arsenic Compounds, Inorganic	Known Carcinogen
N/A	Beryllium and Certain Beryllium Compounds	Known Carcinogen
N/A	Cadmium and Certain Cadmium Compounds	Regulated Carcinogen

CAS Number[1]	Particularly Hazardous Substance	Hazard
N/A	Ceramic Fibers	Suspected Carcinogen
N/A	Chlorobiphenyls	Reproductive Toxicant
N/A	Chromium, Hexavalent, and Certain Chromium Compounds	Known Carcinogen
N/A	Coumarin Anticoagulants (e.g., Warfarin)	Reproductive Toxicant
N/A	Estrogens, Conjugated	Known Carcinogen
N/A	Glasswool	Suspected Carcinogen
N/A	Mercury, Organic and Methyl	Reproductive Toxicant
N/A	Nickel and Certain Nickel Compounds	Known Carcinogen
N/A	PCBs	Reproductive Toxicant
50-00-0	Formaldehyde (Gas)	Suspected Carcinogen / Susp. Reproductive T.
50-14-6	Ergocalciferol (Vitamin D2)	Highly Toxic
50-18-0	Cyclophosphamide (Cytoxan, Neosar)	Known Carcinogen / Susp. Reproductive T.
50-28-2	Estrogens (Not Conjugated):Estradiol-17beta	Suspected Carcinogen
50-29-3	Dichlorodiphenyltrichloroethane (DDT)	Susp. Reproductive T.
50-76-0	Actinomycin D	Highly Toxic
51-83-2	Carbachol (Carbamylcholine chloride)	Highly Toxic
52-24-4	Tris (1-aziridinyl) phosphine sulfate (Thiotepa)	Known Carcinogen
53-16-7	Estrogens (Not Conjugated) Estrone	Suspected Carcinogen
53-86-1	Indomethacin	Highly Toxic
53-96-3	2-Acetylaminofluorene	Regulated Carcinogen
54-62-6	Aminopteridine (Aminopterin)	Highly Toxic
55-18-5	N-Nitrosodiethylamine	Suspected Carcinogen
55-86-7	Nitrogen Mustard Hydrochloride	Suspected Carcinogen
55-91-4	Diisopropyl fluorophosphate	Highly Toxic
55-98-1	1,4-Butanediol dimethylsulfonate (Myleran®; Busulfan)	Known Carcinogen / Reproductive Toxicant
56-23-5	Carbon tetrachloride	Suspected Carcinogen
56-53-1	Diethylstilbestrol (DES)	Known Carcinogen / Reproductive Toxicant
57-14-7	1,1-Dimethylhydrazine (UDMH)	Suspected Carcinogen
57-41-0	Diphenylhydantonin (Phenytoin)	Suspected Carcinogen
57-57-8	β-Propiolactone	Regulated Carcinogen

CAS Number[1]	Particularly Hazardous Substance	Hazard
57-94-3	d-Tubocurarine chloride	Highly Toxic
58-89-9	Lindane	Suspected Carcinogen / Susp. Reproductive T.
59-05-2	Methotrexate (Methylaminopterin)	Highly Toxic / Reproductive Toxicant
59-89-2	*N*-Nitrosomorpholine	Suspected Carcinogen
60-11-7	4-Dimethylaminoazobenzene	Regulated Carcinogen
60-51-5	Dimethoate	Susp. Reproductive T.
60-57-1	Dieldrin	Highly Toxic
61-82-5	Amitrole	Suspected Carcinogen
62-44-2	Phenacetin	Suspected Carcinogen
62-50-0	Ethyl methanesulfonate	Suspected Carcinogen
62-75-9	*N*-Nitrosodimethylamine	Regulated Carcinogen
63-92-3	Phenoxybenzamine hydrochloride	Suspected Carcinogen
64-17-5	Ethyl alcohol (when evaporating from large surface areas)	Reproductive Toxicant
64-67-5	Diethyl sulfate	Suspected Carcinogen
64-86-8	Colchicine	Highly Toxic
65-53-3	Aniline	Reproductive Toxicant
66-27-3	Methyl methanesulfonate	Suspected Carcinogen
66-81-9	Cycloheximide	Highly Toxic
67-56-1	Methyl alcohol	Susp. Reproductive T.
67-64-1	Acetone	Susp. Reproductive T.
67-66-3	Chloroform	Suspected Carcinogen / Susp. Reproductive T.
67-72-1	Hexachloroethane	Suspected Carcinogen
67-73-2	Fluocinolone acetonide (Synsac)	Highly Toxic
68-12-2	Dimethylformamide (DMF)	Susp. Reproductive T.
68-22-4	Norethisterone	Suspected Carcinogen
70-25-7	*N*-Methyl-*N*-nitro-*N*-nitrosoguanidine	Suspected Carcinogen
71-43-2	Benzene	Known Carcinogen / Susp. Reproductive T.
72-33-3	Estrogens (Not Conjugated): Mestranol	Suspected Carcinogen
74-90-8	Hydrogen cyanide	Highly Toxic

CAS Number[1]	Particularly Hazardous Substance	Hazard
75-01-4	Vinyl Chloride	Known Carcinogen / Susp. Reproductive T.
75-07-0	Acetaldehyde	Suspected Carcinogen / Susp. Reproductive T.
75-09-2	Methylene chloride (Dichloromethane)	Regulated Carcinogen / Reproductive Toxicant
75-15-0	Carbon disulfide	Reproductive Toxicant
75-21-8	Ethylene oxide	Regulated Carcinogen / Susp. Reproductive T.
75-27-4	Bromodichloromethane	Suspected Carcinogen
75-55-8	2-Methylaziridine (Propyleneimine)	Suspected Carcinogen / Highly Toxic
75-86-5	Acetone cyanohydrin	Highly Toxic
76-44-8	Heptachlor	Highly Toxic
77-78-1	Dimethyl sulfate	Suspected Carcinogen
78-82-0	Isobutyronitrile	Highly Toxic
78-93-3	Methyl ethyl ketone (MEK)	Susp. Reproductive T.
78-94-4	3-Buten-2-one (Methyl vinyl ketone)	Highly Toxic
79-01-6	Trichloroethylene (TCE)	Susp. Reproductive T.
79-06-1	Acrylamide	Suspected Carcinogen
79-10-7	Acrylic Acid	Highly Toxic
79-44-7	Dimethylcarbamoyl chloride	Suspected Carcinogen
79-46-9	2-Nitropropane	Suspected Carcinogen
81-81-2	Warfarin	Reproductive Toxicant
82-28-0	1-Amino-2-methylanthraquinone	Suspected Carcinogen
90-94-8	Michler′s Ketone	Suspected Carcinogen
91-59-8	2-Naphthylamine (β-Naphthylamine) (2-Aminonaphthalene)	Known Carcinogen
91-94-1	3,3'-Dichlorobenzidine	Regulated Carcinogen
92-67-1	4-Aminobiphenyl (4-Aminodiphenyl)	Known Carcinogen
92-87-5	Benzidine	Known Carcinogen
92-93-3	4-Nitrobiphenyl	Regulated Carcinogen
94-75-7	2,4-Dichlorophenoxyacetic acid (2,4-D)	Susp. Reproductive T.
95-50-1	o-Dichlorobenzene	Susp. Reproductive T.
95-80-7	2,4-Diaminotoluene	Suspected Carcinogen

CAS Number[1]	Particularly Hazardous Substance	Hazard
95-83-0	4-Chloro-o-phenylenediamine	Suspected Carcinogen
96-12-8	1,2-Dibromo-3-chloropropane (DBCP)	Regulated Carcinogen / Reproductive Toxicant
96-45-7	Ethylene thiourea	Suspected Carcinogen
97-56-3	o-Aminoazotoluene	Suspected Carcinogen
98-07-7	Benzotrichloride	Suspected Carcinogen
100-42-5	Styrene (Vinyl benzene)	Susp. Reproductive T.
100-75-4	*N*-Nitrosopiperidine	Suspected Carcinogen
101-14-4	4,4'-Methylene-bis-(2-chloroaniline) (MBOCA)	Regulated Carcinogen
101-61-1	4,4'-Methylene-bis-(*N,N*-dimethylbenzenamine)	Suspected Carcinogen
101-77-9	4,4'-Methylenedianiline (MDA)	Suspected Carcinogen
101-80-4	4,4'-Oxydianiline	Suspected Carcinogen
101-90-6	Diglycidyl resorcinol ether	Suspected Carcinogen
103-85-5	1-Phenyl-2-thiourea	Highly Toxic
106-46-7	1,4-Dichlorobenzene	Suspected Carcinogen
106-89-8	Epichlorohydrin	Suspected Carcinogen
106-93-4	1,2-Dibromoethane (Ethylene dibromide)	Suspected Carcinogen
106-99-0	1,3-Butadiene	Regulated Carcinogen
107-02-8	Acrolein	Highly Toxic
107-06-2	1,2-Dichloroethane	Suspected Carcinogen
107-13-1	Acrylonitrile	Regulated Carcinogen
107-27-7	Ethylmercuric chloride (Chloroethyl mercury)	Highly Toxic
107-30-2	Methyl chloromethyl ether	Regulated Carcinogen
108-88-3	Toluene	Reproductive Toxicant
108-95-2	Phenol (Carbolic acid)	Reproductive Toxicant
109-74-0	n-Butyronitrile	Highly Toxic
109-86-4	Ethylene glycol monomethyl ether (EGME)	Susp. Reproductive T.
110-80-5	Ethylene glycol monoethyl ether (EGEE)	Susp. Reproductive T.
115-28-6	Chlorendic Acid	Suspected Carcinogen
117-81-7	Di(2-ethylhexyl) phthalate (DEHP)	Suspected Carcinogen
118-74-1	Hexachlorobenzene	Suspected Carcinogen
118-96-7	Trinitrotoluene (TNT)	Susp. Reproductive T.
119-93-7	3,3'-Dimethylbenzidine	Suspected Carcinogen
120-71-8	p-Cresidine	Suspected Carcinogen

CAS Number[1]	Particularly Hazardous Substance	Hazard
122-66-7	Hydrazobenzene	Suspected Carcinogen
123-91-1	1,4-Dioxane	Suspected Carcinogen
127-18-4	Tetrachloroethylene	Susp. Reproductive T.
134-29-2	o-Anisidine hydrochloride	Suspected Carcinogen
134-32-7	1-Naphthylamine (α-Naphthylamine) (1-Aminonaphthalene)	Regulated Carcinogen
135-20-6	Cupferron	Suspected Carcinogen
136-40-3	Phenazopyridine hydrochloride	Suspected Carcinogen
139-13-9	Nitrilotriacetic Acid	Suspected Carcinogen
140-88-5	Ethyl acrylate	Suspected Carcinogen
143-50-0	Kepone® (Chlordecone)	Suspected Carcinogen
144-49-0	Fluoroacetic acid	Highly Toxic
148-82-3	Melphalan	Known Carcinogen
151-56-4	Ethyleneimine	Regulated Carcinogen
154-93-8	Bischloroethyl nitrosourea (BCNU) (Carmustine)	Suspected Carcinogen
298-00-0	Methyl parathion	Susp. Reproductive T.
299-75-2	Treosulfan	Known Carcinogen
301-04-2	Lead acetate	Suspected Carcinogen
302-01-2	Hydrazine	Suspected Carcinogen
303-47-9	Ochratoxin A	Suspected Carcinogen
305-03-3	Chlorambucil	Known Carcinogen / Reproductive Toxicant
316-42-7	Emetine dihydrochloride	Highly Toxic
333-41-5	Diazinon	Susp. Reproductive T.
371-62-0	2-Fluoroethanol	Highly Toxic
434-07-1	Oxymetholone	Suspected Carcinogen
437-38-7	Fentanyl	Highly Toxic
438-67-5	Sodium estrone sulfate	Known Carcinogen
443-48-1	Metronidazole	Suspected Carcinogen
446-86-6	Azathioprine	Known Carcinogen
494-03-1	*N,N*-Bis(2-chloroethyl)-2-naphthylamine (Chlornaphazine)	Known Carcinogen
504-24-5	4-Aminopyridine	Highly Toxic
505-60-2	Mustard Gas (Sulfur mustard)	Known Carcinogen

CAS Number[1]	Particularly Hazardous Substance	Hazard
506-61-6	Potassium silver cyanide	Susp. Reproductive T.
513-37-1	Dimethyl vinyl chloride	Suspected Carcinogen
534-52-1	4,6,-Dinitro-o-cresol	Highly Toxic
542-75-6	1,3-Dichloropropene (technical grade)	Suspected Carcinogen
542-88-1	Bis(chloromethyl) ether	Known Carcinogen
556-52-5	Glycidol	Suspected Carcinogen
563-47-3	3-Chloro-2-methylpropene	Suspected Carcinogen
569-61-9	C. I. Basic Red 9 Monohydrochloride	Suspected Carcinogen
591-08-2	1-Acetyl-2-thiourea	Highly Toxic
612-83-9	3,3'-Dichlorobenzidine 2HCL	Regulated Carcinogen
621-64-7	*N*-Nitrosodi-*n*-propylamine	Suspected Carcinogen
630-08-0	Carbon monoxide	Reproductive Toxicant
640-19-7	Fluoroacetamide	Highly Toxic
661-69-8	Hexamethylditin	Highly Toxic
680-31-9	Hexamethyl phosphoramide	Suspected Carcinogen
684-93-5	*N*-Nitroso-*N*-methylurea	Suspected Carcinogen
759-73-9	*N*-Nitroso-*N*-ethylurea	Suspected Carcinogen
814-49-3	Diethyl chlorophosphate	Highly Toxic
814-68-6	Acryloyl chloride	Highly Toxic
818-08-6	Dibutyltin oxide	Highly Toxic
924-16-3	*N*-Nitrosodi-*n*-butylamine	Suspected Carcinogen
930-55-2	*N*-Nitrosopyrrolidine	Suspected Carcinogen
990-73-8	Fentanyl citrate	Highly Toxic
1067-33-0	Diacetoxydibutyltin	Highly Toxic
1116-54-7	*N*-Nitrosodiethanolamine	Suspected Carcinogen
1162-65-8	Aflatoxin B1	Known Carcinogen / Highly Toxic
1239-45-8	Ethidium bromide	Suspected Mutagen
1303-28-2	Arsenic pentoxide	Highly Toxic
1314-20-1	Thorium dioxide	Known Carcinogen
1327-53-3	Arsenic trioxide	Highly Toxic
1330-20-7	Xylene	Susp. Reproductive T.
1332-21-4	Asbestos	Known Carcinogen
1336-36-3	Polychlorinated biphenyls (PCBs)	Reproductive Toxicants

CAS Number[1]	Particularly Hazardous Substance	Hazard
1397-94-0	Antimycin A	Highly Toxic
1402-68-2	Aflatoxins	Known Carcinogen / Highly Toxic
1464-53-5	Diepoxybutane	Suspected Carcinogen
1746-01-6	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	Known Carcinogen / Susp. Reproductive T.
1836-75-5	Nitrofen	Suspected Carcinogen
1912-24-9	Atrazine	Susp. Reproductive T.
1937-37-7	Direct Black 38	Suspected Carcinogen
2385-85-5	Mirex	Suspected Carcinogen
2602-46-2	Direct Blue 6	Suspected Carcinogen
2642-71-9	Azinphos-ethyl (Ethyl guthion)	Highly Toxic
2921-88-2	Chlorpyrifos	Susp. Reproductive T.
3570-80-7	Fluorescein mercuric acetate	Highly Toxic
4368-28-9	Tetrodotoxin	Highly Toxic
4549-40-0	*N*-Nitrosomethylvinylamine	Suspected Carcinogen
6055-19-2	Cyclophosphamide, hydrated	Reproductive Toxicant
7059-24-7	Chromomycin A3	Highly Toxic
7280-37-7	Piperazine estrone sulfate	Known Carcinogen
7429-90-5	Aluminum	Susp. Reproductive T.
7439-92-1	Lead	Reproductive Toxicant
7439-93-2	Lithium	Susp. Reproductive T.
7439-96-5	Manganese	Susp. Reproductive T.
7439-97-6	Mercury	Susp. Reproductive T.
7440-36-0	Antimony	Susp. Reproductive T.
7440-38-2	Arsenic	Susp. Reproductive T.
7440-43-9	Cadmium	Susp. Reproductive T.
7446-09-5	Sulfur dioxide	Susp. Reproductive T.
7446-27-7	Lead phosphate	Suspected Carcinogen
7664-41-7	Ammonia	Susp. Reproductive T.
7726-95-6	Bromine	Susp. Reproductive T.
7758-23-8	Triple super phosphate, granular (TSP)	Susp. Reproductive T.
7758-97-6	Lead chromate	Known Carcinogen
7782-49-2	Selenium	Susp. Reproductive T.

CAS Number[1]	Particularly Hazardous Substance	Hazard
7783-06-4	Hydrogen sulfide	Highly Toxic
7784-42-1	Arsine (Hydrogen arsenide)	Highly Toxic
7789-06-2	Strontium Chromate	Known Carcinogen
8006-61-9	Gasoline	Susp. Reproductive T.
9002-86-2	Polyvinyl chloride (PVC resin)	Susp. Reproductive T.
9004-66-4	Iron Dextran Complex	Suspected Carcinogen
10024-97-2	Nitrous oxide	Susp. Reproductive T.
10034-93-2	Hydrazine sulfate	Suspected Carcinogen
10043-35-3	Boric acid	Susp. Reproductive T.
10043-92-2	Radon	Known Carcinogen
10102-44-0	Nitrogen dioxide	Highly Toxic
10540-29-1	Tamoxifen	Known Carcinogen
13010-47-4	1-(2-Chloroethyl)-3-cyclohexyl-1-nitrosourea (CCNU)	Suspected Carcinogen
13256-22-9	*N*-Nitrososarcosine	Suspected Carcinogen
13463-40-6	Iron pentacarbonyl	Highly Toxic
13530-65-9	Zinc chromate	Known Carcinogen
13552-44-8	4,4'-Methylenedianiline Dihydrochloride	Suspected Carcinogen
13909-09-6	1-(2-Chloroethyl)-3-(4-methylcyclohexyl)-1-nitrosourea (MeCCNU) (Semustine)	Known Carcinogen
14807-96-6	Talc, containing asbestiform fibers	Known Carcinogen
14808-60-7	Silica, Crystalline	Known Carcinogen
15663-27-1	Cisplatin	Suspected Carcinogen
16543-55-8	*N*-Nitrosonornicotine	Suspected Carcinogen
16680-47-0	Sodium equilin sulfate	Known Carcinogen
17702-41-9	Decaborane	Highly Toxic
17804-35-2	Benomyl	Susp. Reproductive T.
25013-16-5	Butylated hydroxyanisole (BHA)	Suspected Carcinogen
25321-14-6	Dinitrotoluene (DNT)	Reproductive Toxicant
28300-74-5	Antimony potassium tartrate	Susp. Reproductive T.
39156-41-7	2,4-Diaminoanisole sulfate	Suspected Carcinogen
59865-13-3	Cyclosporin A (Cyclosporine A) (Ciclosporin)	Known Carcinogen
64091-91-4	4-(*N*-Nitrosomethylamino)-1-(3-pyridyl)-1-butanone (NNK)	Suspected Carcinogen
66733-21-9	Erionite	Known Carcinogen

CAS Number[1]	Particularly Hazardous Substance	Hazard
79217-60-0	Ciclosporin	Known Carcinogen
93384-43-1	Botulinum toxin A	Highly Toxic, Select Toxin
108171-26-2	Chlorinated Paraffins	Suspected Carcinogen

[1] CAS Number indicates the Chemical Abstracts Service registry number.

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