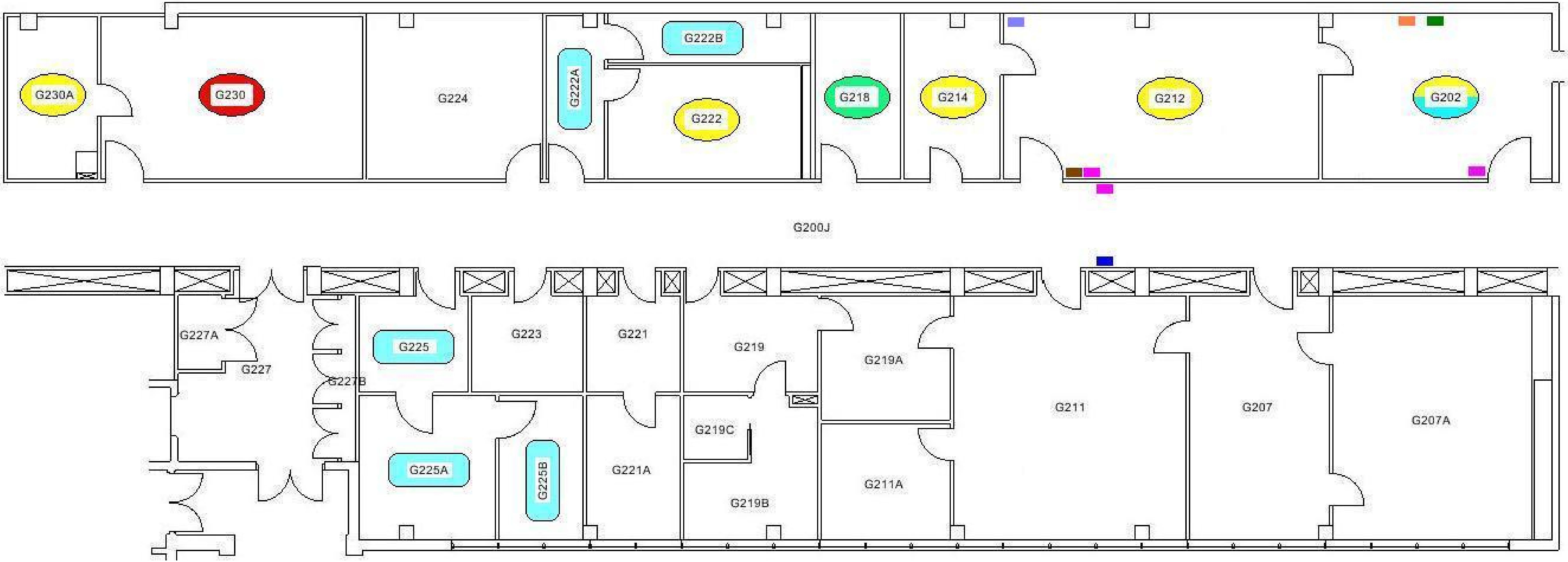
G-Wing (HSB) Level 2 Floor Plan



Chemical Fume Hood & Lab (Work Bench)

Lab (Work Bench) & Instrumentation

Chemical Spill Kit

First Aid Kit

Eye Wash Station

Mechanical Room: (Non-Hazardous) Lab Supplies Storage Area

Office Area

Fire Extinguisher

Shower

Personal Protective Equipment

SOP FOR ASBURY LAB (G212, HSB) University of Washington

Standard Operating Procedures for Chemicals or Processes	
#1 Process	**Coverslip Cleaning for TIRF and TRAP Assays** – Used in coverslip cleaning.
#2 Chemicals Involved **Ethanol, Potassium Hydroxide (KOH), Hydrogen Peroxide and Sulfuric Acid** **Flammable solvents & Acids/Bases**	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-lipify skin and cause irritation of skin and mucous membranes. The Hydrogen Peroxide + Sulfuric Acid mixture (Piranha Solution) should be handled with extreme caution. Follow all procedures involving personal protection outlined below. ***NEVER*** handle this solution outside of the fume hood (see location below). NOTE: MSDS for these chemicals are readily accessible to all users on MYCHEM
#3 Personal Protective Equipment (PPE)	Wear protective goggles, nitrile gloves and lab coat while handling these chemicals. Do not wear open-toed shoes, sandals or worn out shoes. The PPEs are mandatory. All the PPEs are located in G212. Please ask someone in the lab if you are not able to locate them. Never handle these chemicals without the PPEs in place. Always exercise caution and all safety procedures while handling these chemicals. Treat them with the respect they deserve.
#4 Environmental / Ventilation Controls	Handling the chemicals should be done with all sources of ignition eliminated from the vicinity. After completion, ***NEVER*** dump the chemical waste down the drain. Collect them into clearly and properly labeled safe containers and store them in the flammable solvents cabinet or fume hood (clearly segregated from other chemicals) for future pick-up by EH&S. If cabinet and/or fume hood is crowded, notify the lab member in charge of the chemical waste disposal, so that an immediate request for waste pick-up can be placed.
#5 Special Handling Procedures & Storage Requirements	See instructions above. **Flammable cabinet is located in G-202 and Fume Hood is located in G-230.**
#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 G-202, next to the flammable cabinet. A first aid kit is also available above the flammable cabinet.**
#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. **See instructions above.**
#8 Special Precautions for Animal Use (if applicable)	Not Applicable

Particularly hazardous substance involved? (See Appendix H, Lab Safety Manual)	__ 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: CHARLES ASBURY	Title: ASSO. PROFESSOR
Signature:	Date:

Environmental Health and Safety, Box 354400 **to be filled in by PI or Supervisor*

SOP FOR ASBURY LAB (G212, HSB) University of Washington

Standard Operating Procedures for Chemicals or Processes	
#1 Process	**Coverslip Cleaning for TIRF Assays** – Used in coverslip cleaning.
#2 Chemicals Involved **Chloroform** **Flammable solvent**	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-lipify skin and cause irritation of skin and mucous membranes. The chloroform should be handled with extreme caution. Follow all procedures involving personal protection outlined below. ***NEVER*** handle this solution outside of the fume hood (see location below). NOTE: MSDS for these chemicals are readily accessible to all users on MYCHEM
#3 Personal Protective Equipment (PPE)	Wear protective goggles, nitrile gloves and lab coat while handling these chemicals. Do not wear open-toed shoes, sandals or worn out shoes. The PPEs are mandatory. All the PPEs are located in G212 & G-230. Please ask someone in the lab if you are not able to locate them. Never handle these chemicals without the PPEs in place. Always exercise caution and all safety procedures while handling these chemicals. Treat them with the respect they deserve.
#4 Environmental / Ventilation Controls	Handling the chemicals should be done with all sources of ignition eliminated from the vicinity. After completion, ***NEVER*** dump the chemical waste down the drain. Collect them into clearly and properly labeled safe containers and store them in the flammable solvents cabinet or fume hood (clearly segregated from other chemicals) for future pick-up by EH&S. If cabinet and/or fume hood is crowded, notify the lab member in charge of the chemical waste disposal, so that an immediate request for waste pick-up can be placed.
#5 Special Handling Procedures & Storage Requirements	See instructions above. **Flammable cabinet is located in G-202 and Fume Hood is located in G-230.**
#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 G-230 & G-202, next to the flammable cabinet. A first aid kit is also available at both these locations.**
#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. **See instructions above.**
#8 Special Precautions for Animal Use (if applicable)	Not Applicable

Particularly hazardous substance involved? (See Appendix H, Lab Safety Manual)	__ 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: CHARLES ASBURY	Title: ASSO. PROFESSOR
Signature:	Date: Jan 05 2015

Environmental Health and Safety, Box 354400 *to be filled in by PI or Supervisor

SOP FOR ASBURY LAB (G212, HSB) University of Washington

Standard Operating Procedures for Chemicals or Processes	
#1 Process	**Coverslip Cleaning for TIRF Assays** – Used in coverslip cleaning.
#2 Chemicals Involved **Toluene** **Flammable solvent**	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-lipify skin and cause irritation of skin and mucous membranes. Toluene should be handled with extreme caution. Follow all procedures involving personal protection outlined below. ***NEVER*** handle this solution outside of the fume hood (see location below). NOTE: MSDS for these chemicals are readily accessible to all users on MYCHEM
#3 Personal Protective Equipment (PPE)	Wear protective goggles, nitrile gloves and lab coat while handling these chemicals. Do not wear open-toed shoes, sandals or worn out shoes. The PPEs are mandatory. All the PPEs are located in G212 & G-230. Please ask someone in the lab if you are not able to locate them. Never handle these chemicals without the PPEs in place. Always exercise caution and all safety procedures while handling these chemicals. Treat them with the respect they deserve.
#4 Environmental / Ventilation Controls	Handling the chemicals should be done with all sources of ignition eliminated from the vicinity. After completion, ***NEVER*** dump the chemical waste down the drain. Collect them into clearly and properly labeled safe containers and store them in the flammable solvents cabinet or fume hood (clearly segregated from other chemicals) for future pick-up by EH&S. If cabinet and/or fume hood is crowded, notify the lab member in charge of the chemical waste disposal, so that an immediate request for waste pick-up can be placed.
#5 Special Handling Procedures & Storage Requirements	See instructions above. **Flammable cabinet is located in G-202 and Fume Hood is located in G-230.**
#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 G-230 & G-202, next to the flammable cabinet. A first aid kit is also available at both these locations.**
#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. **See instructions above.**
#8 Special Precautions for Animal Use (if applicable)	Not Applicable

Particularly hazardous substance involved? (See Appendix H, Lab Safety Manual)	__ 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: CHARLES ASBURY	Title: ASSO. PROFESSOR
Signature:	Date: Jan 05 2015

LABORATORY SAFETY MANUAL

ENVIRONMENTAL HEALTH AND SAFETY UNIVERSITY OF WASHINGTON

Quick Start Guide

September 2009

To your Chemical Hygiene Plan (CHP) (Including this Laboratory Safety Manual - LSM)

This LSM is your reference for chemical health and safety at the UW. It includes information on who checks the eyewashes, how to dispose of lab glass, how to use a fume hood and much more. Use the Table of Contents and the Index to find the information you need quickly.

Your LSM is part of what the Washington Department of Labor and Industries calls a "Chemical Hygiene Plan." The CHP is required for all laboratories that use hazardous chemicals. EH&S wrote much of your CHP for you – it is this LSM. *However*, you must add additional lab-specific information to have an effective plan, as described below.

For the best use of your LSM and to generate your CHP:

1. Make sure that everyone who works in your laboratory will be able to easily access the LSM and the laboratory-specific information. If your lab is electronically inclined, you can bookmark the PDF version of the LSM on our website and use electronic files to create your lab-specific information. Or you can have a paper CHP by adding lab-specific information in the" My Lab" section following this Quick Start page. There are some options on our website at http://www.ehs.washington.edu/manuals/lsm/index.shtm for getting a paper LSM and various templates. A template for gathering and organizing your lab-specific information is available in LSM Appendix C, pages 3 and 4 or as a Word document template (My Lab Specific Information) on the EH&S web page. Whether you choose paper or electronic, what is important is that all lab staff can have access to the complete CHP while working.
2. Familiarize yourself with the Table of Contents of the LSM. Then read parts of the LSM that you have questions about or are unfamiliar to you.
3. Identify the responsible person, either the Principal Investigator or the Laboratory Supervisor, to be the Chemical Hygiene Officer (CHO) for the lab. Note that person's name in the lab-specific information (My Lab) section at the front of the LSM. This person must be familiar with the duties of the CHO as outlined in Section 1 of the LSM and enforce health and safety in your laboratory.
4. Transfer lab-specific information from your previous CHP or generate new laboratory-specific information. Lab-specific information is discussed in several sections of the LSM, including: SOPs (Section 6 and Appendix D), training (Section 7), and the lab floor plan (Appendix C).
5. If you have a previous edition of the LSM, recycle it after you transfer current lab-specific information to your new LSM.

If you have any questions about the LSM or the lab-specific information, contact EH&S by telephone at 206-543-7388 or by email to uwcho@u.washington.edu.

UNIVERSITY of WASHINGTON

Laboratory Safety Manual

September 2009

Environmental Health and Safety
UNIVERSITY of WASHINGTON

Environmental Health and Safety Department
University of Washington
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October 7, 2009

TO: Principal Investigators and Laboratory Supervisors

FROM: Jude Van Buren Dr.PH, MPH, RN JVB
Director

SUBJECT: UPDATED LABORATORY SAFETY MANUAL

I am delighted to provide for you this revision of the University of Washington's *Laboratory Safety Manual.* This manual was developed in a collaborative effort between the members of the Chemical Hazards Advisory Committee (CHAC), the Environmental Health and Safety Department, and UW researchers.

I would like to thank all who contributed to this revision and 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
Gary Pedersen, Director, Chemistry
Lia Wetzstein, Environmental Science Lab Coordinator and Lecturer, Interdisciplinary Arts and Sciences, Tacoma Campus
Tony Miller, Buyer, Purchasing
Sam Tillery, Manager, Facilities Services' Health Science Maintenance Zone

Major efforts have been made to make this revision more "user friendly" and I believe that you will find it current, addressing the latest worker safety and environmental regulations as well as more concise and easier to understand.

You are encouraged to frequently review this manual with your employees to assure they understand the key University policies and local, state and federal regulatory requirements under which you are expected to operate your laboratories. New regulatory oversight and guidelines have been being given to laboratories in institutions of higher education by agencies such as the Departments of Homeland Security, the Environmental Protection Agency the National Institutes of Health and our state Occupational Health and Safety program. Maintaining your commitment and oversight in addressing the on-going and new requirements that address the safe handling, processing and disposal of chemicals will continue to be essential.

Prior to recycling your older 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 have questions or need a new binder, please call the Department at 206-543-7202, email Occupational Health and Safety at uwcho@uw.edu or visit our website at http://www.ehs.washington.edu/.

A very sincere thank you in your various roles to keep the University of Washington, an exemplary institution where promoting and practicing environmental, health and safety principals are part of the "University way" of pursuing our educational, research, and service missions.

cc: Denis Sapiro – Manager – Occupational Health and Safety Office

Acknowledgments

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Environmental Health and Safety
UNIVERSITY of WASHINGTON

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Environmental Health and Safety
UNIVERSITY *of* WASHINGTON

Section 1 - Chemical Hygiene Plan Responsibilities

Contents

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/04-06-04.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" or CHP. For University of Washington chemical laboratories, the laboratory's chemical hygiene plan is created by combining laboratory-specific information and safety requirements with the generic UW Laboratory Safety Manual.

Your lab's CHP can be completely electronic, completely paper, or a mixture. It must be accessible at all times that workers are at work, so if it is electronic, personnel must know where the files are located and how to access them, and must have access to a computer and the files while working. For ease of electronic use, the UW Laboratory Safety Manual may be "bookmarked" in its entirety as a "pdf" file. Separate sections, templates, etc. can also be bookmarked from the EH&S web site, http://www.ehs.washington.edu/manuals/lsm/index.shtm. A precaution with electronic information is that it must be obvious which files and documents are the current ones that must be used.

If an all-paper CHP is to be used, the Laboratory Safety Manual is set up so that the lab-specific information can be filed in the front of the manual, behind the "My Lab" tab following the Quick Start page. The CHP - consisting of the lab-specific information and lab safety manual - must be accessible to all workers while at work, so cannot be locked in a supervisor's office. For files of laboratory-specific information which may be kept elsewhere than in the front of the manual/CHP because of their size or because they are in daily use (such as chemical inventories, standard operating procedures, or material safety data sheets or other reference materials used during safety training classes), you must reference their locations in the laboratory-specific information area.

Information about safety requirements and procedures must be accessible at all times. If some people want to keep personal copies of the UW Laboratory Safety Manual or the lab's standard operating procedures, all people must be aware of where the master CHP is located. Some information not directly associated with safety procedures and which might be troublesome to replace if lost, such as certifications that individuals completed safety training, can be kept separately in locked cabinets, but the location should be identified in the laboratory-specific information section.

A mixed paper/electronic version of the CHP may work best in your lab. The previous requirements must be met, in that the safety information in the CHP must be accessible at all times to all those at work and all personnel must use the current CHP. A master index of where the parts of the complete CHP are located, identifying the current revision number or date for each part, should be easily available to all personnel at all times.

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 chemical-safety requirements in other regulations.

b. International Fire Code

The cities of Bothell, Seattle, and Tacoma require compliance with the version of the International Fire Code (IFC) they have adopted, but they may also have additional local requirements. For assistance with compliance, contact EH&S at 206-543-0465.

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.

d. US Department of Homeland Security Regulations

The United States Department of Homeland Security has developed Chemical Facility Anti-Terrorism Standards (CFATS) to implement the federal regulations at 6 CFR Part 27. These standards require the University to track and control specific chemicals of interest. The University's MyChem chemical inventory system as described in later sections of this manual is an important component in complying with the regulations.

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 Emergency Evacuation and Operations Plan for the building, 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 formulations, 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. Appendix B is a glossary of useful terminology applicable to this manual related to both chemical and non-chemical hazards.

It would be impossible for one manual to provide complete information about all potential hazards and controls, so use of other references is encouraged, such as Prudent Practices in the Laboratory: Handling and Disposal of Chemicals (National Research Council Committee on Prudent Practices for Handling, Storage, and Disposal of Chemicals in Laboratories). The EH&S web site (http://www.ehs.washington.edu/) contains information about environmental, health and safety policies and procedures for all UW work areas, not just laboratories. Specific policies and procedures are also addressed concerning the control of biological hazards in the UW Biosafety Manual (http://www.ehs.washington.edu/rbsbiosafe/bsmanualindex.shtm); for research diving in the UW Scientific Diving Safety Manual (http://www.ehs.washington.edu/manuals/divingsafetymanualuw.pdf; for LASER safety in the UW LASER Safety Manual (http://www.ehs.washington.edu/manuals/rsmanual/lasermanual.pdf) and for the control of radioactive hazards in the UW Radiation Safety Manual (http://www.ehs.washington.edu/manuals/rsmanual/index.shtm).

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-level person with authority. The CHO must be identified by name in the laboratory-specific information portion of your lab’s CHP.

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/manuals/lsm/lsmc.doc . 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. Establish Practices and Rules

Establish safe work practices and rules to be followed in your laboratory, and enforce compliance with the practices and rules. The CHO cannot delegate or transfer this responsibility. Practices are addressed in Standard Operating Procedures (SOPs) described in Section 6 and Appendix D of this manual, and rules are described throughout this manual but especially in Section 2.

b. Document Safety Procedures

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

c. Identify Hazardous Conditions

Identify hazardous conditions that could result in personal injury or property damage. Inspection checklists are available in Appendix E, Checklists, to aid in evaluating the laboratory periodically. Such inspections should be performed semi-annually unless only a few problems are identified, at which time the schedule may be changed to an annual basis (especially if laboratory personnel and procedures remain constant and few new pieces of equipment are obtained).

d. Ensure Signage/Labels in Place

Ensure appropriate signage is posted and ensure hazardous material containers (including hazardous waste containers) are labeled. Laboratory signage is described in Sections 2.A.7 and 4.C, and labeling is described in Section 2.E of this manual.

e. Identify Hazardous Chemicals

Ensure an accurate list of hazardous chemicals is entered into the MyChem inventory management system and that the list is updated at least annually. Hazardous chemicals can be identified by words such as “Danger” or “Caution” or warnings on the label and MSDS as described in this section at B.2 above, or by contacting EH&S (206-543-7388 or uwcho@uw.edu) for advice. MyChem procedures are described in Section 2.B.

f. Provide and Document Training

Ensure employees and students working in the lab are trained in the hazards of the chemicals present, and the required safety procedures including selection and use of personal protective equipment (PPE). Advice is available in Section 7 of this manual.

g. Ensure Visitor Safety

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. Enforce Restrictions on 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 working in the laboratory as volunteer workers or as employees may not be exposed to agents that pose higher health risks as described in WAC 296-125-030 (http://apps.leg.wa.gov/WAC/default.aspx?cite=296-125-030). 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. Enforce Restrictions on Pets

WAC 478-128 prohibits pets in all University facilities. Ensure that staff do not bring pets into any University facility, including laboratories. (WAC 478-128 can be viewed at http://apps.leg.wa.gov/WAC/default.aspx?cite=478-128 .)

j. Update Documents

Update the laboratory-specific information as conditions or procedures change. Types of laboratory-specific information that may need updating is described throughout this manual and an example list is shown on page 2 of the Cover Sheet Template in Appendix C, page C-3.

k. Perform Annual Reviews

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, page C-3) and file in the laboratory-specific information section of your CHP.

l. Perform Accident Follow-up

Investigate and report all accidents and initiate corrective action. Details for accident follow-up are provided in Section 9.B of this manual, including reporting requirements described in Section 9.B.1.b.

m. Obtain and Post Hazardous Material Permits

Hazardous Material Permits from your controlling fire department (Bothell, Seattle, or Tacoma) are required. This is typically of interest if a laboratory relocates or a new research project will involve highly hazardous chemicals. Contact your Departmental Safety Officer, Departmental Administrator, or EH&S at 206-543-0465 for advice.

2. Department Chair or Director

The department Chair or Director is responsible for the following.

a. Ensure Safety of Occupants

Provide a safe and healthy workplace free from recognized hazards (WAC 296-800-110). This responsibility cannot be delegated or transferred. This can be accomplished by being aware of the University's Accident Prevention Program, being familiar with your Department's Health and Safety Plan and the activities being conducted within your department, being aware of the general requirements in this manual, and taking a reasonable person's approach in minimizing hazards and risks within the control of your department.

b. Enforce Laboratory Control Methods

Ensure that SOPs concerning use of particularly hazardous substances identify authorization requirements. For more information, SOP development is described in Section 6, recommended controls are provided in Sections 2.G and 9, and particularly hazardous substances are defined and examples are listed in Appendix H of this manual.

c. Maintain Records

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

d. Review Accidents

Have procedures in place to become aware of accidents affecting laboratory operations within your department, and ensure corrective actions were taken as necessary to prevent accident recurrence.

e. Ensure Appropriate 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. Comply with Guidelines and Policies

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

b. Report Unsafe Conditions

Report unsafe conditions to your laboratory's Chemical Hygiene Officer, Principal Investigator, a faculty member, your immediate supervisor, the Departmental Safety Officer, or to EH&S (206-543-7262). If you identify a procedure or assigned task as being exceptionally risky, you can perform it only after you believe the risk has been reduced to an acceptable level.

c. Report Accidents

Report accidents and incidents to your supervisor, and to the university using the on-line accident reporting system (http://www.ehs.washington.edu/ohsoars/index.shtm).

d. Use Personal Protective Equipment

Select, maintain and use personal protective equipment appropriately, consistent with your training. Students may be required to provide your own personal protective equipment (PPE), 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. Develop the Lab Safety Manual

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. Liaise with Regulatory Agencies

Act as the liaison between the University and the regulatory agencies enforcing environmental, health and safety regulations.

c. Advise Concerning Laboratory Safety

Act as a resource regarding laboratory safety issues.

d. Perform Laboratory Surveys/Audits

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

e. Maintain an 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. Conduct General Training

Develop and provide 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

Environmental Health and Safety
UNIVERSITY *of* WASHINGTON

Section 2 - Chemical Management

Contents

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A. BASIC LABORATORY SAFETY PRACTICES

1. Working Alone

Do not work alone in the laboratory if the procedures being conducted involve highly hazardous substances or processes (such as are described in section G later in this section). If you are working alone with lesser hazard chemicals, let personnel in other laboratories know of your presence or develop an accountability system with your supervisor or co-workers.

2. Prevent Chemical Exposure

Prevent skin contact with chemicals. For example, use appropriate personal protective equipment (PPE) (goggles, gloves, lab coat, etc. per Lab Safety Manual Section 5.B) but consider it as “the last line of defense” and use other precautions such as using appropriate containment equipment and regularly checking that connections are tight. Clean up spills as soon as possible and minimize clutter to avoid inadvertent spills.

Prevent inhalation of chemicals. For example, use a fume hood whenever handling volatile or aerosolized chemicals, even if they are of relatively low toxicity. Cap chemicals as soon as is convenient. Limit the smelling of chemicals to the minimum amount necessary and only if no other method of identifying a chemical is available.

Prevent ingestion of chemicals. For example, do not 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.

Prevent injection of chemicals. For example, cap needles as soon as the injection is complete. Use needles with inherent safety devices that prevent inadvertent needle sticks. Dispose of sharps into appropriate waste containers. If operating a high pressure system, never check for a pressure leak using your hands.

3. Washing Hands

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

4. Food and Drink

Food and drink increase the chance 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 be directly 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 must 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 is designed for emergency planning in compliance with federal, state and local regulations. Current MyChem chemical inventories are kept by the UW 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 Bothell, Seattle, or Tacoma Fire Department Hazardous Material Storage and Use Permits (occupancy permits), EPA Community Right-To-Know reporting, and Department of Homeland Security chemical security requirements.

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 should be able to readily access an MSDS for any chemical they are using.

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 206-616-4046. 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/epomychem/index.shtm.

To obtain a copy of the MyChem User's Manual, call EH&S at 206-616-4046 or email mychem@u.washington.edu. The manual is available on-line at http://mychem.ehs.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. Dilutions and reagents prepared in the lab for further work do not need to be added to the inventory, but must have a container label applied unless the preparation will be all used or disposed that day. Review and update inventories annually and 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 information 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 Section B.1, above). 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 and updated 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.

Call EH&S at 206-616-3441 to request assistance locating or accessing MSDSs 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 206-685-8973; 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.

If an MSDS or SDS is received with a chemical shipment please maintain a copy in the lab, and send the original MSDS or SDS to EH&S (Box 354110, c/o MSDS Coordinator) for addition to the MyChem database.

C. CHEMICAL PROCUREMENT

Most chemical products can be purchased without restriction from suppliers through eProcurement (on-line ordering system) or through UW Purchasing Services. 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 you open a shipment, you should verify 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. Refer to https://eres.lib.washington.edu/coursepage.asp?cid=1805&page=01 for information and 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 leave a message at 206-598-6058.

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. 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

Ethyl alcohol may no longer be procured from University Stores. The preferred method of procurement is through eProcurement. Instructions for obtaining approval and purchasing this product are detailed on the UW eProcurement web site at http://www.washington.edu/admin/stores/eprocurement/ . Instructions for maintaining accountability for tax-free ethyl alcohol are in Administrative Policy Statement (APS) 15.1 at http://www.washington.edu/admin/rules/APS/15.01.html.

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 Dangerous 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 G: Special Chemical Hazards, below, for examples. Contact the EH&S Building and Fire Safety Office at 206-543-0465 for more information.

7. Compressed Gas Cylinder Procurement

Whenever possible gas cylinders should be purchased through the preferred supplier, Praxair, to ensure that the supplier has a cylinder return authorization program. Instructions are available on the UW eProcurement web site at http://www.washington.edu/admin/stores/eprocurement. Contact information concerning Praxair is also available on the EH&S web page http://www.ehs.washington.edu/fsohazmat/gascylinders.shtm .

If a different vendor must be used to provide a specialty gas, 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. Also see section D.3 below.
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. Also see section G.1.e below.
Pyrophoric Substances	(Materials that will react with the air to ignite when exposed, e.g., tert-butyl lithium.) Store in a cool dry place, making provisions for an airtight seal. Also see section G.1.d below.
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. Also see section G.2.b below.
Toxic Chemicals	Store according to the nature of the chemical, using appropriate security where necessary. Also see section G.1.a below.
Nitrated compounds	Nitrated compounds can be considered explosive; special care and handling may be required. Also see section G.2.a below.

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 that are compatible should be stored in secondary containment tubs that are chemically resistant and unbreakable.

6) Consistent Chemical Storage Locations - Particularly hazardous substances (highly dangerous or toxic 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, flammable acids or combustibles (such as cardboard). 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 be so numerous as to clutter bench top work areas. Storing more than a few chemicals in a fume hood will compromise the effectiveness of the hood unless they are stored on a shelf a few inches above the work surface of the fume hood (so that air can enter the slot at the back of the work surface).

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 local fire code, which is based on the most recent International Fire Code (IFC) adopted by the local jurisdictions. (Note: Local amendments to IFC have been made by Bothell, Seattle, and Tacoma 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 following table (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 the most recent IFC adopted by local jurisdictions. To assure compliance with the IFC, contact the EH&S Building and Fire Safety Office 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	2703.1.1	Gas may only be used and stored in

Material	Quantity Limits per Control Zone	IFC Citation	Comments
	20 cubic feet (gas)		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

In Seattle, 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 in determining local requirements, 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 (Reference: NFPA 30, Table 6.2.3.). Flammable liquid containers larger than 5 gallons are not permitted in laboratories without specific approval.

Table 2-3 Approved Flammable Liquid Storage Containers

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.

2. Transfer to Additional Containers

Chemicals are often transferred from the original container to another container. This second container must be labeled with the chemical name (which must be the same name as on the original container’s label and the MSDS) and hazard warnings. Examples of the second container’s label are shown below 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. Describe any departmental or laboratory-specific requirements for labels in the laboratory-specific information section of your CHP. Types of labels routinely used on containers are shown below. The method of affixing the label to the container (i.e., glue, tape or wire) is also at the discretion of the department/laboratory.

Preparations, sample aliquots, etc. do not need to be labeled if the container will be under the control of a person who knows what is in the container and it will be emptied before the end of the work shift. If a preparation or working solution will be kept for a longer period, the container must be labeled with the content identity and hazards, and should be labeled with date of preparation and preparer’s initials or name.

A container that is too small for labels, installed into a process, or would become unusable for its intended purpose if labeled must still have its contents identified in some way. 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, or color or numeric codes cross-referenced on a chart, or room diagrams identifying locations of the chemicals and hazards.

Label chemicals that form peroxides or other hazardous products when exposed to air with the date the container was first opened, using the form (UoW 1716) shown in Section G.2.b below.

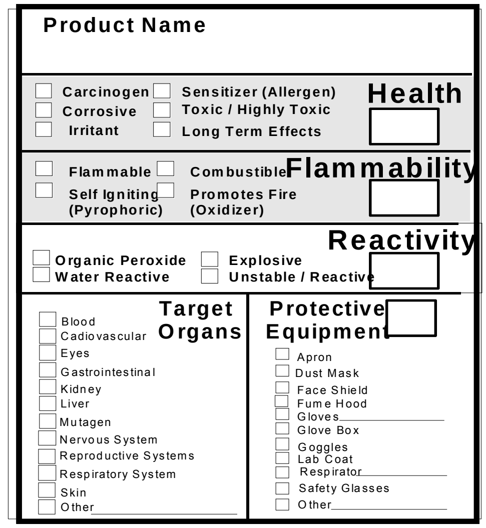
Label chemicals listed in the Chemical Facility Anti-Terrorism Standards (CFATS) with warning labels as described in Section G.9.b below to remind workers that the substances are regulated and cannot be shipped off campus without prior EH&S notification.

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.

a. UW Hazard Label

The UW Hazard Label (Figure 2-1) is no longer available from University Stores, but previous stocks can continue to be used. Various suppliers have similar labels.

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

Received: Feb. 10, 2008

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 your 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 an additional container label for 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. (Information about the GHS labeling system is available at http://www.unece.org/trans/danger/publi/ghs/ghs_rev01/01files_e.html and http://www.osha.gov//dsg/hazcom/ghs.html,)

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. In general, when possible, use freight-only elevators when moving chemicals between floors.

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) The exterior of the container should be clean enough that it could be handled without the need for protective gloves.

3) Chemical bottles must be labeled and should be securely capped and placed in a bottle carrier.

4) 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.

5) A lecture bottle should be moved in a manner that protects the valve. Larger gas cylinders must be moved using precautions listed in Section F.1.c below.

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) The exterior of the containers to be moved should be clean enough that they could be handled without the need for protective gloves.

3) Chemical containers must be labeled and securely closed. Lecture bottles should be packed in a manner that protects the valve.

4) Chemicals should be grouped by compatibility and by hazard class (e.g., flammable, toxic, etc.) and each group should be placed in larger containers or tubs while being transported.

5) 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. Multiple glass bottles in the same tub should be cushioned using the absorbent to prevent the bottles from rattling against each other.

6) 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.

7) For laboratory moves across campus, 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. Refer to Section 10.B.2 of this manual for details.

c. Compressed Gas Cylinders

When moving compressed gas cylinders, they must:

1) Have the 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.7 below for more information about compressed gasses.)

2. Transporting Chemicals off Campus

EH&S is required to notify the Department of Homeland Security if you ship certain listed substances governed by the Chemical Facility Anti-Terrorism Standards (CFATS). Please see Section G.9 below to learn more and to see a list of the 22 “do not ship” chemicals.

a. Vehicle Use

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.d below.

b. Shipment by Others

If you ship hazardous materials by vehicle or air, you are required by law to be trained and certified (see Section F.2.c, following). 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.

c. 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.

d. 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.B.2 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, highly toxic, sensitizing or allergenic, synthesized chemicals, in compressed gas cylinders or at high pressure, present exceptional flammability hazard or have additional specific requirements due to federal regulations. If the degree of hazard is serious enough, such as for a chemical meeting the criteria in Appendix H of this manual, the chemical is classified as a particularly hazardous substance, and precautions for use include such things as:

- Improving the security and integrity of the chemical storage,
- Reviewing proposed procedures by another PI,
- More intensive training on the chemical's hazards and the equipment to be used when handling the chemical,
- Requiring increased proficiency before any particular individual may perform the procedures be demonstrated and documented,
- Requiring a second lab worker be in the lab in case of emergencies,
- Ensuring all safety measures are included in the SOPs, and,
- Checking that any additional measures for shipping such materials have been addressed.

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. Chemicals which have an NFPA rating of “3” or “4” for Reactivity are also considered to be particularly hazardous substances due to being highly dangerous, and the extra precautions taken as described in the opening paragraph of Section G above need to be documented in your SOPs.

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. Several accidents have occurred at the UW due to waste oxidizers being disposed into common waste receptacles under the mistaken belief that the oxidizer would no longer react with the other waste chemicals. Examples of oxidizers 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 at or below 130 °F (54°C) is a pyrophoric. The oxidation of the compound by oxygen in the air proceeds so rapidly that ignition occurs spontaneously. Such chemicals would be considered "particularly hazardous substances and the extra precautions taken as described in the opening paragraph of Section G above need to be documented in your SOPs. Examples are shown in Table 2-7.

Table 2-7 Pyrophoric Chemicals

Barium metal	Potassium metal	Sodium methylate
Lithium diisopropyl amide	Rubidium metal	Tert-butyllithium
Magnesium powder	Silane	Triethylphosphine
Methyl lithium	Sodium hydrosulfite	Tri-n-butylphosphine
Phosphorus sticks	Sodium methoxide	Trimethylaluminum

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. Some of these reactions proceed so violently that the chemicals are classified by NFPA as Reactive code 3 or 4 and the extra precautions taken as described in the opening paragraph of Section G above need to be documented in your SOPs. Examples of water-reactive chemicals are shown in Table 2-8.

Table 2-8 Water Reactive Chemicals

Alpha-toluenesulfonyl fluoride	Oxalyl chloride	Sodium metal
Antimony trichloride	Phosphorus oxychloride	Tert-butyllithium
Calcium hydride	Phosphorus pentachloride	Titanium (IV) chloride
Hydrobromic acid	Phosphorus pentasulfide	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.

Additional factors need to be addressed in your SOPs are described in the opening paragraph of Section G above.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.

The additional precautions you take to control peroxide-forming hazards (described in the opening paragraph of Section G above and in this section) need to be documented in your SOPs. 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. 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).

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. Label the container with the standard peroxide label (UoW 1716) (see Figure 2-4 below). 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.

Figure 2-4 Peroxide Label (UoW 1716)

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 below.

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. Document additional precautions such as those described in the opening paragraph of Section G above in your SOPs.

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. Document additional precautions such as those described in the opening paragraph of Section G above in your SOPs.

3. Highly Toxic Substances

a. Precautions for Use

In laboratories, "Particularly Hazardous Substances" (described and partially listed in Appendix H) includes those chemicals that are highly toxic. The procedures for using such chemicals require additional precautions, as described above in the opening paragraph in Section G. An important point to be aware of is that a highly toxic gas, like arsine, can not be used until proper engineering controls and fire department approval have been obtained. Contact EH&S at 206-543-7388 or email uwcho@u.washington.edu for more information.

b. Categories of Highly Toxic Chemicals

Various regulatory agencies define highly toxic chemicals differently. “Highly Toxic” chemicals according to the Occupational Safety and Health Administration and the Washington Department of Labor and Industries are defined in Appendix H of this Laboratory Safety Manual. The International Fire Code uses essentially the same definition for “highly toxic and poisonous materials” for signage and fire code reasons. Refer to http://www.ehs.washington.edu/fsohazmat/hazmatl.shtm and the current IFC, Chapter 37, Highly Toxic and Toxic Materials for additional information about these codes and requirements.

The EPA and Washington State Department of Ecology have other criteria for classifying a chemical as ”extremely hazardous” or a “substance with high acute toxicity.” These definitions affect their reporting requirements and waste accumulation and disposal requirements.

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 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.

4. Carcinogens and Reproductive Hazards

Additional care must be taken to minimize exposures to known and suspected carcinogens and reproductive hazard chemicals because inadequate information is available in many cases as to what level of exposure may impact the worker. A partial list of such chemicals is given in Appendix H of this Laboratory Safety Manual, Particularly Hazardous Substances. Ways to minimize exposures include steps such as substituting chemicals if possible, using the smallest amounts necessary, and using a fume hood or other control system. Additional information is available on the EH&S Reproductive Hazards web page at http://www.ehs.washington.edu/ohsreprohaz/reprohazguidance.pdf .

5. Sensitizing or Allergenic Chemicals

Potent chemicals which can cause sensitization or allergy may impact researchers by changing their style of life and in some cases forcing them to leave their areas of research. This hazard is not limited to “traditional” laboratory chemicals in that researchers handling animals can become allergic to animal danders and researchers in forest resources can develop allergies to molds, to give two examples. Additional examples are shown in Table 2-11.

Table 2-11 Sensitizing or Allergenic Chemicals

Beryllium	Formaldehyde
1,2,4-Benzenetricarboxylic anhydride	Gluteraldehyde
Bichromates	Isocyanates
Chromium	Latex

1,2-Cyclohexanedicarboxylic anhydride	Nickel
Diazomethane	Phenols (certain types)

Once sensitized, a person may react to extremely low amounts of the chemical. Response may range from a contact dermatitis to anaphylactic shock.

Care must be taken to minimize exposures. Situations which may lead to a high, acute exposure, such as cleaning up a spill, should be carefully assessed to keep the exposure as low as reasonable. If a person is sensitized or allergic to a similar chemical, any control which will prevent exposure to the lab chemical should be implemented, whether improved ventilation, barriers, or improved procedures. If respirators are to be used, the person must comply with all steps in the UW Respiratory Protection Program (http://www.ehs.washington.edu/ohsresp/index.shtm).

6. Synthesized Chemicals

Synthesized chemicals may present unexpected hazards. The first step should always be to perform a literature review concerning the expected hazards from the proposed procedures and the hazards from chemicals with similar structure, taking into account that these hazards are being assumed. Pay particular concern to hazards which may develop from reactions or during purification or subsequent activities. Generate minimal quantities until the basic hazards of the chemical can be determined.

a. Nanoparticles

The term “nanoparticle” is given to particles with at least one dimension less than 100 nanometers. They may be deliberately engineered or develop naturally. Such particles may be more reactive and toxic than bulk size chemicals. Take special care to prevent them from being released into the environment. If your laboratory intends to create nanoparticles in such a manner that they may be aerosolized, measurements of the typical nanoparticle levels before the process begins may be taken and compared to subsequent levels. Additional information about nanoparticle safety guidelines is available from the UW Chemical Hygiene Officer (uwcho@uw.edu).

b. Providing Synthesized Chemicals to Others

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 contact the UW Chemical Hygiene Officer at uwcho@uw.edu .

7. Compressed Gases and Gas Cylinders

Compressed gas and highly pressurized systems present the unusual hazards that the high pressure may result in a physical hazard from the hose, piping or cylinder flying around if the gas were to escape through a leak, and that the large amounts of gas available may quickly injure personnel due to toxic or asphyxiation hazards from a gas release.

Special Fire Department permits and engineering controls such as a gas storage cabinet may be required to use toxic or corrosive gases. Prior to ordering these gases, contact the EH&S Building and Fire Safety Office at 206-616-5519 for an assessment. Extra precautions such as those described in the opening paragraph of Section G above must also be documented in your SOPs for these chemicals.

a. Purchasing Compressed Gas

Whenever possible, researchers should purchase compressed gas through the preferred supplier, Praxair. Ordering information is provided on the UW eProcurement web page with details given in section C.7 above.

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 transporting compressed gas cylinders in passenger elevators, use a freight elevator if available.

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 be returned to the supplier as described earlier in this section concerning procurement of gas cylinders (Section 2.C.7). Additional information about cylinder disposal is described in Section 3.P of this Laboratory Safety Manual. If returning full or partially full cylinders, shipping precautions as described on the web page http://www.ehs.washington.edu/fsohazmat/gascylinders.shtm need to be followed.

d. Compressed Gas Piping and Tubing

1) Steel, copper or stainless steel must be used for all piping systems serving fixed system and apparatus that are permanently charged or charge while unattended. Qualified personnel must install piping.

2) Piping and tubing must be compatible with the gas.

3) Fuel gas Grade T flexible gas tubing with appropriate hose clamps must be used for all petroleum-based products. This tubing is available through Praxair.

4) Provide shut off valves, point of use valves, regulators, pressure relief valves, labeling appropriate for the application and in accordance with the International Fire Code and NFPA 45.

e. Regulators

1) Pressure regulators lower the gas pressure to a useable level. There are two kinds of pressure regulator designs: single and two-stage. They appear similar. Single stage regulators are used when precise control of delivery pressure is not required. Two-stage regulators give precise control.

2) Keep regulators clean. Regulators used for oxidant gasses should especially be free of surface oil and grease.

3) Always use the proper regulator for the gas in the cylinder. Plaques and decals on the regulator indicate which gas the regulator is designed for.

4) A volume restriction orifice installed downstream of the regulator is required for all toxic and highly toxic gases. Specify pressure and flow requirements when ordering compressed gas so that the vendor provides the proper restriction orifice.

8. Flammable and Combustible Liquids

Read the full MSDS for more details before handling flammable and combustible. liquids.

Know the flash points of the flammable or combustible materials that you are using. The flash point is defined as the lowest temperature at which a chemical can vaporize to form an ignitable mixture with air. Many of the common organic solvents and chemicals used in the laboratory have flash points well below room temperature. At or above the flash point temperature, there can be sufficient vapor to ignite if an ignition source is present. Flammable liquids are defined as those having a flash point less than 100 °F (37.8 °C). Combustible liquids have a flash point of 100 °F or higher, but can still produce enough vapor to burn if heated.

Highly flammable chemicals with an NFPA rating of 4 for “Flammability” are also considered particularly hazardous substances and need additional precautions as described in the opening paragraph of Section G above. Also, pre-plan for an emergency by adhering to the precautions in Section 9.A.2.c such as wearing lab coats which resist burning, preventing clutter, and providing clear access to eyewashes, emergency showers and evacuation routes.

The main objectives in working safely with flammable liquids are to avoid accumulation of vapors and to control sources of ignition.

a. Vapor Control

Use less hazardous chemicals if possible. Use the smallest amount of flammable liquid necessary for your procedure. Use closed systems whenever possible. If you must work with open systems, use a fume hood to prevent accumulation of flammable vapor. Close the fume hood sash when not performing your procedure but flammable chemicals are still present.

Each flammable liquid has two fairly definite limits defining the range of concentrations in mixtures with air that will propagate flames or explode. The limits are called the Lower Flammability Limit (LFL) and the Upper Flammability Limit (UFL). These limits are also sometimes referred to as the Lower Explosive Limit (LEL) and the Upper Explosive Limit (UEL). The range that a fire or explosion could occur becomes wider with increasing ambient temperature and in oxygen enriched atmospheres. The flash points and the ranges of LFL to UFL are shown for some typical laboratory chemicals in the following table (Table 2-12. Flash Points and Flammability Limits of Some Chemicals).

Table 2-12 Flash Points and Flammability Limits of Some Chemicals

Chemical	Flash Point °C / °F	Auto-Ignition Temperature °C / °F	Flammability Limits (% volume in air)	
			Lower (LFL)	Upper (UFL)
Acetone	-37.8 / -36	465 / 870	4	60
Benzene	-11.0 / 12	560 / 1040	1.3	7.1
Carbon disulfide	-30.0 / -22	80 / 176	1.3	50
Diethyl ether	-45.0 / -49	160 / 320	1.9	36
Ethanol	12.8 / 55	365 / 690	3.3	19
Methanol	11.1 / 52	385 / 725	6.7	36
Methyl ethyl ketone	-6.1 / 21	516 / 960	1.8	10
Pentane	-40.0 / -40	260 / 500	1.5	7.8
Toluene	4.4 / 40	480 / 896	1.2	7.1
p-Xylene	27.2 / 81	530 / 986	1.1	7

If you are warming flammable liquids above the auto-ignition temperature, make sure there is no exposure to air or oxygen until the temperature drops below the auto-ignition temperature, such as those shown in the table above. Make sure the ovens are appropriately designed for flammable liquids (no internal ignition sources and/or vented mechanically).

If you need to heat flammable liquids, use devices that have good controls, such as steam baths, salt and sand baths, oil baths, heating mantles and hot air baths. Do not use open flames because along with being a potential ignition source, it is also harder to maintain exact control of the heat applied.

You should also minimize the total quantity of flammable materials in the lab, and keep them stored in proper containers (plastic or metal containers or safety cans) as described in Section 2.D.3 above. Cap containers as soon as you have poured out the amount you will need.

To prevent the spill and release of vapors while transporting bottles, use bottle carriers. Dispose of unnecessary flammable chemicals to prevent inadvertent spills.

Be aware that the vapors of many flammable liquids are heavier than air and can travel considerable distances along a benchtop or the floor and can potentially be ignited by an ignition source located somewhere else in the lab or workspace. These vapors can be generated by a spill or during a simple transfer from one container to another.

b. Ignition Source Control

Control all ignition sources in areas where flammable liquids are used. Open flames and spark-producing equipment should not be used.

Use equipment with spark-free, intrinsically safe induction motors or air motors to avoid producing sparks. These motors must meet National Electric Safety Code (US DOC, 1993) Class 1, Division 2, Group C-D explosion resistance specifications. Many stirrers Variacs, outlet strips, ovens, heat tape, hot plates, and heat guns do not conform to these code requirements.

Avoid using equipment with series-wound motors, since they are likely to produce sparks.

Equipment On/Off switches can produce sparks when activated, especially if the equipment uses a lot of power. Place equipment switches as far as possible from any open systems using flammable liquids.

c. Grounding Concerns

Pouring flammable liquids can generate static electricity. The development of static electricity is related to the humidity levels in the area. Cold, dry atmospheres are more likely to facilitate static electricity. Bonding or using grounding straps for metallic or non-metallic containers can prevent static generation.

All metal and polyethylene containers larger than 5 (five) gallons (20 liters) must be grounded to avoid static charge when transferring flammable liquids to another container. Grounding can be direct, as a wire attached to both containers, or indirect, as through wires connected to a common ground system.

When grounding non-metallic containers, contact must be made directly to the liquid rather than to the container.

In the rare circumstance that static electricity cannot be avoided and grounding is not possible, such as pouring small volumes of flammable liquids into a graduate cylinder or beaker, proceed slowly to give any static charge time to disperse. Or, conduct the procedure in an inert atmosphere.

9. Homeland Security Chemicals of Interest

Regulations at Title 6 Code of Federal Regulations Part 27 require all chemical facilities (including universities) comply with the Chemical Facility Anti-Terrorism Standards (CFATS). The rule requires that a chemical facility that either possesses or later comes into possession of listed chemicals (http://www.dhs.gov/xlibrary/assets/chemsec_appendixa-chemicalofinterestlist.pdf) in quantities that meet or exceed threshold quantities report them to the Department of Homeland Security (DHS). Under this regulation, a University building is deemed a chemical facility and EH&S is charged with reporting building exceedances to DHS. EH&S relies on the accuracy of your chemical inventories maintained in the MyChem database to determine what is reportable.

DHS can require a facility to prepare a security vulnerability assessment and implement a site security plan. Failure to comply with these requirements can result in fines and/or imprisonment.

DHS regulates certain chemicals in the rule in any amount if transported (shipped) away from campus. See Table 2-13 below for a list of 22 chemicals regulated in any amount if shipped. Do not ship these chemicals without notifying EH&S in advance. EH&S is responsible for reporting all UW shipments of these chemicals to DHS.

EH&S has developed a “do not ship” warning label which reminds workers that the substance is federally regulated and cannot be shipped without prior EH&S notification. (Refer to section G.9.b below.)

a. Do Not Ship List

DHS identifies 22 chemicals that are reportable in any amount when transported (shipped) away from campus. The following table, Table 2-13 Reportable if Shipped Chemical List, provides a list of these chemicals by name and CAS number.

Table 2-13 Reportable if Shipped Chemical List

Acetone cyanohydrin, stabilized (75-86-5)	Magnesium phosphide (12057-74-8)
Aluminum phosphide (20859-73-8)	Methyldichlorosilane (75-54-7)
Boron tribromide (10294-33-4)	Phosphorus oxychloride (10025-87-3)
Bromine pentafluoride (7789-30-2)	Phosphorus pentasulfide (1314-80-3)
Bromine trifluoride (7787-71-5)	Phosphorus trichloride (7719-12-2)
Calcium phosphide (1305-99-3)	Potassium phosphide (20770-41-6)
Chlorine dioxide (10049-04-4)	Sodium phosphide (12058-85-4)
Chloroacetyl chloride (79-04-9)	Strontium phosphide (12504-16-4)
Chlorosulfonic acid (7790-94-5)	Sulfuryl chloride (7791-25-5)
Lithium amide (7782-89-0)	Titanium tetrachloride (7550-45-0)
Lithium nitride (26134-62-3)	Trichlorosilane (10025-78-2)

b. Do Not Ship Labels

If you possess any of the 22 listed chemicals in a purchased formulation, attach a warning label to the original container to remind workers that the substance is regulated and cannot be shipped away from campus without prior EH&S notification. Notify EH&S before shipments by calling 206-616-0585. See Figure 2-5 Do Not Ship Label for a sample label. Laboratories can print their own labels or obtain printed labels from EH&S by calling 206-616-0585.

Figure 2-5 Do Not Ship Label

c. Disposing of Chemicals on the Do Not Ship List

If you wish to dispose of any of these “do not ship” chemicals, you must submit a chemical waste collection request (http://www.ehs.washington.edu/forms/epo/1470.pdf) to EH&S as described in Section 3 of this manual.

Acetone cyanohydrins (stabilized), aluminum phosphide, and phosphorus pentasulfide must be treated before collection. Contact EH&S for details before filling out the collection request if you wish to dispose of one of these three chemicals.

Section 3
Chem Waste Management

Section 3 - Chemical Waste Management

Contents

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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 for hazardous waste are as follows:

1. Laboratory Workers

If laboratory workers generate chemical waste, they must be able to determine whether their chemical wastes are hazardous by using the guidelines in this chapter. For hazardous waste, they must identify the hazards of the waste and follow accumulation rules, which include labeling, storage and handling requirements. They must know how to request collection of hazardous waste by EH&S and the rules for disposal of chemicals and contaminated items to trash and sanitary sewer. They must prevent the accumulation of “legacy chemicals” and “inherently waste-like chemicals” (defined in this section) by cleaning out their chemical inventory on a regular basis.

Training is available through EH&S. Hazardous waste management is taught in the Managing Laboratory Chemicals course and the Online Hazardous Waste Training course. Sign up for Managing Laboratory Chemicals 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 hazardous waste and manages its proper disposal. EH&S provides guidance and training for laboratory workers on proper hazardous waste management.

B. WHAT QUALIFIES AS HAZARDOUS WASTE?

A chemical or chemical mixture that exhibits any corrosive, flammable, toxic, reactive and/or “persistent in the environment” properties is by legal definition "hazardous". At the UW, some additional chemicals are managed as hazardous waste because they are carcinogenic.

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 Safety Data 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 waste chemical is flammable if it is one of the following:

- 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 above an open beaker, for example.) MSDSs typically include information about flash points if the chemical has one. (Note: The hazardous waste designation of “Flammable” includes not only those classified as “Flammable” per NFPA as described in Section 2.D.3, but also those classified as “Class II Combustible.”)
- A solid or gas capable, under standard temperature and pressure, of causing fire through friction, absorption of moisture or spontaneous chemical changes and burns so vigorously and persistently that it creates a hazard.
- A solid, liquid, or gas that evolves oxygen at room temperature or under slight heating (*e.g.*, peroxides, chlorates, perchlorates, nitrates and permanganates.)

2. Corrosive

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

- An aqueous solution having a pH of less than 2 or greater than 12.5 (note that a chemical is not allowed to be poured down the drain if it has a pH of less than 5.5 or greater than 12 – see below.)
- A solid that, when mixed with an equal part of water, will form a solution with a pH as described above.

3. Reactive

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

- Normally unstable compound that readily undergoes violent change (*e.g.,* acrylonitrile, butyl hydroperoxide).
- 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).
- The compound contains cyanides or sulfides that when exposed to pH conditions between 2 and 12.5 could generate toxic gases in sufficient quantities to endanger 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 lists five categories of toxicity: X, A, B, C, and D. The X category (Tox-X) is the most toxic. If data is available for more than one toxicity test, use the data showing the severest toxicity.

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

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 toxic, but may still be managed as hazardous waste if it is carcinogenic/mutagenic.

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

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

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:

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

If you are not confident enough or willing to use the above equation to determine whether your chemical mixture is toxic, please 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 do not biodegrade quickly in the environment. There are two main categories of persistent chemicals, described below.

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 the 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 online "trash list" of chemicals authorized to be disposed of as solid waste at http://www.ehs.washington.edu/epowaste/trashlist.shtm . This list sometimes supersedes hazardous waste rules. See also Section E below, which explains the trash list and rules in more detail.

8. Local Sewer Limits

These rules determine what can be poured down the sink and sometimes supersede Hazardous Waste rules. Please also refer to the local sewer limits rules in Section F below.

9. Waste Evaluation Request

If you are unsure whether your waste is hazardous, please submit an online Waste Evaluation Request . Fill out all information completely, and attach the MSDS(s) 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, if they have been rinsed and the original labels have been defaced (note that the rinseate may be hazardous waste according to the definitions in Section B, above.) Containers that were designed for solid chemicals should not be used for liquids. Use only containers that show no sign of damage or deterioration.

You must use containers with screw top closures. The lids of 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, below.

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: J-014 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

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

Or, 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.) Waste chemicals may be stored with unused chemicals as long as the containers are properly labeled and your laboratory personnel know the storage location.

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. 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 in Section 2 of this manual. Use secondary containment (tubs, basins or buckets) for segregation of incompatible wastes accumulated in the same area.

5. Accumulation Volume Limits

Accumulate no more than 200 liters (55 gallons) of chemical waste per waste stream or one liter (one quart) of extremely hazardous waste per waste stream. Extremely hazardous waste is waste that is highly toxic, and the one liter limit is designed to limit risk, especially in the event of a spill. See http://www.ehs.washington.edu/epowaste/ehw.shtm for how to determine whether your waste is extremely hazardous waste.

Also, any one type of flammable chemical waste plus chemicals cannot exceed the limits specified by the controlling fire department. For example, in Seattle for class IA flammables (which include ethers and other very flammable solvents,) the total volume of allowed flammables is limited to 60 gallons per control area in a sprinklered building and 30 gallons in a nonsprinklered building. Contact EH&S Building & Fire Safety Office at 206-543-9510 with questions about control areas and volume limits if you accumulate large amounts of flammable hazardous waste, or arrange for more frequent collection of this waste.

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

Chemical waste must not be accumulated (*i.e.* stored) for more than one year.

6. Large Containers (Drums)

If you are accumulating wastes in containers greater than five gallons in volume, make sure that drums used to accumulate regulated wastes are in good condition and are approved by Department of Transportation (DOT) for highway mode transportation. If the drums were shipped to you in the first place, they are very likely DOT-approved.

Drums containing liquids must have ten centimeters of air space between the liquid surface and the lid.

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

7. Inherently Waste-like Chemicals

"Inherently waste-like chemicals" include expired chemicals, chemicals in deteriorating containers and chemicals that appear to be or are unusable. State inspectors may issue fines or infractions for inherently waste-like chemicals in your laboratory. Do not keep chemicals past their expiration date, and conduct cleanouts when you do your annual chemical inventory update.

Please also see the section on "legacy chemicals" in Section G.3, below. Legacy chemicals are those that are left behind by laboratory staff when they leave the university or move laboratories. They become the responsibility of the new space occupants.

D. HAZARDOUS WASTE COLLECTION REQUESTS

1. Hazardous Waste Collection Overview

EH&S collects hazardous chemical waste from all UW campuses and UW owned and operated facilities. There are about 3500 laboratories on and near the Seattle campus. Therefore we may only be near your area once every week or every other week. Therefore, 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 – One-Time

Request collection of your waste by submitting a Chemical Collection Request found online at http://www.ehs.washington.edu/forms/epo/1470.pdf . Fill out all information completely and fax or mail the form (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. For routine collections, EH&S assigns your chemical waste a routine number. To request pickup, you then simply enter your routine number and waste volume in an online form. We will already know what your waste is and where you are located. If you have a routine waste number and want to request a pickup, fill out and send the Routine Collection Request at http://www.ehs.washington.edu/forms/epo/routinepickup.php .

To set up a new routine, fill out and send a New Routine Collection Request at http://www.ehs.washington.edu/forms/epo/1471.pdf . If you have any questions about whether your waste is routine, email chmwaste@u.washington.edu or call 206-616-5835.

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 have more than 100 containers of waste, call 206-616-0595 to arrange a cleanout appointment. Call at least a month before your deadline.

For fewer than 100 containers, fill out and send us copies of the Chemical Collection Request (http://www.ehs.washington.edu/forms/epo/1470.pdf), making sure to put your name on each of the pages. Place completed UW Hazardous Waste Labels on each waste container (not needed for containers with an original label and original contents).

Consider the MyChem Chemical Exchange for your unwanted but useable chemicals. “Useable” chemicals are unexpired and preferably unopened.

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 more than 40% of the total waste generated at the University of Washington (2008). Recycling takes place both in laboratories and at the EH&S hazardous waste facility. For more information, see the Waste Minimization subsection below or visit 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 to incinerate hazardous waste and most batteries are recycled. The rest is incinerated at high temperature.

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. 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 must be managed as hazardous waste. The list changes sometimes due to updated toxicity information; check back occasionally to make sure your chemical may still be disposed of in the trash. Locations other than in King County must check with EH&S (206-616-5835) for local requirements.

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.

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. On the other hand, 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:

- Contents have been removed by "normal, no-nonsense means, such as inverting and draining, shaking, scraping, or scooping", and
- No more than 3% of the contents remain.

If the chemical is "extremely hazardous waste" or a pesticide marked with danger or warning labels, then the container must be triple rinsed before it is legally empty. The rinseate from this process is also considered hazardous waste by law. Lists and definitions for extremely hazardous wastes are on the EH&S website at http://www.ehs.washington.edu/epowaste/ehw.shtm. Also, if your chemical is a known or suspected carcinogen, such as those listed in Appendix H of this manual, EH&S strongly recommends that you triple rinse the container.

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

- Dry the empty 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 chemicals.
- With a pen or marker, cross out or black out the labels on the container.
- Leave the container uncapped. Throw the cap away separately.
- If the container fits in the trashcan, place it there. If it does not fit in the trashcan, place it next to the trash.

- 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.

Consider reusing the empty container for accumulation of waste for that same chemical or other compatible chemicals. If you do reuse a container, 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.

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 members 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.

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). Once corrections are made, they will collect the trash.

F. SEWER DISPOSAL

All wastewater discharged to the sanitary sewer system must be under the local Sewer Discharge Limits designed to protect surface waters and maintain the quality of biosolids from wastewater treatment plants.

1. King County Local Sewer Discharge 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". Records of this disposal must be kept as described in Section F.3 below. If your waste qualifies as hazardous waste (according to the criteria in Section B above) 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 or a Chemical Treatment Log if you are treating waste. Detergents, bleach and other “household” cleaning chemicals are the only exceptions to this rule and do not need to be recorded. Keep the log posted near the sink or point of discharge; the emergency phone number on the Sewer Discharge Log form 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 to see them.

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

4. 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.

5. 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.

6. 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. The biosolids can be re-introduced into the general environment, such as in King County where it is 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 section 2.G.2.b earlier in this manual and 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 parts per million (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

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.) However, sometimes people leave without disposing of chemicals properly.

Legacy chemicals are unwanted chemicals that are sometimes left behind after a move. If you move into a laboratory that has legacy chemicals in it, you should tell your department administrator immediately. If your department cannot, for whatever reason, solve the problem, then these legacy chemicals are “yours” to manage. Unless you think that you will use them, 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 at http://www.ehs.washington.edu/epohazreduce/index.shtm. There you will find an extensive and detailed list of services and resources.

1. Chemical Procurement and Chemical Exchange

Purchase only what you'll use, especially if you're purchasing a hazardous chemical. One recent study suggested that up to 40% of the hazardous waste produced by laboratories is actually unused and expired chemicals.

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. EH&S staff are available to help you get started, and in some cases offer free materials for recycling and treatment. Please see 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.

1. Paper and Cardboard

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. 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/facilities/transportation/recyclingandsolidwaste/.

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/facilities/transportation/recyclingandsolidwaste/.

4. Media and Printer Cartridges

Electronic media, including CDs, tapes, cell phones and LaserJet cartridges, and small amounts of "household" batteries are recycled in E.MEDiA bins throughout campus. This is a joint effort of UW Recycling and EH&S Environmental Programs Office. See the UW Recycling website for more information.

5. Batteries

Small amounts of batteries can be recycled through the E.MEDiA system (see above.) Large, heavy, and/or unusual research or clinical batteries, as well as large volumes of batteries, are handled two ways.

a. One-Time Battery Collection

To request a large one-time collection of batteries, fill out and send a Battery Collection Request at http://www.ehs.washington.edu/forms/epo/1943.pdf.

b. Routine Battery Collection

Routine collection for batteries uses a process similar to that of hazardous chemical waste. 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 have a routine number, request a pickup with 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. Various sizes of sharps containers are available from different vendors. 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 a sturdy cardboard box lined with plastic for safety during transport through the building. Any cardboard box may be used, provided it is sturdy, does not have holes in the bottom or sides, 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 should be sealed with tape identifying the box as containing "laboratory glass." Boxes and tape are available in the Chemistry stockroom and from suppliers, and tape is also available from Biochemistry stores. If the printed tape is not available, the box can be sealed with other packaging tape as long as the box is well marked as containing “laboratory glass.”

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) at http://www.ehs.washington.edu/manuals/rsmanual/14waste.pdf .

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 from the preferred supplier, Praxair, if possible. This ensures the cylinders can be properly disposed of and have a return authorization program for unused gas. As applicable, gas cylinders should be marked FULL / PARTIAL / EMPTY and returned to the supplier. Shipping cylinders that are not empty require shipping precautions as described on the gas cylinder web page (http://www.ehs.washington.edu/fsohazmat/gascylinders.shtm) and

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

Environmental Health and Safety
UNIVERSITY of WASHINGTON

Section 4 - Laboratory Equipment and Facilities

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Figures

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. 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.

Each emergency eyewash must be activated weekly in accordance with Washington Administrative Code (WAC) 296-800-15035 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. During the weekly check, the eyewash should be operated long enough so that there is no visible rust or contaminant in the water, perhaps 30 seconds. If the eyewash is located in a shared area, an individual should be appointed to perform the weekly test. Record this weekly test where it can be audited such as in your lab notebook or lab equipment maintenance record book.

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 showers are tested annually by Facilities Services to ensure they continue to meet ANSI standard water flow requirements. A tag indicating the most recent test date should be found on the equipment. Contact your servicing Facilities Services organization (see Appendix F) if a test or maintenance is needed.

B. FIRE SAFETY EQUIPMENT

1. Flammable Liquid Storage Cabinets

Flammable liquid storage cabinets 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. (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

Laboratory signs may be either permanently mounted or mounted temporarily as described in Section 2.A.7. A synopsis of mandatory and desirable signs is provided in the following table and explanatory material is described in the following paragraphs.

Table 4-1 Safety-Related Signs

Description of Sign	Mandatory?	For more information, see
Emergency contacts / phone numbers	Mandatory	Section 4.C.1
Laboratory floor plan	See Section 4.C.2	Section 4.C.2
Emergency / safety equipment location signs	Mandatory	Section 4.C.3
Food and drink prohibitions	Mandatory if present	Section 4.C.4
Area and equipment warnings	Mandatory if present	Section 4.C.5
“NFPA 704”	See Section 4.C.6	Section 4.C.6
“Sewer Discharge Log” for waste disposal sink	Mandatory if present	Section 3.F.3
“Natural gas emergency shut off valve”	Mandatory if present	-
“Laboratory water – do not drink”	Mandatory if present	-
Lab-specific procedural / operational signs	Optional / Desirable	Section 4.C.7

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. Laboratory Floor Plan

A plan showing evacuation route(s), as well as emergency and safety equipment locations should be posted prominently in each laboratory. See Appendix C for an example laboratory floor plan. If particularly hazardous substances are used in a designated area, the floor plan is mandatory.

3. Emergency/Safety Equipment Location Signs

Signs must be posted identifying the location of exits, safety showers, eyewash stations, fire extinguishers, first aid equipment, flammable storage cabinets, and other safety equipment. Contact Facilities Services to 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 EH&S.

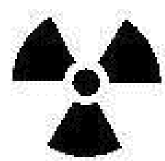
5. Area and Equipment Warnings

Operation and warning signs and labels must be posted on such things as alarm systems, biosafety cabinets, fume hoods (sash opening height). Warnings may also need to be posted in areas or on equipment where special or unusual hazards exist, such as biohazards, lasers, magnetic fields, radioactive materials, high voltage, restricted access, or particularly hazardous substance control areas. These signs may be mandatory depending on the degree of hazard and possibly local codes.

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

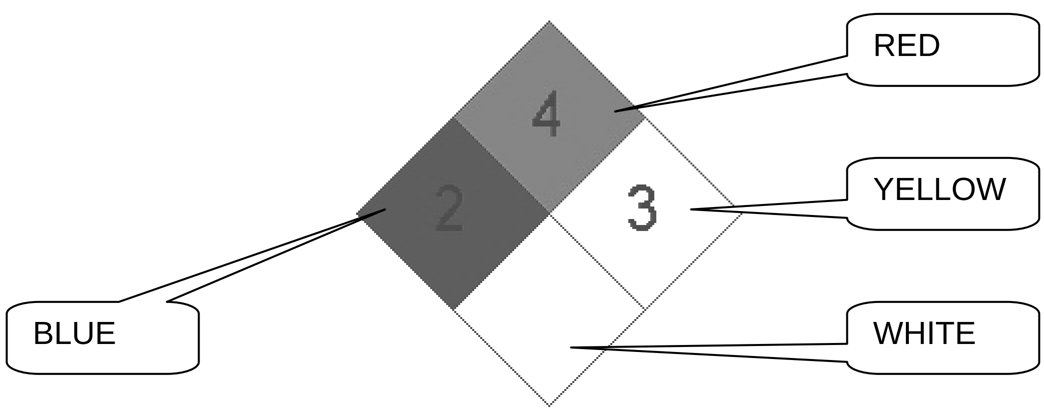
Figure 4-2 Radiation Warning Symbol



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 rating numbers for the Fire, Health and Reactivity fields are given in Table 4-1. Numbers in these fields can range from “0” (zero) to “4”, with “0” meaning essentially no hazard, and “4” indicating an extreme hazard.

Table 4-2 NFPA Standard 704 Numeric Codes

Hazard:	**Fire Hazard**	**Health Hazard**	**Reactivity**
Color:	Red	Blue	Yellow
Location:	Top Quadrant	Left Quadrant	Right Quadrant
Rating	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).

7. Lab-Specific Signs

For common procedures which may cause problems if important steps are neglected, laboratory staff may benefit from having a sign posted at the equipment used for the procedure that reminds staff of the steps that need to be followed.

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.

Additional information about fume hoods and access to an on-line training class in fume hood operation is available at http://www.ehs.washington.edu/fsofumehoods/index.shtm

a. Fume Hood Use

1) Training – Personnel using fume hoods should take the on-line training class (at http://www.ehs.washington.edu/fsofumehoods/index.shtm) or equivalent.

2) 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.)

3) 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.

4) 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 out of the fume hood and into the room.

5) 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.

6) 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.

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

8) 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.

9) Containers – All containers of chemicals must be securely capped when not in use. A rule of thumb is that containers should be open for minutes at the most – which is the maximum time it normally takes to pour a small amount of chemical into another container and cap them. All containers must be labeled with the chemical identity and appropriate hazard warnings (or the material must be used up during the work period and it is 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/or cleaned as described below in Section G.2 Decontamination of Equipment for Service, by the researchers using the hood.

2) Maintenance may require access to the storage cabinets below the hood or to the sides of the hood. If this access is required, the entire cabinet and adjacent area also needs to be emptied, decontaminated, cleaned, and rinsed. Lab staff need to identify a contact for coordinating with Facilities Services as to the work to be done.

3) See Section G.2 below 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 (206-543-7388). 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 re-circulates 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 re-circulated back into the room from the hood.

8. Cold Rooms, Warm Rooms and Environmental Chambers

a. Room Design

Controlled environment rooms generally are completely enclosed with no fresh air and heating/cooling and other environmental systems independent from the building. Rooms large enough to enter 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 people are never left in these areas without light.

b. Chemical Use

Controlled environment 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 controlled environment 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 design 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 the Seattle campus Facilities Services Campus Engineering, 206-543-7372 or your local campus engineering design services (if available). 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 approved cabinets.

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 your servicing Facilities Services organization (see Appendix F) if a ventilation system has a problem. 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 and supplies 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

Place a strainer or mesh pad over all sink drains to prevent objects falling into the plumbing.

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 your servicing Facilities Services organization (see Appendix F).

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. The room occupants should check these potential problems. If a dry trap is suspected, the trap should be filled with a few hundred milliliters of water at least once a month, or infrequently pour ten or twenty milliliters of a slower evaporating chemical such as glycerin, propylene glycol (not ethylene glycol) or mineral oil into the drain. Additional information about unknown odors is available at http://www.ehs.washington.edu/ohs/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 your servicing Facilities Services organization (see Appendix F).

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 a 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 (see Appendix F).

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 (see Appendix F for your supporting Facilities Services contact means).

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 or directly contact your supporting Facilities Services organization (see Appendix F).

c. Equipment Cords and Extension Cords

1) 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. Plugs (110 volt) must have three prongs with a grounding prong longer than the current-prongs.

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

3) 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.

If there is a potential for a worker to contact live electrical circuits of 50 volts or greater while performing equipment installation, modification or maintenance, that person must take electrical safety classes including lock-out/tag-out procedures and wear appropriate arc/flash protective clothing. If at all possible, equipment setup and maintenance must be performed with the equipment in a de-energized condition.

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 206-543-7388 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 WORK AREAS

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 on the Seattle campus and refer to Appendix F for contact numbers for Facilities Services at other locations. 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 unobstructed, emptied of chemicals, decontaminated with a decontaminating chemical as needed, washed with warm, soapy water, and rinsed. 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 and/or cleaned. 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/fso/lab_equip.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

Environmental Health and Safety
UNIVERSITY of WASHINGTON

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://apps.leg.wa.gov/WAC/default.aspx?cite=296-841-20025 . 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 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 the Campus Employee Health Center (206-685-1026 for most work areas, or 206-598-4848 for UWMC employees). 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 may be 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	Section B.3 below
Cuts/Abrasions	Cut-resistant gloves (leather, Kevlar, chain-mail)	Section B.3 below
Dust	Dust goggles, respirators	Section B.1 (Eye protection) and B.4 (Respirators) below
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	Section B.1 below
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	Section B.1.f below
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	Section B.5 below
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, gloves, aprons, sleeves and shoe covers	Section B.1, B.2, and B.3 below
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 and refer to the Respiratory Protection Program web page at http://www.ehs.washington.edu/ohsresp/index.shtm. 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

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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 requirements are described in this section of the manual and a synopsis is provided in the checklist in Appendix E, Section E.G, SOP Required Elements Checklist.

The EH&S Laboratory Safety Standard Compliance class is available for Principal Investigators (PIs) and laboratory supervisors. This class includes information about preparing SOPs. Registration for this class is available 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

The required elements are listed in the checklist in Appendix E, Checklist G. SOP Required Elements Checklist, beginning on page E-22, if you would like to compare an SOP received from another organization to the requirements. 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. Engineering controls provide a permanent means of protection and are preferred over other types of 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 particularly hazardous chemicals in locked cabinets, and using built-in barriers to restrict access to the area or to protect from potentially explosive situations.

2) Use of administrative controls, *i.e.*, specific safe practices such as keeping the fume hood sash as low as possible, storing chemicals with secondary containment, 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., which is the least preferred method of protection if alternatives are available. However, when PPE is required, the PPE must be specified completely, such as the type of glove to be used and whether it is necessary for the entire process or at certain steps. 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. EH&S has preferred treatment options on the web page concerning waste minimization (https://www.ehs.washington.edu/epohazreduce/index.shtm).

f. Particularly Hazardous Substances

Provide additional details if "particularly hazardous substances" (highly toxic or dangerous chemicals, carcinogens, reproductive toxicants or select toxins) are used. Refer to Appendix H for definitions and 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 particularly hazardous substances.

2. Appearance

SOPs obtained from other organizations and SOPs written in the form of step-by-step procedures 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. A checklist is available in Appendix E, SOP Required Elements Checklist, on page E-25, to make it easier to assure that all the safety elements needed in the SOP have been addressed. If SOPs are provided by outside sources (such as equipment suppliers or another laboratory) or modified from a template, they must be carefully reviewed to ensure they describe your protective measures accurately, including describing specific types of PPE and control equipment you will use.

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. An electronic, blank form is available at http://www.ehs.washington.edu/manuals/lsm/sop.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, highly dangerous chemicals, carcinogens, mutagens, teratogens), the 8 basic elements 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.")

Feel free to attach additional information, such as Material Safety Data Sheets (MSDSs) to your SOP. Chemical-specific hazard information is available in the appendices of certain regulations (such as for arsenic and lead), the EH&S web pages, other web sites, and reference books. An example of this additional information is attached to the Example Benzene SOP in this manual, Appendix D, page D-6.

C. EXAMPLE GENERIC SOPS

Example and generic SOPs are included in Appendix D and more are on the EH&S web site (at http://www.ehs.washington.edu/manuals/lsm/examplesoplinks.shtm . If used by your laboratory, these examples must be modified and customized as necessary to make them specific to your laboratory conditions. If your laboratory generates an SOP and would like to make it available to other labs, please attach an electronic copy to an email addressed to uwcho@uw.edu.

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 that pertain to your laboratory. This allows you to become familiar with the required elements, as described on the attached SOP forms (Figures 6-1 and 6-2) and the checklist in Appendix E.

2. Step 2 – Identify Requirements

Identify if any particularly hazardous substances (see Appendix H) 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.

Safety requirements could be noted either by integrating them into the steps in the process or by using a "cover sheet" of safety requirements for the process. 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.

b. By Individual Chemical

By each individual chemical, such as acrylamide, formaldehyde, or 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 mineral acids, 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, are especially dangerous 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 the master copies so that everyone can find them. If they are not physically filed in the laboratory-specific information section of your CHP, the laboratory-specific information pages should be annotated to identify where the SOPs are physically located.

5. Distributing Copies of the SOPs

If you provide working copies of your SOPs to your staff, keep track of how many copies you made and distributed. When you make changes, you will need to assure that the up-dated SOPs reach all those who perform the procedures.

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 .

6. 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? (See Lab Safety Manual Appendix H)	___ 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? (See Lab Safety Manual Appendix H)	_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

Environmental Health and Safety
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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 by PI/Supervisor is required.

3. Employee Safety Training Checklist

A checklist describing required and recommended training for each laboratory employee is available at http://www.ehs.washington.edu/forms/pso/labemployeesafetytrain.pdf and a copy is also located in Appendix C of this manual. This checklist can also be used to document and track the training received by an individual, as described below in Section D.

B. LABORATORY-SPECIFIC SAFETY TRAINING CONTENTS

Principal Investigators or laboratory supervisors must ensure that additional training on laboratory-specific safety topics 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 your lab's Chemical Hygiene Plan (CHP) consists of the UW generic Laboratory Safety Manual and your laboratory-specific information. A CHP is required by regulation, and personnel must know where a copy of the regulation can be found (the Hazardous Chemicals in Laboratories regulation - WAC 296-828 - is in Appendix A of each UW Laboratory Safety Manual.) Personnel should have a general knowledge of what is contained in the regulation and the generic UW Laboratory Safety Manual.

Standard Operating Procedures (SOPs) concerning your procedures are a major part of the lab-specific information that personnel must know. 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.

Your lab's CHP can be either completely electronic, completely paper, or a mixture. If you have a completely or partially electronic CHP, all your personnel handling chemicals must know where the current electronic copy is. If personnel may transfer files to other locations, all your personnel must understand the system set up to assure that all personnel work from the current file. Conversely, if your CHP contains paper records of which there may be multiple copies (such as SOPs), all personnel must be able to identify the current paper copy, by revision number or date, and know how to refer to a master index or file identifying the current documents. In other words, all your personnel must know how the laboratory-specific information is being handled, no matter what procedure you use.

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 a short time, such as 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. Workplace Hazards

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 earlier in this manual.

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.

5. 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.

6. 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.

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. Emergency Response

Emergency response steps that should be taken if a spill or accident happens must be taught and should be occasionally exercised. The level of training needs to be commensurate with the hazards of the chemicals in use – use of a pyrophoric chemical requires more training than use of an irritant.

Training must address how to summon emergency assistance by dialing 911 or activating the fire alarm pull station (but simulate the action). 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.

Practice responses should be exercised occasionally. It might be especially beneficial to practice trying to find the emergency eyewash or shower while blindfolded, if your laboratory has an eyewash or shower. Additional information about emergency response is located in Section 9 and information about emergency response training for designated individuals can be found in Section 9.A.6.

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 web site http://www.ehs.washington.edu/psotrain/index.shtm or by calling 206-543-7201.

1. Required Training

a. 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. An annual refresher is required.

b. 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.

c. General Asbestos Awareness

Online or classroom session satisfies the regulatory requirement for every UW employee to receive annual refresher training in general asbestos awareness.

d. Radiation Safety Training

Initial radiation safety is primarily an on-line course (with one in-person class) required for all personnel being authorized to use radioactive material. Pre-registration is required. Other radiation safety courses are available and may be required depending upon materials and equipment to be used. Call 206-543-0463 for a schedule or to pre-register for the initial class or see http://www.ehs.washington.edu/rsotrain/index.shtm .

e. 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.

f. Shipping 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. Online training is available on Shipping Biological Substance Category B and Shipping Dry Ice with non-dangerous goods or Exempt Patient Specimens.

2. Recommended Training

a. Biosafety – General Training

(Replaces ABSL/BSL-2 training) This class is for Principal Investigators and their staff who are working with infectious agents and recombinant DNA. It covers the review and approval process for biological agents at the UW and the requirements governing their use (e.g. facilities, equipment, practices).

b. Compressed Gas Safety

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

c. 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.

d. Fume Hood Training, Online

For anyone who uses fume hoods in their work or education.

e. Laboratory Safety Standard Compliance

This is recommended training for supervisors, PIs, and others responsible for chemical laboratory safety compliance. It covers how to comply with the requirements of the Washington 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 Laboratory Chemicals

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 chemical hazards, 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 regulations relating to hazardous chemical exposures in labs.

g. MyChem Training

The MyChem chemical inventory and MSDS database class 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 206-616-4046 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 which can be used to document a training session given to a group and for the UW Laboratory Employee Safety Training Checklist which can be used to document an individual's training. Training certificates (including email notifications of course completions) can also be copied and maintained as a record of an individual's safety training. Along with formal training, it is wise to record any safety training or topics covered during staff meetings.

You should also keep a copy of any training materials generated for safety training, such as a lesson outline, to demonstrate the scope of your training if inspected by Washington State Department of Labor and Industries, and to help in training new employees.

Training records should be maintained for as long as any particular trained employee remains employed in the work area. (If there is a chance that an employee who left will be returning soon, it might be a good idea to keep the records longer.)

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

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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/ohs/plmcsform.php.

The latest edition of the Laboratory Safety Manual is also always available electronically for viewing the complete manual or individual sections, on the EH&S website at http://www.ehs.washington.edu/manuals/lsm/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 Investigator or laboratory supervisor 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. (Refer to Section 7.D for information on what to include in your laboratory training documentation.)

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, 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.

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Section 9 - Emergency Preparedness and Response

Contents

Tables

A. BEFORE AN EMERGENCY

This section describes emergency guidelines and requirements for laboratory operations. It supplements emergency preparation and response procedures described in other documents, including your Departmental Health and Safety Plan, your building Emergency Evacuation and Operations Plan, and the UW Emergency Response Management Plan. These other documents describe emergency preparedness and response for departments, buildings, and the entire campus, respectively. Instructors teaching laboratory classes must also follow university and departmental rules for emergencies during class.

Principal Investigators must prepare laboratory personnel for emergencies such as injuries, fires or explosions, chemical spills, floods, power failures and earthquakes. To prepare for an emergency, laboratory personnel should plan, obtain response kits and materials, modify facilities and practice responses. Staff should also be encouraged to prepare for emergencies at home.

1. Departmental Plans and Policies

As part of their new employee orientation, employees must be informed of evacuation procedures and the Evacuation Assembly Point(s) as described in the building or department's Emergency Evacuation and Operations Plan (EEOP). Personnel should 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).

Your department's Health and Safety Plan may also discuss first aid plans and training. If so, include this in your new employee orientations.

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

Employees must also be informed of all departmental safety policies, such as those regarding security or working alone.

2. Planning and Prevention

Emergency response on the Seattle campus is provided by the University of Washington Police Department and Seattle Fire Department, and local fire and police departments respond at Bothell, Tacoma, and off-site locations. EH&S will provide liaison with these organizations and provide advice, but each laboratory is responsible for accident prevention and planning for first aid and chemical spill response within the laboratory.

a. Accident Prevention

Help prevent emergencies in laboratories by doing the following:

1) Post emergency phone numbers and floor plans
2) Know locations of shutoffs for equipment including electrical, gas, water
3) Train personnel to retrieve MSDSs for laboratory chemicals.
4) Separate incompatible chemicals and put them in secondary containment
5) Frequently dispose of chemical wastes, and clean out unneeded chemicals and surplus or dispose of unneeded items
6) Ensure electrical wires and equipment are in good condition
7) Discuss accidents and near misses to prevent future accidents
8) Complete the laboratory inspection checklist periodically
9) Discuss safety topics periodically in staff meetings

b. Hazards Assessment /Risk Minimization

When a new experiment or process is in development, assess possible hazards and identify ways to reduce risks. 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 when they are involved with their development, and they may provide good perspective too.

Read the following sections about specific hazards such as fires and explosions. There are also sections about training and special authorizations for the use of particularly hazardous chemicals.

Information about hazards and controls are available in product MSDSs, from colleagues and from EH&S (call 206-543-7388 or email uwcho@u.washington.edu for advice.)

c. Fire and Explosion Prevention

To prevent and minimize the effects of fires and explosions, do the following when using flammable, reactive, or explosive materials:

1) Determine if a non-flammable substitute for your material is available
2) Use a minimum amount of the material at any one time
3) Maintain proper clearances for aisles, eyewashes, emergency showers and underneath and around sprinkler heads
4) Close fume hood sashes when they are not in use
5) Keep containers closed
6) Practice good housekeeping, such as recycling empty cardboard boxes and disposing of unnecessary or outdated chemicals
7) Have the appropriate fire extinguisher available for the materials in use
8) Wear fire-resistant lab coats instead of plastic
9) If using chemicals in a closed system, frequently check that connections are tight
10) Use chemicals and reaction systems in a ventilated enclosure such as a fume hood
11) Reduce or eliminate open flames and spark-producing equipment
12) Use a refrigerator/freezer designed to store flammable materials
13) Use barriers that provide adequate protection from an explosion
14) Consider if utility outages would increase risks while using the material
15) Anticipate that intermediates and wastes can be flammable or explosive
16) Use appropriate containers and locations to accumulate wastes
17) Train staff as to the chemicals, their hazards and precautions. Document the training. Exercise responses occasionally.

d. 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 procedures for cleaning spills in a laboratory should be included in the SOPs developed for each of the laboratory's processes (see Section 6 of this manual). Pay special attention to additional precautions that may be desirable for pyrophoric, water reactive, and oxidizing chemicals, and those that may generate toxic gases if a reaction were to occur.

Chemicals should be acquired in small quantities for ease of handling and to limit the amount spilled if a container ruptures. Chemicals should be transported between rooms in a tub or bottle carriers designed to prevent breakage and to hold the contents in case of breakage.

All laboratories should have a chemical spill cleanup kit appropriate for the chemicals in the lab.

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. A checklist on earthquake preparation for laboratory personnel is in Appendix E of the manual and on the EH&S web site at http://www.ehs.washington.edu/fsoemerprep/labearthquake.shtm . Also, refer to the department's EEOP for departmental procedures for earthquakes. Call EH&S 206-543-7388 if you have questions about earthquake preparedness.

f. Gas Leaks and Unknown Odors

All staff need to know what gases and volatile chemicals in their laboratory 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. Previous incidents with odors as well as possible odors from adjacent laboratories should be discussed during staff meetings if they are issues.

g. Utility Outages: Pre-planning and Mitigation

1) To pre-plan for utility failure, consider the utilities laboratory operations depend on and determine if interruptions are unacceptable. Utility outages that can affect laboratory operations include:

- Electrical power systems
- Backup power system or switching systems
- Compressed air systems
- Ventilation systems (fume hoods, biological safety cabinets, etc.)
- Natural gas system
- Supplied gas systems (medical air, O2, N2O, N2, EtO, etc.)
- Vacuum systems
- Potable water systems (loss or contamination)
- Non-potable water systems (loss or contamination)
- Sewage systems
- Heating systems
- Fire protection systems
- Refrigeration systems (refrigerators, 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 of shutdowns on laboratory operations include:

- Maintaining backup (split) samples at another location
- Maintaining records at another location
- Using emergency power circuits (if available) only for equipment that needs it
- Installing devices to improve services, such as water filters for potable water and surge protectors or Uninterruptible Power Systems for electrical power
- Planning the steps needed to be taken to safely shut the process(es) down and start it (them) up again
- Planning actions to prevent uncontrolled reactions
- Contracting for emergency supplies and services. For example, if refrigerators or freezers are used for specimens, locate a source for dry ice and liquid nitrogen freezers in case of electrical failure.
- Connecting incubators, refrigerators and freezers to battery powered automatic phone dialing systems or alarm monitoring services which detect power interruptions and alert the designated person. Being alerted to an outage does not solve the problem but it can give employees extra time to react.
- Developing procedures for card reader doors and other security systems that typically have a four-hour battery backup and procedures to communicate changes to normal access routes if necessary
- Having flashlights in areas that do not have emergency lighting and periodically check their condition
- Being aware of the various alarm systems and the appropriate responses to them (including fire alarms, ventilation system alarms, fume hood low flow alarms, gas leak detection systems.)
- Advising staff that communication channels set up for other disaster situations (adverse weather) will be used during long-term power outages
- Maintaining good habits for safe chemical use, such keeping containers closed
- Conducting periodic trainings, drills or exercises.

h. Unattended Operations and Floods

Avoid leaving operations or experiments unattended. At least post on the door to the room the name and phone number of the person responsible for the operation in case of emergency. In addition, identify the chemicals in use and post clear directions for shutdown so that an untrained person could shut down the operation during an emergency.

In general, to avoid failures in equipment while no one is in the lab, maintain and operate equipment properly. Replace damaged equipment and electrical cords. Do not use extension cords for hooking up to electrical power; use strip outlets if your cord does not reach the outlet. Check equipment periodically.

Water should never be left running unattended. Water can flood into the floor below your laboratory; in fact, this happens too often. If it is necessary to have water running unattended, install a commercially available water flow device that sets off an alarm if a leak occurs or use a shutoff valve that kicks in if the water level rises too high. Use copper tubing with proper fittings or Tygon tubing, which is less likely to become brittle than rubber tubing. If using tubing, make sure the ends are tightly connected and tied tight. Anchor outlet hoses into sinks or drains.

Do not leave open flames unattended.

i. Inclement Weather

Plan for inclement weather, including lightning, heavy snow, hail or ice storms, high winds, heavy rainfall, flooding, and even high heat loads, depending on the laboratory's location.

Staff must have an emergency kit 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. If an activity must continue on a daily basis, such as an experiment or caring for research animals, devise a contingency plan for inclement weather. Consider who could travel to the laboratory and provide the necessary service. Realize that certain roads and building entrances that you usually use may not be available.

Plan for these events by considering the following beforehand:

1) How to protect personnel.
2) How to shut down experiments in a timely manner or safely continue experiments in emergency conditions.
3) How to protect experimental results and essential materials.
4) How to protect equipment and supplies from the weather.

j. Security Issues

Plan for ways to avoid and respond to violence, vandalism, suspicious people and suspicious packages. Laboratories can be targets for such activities. Related information is available on the EH&S and the Office of Emergency Management web sites.

In general, laboratory security can be improved if all staff:

1) Know all 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) Do not leave out materials which may be attractive to thieves
6) Properly dispose of hazardous agents which are no longer needed

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 policies to increase security. All staff must be periodically reminded of these policies.

k. Field Operations

Plan for emergencies that may occur during field operations and it is desirable to write a safety plan. Take into account the remoteness of the operation and the risks associated with the activities. Minimum considerations include:

1) Become knowledgeable about potential threats in the area

2) Determine access to first aid, CPR and medical response and have a first aid kit available

3) Determine communications to be used in case of emergency

4) Devise alternative plans for inclement weather

5) Develop checklists to ensure necessary supplies and equipment are brought to the site

The University of Washington Office of Risk Management has additional information concerning field trips away from the area, including the "Field Trip Guide Risk Management – A Guide for Organizers." See http://f2.washington.edu/treasury/riskmgmt/insure/fieldtrip for more information. Many departments have developed handbooks or safety plans when preparing for earlier field trips, so there may be information concerning projects similar to your field work or pertaining to your trip locale available within your department or the UW for review and guidance.

3. Spill, First Aid and Disaster Kits

Purchase emergency kits appropriate for your laboratory. Inspect them routinely (*i.e*, semi-annually and after use) to make sure they are complete and ready for response.

a. Chemical Spill Kits

A custom general-purpose kit is available through VWR for approximately $50. This kit was designed by UW EH&S to be appropriate for most types of relatively small spills. The part number for the VWR general-purpose spill kit is ***#TXGENERALSPILL***. It can be ordered directly from VWR or purchased at either BioChemistry Stores (Health Sciences J-014) or Chemistry Stores (Bagley Hall 036). The contents of the basic kit are listed below:

Table 9-1 General Purpose Chemical Spill Kit Contents

Item	Description
Absorbent	Five spill pads, universal for acid, base, oil, solvents
Neutralizer	One 64 oz. box baking soda for neutralizing acids
Brush and dustpan	One snap together dust pan and whisk broom
Plastic bags	Four 18 x 30, yellow hazardous material heavy duty waste bags
Plastic drum	One 5-gallon re-useable screw top plastic drum to store kit supplies and hold bagged spill waste
Goggles	One chemical splash protection goggles
Impervious gloves	One pair Silvershield gloves (multi-layer construction, impervious to most chemicals)
Lightweight gloves	Eight pairs of Microgrip powder-free nitrile gloves, various sizes

Item	Description
Forms	EH&S Chemical Collection Request and hazardous waste labels

b. Mercury Spill Kits

A custom general-purpose kit is available through VWR for approximately $30. This kit was designed by UW EH&S to be appropriate for small mercury spills, such as those from a broken mercury thermometer, on impervious surfaces. The part number for the VWR general-purpose spill kit is ***#TXMERCURYSPILL***. It can be ordered directly from VWR or purchased at either BioChemistry Stores (Health Sciences J-014) or Chemistry Stores (Bagley Hall 036). The contents of the kits are listed below:

Table 9-2 Mercury Spill Kit Contents

Item	Description
Scraper	One plastic scraper
Syringe	One 1 cc syringe to aspirate visible mercury droplets
Amalgamating powder	One package, Hg-Absorb powder to amalgamate micro-droplets
Sponge	One sponge to wipe surfaces after using Hg-Absorb powder
Plastic bag	One 9 x 12 reseal-able bag for waste (holds kit contents)
Gloves	One pair, Nitrile gloves, large size
Forms	Chemical Collection Request and hazardous waste labels

c. Biological Spill Kits

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

d. First Aid Kits

First aid supplies must be readily accessible to employees. The size of a first aid kit depends upon the number of people who may use the kit, as shown in the following table (Table 9-3, Typical First Aid Kit Contents). Each laboratory must establish procedures to assure that first aid kits remain stocked.

Table 9-3 Typical First Aid Kit Contents

Required Items	# People		
	1 - 5	6 – 15	16 -30
Absorbent gauze 2'x6'	0 pk	1 pk	2 pk
Adhesive bandages 1"	1 bx	1 bx	2 bx
Bandage compress 4"	1 pk	2 pk	2 pk
Eye dressing	0 pk	1 pk	1 pk
Scissors and tweezers	1 pk	1 pk	1 pk

Triangle bandages	1 pk	2 pk	6 pk
Antiseptic soap/pads	1 pk	1 pk	1 pk
Kling bandage 4"	1 dz	1 dz	1 dz
Surgipad dressing	2 ea	2 ea	3 ea
Adhesive tape	1 pk	1 pk	1 pk
Multi-trauma dressing	0 ea	1 ea	1 ea
Kerlix dressing 3"	0 pk	1 pk	1 pk

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. The gel could be kept in the first aid kit (or in a spill kit or close to the work area). Calcium gluconate gel can be purchased from EH&S (see http://www.ehs.washington.edu/manuals/tips/hydrofluoricacid.pdf). It has a relatively short shelf life of six months so the PI/laboratory supervisor needs to have a process for replacing it periodically.

e. Disaster Kits

Disaster kit information is on the UW Emergency Management web site at http://www.washington.edu/emergency/prepare/disaster_kit.php.

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. Training classes are available through EH&S, with online registration at http://www.ehs.washington.edu/psotrain/index.shtm. 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.

Fire extinguishers should be conspicuously located, wall mounted, and easily accessible. The fire extinguishers available to the laboratory staff should be selected based on the materials inside or outside the lab. See Table 9-4 for the list of fire classes.

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,	Carbon Dioxide (BC) or Dry

	fuse boxes, circuit breakers, machinery, and appliances	Chemical (ABC)
D	Combustible metals (e.g., Na, Mg)	Special Extinguisher (D)

University laboratories using hazardous chemicals should have an ABC rated dry chemical fire extinguisher located 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 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 needed.

Laboratories also may request 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 (e.g., paper, wood, plastic).

On the Seattle campus, extinguishers are certified annually by Facilities Services as part of the routine building maintenance. If an extinguisher needs to be refilled, contact Facilities Services at 206-685-1411. To request additional or alternative extinguishers, contact EH&S at 206-543-0465. For repair or replacement of fire extinguishers at Bothell or Tacoma campuses, please refer to Appendix F.

Automatic fire suppression systems are 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 can cause eye damage 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 where chemicals are being used, although this distance should be less if doors interfere with access. Always maintain clear paths to eyewash stations.

Chemicals 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 personnel practice locating the eyewash station while keeping their eyes closed. If at all possible, don’t work alone when working with these chemicals.

Eyewashes must be flushed weekly by laboratory staff to ensure they are operating correctly.

Refer to Section 4.A 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.

Refer to Section 4.A for additional information on safety showers.

d. Deluge Hoses

Deluge hoses have been replaced with dual eyewash stations. Deluge hoses are not acceptable alternatives to an eyewash or safety shower. They can be used for washing glassware and other materials.

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.

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. Training Staff for Emergencies

Train staff for emergencies as appropriate. Periodic drills and exercises, including “table top” discussions, keep knowledge current and interest fresh. Additional information on training and documentation is in Section 7 of this manual.

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. Training must be commensurate with the hazards of the chemicals in use – corrosive, flammable, reactive or explosive chemicals require more emphasis on emergency response than laboratories that have an inventory limited to irritant chemicals.

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 departmental Emergency Evacuation and Operations Plan.

B. RESPONSE TO SPECIFIC INCIDENTS / ACCIDENTS

1. Accidents Resulting in Personal Injury or Exposure

For any accident involving personal injury, call 911 for emergency response as soon as possible while conducting the following first aid responses as appropriate. Do not remove equipment involved in the accident and do not move it unless necessary to provide aid to the victim(s) or to prevent further damage or injury. Depending on the seriousness of the injuries, a formal accident investigation may be required in compliance with Washington State Department of Labor and Industries regulations (Washington Administrative Code, WAC 296-800-320).

a. Chemical Exposure

If a hazardous chemical is in someone's eyes, flush eyes for at least 15 minutes in the eyewash, holding the victim's eyelids open. Call 911 as soon as possible.

If a toxic or corrosive chemical is on someone's skin, flush area affected for at least 15 minutes. If necessary, use the safety shower and remove contaminated apparel. (For hydrofluoric acid, when calcium gluconate treatment is available, instead flush skin for five minutes and immediately apply the calcium gluconate. For more details, see the HF example Standard Operating Procedure.) Call 911 as soon as possible.

If a person is exposed to a toxic material in the air, remove the person to fresh air and call 911 as soon as possible. Do not re-enter an area that may still be contaminated.

All personnel in the laboratory should be able to retrieve an MSDS for any hazardous chemical in the laboratory so they can bring it to the emergency room. Transport the victim by ambulance.

Contact the Occupational Health Nurse at UW Campus Health Services (206-685-1026) if there is a concern about possible long-term health effects from a workplace exposure.

b. Reporting

After immediate, emergency actions have been taken, report the accident or incident to the work area supervisor, department administrator, or other designated department contact as soon as possible. If the accident results in a fatality or hospitalization, also report the accident immediately to EH&S at 206-543-7262. After routine office hours, EH&S can be contacted via the UW Police Department at 206-685-UWPD (8973). If the accident involved a University vehicle, it must be reported immediately to the UW Police Department at 911 or 206-685-UWPD (8973), and to UW Fleet Services using the procedures found in the vehicle's glove compartment.

All faculty, staff, students and visitors are required to report an accident or incident using the online accident reporting system within 24 hours of the incident or accident if a person was injured or property damage occurred. Also report any on-the-job incident that barely missed causing an injury or illness or property damage. The online system is available at http://www.ehs.washington.edu/ohsoars/index.shtm.

c. Medical Treatment Reports

An employee who seeks medical treatment for a work related injury or illness must submit a State of Washington Accident Report Form, which is initiated by the health care provider. Also, notify UW Risk Management at 206-543-0183. More information is available at http://f2.washington.edu/treasury/riskmgmt/wc .

2. Fires and Explosions

In the event of a fire or explosion, activate the alarm system and evacuate as soon as possible. You may attempt to use an appropriate fire extinguisher to fight the fire if it is easily extinguished (*i.e*., smaller than a trashcan), you have been trained within the last year on how to use a fire extinguisher and you have a clear exit.

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. Call 911 and provide first aid. Assist to evacuate as needed. Remain in contact with emergency responders.

Report all fires and explosions immediately. Even if the fire was small, contained and readily extinguished by laboratory personnel, and you did not call 911, immediately report the incident to the University Police on the Seattle campus at 206-685-UWPD (8973). 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 911, the best course of action is to call 911 and let the dispatch operator assist in deciding a proper response.

Submit an accident report on the online accident reporting system on the EH&S web site at http://www.ehs.washington.edu/ohsoars/index.shtm.

3. Spills

Your response to a spill depends on the danger it poses. Take the following action(s) as necessary.

a. Evacuate Building as Necessary

If a spill endangers people outside your laboratory (such as if a toxic gas could go down the hall, or a flammable solvent spill might catch on fire), pull the nearest fire alarm to initiate evacuation of your building. Pulling the alarm will also call the local police and fire departments who will respond to the spill. Evacuate immediately. If you are able (i.e., if you are not injured or assisting someone else), make yourself available to describe the situation to emergency personnel when they arrive.

b. Evacuate Room as Necessary

If a spill endangers people within your lab room, evacuate the room, shutting down any flame producing equipment if possible. Report the situation to 911 and your PI / Department staff as soon as possible. Keep people from re-entering the room. If the chemical is volatile and the laboratory has a fume hood or other ventilation exhaust system, it may be possible to let the chemical evaporate. Otherwise, a spill cleanup as described below may be necessary.

c. Responding to Exposures

If the spill caused or is likely to cause an injury or illness, call 911. This number works on all campuses as well as from cell phones and off campus locations. (Harborview and UW Medical Centers have internal emergency numbers – in those areas, refer to your Emergency Reference Guide.) In all cases, explain your circumstances to the operator. Injured personnel should be transported by trained medics and not volunteers. Specific additional details for responding to personal contamination incidents are described in Section B.1, above.

d. Spill Cleanup

If you know what the chemical is and its hazards, and have appropriate PPE and spill cleanup materials, clean up the spill using care and referring to the SOP. If you are unable to clean up the spill due to lack of knowledge or materials, call EH&S at 206-543-0467. EH&S provides spill advice and will call the hazardous materials response contractor if you cannot clean up your spill. All clean-up costs are paid by the responsible department or laboratory.

A large spill of a toxic, low-volatility chemical (such as 500 milliliters of formaldehyde or 20 milliliters of mercury) that occurs outside of a fume hood may be especially problematic. Evacuate the room and call EH&S (206-543-0467) before attempting to clean up these types of spills. Even if you were approved for use of a respirator for that particular material prior to the spill, it may not provide adequate protection.

For advice from EH&S if a spill occurs after normal work hours, contact the UWPD at 206-685-UWPD (8973) who can get in touch with the EH&S spill experts.

e. Spill Waste

Waste generated during spill cleanup is usually hazardous waste. There are a few exceptions, such as neutralized and absorbed acid spills. Place hazardous spill waste in double plastic bags or the plastic bucket, label as hazardous waste, and initiate a Chemical Collection Request.

If you have nonhazardous spill waste, double bag it, tie the bags closed, and label it as non-hazardous waste. Put it in the trash or next to it for Custodial Services to collect.

f. Documentation and Process Improvement

After the incident, fill out an accident report (on the EH&S Web site at http://www.ehs.washington.edu/ohsoars/index.shtm) with your supervisor. Replace used clean-up materials. Determine if additional or other types of cleanup materials would be desirable. Also, discuss as a group what could have been done differently. Document any changes by updating the applicable Standard Operating Procedure(s).

g. 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. It is nearly impossible to clean up mercury spills on soft surfaces such as carpeting and shoes and typically requires removal and disposal of these contaminated items 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 with mercury or mercury-containing equipment should have a mercury spill kit immediately available.

Follow-up monitoring 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.

4. Radioactive Material Spills

a. Notify Authorized Investigator and Determine Hazard

Notify the Authorized Investigator or Laboratory Safety Agent responsible for the area (best authority for immediate information regarding the hazard). Determine the radionuclide(s) involved and group them by their “Annual Limit on Intake” (ALI). Determine each radionuclide’s approximate activity. Use this information to determine if this is a major or minor spill.

Table 9-5 Radionuclides in Use and Their ALI Groupings

GROUP I ALI > 10 mCi	GROUP II 1 mCi < ALI < 10 mCi			GROUP III 0.1 mCi < ALI < 1 mCi		GROUP IV 0.01mCi < ALI < 0.1 mCi
H-3	C-14	Mn-54	Mo-99	Na-22	Sr-89	Sr-90
F-18	Na-24	Fe-55	In-111	P-32	Cd-109	I-125
Cr-51	P-33	Co-57	I-123	Cl-36	Ag-110m	I-131
Cu-64	S-35	Co-58	Hg-197	Ca-47	Cd-115m	
Tc-99m	K-42	Ga-67	Au-198	Fe-59	Ir-192	
In-113m	Ca-45	Hg-203 (inorganic)		Zn-65	Hg-203 (organic)	

b. Major Spills (Spills Approximating the ALI)

A spill is a major spill if more than 10 milliCuries of a Group I radionuclide, or more than 1 milliCurie of a Group II radionuclide, or more than 0.1 milliCuries of a Group III radionuclide, or more than 0.01 milliCuries of a Group IV radionuclide is spilled.

1) Clear the Area. Notify all persons not involved in the spill to vacate the room.
2) Prevent the Spread. Cover the spill with absorbent pads or diatomaceous earth, but do not attempt to clean it up. Confine the movement of all personnel potentially contaminated to prevent the spread.
3) Shield the Source. If necessary, the spill should be shielded, but only if it can be done without further contamination or without significantly increasing your radiation exposure.
4) Close the Room. Leave the room and lock the door(s) to prevent entry.
5) Notify the Radiation Safety Office immediately (543-0463).

c. Minor Spills (Less than Major Spill Quantities)

1) Notify persons in the area that a spill has occurred.

2) Prevent the spread by stopping persons from tracking through the area. Mitigate movement caused by air currents (hoods, fans, etc.), dripping water, dusting, mopping, or other physical actions. Cover the spill with absorbent paper or pads or spread absorbent diatomaceous earth.

3) Make a decontamination plan. A prudent action is to safeguard the area while making a thorough plan of the steps to be taken in the decontamination procedure. Protective clothing, footwear, gloves, and respirators should be used as needed. The use of remote handling tongs should also be considered whenever possible. Begin decontamination by removing absorbent cover materials. Carefully fold the absorbent paper or pads and scoop up any absorbent diatomaceous earth with cardboard. Always decontaminate the spill by working from the outside toward the center. Avoid using cleaning solutions during the first part of clean-up and only use them later if it can be assured that these cleaners will neither volatilize nor “fix” the radioactive material.

4) Make full use of appropriate instruments and available assistance. Each step of the decontamination should be monitored. One person should be kept clean to operate instruments and do other monitoring. If instruments become contaminated, any progress is compromised. Be sure to check the area around the spill, hands, and clothing for contamination. For most beta and gamma emitters, survey the area with a low-range, thin-window Geiger-Muller (G-M) survey meter. For I-125, survey with a thin crystal sodium iodide (NaI) detector. Survey H-3, C-14, and S-35 spills with wipes counted in a liquid scintillation counter (LSC).

5) Insert contaminated articles and cleaning materials into a plastic bag. Also, insert into the plastic bag all other potentially contaminated materials such as disposable gloves. Dispose the plastic bag in the radioactive waste container. In some instances, it may be better to dispose of a contaminated article than to attempt to decontaminate. Keep a record of the incident and decontamination procedures.

6) Notify the Radiation Safety Office of your actions and progress (206-543-0463).

d. Maximum Contamination Levels

Additional information about radiation safety is in the UW Radiation Safety Manual (http://www.ehs.washington.edu/manuals/rsmanual/index.shtm). Surface contamination control guidance has been proposed in the Washington Administrative Code and is below in simplified form:

1) Alpha Emitters (300 dpm/100 cm^2 Maximum, and 100 dpm/100 cm^2 Average). The maximum contamination should not be on an area more than 100 cm^2 and measurement of the average contaminant should not be averaged over more than one square meter. Higher limits may be acceptable for certain alpha emitting radionuclides. Contact the Radiation Safety Office to make this determination.

2) Beta-Gamma Emitters (15,000 dpm/100 cm^2 Maximum, and 5000 dpm/100 cm^2 Average). The maximum contamination should not be on an area more than 100 cm^2 and measurement of the average contaminant should not be averaged over more than one square meter.

3) Removable Contamination. Surfaces should be cleaned until removable contamination is negligible and cannot be distinguished from background radiation levels. If this is not possible, contact the Radiation Safety Office for assistance in determining removable contamination levels.

5. Earthquake Response

Drop, Cover, and Hold On! Take shelter under a workbench or other protective cover until the earth movement stops. Afterwards, if safe to do so, shut down any procedures that 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 Evacuation 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 and the UW Emergency Management web page: http://www.washington.edu/emergency/.

6. 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 enables recognition even at low concentrations. If you smell natural gas in the laboratory, do the following:

   - Turn off all sources of ignition (open flames, electrical equipment.)
   - Check laboratory gas outlets for open valves.
   - Call Facilities Services (see phone numbers in Appendix F) to have the location of the gas leak identified.

2) For strong, widespread and/or quickly worsening odor:

   - Pull the emergency alarm at a pull station.
   - Turn off all sources of ignition (open flames, electrical equipment).
   - Close the emergency gas valve for your floor or area if one exists.
   - Evacuate the building immediately and go to your assembly area.
   - 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 the online accident reporting system 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 as appropriate:

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. If escaping gas is

leaking out of the control device or no control device is available, evacuate the area. 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/ohs/iaq.shtm .

7. Utility Outage

The safety of you and those around you is the first consideration during a utility outage. Remain calm. Assess the situation; if conditions seem dangerous, evacuate the area while assisting others to evacuate. Do not re-enter the building until competent authority has determined it is safe to do so.

If the situation does not seem dangerous, notify your supervisor or the building coordinator of the failure, shut off work in progress that could cause hazards, close containers and 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, not 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 Procedures

1) Assess the extent of the outage in your area.
2) On a UW campus, report the outage to Facilities Services (see phone numbers in Appendix F). 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 Failure Procedures

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
   - Note the step in your 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 wellbeing 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 the online accident reporting system at http://www.ehs.washington.edu/ohsoars/index.shtm.

8. Laboratory Floods

If your laboratory is flooded, find the source of the water. Shut the water off. If safe, also shut down any equipment that could cause a dangerous electrical situation during a flood. Cover equipment and desks if water is dripping onto them. Then, get help quickly. During work hours, contact your building coordinator. After hours, call UW Police at 911 if on the UW Seattle Campus or Facilities Services emergency numbers (see Appendix F) if at other locations. Also, notify the supervisor, principal investigator or department administrator in charge of the flooding laboratory as soon as possible.

If the water is contaminated by chemicals, call EH&S at 206-543-0467.

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 the online accident reporting system at http://www.ehs.washington.edu/ohsoars/index.shtm.

9. 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 (KOMO 1000AM or other more current radio station as listed on the Office of Emergency Management web page or the UW information line at 206-UWS-INFO) for instructions pertaining to University operations and use email and telephones to maintain contact with your department and laboratory staff.

10. 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 contacting police, 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 or package, do not handle it. Evacuate the area and call 911. 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 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 across the hall "for a minute." Do not leave items unattended.

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.

In all cases, submit an accident report on the online accident reporting system at http://www.ehs.washington.edu/ohsoars/index.shtm.

11. Emergencies during Field Operations

Do the best you can to stabilize injuries. Call for aid. After the emergency response, submit an accident report into the online accident reporting system even if you are outside the United States (http://www.ehs.washington.edu/ohsoars/index.shtm).

Section 10
Move In / Moving Out

Environmental Health and Safety
UNIVERSITY of WASHINGTON

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 that building's Building Coordinator immediately for assistance in locating the department and researcher previously occupying the room.

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 EH&S Building & Fire Safety Office at 206-543-0465.

Facilities Services must be used 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, contact them as described in Appendix F.

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 Building and Fire 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, you must leave your portion of 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 PI's 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 the PI. 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 and 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 or a contractor managed through Capital Projects Office must be hired for tasks involving removal of materials and equipment attached to the walls and floors and electrical and plumbing work. To request this work from Facilities Services, refer to Appendix F.

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. The form can be found at the following link: http://www.ehs.washington.edu/forms/fso/1800.pdf

Environmental Health and Safety
UNIVERSITY of WASHINGTON

Appendix A - WAC 296-828 Hazardous Chemicals in Laboratories

Washington Industrial Safety & Health Act (WISHA)
Department of Labor & Industries
April 2006

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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

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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)

Notes

Hazardous Chemicals in Laboratories

Chapter 296-828 WAC

Quick Reference

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Hazardous Chemicals in Laboratories

Chapter 296-828 WAC

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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

Question	Answer	
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

TITLE **PAGE**

Using Hazardous Chemicals in Laboratories

WAC 296-828-200

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.

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.

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–

Rule

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–

Hazardous Chemicals in Laboratories

WAC 296-828-300

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.

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Hazardous Chemicals in Laboratories

Chapter 296-828 WAC

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]

Environmental Health and Safety
UNIVERSITY of WASHINGTON

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.
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.
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 (below 100 °F) generally present special fire hazards.
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 prolonged period of time.

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.
dermatitis	Inflammation of the skin.
designated area	An area which may be used for work with “select carcinogens,” reproductive toxins, highly toxic chemicals or highly dangerous chemicals. 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	The University of Washington Department of Environmental Health and Safety. Box 354400, 201 Hall Health, Seattle, Washington 98195, 206-543-7262.
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). (Hazardous waste definition is less than 140 °F.)

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/ghs/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.

highly dangerous Chemicals which have extreme hazard due to flammability or reactivity. The criteria for being considered highly dangerous at the University of Washington is an NFPA rating of "4" for flammability or a reactivity rating of "3" or "4."

highly toxic The following criteria identify highly toxic chemicals in accordance with OSHA and Washington State regulations for identification on MSDSs and when determining controls, based on mammalian testing:

- Oral route: LD_{50} of 50 mg/kg or less when administered to albino rats weighing 200-300 grams each.
- 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.
- 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. This code is updated periodically, and after being published, the version needs to be adopted by the Bothell, Seattle and Tacoma Fire Departments for implementation in the building codes affecting UW facilities at those campuses. Contact EH&S Building and Fire Safety Office at 206-543-0465 for advice about current codes.

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, typically swallowing and passing it into the digestive system.

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 or slow down an unwanted chemical reaction 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. No longer in use. 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 has been shown 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 mechanical ventilation system for capturing and exhausting contaminants from the air at the point where the contaminants are produced (welding, grinding, sanding, other processes or operations), as opposed to “general exhaust.” The work area is often partially enclosed to improve the capture of the contaminants.
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 or other healthcare provider 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.
nanoparticle	A particle having at least one dimension on the scale of 100 nanometers or smaller, where chemical and physical properties may differ from bulk material properties. Typically the term applies to deliberately human-designed particles and not those which may occur in nature such as proteins or as a byproduct of other processes, such as the release of nanoparticle-sized combustion products.
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).
palpitation	Irregular, rapid heartbeat.
particularly hazardous substances	Chemicals that are “highly toxic,” “highly dangerous,” “select carcinogens,” “reproductive toxins,” or “select 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. Also referred to as “peroxide-forming chemicals.
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.).
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).

secondary containment A tub, basin, pan, lined box, impervious berm or other type of larger containment system surrounding chemical bottles or cans in storage or use, and able to hold the contents of the largest container of chemical if it were to break open or spill.

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:

- It is regulated under WISHA as a carcinogen;
- 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);
- It is listed under Group I ("carcinogenic to humans") by the International Agency for Research on Cancer (IARC) Monographs (latest editions); or
- 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:
  - 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;
  - 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.

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 current International Fire Code (IFC) 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) should be stated on the chemical's MSDS.

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.
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.

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.

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Appendix C - Templates for Lab Specific Information

Contents

Figures

A. LABORATORY-SPECIFIC INFORMATION

The following pages contain templates and examples that can be used to note laboratory-specific information that is required to complete your lab's Chemical Hygiene Plan (CHP). These templates are also available as documents which can be downloaded from the EH&S web pages, from http://www.ehs.washington.edu/manuals/lsm/index.shtm .

Your lab's CHP consists of the generic UW Laboratory Safety Manual plus your lab's laboratory-specific information. These materials must be accessible to your workers at all times, and your workers must know where these materials are.

If you have paper copies of your laboratory-specific information, you should typically file these pages in the front of the safety manual for easy reference, or maintain them in a location that everyone knows is the location of the laboratory-specific information for your CHP. If you keep electronic copies of all or some of your laboratory-specific information, everyone in the lab must know which are the current files, and how to access them.

Figure C-1 Laboratory-Specific Information

(Begins on next sheet)

Laboratory-Specific Information

This Chemical Hygiene Plan (CHP) 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 CHP covers the following laboratory spaces:

Building(s):
Room #(s):
If Parts of Room(s), Description of Area:

This CHP, consisting of the UW Laboratory Safety Manual and our laboratory-specific information, was reviewed and updated:
On: By:

The items listed below identify our laboratory-specific information that is attached (or filed in its noted location), and that applies to our laboratory:

✓	Laboratory-specific information cover sheet (*i.e.*, these pages)
✓	Laboratory floor plan(s)
	General laboratory safety rules, applicable at all times in our laboratory
	Designations of individuals performing particular tasks (e.g., checking first aid supplies, maintaining chemical inventories, weekly eyewash check, 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 Plan
✓	Standard Operating Procedures (SOPs), or location if filed separately
✓	MyChem Chemical Inventory Report, or location if filed separately
	Locations of MSDSs, other reference materials, University or departmental safety rules that apply to us, equipment maintenance manuals, other paper documents (such as a building evacuation plan or departmental health and safety plan) if filed separately from this CHP, etc.

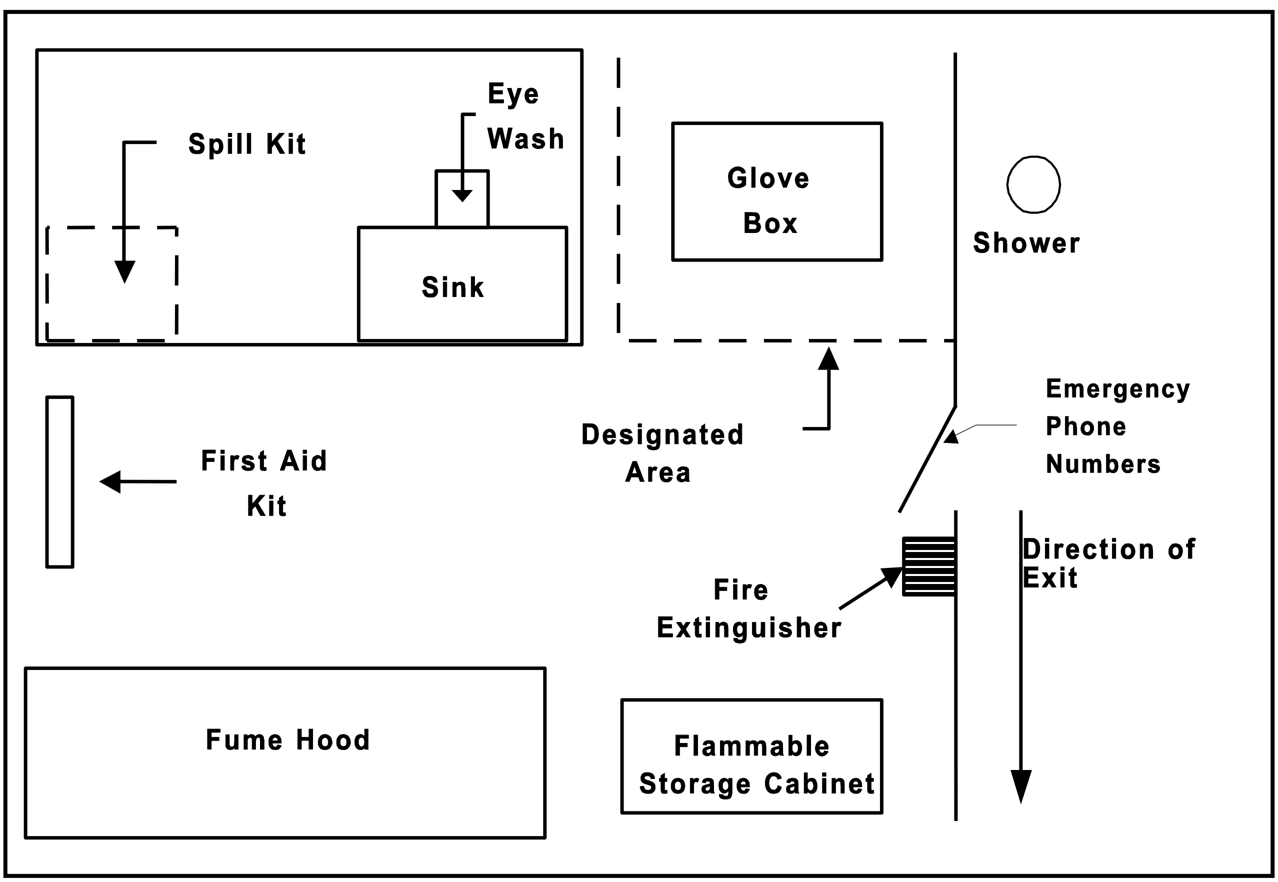
B. LABORATORY FLOOR PLANS

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, in Figure C-2.

Eyewash Stations
Emergency Showers
Fire Extinguishers
First Aid Kits
Flammable Liquid Storage Cabinets
Glove Boxes
Emergency Phone Number Signs
Direction of Exit
Gas Shut-Off Valves for Benches
Ventilation Systems
Spill Kits
Electrical Panels/Circuit Boxes
Any other specialized equipment or operation with safety implications.

(If select carcinogens, reproductive toxicants, select agents, highly toxic or highly dangerous chemicals 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 FORMS

The following page (Figure C-3, Example Chemical Safety Training Log) 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.

The UW Laboratory Employee Safety Training Checklist can also be used to plan, track and document the training received by a specific individual, Figure C-4 beginning on page C-8 below. A "pdf" version of this form is available at http://www.ehs.washington.edu/forms/pso/labemployeesafetytrain.pdf for your use.

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. Attach training outline and other reference materials useful for training new personnel.			
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*

Figure C-4 UW Laboratory Employee Safety Training Checklist

UW LABORATORY EMPLOYEE SAFETY TRAINING CHECKLIST

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. This includes administrative personnel who handle lab chemicals for such tasks as receiving, inventory, and stocking. Training must occur prior to assignments involving potential exposure to chemicals. EH&S provides general 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. Laboratory staff must also receive training applicable to all UW employees such as an orientation to the department Health and Safety Plan, Emergency Evacuation and Operations Plan, etc.

Employee Name: ___________________________________ **Date:** ______________

Supervisor Name: ___________________________________ **Date:** _______________

Laboratory Specific Training		
The below types of training are required for each laboratory staff person and are to be provided by the Laboratory P.I., Manager, or Chemical Hygiene Officer. Details about each subject are discussed in Section 7 of the UW Laboratory Safety Manual, online at http://www.ehs.washington.edu/manuals/lsm/index.shtm.		
Have you received the following?		**Date**
Orientation to the content and location of the Chemical Hygiene Plan, including: • UW Laboratory Safety Manual • Lab-specific Standard Operating Procedures • Other lab specific information	☐ YES	
Methods for finding exposure limits	☐ YES	
Material Safety Data Sheets (MSDSs) and other safety references	☐ YES	
The hazards of the workplace and how to detect the presence or release of hazardous chemicals and the basic signs and symptoms of chemical overexposure	☐ YES	
Requirements for Personal Protective Equipment (PPE) and how to select, don, doff, and maintain it	☐ YES	
How to segregate and safely store chemicals in the laboratory	☐ YES	
Proper disposal of all laboratory waste	☐ YES	
How to safely clean up spills and respond to other emergencies	☐ YES	

EH&S Laboratory Safety Training	
Answer the following questions. If YES, fill in the date when the training is completed. For more information about the classes, see http://www.ehs.washington.edu/psotrain/index.shtm or contact the EH&S Training Office at ehstrain@u.washington.edu or 206.543.7201.	
	Date
Are you responsible for chemical safety in your laboratory?	
☐ No ☐ Yes If Yes, take the Laboratory Safety Standard Compliance class.	
Do you work with hazardous chemicals?	
☐ No ☐ Yes If Yes, take the Managing Laboratory Chemicals class.	
Will you be maintaining your laboratory chemical inventory?	
☐ No ☐ Yes If Yes, take the MyChem class.	
Do you need to wear a respirator on the job?	
☐ No ☐ Yes If Yes, follow the instructions at: http://www.ehs.washington.edu/ohsresp/index.shtm. REQUIRED	

UW Laboratory Employee Safety Training Checklist

Do you work in an Animal Biological Safety Level-2 or Biological Safety Level-2 Laboratory?	
☐ No ☐ Yes If Yes, recommend taking the ABSL/BSL-2 class.	
Will you work in an Animal Biological Safety Level-3 or Biological Safety Level-3 Laboratory?	
☐ No ☐ Yes If Yes, contact the EH&S Research and Biosafety Office at 206.221.7770 additional training may be required. REQUIRED	
Are you planning to work with Select Agents?	
☐ No ☐ Yes If Yes, contact the EH&S Research and Biosafety Office at 206.221.7770 additional training may be required. REQUIRED	
Do you work with human cells, tissue or body fluids?	
☐ No ☐ Yes If Yes, take the Bloodborne Pathogens for Researchers class (initial and annually thereafter.) REQUIRED	
Are you planning to use ionizing radiation?	
☐ No ☐ Yes If Yes, follow the instructions at: http://www.ehs.washington.edu/rso/index.shtm. REQUIRED	
Are you planning to use non-ionizing radiation?	
☐ No ☐ Yes If Yes, review the online information at: http://www.ehs.washington.edu/rsononion/index.shtm.	
Do you package, ship, and/or transport hazardous materials or infectious substances?	
☐ No ☐ Yes If Yes, take the Shipping and Transporting Hazardous Materials class or if applicable the “Online Shipping Biological Substance Category B” or the “Online Shipping Dry Ice with non-dangerous goods or Exempt Patient Specimens” modules; retake classes biannually. REQUIRED	
Do you use a fume hood (see http://www.ehs.washington.edu/fsofumehoods/index.shtm)?	
☐ No ☐ Yes If Yes, you should take the on-line Fume Hood class.	
Do you handle cylinders containing hazardous, toxic, or flammable compressed gases?	
☐ No ☐ Yes If Yes, you should take the Compressed Gas Safety class.	
Have you volunteered to be one of the First Aid and CPR staff for your lab?	
☐ No ☐ Yes If Yes, take the First Aid and CPR Certification class.	
Are you expected to use a fire extinguisher in the event of an emergency?	
☐ No ☐ Yes If Yes, take the Fire Extinguisher Training class annually. REQUIRED	

Additional Specific Training
Use this section for any additional safety training needed in your laboratory due to “unusual hazards” such as forklift operation, confined space entry, maintaining powered equipment [lockout/tagout], working at heights [fall protection], lifting safety, hydrofluoric acid, or perchloric acid fume hood use.

After all of the training has been completed have the new employee sign and date this form and save it in your laboratory training records.

Employee Signature: ______________________________________ Date: ___________

Appendix D
Example SOPs

Environmental Health and Safety
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Appendix D - Example Standard Operating Procedures

Contents

Figures

A. BLANK STANDARD OPERATING PROCEDURE (SOP) FORM

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/manuals/lsm/sop.doc.

Figure D-1 Blank Standard Operating Procedure (SOP) Form

University of Washington Template
(SOP Cover Sheet for Compliance with WAC 296-828)

Standard Operating Procedures for Chemicals or Processes	
#1 Process (if applicable)	
#2 Chemicals	
#3 Personal Protective Equipment (PPE)	
#4 Environmental / Ventilation Controls	
#5 Special Handling Procedures & Storage Requirements	
#6 Spill and Accident Procedures	
#7 Waste Disposal	
#8 Special Precautions for Animal Use (if applicable)	

Particularly hazardous substance involved? (See Appendix H, Lab Safety Manual)	__ YES:	Blocks #9 to #11 are Mandatory
	__ NO:	Blocks #9 to #11 are Optional.

#9 Approval Required	
#10 Decontamination	
#11 Designated Area	

Name:	Title:
Signature:	Date:

Environmental Health and Safety, Box 354400 **to be filled in by PI or Supervisor*

B. EXAMPLE STANDARD OPERATING PROCEDURE (SOP) FORMS

The following pages contain example SOPs. They contain general safety information. Additional example SOPs can be found on the EH&S web site at http://www.ehs.washington.edu/manuals/lsm/examplesoplinks.shtm. 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-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? (See Appendix H. Lab Safety Manual)		_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

<table>
<tr><th colspan="4">Standard Operating Procedures for Chemicals or Processes</th></tr>
<tr><td>#1 Process
(if applicable)</td><td colspan="3">Use of Acrylamide. Use in polyacrylamide gels.</td></tr>
<tr><td>#2 Chemicals</td><td colspan="3">Un-polymerized acrylamide is toxic (neurotoxin) and suspect carcinogen.</td></tr>
<tr><td>#3 Personal Protective Equipment (PPE)</td><td colspan="3">Double layers of nitrile gloves, lab coat, and goggles required when handling the solid powder. Use diapers when pouring gels.</td></tr>
<tr><td>#4 Environmental / Ventilation Controls</td><td colspan="3">Handle powder inside the designated fume hood located in *</td></tr>
<tr><td>#5 Special Handling Procedures & Storage Requirements</td><td colspan="3">Avoid getting the unpolymerized acrylamide on skin, gloves, clothing, etc.</td></tr>
<tr><td>#6 Spill and Accident Procedures</td><td colspan="3">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.</td></tr>
<tr><td>#7 Waste Disposal</td><td colspan="3">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.</td></tr>
<tr><td>#8 Special Precautions for Animal Use
(if applicable)</td><td colspan="3">N/A</td></tr>
<tr><td colspan="2" rowspan="2">Particularly hazardous substance involved?
(See Appendix H, Lab Safety Manual)</td><td>_X_ 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">Users must receive specific process training and information about acrylamide from their supervisor before being authorized to perform procedures.</td></tr>
<tr><td>#10 Decontamination</td><td colspan="3">Double nitrile gloves. Use copious amounts of soap and water.</td></tr>
<tr><td>#11 Designated Area</td><td colspan="3">Inside fume hood between microscope and water bath.</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-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? (See Appendix H, Lab Safety Manual)	_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 Equipment Operation

Procedures for the Lindberg Blue High Temperature Furnace and Tube Furnace

July 31, 2007

Purpose and Scope:
This document describes the procedures and policies for using the MSE department High Temperature and Tube furnaces. The scope of this document is to establish user procedures. Instrument maintenance and repair are outside the scope of this document.

Responsibilities:
This document is maintained by the department Lab manager or Scientific Instructional Technician (SIT). The SIT is responsible for general maintenance and for arranging repair when necessary. If you feel that the instrument is in need of repair or is not operating correctly please notify the SIT immediately. The SIT will operate the instruments according to the procedures set down in this document and will provide instruction and training to users within the department. Users are responsible for using the instrument described according to these procedures. These procedures assume that the user has had at least one training session.

Definitions:
N/A

Prerequisites:
All users must read this document and obtain approval and training from the SIT.

Precautions:
Use the proper safety equipment and safety protocols when using these furnaces. They reach a temperature of 1700 Celsius. The elements for the furnaces are exposed and can be easily damaged if bumped or scraped. They are very expensive to replace. The furnace elements are operated at a high current and can be dangerous if touched.

Do not attempt repair or service. If service is required, contact the Lab manager or the SIT immediately. Always use the provided hearth plate on the bottom of the furnace.

If material being used is hazardous or contains burn-off products that can damage the furnace the user must first make arrangements with the SIT or Lab manager.

Procedure:
Following is a step by step description of a general operating procedure. Each process can be unique and some steps may not be required or the order may vary.

1. Determine the type of process required before beginning. If your process doesn’t require temperatures above 1000 Celsius then please use a box furnace. If your process will utilize temperatures below 1000 Celsius it could damage the elements

2. Check that the furnace is available.

3. Fill out the furnace use log.

4. Program the furnace: See controller manual.

5. Place the material carefully in the furnace. Do not touch the edges. Do not put material in the furnace that is too big or that could boil over, sputter, or in any other way cause damage to the furnace. It is best to maintain a □” clearance around all items in the furnace to assure proper convective currents around

your sample. Placing the samples on stands assures currents around the majority of the bottom of the sample.

6. Material should be placed in the furnace before starting the program. Opening the furnace at high temperatures will damage the elements.

7. High temperature gloves, face shields, and furnace tongs are provided for your safety.

8. Do not set materials from the furnace onto any wood surfaces. There is a metal table and high temperature refractory materials in the lab for that purpose.

9. Do not hesitate to ask questions.

10. A burn kit is available in the lab. If an accident occurs that is life threatening, call 911 immediately. If a minor accident occurs, it is recommended that the injured party go to Hall health and also to fill out an accident report. Information for reporting accidents can be found at: http://www.ehs.washington.edu/ohsoars/index.shtm .

Implementation and Training:
This SOP will be available to all users and must be adhered to. The SIT will train users in the implementation of this document.

Figure D-6 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? (See Appendix H, Lab Safety Manual)		_X_ YES:	Blocks #9 to #11 are Mandatory
		__ NO:	Blocks #9 to #11 are Optional.
#9 Approval Required	Written 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:		

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Figure D-7 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 flame-resistant lab coat and chemical splash goggles, consult Appendix C for proper glove selection. Call EH&S (3-7388) for further information. A flame-resistant 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? (See Appendix H, Lab Safety Manual)	__ 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-8 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	Disposal of sample tissues or material soaked in formaldehyde should be disposed of

(if applicable)	by *_________________________________.		
Particularly hazardous substance involved? (See Appendix H, Lab Safety Manual)		_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:

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Figure D-9 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 and lab coat. Gloves and face shield 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 the 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? (See Appendix H, Lab Safety Manual)		__ 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 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 lab coat, closed-toed shoes, chemical splash goggles and heavy-duty neoprene gloves for concentrated acids. For diluted acids greater than pH 2, use nitrile gloves. An apron is recommended for additional personal protection when pouring from a large bottle.		
#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? (See Appendix H, Lab Safety Manual)		__ 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 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 lab coat and chemical splash goggles. For concentrated bases use heavy duty neoprene gloves or natural rubber gloves. An apron is recommended for additional 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? (See Appendix H, Lab Safety Manual)		__ 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-12 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? (See Appendix H, Lab Safety Manual)	_X_ YES: ___ NO:	Blocks #9 to #11 are Mandatory 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-13 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 lab coat, chemical splash gloves and heavy duty nitrile or neoprene gloves. Call EH&S (3-0467) for further information if needed. An apron is recommended for additional 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? (See Appendix H, Lab Safety Manual)		__ 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:

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Figure D-14 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, lab coat and butyl gloves unless other hazards indicate another selection.		
#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 Peroxide Warning Sticker (UoW Form 1716) 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? (See Appendix H, Lab Safety Manual)		__ 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:

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Figure D-15 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 (4°C)	
#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? (See Appendix H, Lab Safety Manual)	_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:	

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Appendix E
Checklists

Environmental Health and Safety
UNIVERSITY of WASHINGTON

Appendix E - Checklists

Contents

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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?
- Are 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**	**NA**	**ITEM**	**EH&S Reference**
Written Laboratory Safety Policies and Procedures					
1				Is there a current UW Lab ***Safety Manual*** accessible to every worker in the lab?	UW Lab Safety Manual (LSM)
2				Are there up-to-date written ***Standard Operating Procedures*** (***SOPs***)?	LSM Section 6
3				Is there an up-to-date laboratory ***floor plan*** posted in the laboratory?	LSM Appendix C
4				Is a laboratory ***floor plan*** included in MyLab Section of the UW Lab ***Safety Manual***?	LSM Appendix C
5				Are ***emergency phone numbers*** posted in lab near telephone?	LSM Section 9
6				Do employees have ***ready access*** to ***MSDSs***?	LSM Section 2
7				Is the lab's ***inventory*** entered into ***MYCHEM***?	LSM Section 2
8				Has the lab's inventory and contact info been ***updated on MYCHEM in the last year***?	LSM Section 2
Employee Training					
9				Have ***ALL lab employees*** attended ***chemical safety training*** for lab workers (Managing Laboratory Chemicals or equivalent)?	LSM Section 7
10				Have ***supervisors*** and ***PIs*** attended ***Lab*** S***afety Standard Compliance*** *class?*	LSM Section 7
11				Have all lab employees received ***laboratory specific safety training****?*	LSM Section 7
12				Are ***training records complete*** and available upon request to outside inspectors?	LSM Section 7
Emergency Kits/Safety Equipment					
13				Does the laboratory have a ***first aid kit*** and chemical/biological ***spill kits***?	LSM Section 9
14				Are ***eyewash/showers accessible*** within 10 seconds (approx 50 ft)?	LSM Section 4
15				Are emergency ***eyewash*** and ***shower*** stations free of ***obstructions***?	LSM Section 4
16				Are tests current for the emergency shower (annually) and eyewash (weekly)?	LSM Section 4
17				Can ALL chemical work be done more than six inches into a ***fume hood***?	LSM Section 4
18				Have ***BSCs*** and ***fume hoods*** been tested and ***certified*** in the past year?	LSM Section 4
19				Are ***fume hood sashes*** in good condition and being used at the proper setting?	LSM Section 4
20				Are chemical fume hoods kept ***uncluttered*** so that air flows properly?	LSM Section 4

21				Are appropriate ***hazard warning signs*** (chem/rad/bio) posted in lab?	LSM Section 4
Fire/Electrical Safety/Seismic					
22				Are aisles, exits, and adjoining hallways maintained ***free of obstructions***?	LSM Section 9
23				Are ***fire extinguishers*** easily accessible and free of obstructions?	LSM Section 9
24				Have ***fire extinguishers been inspected*** in the past year?	LSM Section 9
25				Are there ***18 inches of clearance*** between stored items and fire sprinklers?	LSM Section 9
26				Do suspended ceilings have all of their ***ceiling tiles*** in place?	LSM Section 9
27				Are ***extension cords*** used only as temporary wiring?	LSM Section 4
28				Are extension cords or power strips not ***daisy-chained*** to each other?	LSM Section 4
29				Are ***electrical cords*** in good condition with no breaks or exposed wiring?	LSM Section 4
30				Are tall bookcases, filing cabinets, and furnishings ***near doorways & exits secured***?	LSM Section 9
Hazardous Material Safety					
31				Are all containers clearly ***labeled*** with their contents and primary hazard(s)?	LSM Section 2
32				Are all containers in ***good condition*** (not corroded or leaking)?	LSM Section 2
33				Are ***incompatible*** hazardous materials segregated?	LSM Section 2
34				Are ***hazardous materials storage cabinets*** properly ***labeled***?	LSM Section 2
35				Is the amount of ***flammable*** liquids outside of storage cabinets under ***10 gallons***?	LSM Section 2
36				Are chemical & waste containers ***kept away from sinks and floor drains***?	LSM Section 3
37				Have **peroxide forming compounds** not exceeded their expiration dates?	LSM Section 3
38				Are ***peroxide*** formers labeled with the date they were opened and ***expiration*** date?	LSM Section 3
39				Are ***compressed gas cylinders secured*** to prevent them from falling or tipping?	LSM Section 2
40				Are ***incompatible*** compressed gas cylinders stored separately?	LSM Section 2
41				Is ***food and drink*** only consumed outside of laboratory?	LSM Section 4
42				Are laboratory surfaces organized and ***clean of gross chemical contamination***?	LSM Section 2
Hazardous Chemical Wastes					
43				Are chemical ***waste containers compatible with contents*** & in good condition?	LSM Section 3
44				Are chemical ***waste containers closed***?	LSM Section 3
45				Are chemical wastes ***segregated*** by hazard class?	LSM Section 3
46				Are chemical waste containers ***labeled*** with UW Hazardous Waste label (UoW 1157)?	LSM Section 3
47				Is the lab free of ***chemicals*** that are ***expired or unneeded?***	LSM Section 3
48				Is a ***Sewer Discharge Log*** kept for chemicals discharged in the sink?	LSM Section 3
Biological Safety					
49				If work involves infectious agents or recombinant DNA, does the PI have a Biological Use Authorization Letter?	UW Biosafety Manual, Section III
50				Are blades, needles and other ***sharps*** promptly disposed of in sharps containers?	LSM Section 3

51				Has ***autoclave*** been structurally inspected and tested within the past two years?	LSM Section 4
52				Are needles disposed of after a single use and ***not recapped***/reused?	LSM Section 3
Radiation Safety					
53				Are radioactive ***stock solutions*** secured in a locked cabinet when not in use?	UW Radiation Safety Manual, Section 9
54				Are ***surveys*** done regularly in areas where radioactive material is used or stored?	UW Radiation Safety Manual, Section 13
55				Are surveys done with the proper ***calibrated instrument***?	UW Radiation Safety Manual, Section 13
Personal Protective Equipment					
56				Is ***PPE*** identified in the lab SOPs available to lab workers and in good condition?	LSM Section 5
57				Are **lab coats** worn in the laboratory?	LSM Section 5

Comments:
Corrective Action Items:
Laboratory Survey Conducted By: (Print)
PI or Supervisor Signature: **Date:**

C. "TOP 25" LABORATORY SELF-AUDITING 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 Building and Fire 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 (2009) UW Laboratory Safety Manual or is it accessible to every worker whenever work is done in the lab (online or from other digital media)?

Corrective Action: Link to the UW Laboratory Safety Manual through the EH&S website. Order hard copy of manual through Copy Services if desired.

Online: http://www.ehs.washington.edu/manuals/lsm/index.shtm

Completion Date: ____________________

1 ☐ **Yes** ☐ **No** ☐ **N/A**

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?

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/lsm/lsm6.pdf

http://www.ehs.washington.edu/forms/epo/soptemplate.doc

Completion Date: ____________________

2 ☐ **Yes** ☐ **No** ☐ **N/A**

3. Is the lab's chemical inventory entered into MyChem? Has the inventory and contact information on MyChem been updated in the past year?

Corrective Action: If your chemical inventory is not entered in MyChem, apply for a new account at EH&S website. If you already have an account, update the chemical inventory and contact information in MyChem by logging into your MyChem account on the EH&S website.

Online: http://www.ehs.washington.edu/epomychem/index.shtm

Completion Date: ____________________

3 ☐ **Yes** ☐ **No** ☐ **N/A**

4. 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?

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/lsm/lsmc.pdf

Completion Date: ____________________

4 ☐ **Yes** ☐ **No** ☐ **N/A**

Employee and Visitor Training

5. 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?

5 ☐ **Yes** ☐ **No** ☐ **N/A**

Corrective Action: Staff must attend the two-hour class *Managing Laboratory Chemicals* 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

6. 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?

6 ☐ **Yes** ☐ **No** ☐ **N/A**

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

http://www.ehs.washington.edu/epo/spills/hgspills.shtm

http://www.ehs.washington.edu/rbsbiosafe/spillsbio.shtm

Completion Date: ______________________

Laboratory Conditions

7. Are aisles, exits, and adjoining hallways maintained free of obstructions that would hinder emergency access or exiting?

7 ☐ **Yes** ☐ **No** ☐ **N/A**

Corrective Action: Remove obstructions from aisles, exits, and adjoining hallways.

Online: http://www.ehs.washington.edu/fsofire/fireprevention.shtm

Completion Date: ______________________

8. Are fire extinguishers located so that they are easily accessible and not blocked by stored materials?

8 ☐ **Yes** ☐ **No** ☐ **N/A**

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: ______________________

9. Are all emergency eyewash and shower stations free of obstructions and located such that they can be accessed within 10 seconds (approx 50 ft)?

9 ☐ **Yes** ☐ **No** ☐ **N/A**

Corrective Action: Remove all obstructions from emergency eyewashes and showers.

Online: http://www.ehs.washington.edu/fsohazmat/eyewash.shtm

Completion Date: ______________________

10. 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?

10 ☐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: ____________________

11. 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.)

11 ☐ 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: ____________________

12. Are bookcases, filing cabinets, and furnishings over 4 feet tall near doorways and other emergency exits secured to keep from tipping over?

12 ☐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

13. Do employees have ready access to MSDSs?

13 ☐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: ____________________

14. 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)?

14 ☐Yes ☐ No ☐ N/A

Corrective Action: Label all chemical containers using UW Hazard Label (or equivalent). 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/lsm/lsm2.pdf
http://www.ehs.washington.edu/eporecycle/chemex.shtm
http://www.ehs.washington.edu/epowaste/chemwaste.shtm

Completion Date: ____________________

15. Are incompatible hazardous materials segregated and stored separately?

15 ☐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/lsm/lsm2.pdf

Completion Date: ____________________

16 ☐Yes ☐ No ☐ N/A

16. Are excess flammable and combustible liquids (only 10 gallons allowed outside of cabinets) kept in approved storage cabinets?

Corrective Action: Keep excess flammable and combustible liquids in approved storage cabinets marked, "FLAMMABLE KEEP FIRE AWAY."

Online: http://www.ehs.washington.edu/manuals/lsm/lsm4.pdf

Completion Date: ______________________

17 ☐Yes ☐ No ☐ N/A

17. 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?

Corrective Action: Label all peroxide formers with opening and expiration dates using the UoW Form 1716, Caution – Peroxide Forming Chemical label. 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: ______________________

18 ☐Yes ☐ No ☐ N/A

18. 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.)

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: ______________________

19 ☐Yes ☐ No ☐ N/A

19. 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?

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

20 ☐Yes ☐ No ☐ N/A

20. 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?

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/resocchealth.shtm

Occupational Health Hazard Questionnaire Form:

http://depts.washington.edu/iacuc/iacucforms/OHreview.doc

Completion Date: ______________________

21. Do lab personnel promptly dispose of blades, needles and other sharps in sharps containers and do not recap needles?

21 ☐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

22. Do lab personnel secure all radioactive material stock solutions inside a locked container/cabinet when the materials are not in use?

22 ☐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: ____________________

23. Are surveys done regularly in areas where radioactive material is used or stored using a calibrated instrument capable of detecting the radionuclides in question?

23 ☐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

24. 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)?

24 ☐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: ____________________

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.

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)

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: ____________________

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.
- ❑ 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 Building & Fire Safety Office at 206-543-0465. To update fire extinguishers and safety showers, enter work order through local Facilities Services procedures (Refer to Appendix F, Lab Safety Manual for servicing Facilities Services.)
- ❑ 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 Building & Fire 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 your local Facilities Services. (Refer to Appendix F, Lab Safety Manual for servicing Facilities Services.**)**
- ❑ 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. (Refer to Appendix F, Lab Safety Manual for servicing Facilities Services.).

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 your local fire department if one has not already been obtained by the department for the lab. (In Seattle, 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 Building & Fire 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 206-616-4046 to obtain a MyChem account (training is available through EH&S) or
  - ❑ Update your contact information and location if you are an existing PI. EH&s can transfer MyChem inventories to your new locationand help can be obtained by calling 206-616-4046.

- ❑ Call the Building & Fire 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 Building & Fire 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/resocchealth.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 Laboratory Chemicals: 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://www.ehs.washington.edu/forms/fso/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/fsobiocab/approvedlist2.shtm .
- ❑ 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 with your local Facilities Services to remove materials or equipment that are attached to the building or would impact building materials. Refer to the Laboratory Safety Manual, Appendix F, for contact means.
    - ❑ Decontaminate your laboratory equipment if it has or may have come into contact with hazardous materials. Follow the instructions and fill out Form UoW 1803 Notice of Laboratory Equipment Decontamination and attach it to the equipment. For more details, see the form at http://www.ehs.washington.edu/forms/fso/lab_equip.pdf. To schedule pickup or drop off of surplus equipment, see http://www.washington.edu/facilities/transportation/movingandsurplus .
- ❑ 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.

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G. SOP REQUIRED ELEMENTS CHECKLIST

Instructions: Use this SOP checklist to ensure that all required safety elements are present in an existing SOP. There may be an instance where a required element is not applicable under certain specific circumstances. For those elements deemed “Not Applicable,” enter “N/A” in the Element Present column. Include rationale in the comments field for any elements deemed not applicable. Add any missing elements to your existing SOP

SOP Title, Date	
PI or Lab Name	
Department	

Element Present	General Required Elements
☐	**Process or Experiment Description** Are the chemicals, process or equipment identified well enough there will be no confusion as to what the SOP pertains to – and doesn’t pertain to?
☐	**Hazardous Chemicals/Class of Hazardous Chemicals** Are all hazardous chemicals/chemical classes involved in the procedure addressed – raw stocks, intermediates, final products, and wastes?.
☐	**PPE – Personal Protective Equipment** Is the personal protective equipment to be used described well enough that there will be no confusion as to what is required at what stages of the procedure?
☐	**Engineering/Ventilation Controls** Are the environmental controls and ventilation systems needed to safely use the chemicals identified? This may include hoods, environmental rooms, aerosol suppression devices, filtering or absorption devices, etc. Does the SOP note that the equipment must be checked for proper operation before use?
☐	**Special Handling Procedures and Storage Requirements** Are any special storage requirements for the chemicals noted?. This may include restricted access areas, special containment devices, and safe methods of transportation.
☐	**Spill and Accident Procedures** Are spill or accidental release procedures identified? Are there any specifications as to how big a spill could be safely handled, who might be designated to clean up the spill, and if any special spill clean-up materials are needed?
☐	**Waste Disposal** Are waste disposal procedures identified? (For more information refer to Section 3 of this manual.)
☐	**Special Precautions if Using Animals** Are procedures for safely handling the animal described?
If particularly hazardous substances are used in the process, the following should also be present. (Definitions and partial listings of these acute toxicants, carcinogens, reproductive hazards and select toxins are in Appendix H of the laboratory safety manual.)	
☐	**Approvals** Are special requirements for training and approval noted, before someone can perform the procedure?
☐	**Decontamination Procedures** Are special precautions identified for handling the especially hazardous materials?
☐	**Designated Area/Equipment** Is a specific area and specific equipment for safe use of the hazardous material identified?

Name:	Title:
Signature:	Date:
Comments:	

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Appendix F
Resources

Environmental Health and Safety
UNIVERSITY of WASHINGTON

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

Topic	***Phone***
Bothell Campus Info Line	425.352.3333
Alert System	*See Link*
Emergencies	9-1-1
Facilities Services Work Request Emergency phone number: 425.352.5466	
Risk Management / Worker's Compensation	425.352.3637
Safe Campus	425.352.7233
Safety Escort Service	425.352.5359
UWB Security and Campus Safety (safety@uwb.edu)	425.352.5359
Bothell Fire Department (Administration) Station # 42, 10726 Beardslee Blvd. Bothell, WA 98011	425.486.1678
Building Evacuation Planning	206.543.0465
Building Repairs and Maintenance: *See Facilities Services*	*See Listings*
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
Emergencies, All Campuses	9-1-1
Fires, All Campuses	9-1-1
Harborview Medical Center	3000 or 9-1-1
UW Medical Center	9-1-1
Environmental Health & Safety (EH&S)	206.543.7262
Bothell Campus, EH&S Manager	206.543.7221
Seattle Campus, Building and Fire Safety Office	206.543.0465
Seattle Campus, Environmental Programs Office	206.616.5835

Topic	*Phone*
Seattle Campus, Occupational Safety and Health Office	206.543.7388
Seattle Campus, Radiation Safety Office	206-543-0463
Seattle Campus, Research and Biological Safety Office	206.221.7770
Tacoma Campus, EH&S Manager	206.543.7221
Electromagnetic Radiation	206.543.0463
Ergonomics	206.543.7388
Explosion	206.543.0465
Facilities Services:	*See Below*
Bothell Campus Work Request Emergency phone number: 425.352.5466	
Seattle Campus Emergency Repair	206.685.1411
Seattle Campus Information	*See Link*
Seattle Campus Central Zone	206.685.8814
Seattle Campus Health Sciences Zone	206.543.3010
Seattle Campus North East Zone	206.685.8815
Seattle Campus Outside Zone	206.616.5042
Seattle Campus South West Zone (includes Housing & Food Services)	206.543.5677
Tacoma Campus e-mail: facility@u.washington.edu Emergency phone number: 253.606.2908	253.692.5700
Fall Prevention	206.543.7388
Fire Safety	206.543.0465
Fire Safety Equipment Repair (Fire Extinguishers, etc.)	*See Below*
Bothell Campus Work Request Emergency phone number: 425.352.5466	
Seattle Campus	206.685.1411
Tacoma Campus	253.692.5700
Fire/Building Code Consultations	206.543.0465
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

Topic	***Phone***
Fume Hood Maintenance/Repair	*See Below*
Bothell Campus: Work Order Emergency phone number: 425.352.5466	
Harborview Medical Center	206.731.3191
Seattle Campus / South Campus	206.543.3010
Seattle Campus / Upper Campus	206.685.1411
Seattle Campus / UW Medical Center	206.598.4645
Tacoma Campus Emergency: 253.606.2908	253.692.5700
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:	*See Below*
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	206.616.4046
Material Safety Data Sheets (MSDSs)/Inventory	206.616.4046
Noise/Hearing Conservation	206.543.7388
Occupational Health Nurse (Medical surveillance)	206.221.7770
Occupational Health Nurse (Clinical/Consultation)	206.598.4848

Topic	***Phone***
Odors: Indoor Air Quality	206.543.7388
Personal Protective Equipment	206.543.7388
Pest Control	206.543.7388
Bothell Campus Work Request Emergency phone number: 425.352.5466	
Seattle Campus, Off-Campus	206.543.7388
Tacoma Campus Emergency: 253.606.2908	253.692.5700
Physical Plant: *See Facilities Services*	*See Listings*
Police / Security	*See Below*
Bothell Security and Campus Safety	425.352.5222
Harborview Medical Center Public Safety Emergencies Non-Emergency phone number:	 206.744.5555 206.744.3193
Tacoma Campus Safety and Security Emergencies: 253.692.4888 E-mail: uwtsafe@u.washington.edu	253.692.4416 Or #333
UW Medical Center Public Safety	206.598.4909
UW Police Department Emergencies Non-Emergency phone number:	 9-1-1 206.685.8973
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	*See Below*
Bothell Security and Campus Safety	425.352.5359
Harborview Medical Center	206.731.8742
Seattle General Campus, Health Sciences, Off-Campus	206.543.7388
Tacoma Campus Safety and Security Emergencies: 253.692.4888 E-mail: uwtsafe@u.washington.edu	253.692.4416 Or #333
UW Medical Center	206.598.4645
Sanitation	206.543.7388
Scaffold	206.543.7388
Seattle Campus Info Line	206.897.4636

Topic	***Phone***
Seattle Fire Department (Administrative)	206.386.1400
Security: See Police / Security	*See Listings*
Sharps Disposal	206.543.7388
Shipping & Transporting	*See Below*
Biological/Infectious Waste	206.543.7388
Hazardous Materials	206.616.5835
Radioactive Materials	206.543.0463
Spills-Hazardous	*See Below*
Biological	206.221.7770
Chemical - Advice	206.616.5835
Emergency Assistance	9-1-1
Laboratory Spills	206.616.5835
Radioactive	206.543.0463
Swimming Pools	206.543.7388
Surplus Chemical Exchange	206.616.4046
Surveys, Radiation Safety	206.543.6328
Surveys, Safety	206.543.0465
Tacoma Campus	*See Below*
Alert	*See Link*
Campus Safety and Security Emergencies: 253.692.4888 E-mail: uwtsafe@u.washington.edu	253.692.4416 Or #333
Campus Safety Escort	#333
Facilities Services e-mail: facility@u.washington.edu Emergency phone number: 253.606.2908	253.692.5700
Worker's Compensation / Risk Management	253.692.5669
Tacoma Fire Department (Administration) 901 S. Fawcett Ave. Tacoma, WA 98402-5699	253.591.5737
Training	*See Below*
Health and Safety	206.543.7262
Radiation Safety	206.543.0463
Ultraviolet Light	206.543.0463

Topic	***Phone***
Waste Disposal – Hazardous	*See Below*
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	*See Below*
Bothell Campus Emergency Response	9-1-1
Other Actions, *See Bothell Campus*	*See Listings*
Seattle Campus Human Resources: Upper Campus	206.685.1516
Seattle Campus Human Resources: Medical Centers, Health Sciences	206.731.3366
Tacoma Campus, Emergency Response	9-1-1
Other Actions, *See Tacoma Campus*	*See Listing*

B. WEB RESOURCES

Resource	Web Address
EH&S Offices	
Building and Fire Safety	www.ehs.washington.edu/fso/
Environmental Programs	www.ehs.washington.edu/epo/
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	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/
UW 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

Environmental Health and Safety
UNIVERSITY of WASHINGTON

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-3, 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 Section C). 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 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 halogenated 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. OFF-CAMPUS SOURCES FOR GLOVES

Table G-2 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		

F. 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-3 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

Chemical	Excellent	Very Good
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	
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	

Chemical	Excellent	Very Good
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	
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]	

Chemical	Excellent	Very Good
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]	
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

Chemical	Excellent	Very Good
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]	
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	

Chemical	Excellent	Very Good
	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
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]

Chemical	Excellent	Very Good
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	
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

Chemical	Excellent	Very Good
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
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]

Chemical	Excellent	Very Good
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
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

Chemical	Excellent	Very Good
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 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

Chemical	Excellent	Very Good
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]
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

Chemical	Excellent	Very Good
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	
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

Chemical	Excellent	Very Good
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
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	

Chemical	Excellent	Very Good
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]	
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

Chemical	Excellent	Very Good
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

Environmental Health and Safety
UNIVERSITY of WASHINGTON

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 like acrylamide that has completely reacted to form a gel will no longer cause significant exposure. Another example is that one chemical may present much less risk of injury 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. Highly Toxic

The Washington State Department of Labor and Industries has adopted the following criteria to identify highly toxic chemicals (Washington Administrative Code 296-839-20005).

For reference, LD_{50} (Lethal Dose – 50%) is a single dose of a material expected to kill 50% of a group of test animals. LC_{50} (Lethal Concentration – 50%) is a calculated concentration of a material in air or water, 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 200 milligrams per kilogram (mg/kg) of body weight when administered by continuous contact for 24 hours (or less) with the bare skin of albino rabbits weighing between 2 to 3 kilograms each.

b. Oral Route

For an oral route, the median lethal dose (LD_{50}) is less than or equal to 50 mg/kg per kilogram of body weight when administered orally to albino rats weighing between 200 to 300 grams each.

c. Inhalation Route

The median lethal concentration (LC_{50}) for an inhalation route is less than or equal to 200 parts per million (ppm) for gases or vapors and 2 milligrams per liter of air (mg/l) for dusts, mists or fumes where time of exposure is any time up to 1 hour when administered to albino rats weighing between 200 to 300 grams each.

This definition should be considered as the minimum “floor” for consideration as “highly toxic.” 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.

Some agencies maintain lists of chemicals that they have evaluated as meeting one of the definitions for highly toxic, such as at http://www.ilpi.com/msds/ref/highlytoxic.html and then select the Brookhaven National Lab list in the “Further Reading” section of that web site. Another list is at http://ptcl.chem.ox.ac.uk/MSDS/hightoxicity.html .

2. Highly Dangerous

Highly dangerous chemicals present exceptional risks due to flammability or reactivity. At the University of Washington, “Highly Dangerous” chemicals are those with an NFPA classification of “4” for flammability or an NFPA classification of “4” or “3” for reactivity.

3. 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 human carcinogens” in the Annual Report on Carcinogens published by the National Toxicology Program (NTP) (latest edition – 11th Report) (http://ntp-server.niehs.nih.gov/);

OR

It is listed as "carcinogenic to humans" by the International Agency for Research on Cancer (IARC) Monographs (latest edition as of September 24, 2009, IARC monograph volume 100A) (http://monographs.iarc.fr/ENG/Classification/index.php);

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.

4. 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."

General information about reproductive hazards is available on the EH&S web site at http://www.ehs.washington.edu/ohsreprohaz/reprohazguidance.pdf .

5. 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 206-221-7770.

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 one of the definitions for highly toxic or highly dangerous, and were listed on at least one MyChem chemical inventory at the time of list preparation. Table H-2 lists the substances by Chemical Abstracts Service (CAS) Registry Number.

Chemicals on this list (and similar chemicals meeting the criteria given earlier in this section) are considered to be "particularly hazardous substances" if they are in a pure or concentrated state and have not undergone a chemical reaction such as gelling. When listed chemicals have been diluted or reacted, they may not fall within the criteria for a "particularly hazardous substance" and thus would probably not need to be handled as "particularly hazardous substances." The hazard after dilution or reaction does need to be re-assessed because it could still be significant.

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	Highly Dangerous / Suspected Carcinogen / Susp. Reproductive T.
Acetone	67-64-1	Susp. Reproductive T.
Acetone cyanohydrin	75-86-5	Highly Toxic
2-Acetylaminofluorene	53-96-3	Regulated Carcinogen
Acetylene	74-86-2	Highly Dangerous
3-Acetylpyridine	350-03-8	Highly Toxic
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®	309-00-2	Highly Toxic
Allyl alcohol	107-18-6	Highly Toxic
Allylamine	107-11-9	Highly Toxic
Allyl isothiocyanate	57-06-7	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

Particularly Hazardous Substances	CAS Number[1]	Hazard
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.
Ammonium nitrate	6484-52-2	Highly Dangerous
Ammonium perchlorate	7790-98-9	Highly Dangerous
d-Amphetamine sulfate	51-63-8	Highly Toxic
Analgesic Mixtures Containing Phenacetin	N/A	Known Carcinogen
Aniline	65-53-3	Reproductive Toxicant
2-Anilinoethanol	122-98-5	Highly Toxic
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
Aristolochic acid	313-67-7	Known Carcinogen
Arsenic	7440-38-2	Susp. Reproductive T.
Arsenic Compounds, Inorganic	N/A	Known Carcinogen / Susp. Reproductive T.
Arsenic (V) oxide	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
Barium metal	7440-39-3	Highly Dangerous
Benodicarb Pestanal (2,3-Isopropyliden dioxyphenyl N-methyl carbamate)	22781-23-3	Highly Toxic
Benomyl	17804-35-2	Susp. Reproductive T.
Benzene	71-43-2	Known Carcinogen / Susp. Reproductive T.
Benzenethiol	108-98-5	Highly Toxic
Benzidine	92-87-5	Known Carcinogen
Benzo[α]pyrene	50-32-8	Known Carcinogen
Benzotrichloride	98-07-7	Suspected Carcinogen /

Particularly Hazardous Substances	CAS Number[1]	Hazard
		Highly Toxic
Benzoyl chloride	98-88-4	Highly Toxic
Beryllium and Certain Beryllium Compounds	7440-41-7	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 / Highly Toxic
2,2-Bis(4-chlorophenyl)-1,1-dichloroethylene, DDT -		Suspected Carcinogen
Bisphenol A diglycidyl ether	1675-54-3	Highly Toxic
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
1,3-Butadiene diepoxide (See Diepoxybutane)		
Butane	106-97-8	Highly Dangerous
1,4-Butanediol dimethylsulfonate (Myleran®; Busulfan)	55-98-1	Known Carcinogen / Reproductive Toxicant
2-Butanone peroxide	1338-23-4	Highly Toxic
3-Buten-2-one (Methyl vinyl ketone)	78-94-4	Highly Toxic
Butylated hydroxyanisole (BHA)	25013-16-5	Suspected Carcinogen
Tert-Butyllithium	594-19-4	Highly Dangerous
4-tert-Butyltoluene	98-51-1	Highly Toxic
n-Butyronitrile	109-74-0	Highly Toxic
Cadmium and Certain Cadmium Compounds	7440-43-9	Regulated Carcinogen
Calcium carbide	75-20-7	Highly Dangerous
Carbachol (Carbamylcholine chloride)	51-83-2	Highly Toxic
Carbofuran (2,3-Dihydro-2,2-dimethyl-7-benzofuranol N-methyl carbamate)	1563-66-2	Highly Toxic
Carbolic acid (See Phenol)		
Carbon disulfide	75-15-0	Reproductive Toxicant
Carbon monoxide	630-08-0	Highly Dangerous / Reproductive Toxicant
Carbon tetrachloride	56-23-5	Suspected Carcinogen
Carmustine (See Bischloroethyl nitrosourea)		

Particularly Hazardous Substances	CAS Number[1]	Hazard
d-Carvone	2244-16-8	Highly Toxic
Ceramic Fibers	N/A	Suspected Carcinogen
Chloracetone	78-95-5	Highly Toxic
Chlorambucil	305-03-3	Known Carcinogen / Reproductive Toxicant
Chlorendic Acid	115-28-6	Suspected Carcinogen
Chlorinated Paraffins	108171-26-2	Suspected Carcinogen
Chlorine	7782-50-5	Highly Toxic
Chloroacetoaldehyde		Highly Toxic
2-Chloroacetophenone		Highly Toxic
Chlorobiphenyls	N/A	Reproductive Toxicant
1-Chloro-2,4-dinitrobenzene	97-00-7	Highly Toxic
2-Chloroethanol	107-07-3	Highly Toxic
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
2-Chloropyridine	109-09-1	Highly Toxic
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
p-Cresidine	120-71-8	Suspected Carcinogen
Crotonaldehyde	4170-30-3	Highly Toxic
Cupferron	135-20-6	Suspected Carcinogen
2-Cyclohexen-1-one	930-68-7	Highly Toxic

Particularly Hazardous Substances	CAS Number[1]	Hazard
Cycloheximide	66-81-9	Highly Toxic
1-Cyclohexyl-2-pyrrolidinone	6837-24-7	Highly Toxic
Cyclophosphamide (Cytoxan, Neosar)	50-18-0	Known Carcinogen / Reproductive Toxicant
Cyclopiazonic acid from Penicilium cyclopium	18172-33-3	Highly Toxic
Cyclopentadienylmanganese tricarbonyl	12079-65-1	Highly Toxic
Cyclosporin A (Cyclosporine A) (Ciclosporin)	59865-13-3	Known Carcinogen
Decaborane	17702-41-9	Highly Toxic
Deuterium		Highly Dangerous
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
1,3-Diaminopropane	109-76-2	Highly Toxic
2,4-Diaminotoluene	95-80-7	Suspected Carcinogen
Diazinon	333-41-5	Susp. Reproductive T. / Highly Toxic
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
trans-1,4-Dichloro-2-butene	110-57-6	Highly Toxic
Dichlorodiphenyltrichloroethane (DDT)	50-29-3	Susp. Reproductive T.
1,2-Dichloroethane	107-06-2	Suspected Carcinogen
1,1-Dichloroethene (Vinylidene chloride)	75-35-4	Highly Dangerous
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 ®	62-73-7	Highly Toxic
Dieldrin	60-57-1	Highly Toxic
Diepoxybutane	1464-53-5	Suspected Carcinogen / Highly Toxic
2-(Diethylamino)ethyl acrylate	2426-54-2	Highly Toxic

Particularly Hazardous Substances	CAS Number[1]	Hazard
Diethyl chlorophosphate	814-49-3	Highly Toxic
Diethylstilbestrol (DES)	56-53-1	Known Carcinogen / Reproductive Toxicant
Diethyl sulfate	64-67-5	Suspected Carcinogen
Diethylzinc	557-20-0	Highly Dangerous
Diglycidyl resorcinol ether	101-90-6	Suspected Carcinogen
Dihexylamine	143-16-8	Highly Toxic
24(R), 25-Dihydroxy-Vitamin D3	55721-11-4	Highly Toxic
Diisopropyl fluorophosphate	55-91-4	Highly Toxic
Dimethoate	60-51-5	Susp. Reproductive T.
Dimethylamine	124-40-7	Highly Dangerous
4-Dimethylaminoazobenzene	60-11-7	Regulated Carcinogen
4,4-(Dimethylamino)benzophenone (See Michler's Ketone)		
3,3'-Dimethylbenzidine	119-93-7	Suspected Carcinogen
Dimethylcarbamyl chloride	79-44-7	Suspected Carcinogen / Highly Toxic
Dimethylformamide (DMF)	68-12-2	Susp. Reproductive T.
1,1-Dimethylhydrazine (UDMH)	57-14-7	Suspected Carcinogen
Dimethylmercury	593-74-8	Highly Toxic
Dimethyl sulfate	77-78-1	Suspected Carcinogen / Highly Toxic
Dimethyl sulfide	75-18-3	Highly Dangerous
Dimethyl vinyl chloride	513-37-1	Suspected Carcinogen
o-Dinitrobenzene	528-29-0	Highly Dangerous
4,6,-Dinitro-o-cresol	534-52-1	Highly Toxic
2,4-Dinitrophenol	51-28-5	Highly Toxic
2,4-Dinitrotoluene	121-14-2	Highly Dangerous
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
Divinyl sulfone	77-77-0	Highly Toxic
Drabkins Reagent		Highly Toxic
Emetine dihydrochloride	316-42-7	Highly Toxic
Endothall	145-73-3	Highly Toxic
Endrin Pestanal ®	72-20-8	Highly Toxic

Particularly Hazardous Substances	CAS Number[1]	Hazard
Epichlorohydrin	106-89-8	Suspected Carcinogen / Highly Toxic
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
Ethanolamine	141-43-5	Highly Toxic
Ethidium bromide	1239-45-8	Suspected Mutagen
Ethion	563-12-2	Highly Toxic
Ethoprophos Pestanal ®	13194-48-4	Highly Toxic
Ethyl acrylate	140-88-5	Suspected Carcinogen
Ethyl alcohol (when evaporating from large surface areas)	64-17-5	Reproductive Toxicant
Ethylamine	75-04-7	Highly Dangerous
Ethyl chloride	75-00-3	Highly Dangerous
Ethylene	74-85-1	Highly Dangerous
Ethyl mercuric chloride (Chloroethyl mercury)	107-27-7	Highly Toxic
Ethyl methanesulfonate	62-50-0	Suspected Carcinogen
Ethylene dibromide (See 1,2-Dibromoethane)		
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	Highly Dangerous / Regulated Carcinogen / Susp. Reproductive T.
Ethylene thiourea	96-45-7	Suspected Carcinogen
Ethyleneimine	151-56-4	Regulated Carcinogen
Ethyl ether	60-29-7	Highly Dangerous
Ethyl mercaptan	75-08-1	Highly Dangerous
Etoposide	33419-42-0	Known Carcinogen
Fentanyl	437-38-7	Highly Toxic
Fentanyl citrate	990-73-8	Highly Toxic
Fluocinolone acetonide 21-acetate	356-12-7	Highly Toxic
Fluocinolone acetonide (Synsac)	67-73-2	Highly Toxic
Fluorescein mercuric acetate	3570-80-7	Highly Toxic
Fluoroacetamide	640-19-7	Highly Toxic

Particularly Hazardous Substances	CAS Number[1]	Hazard
Fluoroacetic acid	144-49-0	Highly Toxic
dl-Fluorocitric acid		Highly Toxic
2-Fluoroethanol	371-62-0	Highly Toxic
Fonofos Pestanal ®	944-22-9	Highly Toxic
Formaldehyde (Gas)	50-00-0	Known Carcinogen / Susp. Reproductive T.
Furan	110-00-9	Highly Dangerous
Gallium arsenide	1303-00-0	Known Carcinogen
Gasoline	8006-61-9	Susp. Reproductive T.
Glasswool	N/A	Suspected Carcinogen
Glycidol	556-52-5	Suspected Carcinogen
Heptachlor	76-44-8	Highly Toxic
Hexachlorobenzene	118-74-1	Suspected Carcinogen
Hexachlorocyclopentadiene	77-47-4	Highly Toxic
Hexachloroethane	67-72-1	Suspected Carcinogen
Hexafluoro acetone trihydrate	34202-69-2	Highly Toxic
Hexamethyl phosphoramide	680-31-9	Suspected Carcinogen
Hexamethylditin	661-69-8	Highly Toxic
Hydrazine	302-01-2	Suspected Carcinogen / Highly Toxic
Hydrazine sulfate	10034-93-2	Suspected Carcinogen
Hydrazobenzene	122-66-7	Suspected Carcinogen
Hydrogen	1333-74-0	Highly Dangerous
Hydrogen cyanide	74-90-8	Highly Toxic
Hydrogen sulfide	7783-06-4	Highly Dangerous / Highly Toxic
2-Idioethanol		Highly Toxic
Indomethacin	53-86-1	Highly Toxic
Iodoform	75-47-8	Highly Toxic
Iron Dextran Complex	9004-66-4	Suspected Carcinogen
Iron pentacarbonyl	13463-40-6	Highly Toxic
Isobutane	75-28-5	Highly Dangerous
Isobutyronitrile	78-82-0	Highly Toxic
2-Isocyanatoethyl methacrylate	30674-80-7	Highly Toxic
Isopentane	78-78-4	Highly Dangerous
Isophorone diisocyanate	4098-71-9	Highly Toxic
Isoprene	78-79-5	Highly Dangerous

Particularly Hazardous Substances	CAS Number[1]	Hazard
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. / Highly Toxic
Lithium	7439-93-2	Susp. Reproductive T.
Lithium aluminum hydride	16853-85-3	Highly Dangerous
Lithium diisopropylamide	4111-54-0	Highly Dangerous
Lithium hydride	7580-67-8	Highly Dangerous
Magnesium powder	7439-95-4	Highly Dangerous
Manganese	7439-96-5	Susp. Reproductive T.
Mechloethamine hydrochloride	55-86-7	Suspected Carcinogen / Highly Toxic
Melphalan	148-82-3	Known Carcinogen
Merbromin	129-16-8	Highly Toxic
Mercuric nitrate	10045-94-0	Highly Toxic
Mercuric oxide	21908-53-2	Highly Toxic
Mercuric thiocyanate	592-85-8	Highly Toxic
Mercury (II) bromide	7789-47-1	Highly Toxic
Mercury (II) chloride	7487-94-7	Highly Toxic
Mercury (II) iodide	7774-29-0	Highly Toxic
Mercury, Metallic and Salts	7439-97-6	Susp. Reproductive T.
Mercury, Organic and Methyl	N/A	Reproductive Toxicant
Methadone hydrochloride	1095-90-5	Highly Toxic
Methane	74-82-8	Highly Dangerous
Methotrexate (Methylaminopterin)	59-05-2	Highly Toxic / Reproductive Toxicant
8-Methoxypsoralen (Methoxsalen) plus Ultraviolet A radiation	298-81-7	Known Carcinogen
Methyl alcohol	67-56-1	Susp. Reproductive T.
Methylamine	74-89-5	Highly Dangerous
2-Methylaziridine (Propyleneimine)	75-55-8	Suspected Carcinogen / Highly Toxic
Methyl chloride	74-87-3	Highly Dangerous
Methyl chloroformate	79-22-1	Highly Toxic
Methyl chloromethyl ether	107-30-2	Regulated Carcinogen / Highly

Particularly Hazardous Substances	CAS Number[1]	Hazard
		Toxic
4,4'-Methylene-bis-(2-chloroaniline) (MBOCA)	101-14-4	Regulated Carcinogen
4,4’-Methylene bis(cyclohexyl isocyanate)	5124-30-1	Highly Toxic
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
Methyl ether	115-10-6	Highly Dangerous
Methyl ethyl ketone (MEK)	78-93-3	Susp. Reproductive T.
Methyl formate	107-31-3	Highly Dangerous
Methylhydrazine	60-34-4	Highly Toxic
Methyl isocyanate	624-83-9	Highly Dangerous / Highly Toxic
Methyl isothiocyanate	556-61-6	Highly Toxic
Methyl lithium	917-54-4	Highly Dangerous
Methyl mercaptan	74-93-1	Highly Dangerous
Methyl methanesulfonate	66-27-3	Suspected Carcinogen
N-Methyl-*N*-nitro-*N*-nitrosoguanidine	70-25-7	Suspected Carcinogen
Methyl parathion	56-38-2	Susp. Reproductive T. / Highly Toxic
Methyl parathion	298-00-0	Susp. Reproductive T. / Highly Toxic
2-Methyl propionitrile (See Isobutyronitrile)		
Metronidazole	443-48-1	Suspected Carcinogen
Michler′s Ketone	90-94-8	Suspected Carcinogen
Mirex	2385-85-5	Suspected Carcinogen
Mitomycin	50-07-7	Highly Toxic
Monensin sodium	22373-78-0	Highly Toxic
Monitor 4 (o,s-Dimethylphosphoramidothioate)	10265-92-6	Highly Toxic
Muscimol	2763-96-4	Highly Toxic
Mustard Gas (Sulfur mustard)	505-60-2	Known Carcinogen
1-Naphthylamine (α-Naphthylamine) (1-Aminonaphthalene)	134-32-7	Regulated Carcinogen
2-Naphthylamine (β-Naphthylamine) (2-Aminonaphthalene)	91-59-8	Known Carcinogen
1-(1-Naphthyl)-2-thiourea	86-88-4	Highly Toxic
Nickel and Certain Nickel Compounds	N/A	Known Carcinogen
Nickel carbonyl	13463-39-3	Highly Dangerous / Highly Toxic

Particularly Hazardous Substances	CAS Number[1]	Hazard
Nicotine	54-11-5	Highly Toxic
Nitric acid (Fuming)	7697-37-2	Highly Toxic
Nitrilotriacetic Acid	139-13-9	Suspected Carcinogen
p-Nitroaniline	100-01-6	Highly Dangerous
4-Nitrobenzonitrile	619-72-7	Highly Toxic
4-Nitrobiphenyl	92-93-3	Regulated Carcinogen
Nitroethane	79-24-3	Highly Dangerous
Nitrofen	1836-75-5	Suspected Carcinogen
Nitrogen dioxide	10102-44-0	Highly Toxic
Nitromethane	75-52-5	Highly Dangerous
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 / Highly Toxic
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
o-Nitrotoluene	88-72-2	Highly Dangerous
Nitrous oxide	10024-97-2	Susp. Reproductive T.
Norethisterone	68-22-4	Suspected Carcinogen
Novantrone mitoxantrone HCl	70476-82-3	Highly Toxic
Ochratoxin A	303-47-9	Suspected Carcinogen
Osmium tetroxide	20816-12-0	Highly Toxic
4,4'-Oxydianiline	101-80-4	Suspected Carcinogen
Oxymetholone	434-07-1	Suspected Carcinogen
Pentachlorophenol	87-86-5	Highly Toxic
Pentane	109-66-0	Highly Dangerous

Particularly Hazardous Substances	CAS Number[1]	Hazard
1-Pentene	109-67-1	Highly Dangerous
Perchloric acid	7601-90-3	Highly Dangerous
Petroleum ether	8032-32-4	Highly Dangerous
Phenacetin	62-44-2	Known Carcinogen
Phenazopyridine hydrochloride	136-40-3	Suspected Carcinogen
Phenol (Carbolic acid)	108-95-2	Reproductive Toxicant
Phenoxybenzamine hydrochloride	63-92-3	Suspected Carcinogen
1,4-Phenylenediisothiocyanic acid	4044-65-9	Highly Toxic
Phenylmercuric acetate	62-38-4	Highly Toxic
1-Phenylpiperazine	92-54-6	Highly Toxic
1-Phenyl-2-thiourea	103-85-5	Highly Toxic
Phenytoin	57-41-0	Suspected Carcinogen
Phosgene	75-44-5	Highly Toxic
Phosphorus oxychloride	10025-87-3	Highly Dangerous / Highly Toxic
Phosphorus sticks	7723-14-0	Highly Dangerous
Phosphorus trichloride	7719-12-2	Highly Toxic
Picric acid	88-89-1	Highly Dangerous
Piperazine estrone sulfate	7280-37-7	Known Carcinogen
Piperidine	110-89-4	Highly Dangerous
Piperonyl butoxide	51-03-6	Highly Toxic
Polychlorinated biphenyls (PCBs)	1336-36-3	Reproductive Toxicant
Poly(tetrafluoroethylene)	9002-84-0	Highly Dangerous
Polyvinyl chloride (PVC resin)	9002-86-2	Susp. Reproductive T.
Potassium metal	7440-09-7	Highly Dangerous
Potassium cyanide	151-50-8	Highly Toxic
Potassium silver cyanide	506-61-6	Susp. Reproductive T.
Procarbazine	671-16-9	Reproductive Toxicant
Propane	74-98-6	Highly Dangerous
Propargyl alcohol	107-19-7	Highly Toxic
β-Propiolactone	57-57-8	Regulated Carcinogen / Highly Toxic
Propiononitrile	107-12-0	Highly Toxic
Propylene	115-07-1	Highly Dangerous
Propylene oxide	75-56-9	Highly Dangerous
Propyleneimine (See 2-Methylaziridine)		
Protoveratrine A	143-57-7	Highly Toxic

Particularly Hazardous Substances	CAS Number[1]	Hazard
Radon	10043-92-2	Known Carcinogen
Rubidium metal	7440-17-7	Highly Dangerous
Selenium	7782-49-2	Susp. Reproductive T.
Silane	7803-62-5	Highly Dangerous
Silica, Crystalline	14808-60-7	Known Carcinogen
Sodium azide	26628-22-8	Highly Toxic
Sodium dichromate	10588-01-9	Highly Toxic
Sodium equilin sulfate	16680-47-0	Known Carcinogen
Sodium estrone sulfate	438-67-5	Known Carcinogen
Sodium meta arsenite	7784-46-5	Highly Toxic
Sodium methoxide (Sodium methylate)	124-41-4	Highly Dangerous
Sodium selenite	10102-18-8	Highly Toxic
Strontium Chromate	7789-06-2	Known Carcinogen
Strychnine	57-24-9	Highly Toxic
Styrene (Vinyl benzene)	100-42-5	Susp. Reproductive T.
Sulfur dioxide	7446-09-5	Susp. Reproductive T.
Sulfur monochloride	10025-67-9	Highly Toxic
Talc, containing asbestiform fibers	14807-96-6	Known Carcinogen
Tamoxifen	10540-29-1	Known Carcinogen
Tert-butyllithium	594-19-4	Highly Dangerous
Tetrabutylphosphonium chloride	2304-30-5	Highly Toxic
2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	1746-01-6	Highly Toxic / Known Carcinogen / Susp. Reproductive T.
Tetrachloroethylene	127-18-4	Susp. Reproductive T.
Tetraethyl dithiopyrophosphate	3689-24-5	Highly Toxic
Tetraethyl tin	597-64-8	Highly Toxic
Tetranitromethane	509-14-8	Highly Toxic
Tetrodotoxin	4368-28-9	Highly Toxic
Thallium	7440-28-0	Highly Toxic
Thallium (III) oxide	1314-32-5	Highly Toxic
Thallium (I) sulfate	7446-18-6	Highly Toxic
Thimerosal	54-64-8	Highly Toxic
Thiophosphoryl chloride	3982-91-0	Highly Toxic
Thiotepa (See Tris (1-aziridinyl) phosphine sulfate)		
Thorium dioxide	1314-20-1	Known Carcinogen
Titanium (IV) chloride	7550-45-0	Highly Dangerous

Particularly Hazardous Substances	CAS Number[1]	Hazard
TNT (Trinitrotoluene)	118-96-7	Highly Dangerous / Susp. Reproductive T.
Toluene	108-88-3	Reproductive Toxicant
o-Toluidine	95-53-4	Known Carcinogen
Tolylene 2,4-diisocyanate	584-84-9	Highly Toxic
Toxaphene Reference Standard	8001-35-2	Highly Toxic
Treosulfan	299-75-2	Known Carcinogen
Trichloroethylene (TCE)	79-01-6	Susp. Reproductive T.
Trichlorosilane	10025-78-2	Highly Dangerous
Triethylphosphine	554-70-1	Highly Dangerous
Trimethoxysilane	2487-90-3	Highly Toxic
Trimethylaluminum	75-24-1	Highly Dangerous
Trimethylamine	75-50-3	Highly Dangerous
Trinitrobenzene	99-35-4	Highly Dangerous
Trinitrotoluene (TNT)	118-96-7	Highly Dangerous / Susp. Reproductive T.
Triphenyltin hydroxide	76-87-9	Highly Toxic
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
Tubercidin from Streptomyces tubercidicus	69-33-0	Highly Toxic
Valinomycin	2001-95-8	Highly Toxic
Vanadium pentoxide (Dust)	1314-62-1	Highly Toxic
Vinyl chloride	75-01-4	Highly Dangerous / Known Carcinogen / Susp. Reproductive T.
Vinyl ethyl ether	109-92-2	Highly Dangerous
Vinylidene chloride	75-35-4	Highly Dangerous
Vinyl methyl ether	107-25-5	Highly Dangerous
(+)-Vitamin D/3 (Cholecalciferol)	67-97-0	Highly Toxic
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
	Amanita Muscaria	Highly Toxic
	d-Amethopterin hydrate	Highly Toxic
	dl-Amethopterin hydrate	Highly Toxic
	Avidin FITC Conjugate	Highly Toxic
	2,2-Bis(4-chlorophenyl)-1,1-dichloroethylene, DDT -	Suspected Carcinogen
	α-Bungarotoxin	Highly Toxic
	Chloroacetoaldehyde	Highly Toxic
	2-Chloroacetophenone	Highly Toxic
	2-Chloroethyl ether	Highly Toxic
	Deuterium	Highly Dangerous
	Drabkins Reagent	Highly Toxic
	dl-Fluorocitric acid	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 / Susp. Reproductive T.
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.
50-07-7	Mitomycin	Highly Toxic
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.

CAS Number[1]	Particularly Hazardous Substance	Hazard
50-32-8	Benzo[α]pyrene	Known Carcinogen
50-76-0	Actinomycin D	Highly Toxic
51-03-6	Piperonyl butoxide	Highly Toxic
51-28-5	2,4-Dinitrophenol	Highly Toxic
51-63-8	d-Amphetamine sulfate	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
54-11-5	Nicotine	Highly Toxic
54-62-6	Aminopteridine (Aminopterin)	Highly Toxic
54-64-8	Thimerosal	Highly Toxic
55-18-5	N-Nitrosodiethylamine	Suspected Carcinogen
55-86-7	Mechlorethamine hydrochloride	Suspected Carcinogen / Highly Toxic
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
56-38-2	Methyl parathion	Susp. Reproductive T. / Highly Toxic
56-53-1	Diethylstilbestrol (DES)	Known Carcinogen / Reproductive Toxicant
57-06-7	Allyl isothiocyanate	Highly Toxic
57-14-7	1,1-Dimethylhydrazine (UDMH)	Suspected Carcinogen
57-24-9	Strychnine	Highly Toxic
57-41-0	Diphenylhydantonin (Phenytoin)	Suspected Carcinogen
57-57-8	β-Propiolactone	Regulated Carcinogen / Highly Toxic
57-94-3	d-Tubocurarine chloride	Highly Toxic
58-89-9	Lindane	Suspected Carcinogen / Susp. Reproductive T. / Highly Toxic
59-05-2	Methotrexate (Methylaminopterin)	Highly Toxic / Reproductive Toxicant
59-89-2	*N*-Nitrosomorpholine	Suspected Carcinogen
60-11-7	4-Dimethylaminoazobenzene	Regulated Carcinogen
60-29-7	Ethyl ether	Highly Dangerous

CAS Number[1]	Particularly Hazardous Substance	Hazard
60-34-4	Methylhydrazine	Highly Toxic
60-51-5	Dimethoate	Susp. Reproductive T.
60-57-1	Dieldrin	Highly Toxic
61-82-5	Amitrole	Suspected Carcinogen
62-38-4	Phenylmercuric acetate	Highly Toxic
62-44-2	Phenacetin	Known Carcinogen
62-50-0	Ethyl methanesulfonate	Suspected Carcinogen
62-73-7	Dichlorvos Pestanal ®	Highly Toxic
62-75-9	*N*-Nitrosodimethylamine	Regulated Carcinogen / Highly Toxic
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
67-97-0	(+)-Vitamin D/3 (Cholecalciferol)	(Highly Toxic)
68-12-2	Dimethylformamide (DMF)	Susp. Reproductive T.
68-22-4	Norethisterone	Suspected Carcinogen
69-33-0	Tubercidin from Streptomyces tubercidicus	Highly Toxic
70-25-7	*N*-Methyl-*N*-nitro-*N*-nitrosoguanidine	Suspected Carcinogen
71-43-2	Benzene	Known Carcinogen / Susp. Reproductive T.
72-20-8	Endrin Pestanal ®	Highly Toxic
72-33-3	Estrogens (Not Conjugated): Mestranol	Suspected Carcinogen
74-82-8	Methane	Highly Dangerous
74-84-0	Ethane	Highly Dangerous
74-85-1	Ethylene	Highly Dangerous
74-86-2	Acetylene	Highly Dangerous
74-87-3	Methyl chloride	Highly Dangerous

CAS Number[1]	Particularly Hazardous Substance	Hazard
74-89-5	Methylamine	Highly Dangerous
74-90-8	Hydrogen cyanide	Highly Toxic
74-93-1	Methyl mercaptan	Highly Dangerous
74-98-6	Propane	Highly Dangerous
75-00-3	Ethyl chloride	Highly Dangerous
75-01-4	Vinyl chloride	Highly Dangerous / Known Carcinogen / Susp. Reproductive T.
75-04-7	Ethylamine	Highly Dangerous
75-07-0	Acetaldehyde	Highly Dangerous / Suspected Carcinogen / Susp. Reproductive T.
75-08-1	Ethyl mercaptan	Highly Dangerous
75-09-2	Methylene chloride (Dichloromethane)	Regulated Carcinogen / Reproductive Toxicant
75-15-0	Carbon disulfide	Reproductive Toxicant
75-18-3	Dimethyl sulfide	Highly Dangerous
75-20-7	Calcium carbide	Highly Dangerous
75-21-8	Ethylene oxide	Highly Dangerous / Regulated Carcinogen / Susp. Reproductive T.
75-24-1	Trimethylaluminum	Highly Dangerous
75-27-4	Bromodichloromethane	Suspected Carcinogen
75-28-5	Isobutane	Highly Dangerous
75-35-4	1,1-Dichloroethene (Vinylidene chloride)	Highly Dangerous
75-44-5	Phosgene	Highly Toxic
75-47-8	Iodoform	Highly Toxic
75-50-3	Trimethylamine	Highly Dangerous
75-52-5	Nitromethane	Highly Dangerous
75-55-8	2-Methylaziridine (Propyleneimine)	Suspected Carcinogen / Highly Toxic
75-56-9	Propylene oxide	Highly Dangerous
75-86-5	Acetone cyanohydrin	Highly Toxic
76-44-8	Heptachlor	Highly Toxic
76-87-9	Triphenyltin hydroxide	Highly Toxic
77-47-4	Hexachlorocyclopentadiene	Highly Toxic
77-77-0	Divinyl sulfone	Highly Toxic
77-78-1	Dimethyl sulfate	Suspected Carcinogen / Highly Toxic

CAS Number[1]	Particularly Hazardous Substance	Hazard
78-78-4	Isopentane	Highly Dangerous
78-79-5	Isoprene	Highly Dangerous
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
78-95-5	Chloracetone	Highly Toxic
79-01-6	Trichloroethylene (TCE)	Susp. Reproductive T.
79-06-1	Acrylamide	Suspected Carcinogen
79-10-7	Acrylic Acid	Highly Toxic
79-22-1	Methyl chloroformate	Highly Toxic
79-24-3	Nitroethane	Highly Dangerous
79-44-7	Dimethylcarbamyl chloride	Suspected Carcinogen / Highly Toxic
79-46-9	2-Nitropropane	Suspected Carcinogen
81-81-2	Warfarin	Reproductive Toxicant
82-28-0	1-Amino-2-methylanthraquinone	Suspected Carcinogen
86-88-4	1-(1-Naphthyl)-2-thiourea	Highly Toxic
87-86-5	Pentachlorophenol	Highly Toxic
88-72-2	o-Nitrotoluene	Highly Dangerous
88-89-1	Picric acid	Highly Dangerous
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
92-54-6	1-Phenylpiperazine	Highly Toxic
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.
95-53-4	o-Toluidine	Known Carcinogen
95-80-7	2,4-Diaminotoluene	Suspected Carcinogen
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
97-00-7	1-Chloro-2,4-dinitrobenzene	Highly Toxic
97-56-3	o-Aminoazotoluene	Suspected Carcinogen

CAS Number[1]	Particularly Hazardous Substance	Hazard
98-07-7	Benzotrichloride	Suspected Carcinogen / Highly Toxic
98-51-1	4-tert-Butyltoluene	Highly Toxic
98-88-4	Benzoyl chloride	Highly Toxic
99-35-4	Trinitrobenzene	Highly Dangerous
100-01-6	p-Nitroaniline	Highly Dangerous
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 / Highly Toxic
106-93-4	1,2-Dibromoethane (Ethylene dibromide)	Suspected Carcinogen
106-97-8	Butane	Highly Dangerous
106-99-0	1,3-Butadiene	Regulated Carcinogen
107-02-8	Acrolein	Highly Toxic
107-06-2	1,2-Dichloroethane	Suspected Carcinogen
107-07-3	2-Chloroethanol	Highly Toxic
107-11-9	Allylamine	Highly Toxic
107-12-0	Propiononitrile	Highly Toxic
107-13-1	Acrylonitrile	Regulated Carcinogen
107-18-6	Allyl alcohol	Highly Toxic
107-19-7	Propargyl alcohol	Highly Toxic
107-25-5	Vinyl methyl ether	Highly Dangerous
107-27-7	Ethylmercuric chloride (Chloroethyl mercury)	Highly Toxic
107-30-2	Methyl chloromethyl ether	Regulated Carcinogen / Highly Toxic
107-31-3	Methyl formate	Highly Dangerous
108-88-3	Toluene	Reproductive Toxicant
108-95-2	Phenol (Carbolic acid)	Reproductive Toxicant
108-98-5	Benzenethiol	Highly Toxic
109-09-1	2-Chloropyridine	Highly Toxic

CAS Number[1]	Particularly Hazardous Substance	Hazard
109-66-0	Pentane	Highly Dangerous
109-67-1	1-Pentene	Highly Dangerous
109-74-0	n-Butyronitrile	Highly Toxic
109-76-2	1,3-Diaminopropane	Highly Toxic
109-86-4	Ethylene glycol monomethyl ether (EGME)	Susp. Reproductive T.
109-92-2	Vinyl ethyl ether	Highly Dangerous
110-00-9	Furan	Highly Dangerous
110-57-6	trans-1,4-Dichloro-2-butene	Highly Toxic
110-80-5	Ethylene glycol monoethyl ether (EGEE)	Susp. Reproductive T.
110-89-4	Piperidine	Highly Dangerous
115-07-1	Propylene	Highly Dangerous
115-10-6	Methyl ether	Highly Dangerous
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)	Highly Dangerous / Susp. Reproductive T.
119-93-7	3,3'-Dimethylbenzidine	Suspected Carcinogen
120-71-8	p-Cresidine	Suspected Carcinogen
121-14-2	2,4-Dinitrotoluene	Highly Dangerous
122-66-7	Hydrazobenzene	Suspected Carcinogen
122-98-5	2-Anilinoethanol	Highly Toxic
123-91-1	1,4-Dioxane	Suspected Carcinogen
124-40-3	Dimethylamine	Highly Dangerous
124-41-4	Sodium methoxide (Sodium methylate)	Highly Dangerous
127-18-4	Tetrachloroethylene	Susp. Reproductive T.
129-16-8	Merbromin	Highly Toxic
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
137-05-3	Methyl-2-cyanoacrylate	Highly Toxic
139-13-9	Nitrilotriacetic Acid	Suspected Carcinogen
140-88-5	Ethyl acrylate	Suspected Carcinogen
141-43-5	Ethanolamine	Highly Toxic
143-16-8	Dihexylamine	Highly Toxic

CAS Number[1]	Particularly Hazardous Substance	Hazard
143-50-0	Kepone® (Chlordecone)	Suspected Carcinogen
143-57-7	Protoveratrine A	Highly Toxic
144-49-0	Fluoroacetic acid	Highly Toxic
145-73-3	Endothall	Highly Toxic
148-82-3	Melphalan	Known Carcinogen
151-50-8	Potassium cyanide	Highly Toxic
151-56-4	Ethyleneimine	Regulated Carcinogen
154-93-8	Bischloroethyl nitrosourea (BCNU) (Carmustine)	Suspected Carcinogen / Highly Toxic
298-00-0	Methyl parathion	Susp. Reproductive T.
298-81-7	8-Methoxypsoralen (Methoxsalen) plus Ultraviolet A radiation	Known Carcinogen
299-75-2	Treosulfan	Known Carcinogen
301-04-2	Lead acetate	Suspected Carcinogen
302-01-2	Hydrazine	Suspected Carcinogen / Highly Toxic
303-47-9	Ochratoxin A	Suspected Carcinogen
305-03-3	Chlorambucil	Known Carcinogen / Reproductive Toxicant
309-00-2	Aldrin Pestanal ®	Highly Toxic
313-67-7	Aristolochic acid	Known Carcinogen
316-42-7	Emetine dihydrochloride	Highly Toxic
333-41-5	Diazinon	Susp. Reproductive T. / Highly Toxic
350-03-8	3-Acetylpyridine	Highly Toxic
356-12-7	Fluocinolone acetonide 21-acetate	Highly Toxic
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
506-61-6	Potassium silver cyanide	Susp. Reproductive T.
509-14-8	Tetranitromethane	Highly Toxic
513-37-1	Dimethyl vinyl chloride	Suspected Carcinogen

CAS Number[1]	Particularly Hazardous Substance	Hazard
528-29-0	o-Dinitrobenzene	Highly Dangerous
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
554-70-1	Triethylphosphine	Highly Dangerous
556-52-5	Glycidol	Suspected Carcinogen
556-61-6	Methyl isothiocyanate	Highly Toxic
557-20-0	Diethylzinc	Highly Dangerous
563-12-2	Ethion	Highly Toxic
563-47-3	3-Chloro-2-methylpropene	Suspected Carcinogen
569-61-9	C. I. Basic Red 9 Monohydrochloride	Suspected Carcinogen
584-84-9	Tolylene 2,4-diisocyanate	Highly Toxic
591-08-2	1-Acetyl-2-thiourea	Highly Toxic
592-85-8	Mercuric thiocyanate	Highly Toxic
593-74-8	Dimethylmercury	Highly Toxic
594-19-4	Tert-butyllithium	Highly Dangerous
597-64-8	Tetraethyl tin	Highly Toxic
612-83-9	3,3'-Dichlorobenzidine 2HCL	Regulated Carcinogen
619-72-7	4-Nitrobenzonitrile	Highly Toxic
621-64-7	*N*-Nitrosodi-*n*-propylamine	Suspected Carcinogen
624-83-9	Methyl isocyanate	Highly Dangerous / Highly Toxic
630-08-0	Carbon monoxide	Highly Dangerous / 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
917-54-4	Methyl lithium	Highly Dangerous
924-16-3	*N*-Nitrosodi-*n*-butylamine	Suspected Carcinogen
930-55-2	*N*-Nitrosopyrrolidine	Suspected Carcinogen
930-68-7	2-Cyclohexen-1-one	Highly Toxic
944-22-9	Fonofos Pestanal ®	Highly Toxic

CAS Number[1]	Particularly Hazardous Substance	Hazard
990-73-8	Fentanyl citrate	Highly Toxic
1067-33-0	Diacetoxydibutyltin	Highly Toxic
1095-90-5	Methadone hydrochloride	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
1303-00-0	Gallium arsenide	Known Carcinogen
1303-28-2	Arsenic (V) oxide	Highly Toxic
1314-20-1	Thorium dioxide	Known Carcinogen
1314-32-5	Thallium (III) oxide	Highly Toxic
1314-62-1	Vanadium pentoxide (Dust)	Highly Toxic
1327-53-3	Arsenic trioxide	Highly Toxic
1330-20-7	Xylene	Susp. Reproductive T.
1332-21-4	Asbestos	Known Carcinogen
1333-74-0	Hydrogen	Highly Dangerous
1336-36-3	Polychlorinated biphenyls (PCBs)	Reproductive Toxicants
1338-23-4	2-Butanone peroxide	Highly Toxic
1397-94-0	Antimycin A	Highly Toxic
1402-68-2	Aflatoxins	Known Carcinogen / Highly Toxic
1464-53-5	Diepoxybutane	Suspected Carcinogen / Highly Toxic
1563-66-2	Carbofuran (2,3-Dihydro-2,2-dimethyl-7-benzofuranol N-methyl carbamate)	Highly Toxic
1675-54-3	Bisphenol A diglycidyl ether	Highly Toxic
1746-01-6	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	Highly Toxic / 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
2001-95-8	Valinomycin	Highly Toxic
2244-16-8	d-Carvone	Highly Toxic
2304-30-5	Tetrabutylphosphonium chloride	Highly Toxic
2385-85-5	Mirex	Suspected Carcinogen
2426-54-2	2-(Diethylamino)ethyl acrylate	Highly Toxic
2487-90-3	Trimethoxysilane	Highly Toxic

CAS Number[1]	Particularly Hazardous Substance	Hazard
2602-46-2	Direct Blue 6	Suspected Carcinogen
2642-71-9	Azinphos-ethyl (Ethyl guthion)	Highly Toxic
2763-96-4	Muscimol	Highly Toxic
2921-88-2	Chlorpyrifos	Susp. Reproductive T.
3570-80-7	Fluorescein mercuric acetate	Highly Toxic
3689-24-5	Tetraethyl dithiopyrophosphate	Highly Toxic
3982-91-0	Thiophosphoryl chloride	Highly Toxic
4044-65-9	1,4-Phenylenediisothiocyanic acid	Highly Toxic
4098-71-9	Isophorone diisocyanate	Highly Toxic
4111-54-0	Lithium diisopropylamide	Highly Dangerous
4170-30-3	Crotonaldehyde	Highly Toxic
4368-28-9	Tetrodotoxin	Highly Toxic
4549-40-0	*N*-Nitrosomethylvinylamine	Suspected Carcinogen
5124-30-1	4,4’-Methylene bis(cyclohexyl isocyanate)	Highly Toxic
6055-19-2	Cyclophosphamide, hydrated	Reproductive Toxicant
6484-52-2	Ammonium nitrate	Highly Dangerous
6837-24-7	1-Cyclohexyl-2-pyrrolidinone	Highly Toxic
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.
7439-95-4	Magnesium powder	Highly Dangerous
7439-96-5	Manganese	Susp. Reproductive T.
7439-97-6	Mercury	Susp. Reproductive T.
7440-09-7	Potassium metal	Highly Dangerous
7440-17-7	Rubidium metal	Highly Dangerous
7440-28-0	Thallium	Highly Toxic
7440-36-0	Antimony	Susp. Reproductive T.
7440-38-2	Arsenic	Susp. Reproductive T.
7440-39-3	Barium metal	Highly Dangerous
7440-41-7	Beryllium and Certain Beryllium Compounds	Known Carcinogen
7440-43-9	Cadmium and Certain Cadmium Compounds	Regulated Carcinogen / Susp. Reproductive T.
7446-09-5	Sulfur dioxide	Susp. Reproductive T.
7446-18-6	Thallium (I) sulfate	Highly Toxic

CAS Number[1]	Particularly Hazardous Substance	Hazard
7446-27-7	Lead phosphate	Suspected Carcinogen
7487-94-7	Mercury (II) chloride	Highly Toxic
7550-45-0	Titanium (IV) chloride	Highly Dangerous
7580-67-8	Lithium hydride	Highly Dangerous
7601-90-3	Perchloric acid	Highly Dangerous
7664-41-7	Ammonia	Susp. Reproductive T.
7697-37-2	Nitric acid (Fuming)	Highly Toxic
7719-12-2	Phosphorus trichloride	Highly Toxic
7723-14-0	Phosphorus sticks	
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
7774-29-0	Mercury (II) iodide	Highly Toxic
7782-49-2	Selenium	Susp. Reproductive T.
7782-50-5	Chlorine	Highly Toxic
7783-06-4	Hydrogen sulfide	Highly Dangerous / Highly Toxic
7784-42-1	Arsine (Hydrogen arsenide)	Highly Toxic
7784-46-5	Sodium meta arsenite	Highly Toxic
7789-06-2	Strontium Chromate	Known Carcinogen
7789-47-1	Mercury (II) bromide	Highly Toxic
7790-98-9	Ammonium perchlorate	Highly Dangerous
7803-62-5	Silane	Highly Dangerous
8001-35-2	Toxaphene Reference Standard	Highly Toxic
8006-61-9	Gasoline	Susp. Reproductive T.
8032-32-4	Petroleum ether	Highly Dangerous
9002-84-0	Poly(tetrafluoroethylene)	Highly Dangerous
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.
10025-67-9	Sulfur monochloride	Highly Toxic
10025-78-2	Trichlorosilane	Highly Dangerous
10025-87-3	Phosphorus oxychloride	Highly Dangerous / Highly Toxic
10034-93-2	Hydrazine sulfate	Suspected Carcinogen
10043-35-3	Boric acid	Susp. Reproductive T.
10043-92-2	Radon	Known Carcinogen

CAS Number[1]	Particularly Hazardous Substance	Hazard
10045-94-0	Mercuric nitrate	Highly Toxic
10102-18-8	Sodium selenite	Highly Toxic
10102-44-0	Nitrogen dioxide	Highly Toxic
10265-92-6	Monitor 4 (o,s-Dimethylphosphoramidothioate)	Highly Toxic
10540-29-1	Tamoxifen	Known Carcinogen
10588-01-9	Sodium dichromate	Highly Toxic
12079-65-1	Cyclopentadienylmanganese tricarbonyl	Highly Toxic
13010-47-4	1-(2-Chloroethyl)-3-cyclohexyl-1-nitrosourea (CCNU)	Suspected Carcinogen
13194-48-4	Ethoprophos Pestanal ®	Highly Toxic
13256-22-9	*N*-Nitrososarcosine	Suspected Carcinogen
13463-39-3	Nickel carbonyl	Highly Hazardous / Highly Toxic
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
16853-85-3	Lithium aluminum hydride	Highly Dangerous
17702-41-9	Decaborane	Highly Toxic
17804-35-2	Benomyl	Susp. Reproductive T.
18172-33-3	Cyclopiazonic acid from Penicilium cyclopium	Highly Toxic
20816-12-0	Osmium tetroxide	Highly Toxic
21908-53-2	Mercuric oxide	Highly Toxic
22373-78-0	Monensin sodium	Highly Toxic
22781-23-3	Benodicarb Pestanal (2,3-Isopropyliden dioxyphenyl N-methyl carbamate)	Highly Toxic
25013-16-5	Butylated hydroxyanisole (BHA)	Suspected Carcinogen

CAS Number[1]	Particularly Hazardous Substance	Hazard
25321-14-6	Dinitrotoluene (DNT)	Reproductive Toxicant
26628-22-8	Sodium azide	Highly Toxic
28300-74-5	Antimony potassium tartrate	Susp. Reproductive T.
30674-80-7	2-Isocyanatoethyl methacrylate	Highly Toxic
33419-42-0	Etoposide	Known Carcinogen
34202-69-2	Hexafluoro acetone trihydrate	Highly Toxic
39156-41-7	2,4-Diaminoanisole sulfate	Suspected Carcinogen
55721-11-4	24(R), 25-Dihydroxy-Vitamin D3	Highly Toxic
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
70476-82-3	Novantrone mitoxantrone HCl	Highly Toxic
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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