UNIVERSITY of PUGET SOUND

The University of Puget Sound Chemical Hygiene Plan

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University of Puget Sound
Chemical Hygiene Plan

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I. PURPOSE

The University of Puget Sound Chemical Hygiene Plan (CHP) establishes a standard intended to:

- Inform and train University personnel, including faculty, staff, and student workers, as required by the Washington Industrial Safety and Health Administration Standard on Occupational Exposure to Hazardous Chemicals in Laboratories, WAC 296-828.

- Protect laboratory personnel from workplace health and safety hazards. The University of Puget Sound uses appropriate methods to afford such protection to its employees, including engineering controls (such as fume hoods) and administrative controls (such as Standard Operating Procedures, or SOPs). Personal protective equipment (PPE) is provided where other controls are not sufficient or feasible.

- Ensure that employee exposures to hazardous substances in the laboratory do not exceed the levels listed in WAC 296-841. The University of Puget Sound evaluates respiratory exposures to chemicals as required by WAC 296-828-20010, including air monitoring when necessary. Air monitoring results are compared against the appropriate Permissible Exposure Limits (PELs), as promulgated by the Washington Industrial Safety and Health Act (WISHA). These are found in WAC 296-841-20025. Where there is no WISHA PEL, other recommended reference values (such as NIOSH RELs, ACGIH TLVs, AIHA WEELs or product manufacturers' recommendations) may be used.

Affected employees can review this plan at any time. It is readily available on Science Safety Committee SoundNet. Additionally, employees may request a copy from the Facilities Help Desk (253-879-3713).

II. SCOPE

The University of Puget Sound strives to provide facilities free from recognized hazards likely to cause physical harm and to comply with federal, state, and local laws and regulations. This Chemical Hygiene Plan applies to all who work with hazardous chemicals, or whose work may put them in proximity to hazardous chemicals both in academic teaching laboratories and research laboratories. People covered under this CHP include laboratory faculty and staff, researchers, storeroom staff, and student workers.

The person with primary responsibility for safety in a given area (such as a laboratory or storeroom) is the individual who has overall control over and accountability for employee safety in that area. Additionally, it is the responsibility of each employee to follow established safety procedures/protocols when handling or storing chemicals, to properly use and care for assigned PPE, and to ensure that his/her work does not create a hazardous condition.

The University of Puget Sound also requires that non-employee students and visitors follow the safety practices mandatory for faculty, staff, and student workers when in affected areas.

NOTE: Hazardous Materials are materials that are a danger or hazard to people or the environment. Any chemical which is classified as a health hazard or simple asphyxiant in accordance with the Hazard Communication Standard, WAC 296-901-140, in considered a Hazardous chemical. See Section XIV, Definitions.

III. REFERENCES

- Washington Administrative Code (WAC) Chapters 296-828 and any other chapters referenced therein or appropriate to the task being performed. Specific to Safety Standards for Hazardous Chemicals in Laboratories. http://www.lni.wa.gov/safety/rules/chapter/828/WAC296-828.PDF
- Washington Industrial Safety and Health Act (WISHA). Administered by the Washington Department of Labor & Industries (L&I), Division of Safety and Health (DOSH). https://www.lni.wa.gov/safety/
- Occupational Safety and Health Administration (OSHA). Superseded in Washington State by WISHA, but OSHA standard interpretations inform WISHA application and compliance. https://www.osha.gov/laws-regs/standardinterpretations/standardnumber
- Prudent Practices in the Laboratory: Handling and Disposal of Chemicals. Washington, DC. National Academy Press. https://www.nap.edu/catalog/12654/prudent-practices-in-the-laboratory-handling-and-management-of-chemical

Note that many other useful references are available, with new and updated references regularly published, for topics that include laboratory safety management, carcinogenicity and other chemical hazards, PPE, and occupational exposure values other than the OSHA/WISHA PELs. For help in selecting appropriate resources not on this list, contact the Facilities Help Desk at 253-879-3713.

IV. CHEMICAL HYGIENE RESPONSIBILITIES

Policies to protect students, faculty, staff, visitors, and the environment are required for the safe handling, use, storage, and disposal of chemicals. Individual responsibilities for implementation include the following measures:

- Never exceed PELs or other appropriate reference standards.
- Provide and maintain adequate ventilation.
- Avoid underestimation of risk.
- Provide the lowest possible chemical exposures, even for chemicals which have no listed significant hazard.
- Anticipate that mixtures of chemicals are more hazardous than the individual chemical components and may have different kinds of hazards.

Responsibility for various aspects of the CHP is distributed as follows:

A. University of Puget Sound Administration

University of Puget Sound's administrative staff have ultimate responsibility for providing institutional support of the CHP.

B. Chemical Hygiene Officer:

- Administer the CHP.
- Ensure that departmental faculty, staff and student workers have access to the CHP.
- Work with Department Chairs, Laboratory Supervisors, Storeroom Coordinators, Science Safety Committee members, and staff and student workers to provide adequate facilities and to develop and implement appropriate policies and practices.
- Monitor the procurement, use, and disposal of chemicals in laboratories.
- Maintain appropriate records, such as training records, records of annual reviews, and audits of laboratories, storerooms, and storage spaces.
- Provide technical assistance for complying with the CHP and answer chemical safety questions for employees.
- Review and update the CHP at least annually or when there are changes in conditions, procedures or chemicals. Involve Departmental Chairs, Science Safety Committee members and other departmental personnel as needed.
- Ensure that an annual exposure evaluation is conducted, and that air monitoring is provided if indicated.
- Work with and provide overall direction and oversight of Storeroom Coordinators conducting hazardous waste disposal.
- Know the current legal requirements concerning regulated substances.
- Seek ways to improve the CHP.

Unless otherwise noted, the Environmental Health and Safety (EHS) Manager serves in the role of Chemical Hygiene Officer.

C. Department Chairs

- Ensure that adequate facilities and appropriate policies and practices are provided and/or implemented as necessary to support the CHP.
- Appoint and/or approve the departmental Science Safety Committee members.
- Support the Chemical Hygiene Officer in the annual review and update of the CHP and in ensuring departmental faculty, staff and student workers have received the necessary training.
- Ensure timely and adequate participation in audits and/or inspections pertaining to the CHP.
- Follow-up on action items arising out of audits and/or inspections that cannot be solved at a lower level.

D. Laboratory Supervisors:

Each teaching and research lab will have a Laboratory Supervisor; i.e. normally the faculty member primarily responsible for the teaching or research lab. Laboratory supervisors will plan and conduct each laboratory operation in accordance with the requirements of the CHP. This requires a working knowledge of the written CHP and of the evaluation of hazards and use of appropriate controls. The supervisor will advise and guide all lab users as follows.

- Consult with the Chemical Hygiene Officer before purchasing or producing any particularly hazardous substances. These are chemicals that may be considered extremely hazardous, such as select carcinogens, reproductive toxins, and chemicals with a high degree of acute toxicity or a particularly significant physical hazard.
- Ensure the effectiveness and implementation of the CHP, working with the EHS Manager as necessary. When necessary, modify and expand the plan to cover the hazards and safe work practices unique to each lab. All such modifications must be in writing and maintained with the laboratory copy of the most current CHP edition.
- Supervise the performance of other University personnel working in the laboratory, to ensure that they follow safe laboratory practices and procedures, including Standard Operating Procedures (SOPs) and laboratory lesson plans.
- Acquire the necessary information to recognize and control laboratory chemical hazards and to understand the current regulatory requirements of hazardous substances used in the laboratory, working with the EHS Manager as necessary.
- Use appropriate safe laboratory practices and controls (such as properly functioning hoods and PPE) to reduce the potential for employees' exposure to hazardous chemicals.
- Report to EHS/Science Storeroom Coordinators any unusual physical and sensory characteristics (odor, appearance) of hazardous chemicals.
- Report to EHS/Science Storeroom Coordinators the signs and symptoms of any perceived chemical overexposure.
- Provide and document area- or lab-specific training so that personnel can follow standard procedures for handling and storing hazardous chemicals, including dealing with accidents involving hazardous chemicals.
- Routinely inspect or verify inspection of emergency equipment.

- Ensure that laboratory waste is collected for disposal and appropriately labeled as required by the University of Puget Sound Laboratory Management Plan and this CHP.

E. Storeroom Coordinators

- Manage the safe storage and handling of chemicals in the Chemistry and Biology storerooms, ensuring that safe practices, including appropriate SOPs, are followed.
- Ensure that new products are purchased according to the CHP and departmental policies and Safety Data Sheets (SDS) are entered into the Chimera database before used in the department.
- Contact the Chemical Hygiene Officer for approval before purchasing any particularly hazardous substances. These are chemicals that may be considered extremely hazardous, such as select carcinogens, reproductive toxins, and chemicals with a high degree of acute toxicity or a particularly significant physical hazard.
- Support the Laboratory Supervisors in implementing the CHP in their laboratories, as needed and requested.
- Participate in the Science Safety Committee as active members.
- Provide specific program technical guidance to develop and implement provisions of the CHP.
- Participate as requested by the Chemical Hygiene Officer in the annual review of the CHP.
- Participate in required regular chemical hygiene and housekeeping inspections of the laboratory and control/emergency equipment.
- Ensure that departmental hazardous waste is properly collected, labeled and prepared for hazardous waste disposal, as required by the University of Puget Sound Laboratory Management Plan and this CHP.

F. Department Science Safety Committee Member

- Participate in the Science Safety Committee and keep the Chemical Hygiene Officer informed of ways to improve department-related aspects of the CHP. Note that the Sciences Health and Safety Committee also serves as the Science Safety Committee and its members consider the safe handling of hazardous substances and effectiveness of the CHP during their meetings.
- Provide specific program technical guidance to develop and implement provisions of the CHP.
- Encourage the use of appropriate SOPs by other laboratory employees.
- Participate as requested by the Chemical Hygiene Officer in the annual review of the CHP.
- Participate in required regular chemical hygiene and housekeeping inspections of the laboratory and control/emergency equipment.

G. Science/Laboratory Personnel (Faculty, Staff and Student Workers):

- Follow established SOPs and/or laboratory lesson plans.
- Appropriately use the PPE provided by the Laboratory Supervisor.
- Keep your PPE in working order and inform the Laboratory Supervisor when new PPE is required or if there is a problem with the PPE provided.
- Report accidents/incidents to the Laboratory Supervisor (or call Security Services at 253-879-3311 if it is an emergency).

- Actively participate in all CHP and hazard recognition/control training.
- Use approved methods for the collection and storage of chemical waste and for the labeling of secondary chemical containers, as outlined in the UPS Laboratory Management Plan and this CHP.

V. GENERAL PRINCIPLES OF THE CHP

The CHP recommends the following standard safety principles when working with hazardous chemicals:

- Appropriate laboratory practices (e.g. SOPs, signage where needed, and well-considered standards of dress and behavior).
- Engineering controls (e.g. fume hoods, alarms and monitors).
- Use of other safeguards (e.g. PPE).

While these safety principles are essential for protecting laboratory personnel, there is no substitute for personal knowledge and vigilant awareness working with and around hazardous chemicals. For instance, the proposal to use a particularly dangerous chemical may require additional controls to protect the laboratory worker. Refer to Section XII for the requirements for purchase of chemicals that may be considered extremely hazardous, such as select carcinogens, reproductive toxins, and chemicals with a high degree of acute toxicity or a particularly significant physical hazard.

A Laboratory Supervisor may determine a need for modifications to standard operating procedures, to meet their laboratory's uses and operational needs. These modifications must be in writing and maintained with the laboratory copy of the CHP. Modifications to the CHP itself may be suggested but should be made through the Chemical Hygiene Officer.

Employees need to wear clothing and PPE that provides adequate protection when working in the laboratory. A lab coat may be required for a specific department, laboratory or procedure. Sandals, open-toed, or open-backed shoes provide insufficient protection in the laboratory. Impermeable gloves are often the most important item of PPE for protection against direct skin contact and possible absorption of certain chemicals through the skin. Refer to Appendix A for an example of a useful Chemical Resistance Guide by class of chemical. Glove manufacturers also provide chemical resistance guides and the product manufacturer may be a good source of information for chemicals not otherwise rated.

Protective safety glasses provide only minimum eye protection when working in the laboratory. Therefore, ANSI-approved splash goggles are mandatory eye protection if the possibility for exposure to liquid chemicals exists. Cryogenic hazards require specialized PPE and adherence to the University of Puget Sound SOP for Handling Cryogenic Fluids. Individual labs may also choose to have more stringent PPE requirements.

Fume hoods provide the best means of preventing airborne substances from being released into the laboratory environment during normal laboratory operations. Some chemicals **require the use of a fume hood** due to their toxicity, foul odor, or other harmful properties. Generally, respirators would

not be required with the use of a hood, but air monitoring can be used to verify that respiratory protection is not necessary for a specific task or project. When there is a question, contact the EHS Department (through the Facilities Help Desk at 253-879-3713) to arrange for air monitoring, to ensure compliance with the PEL or other appropriate reference limit.

VI. THE LABORATORY FACILITY

The following summarizes University of Puget Sound's facility design, use, and maintenance:

A. Design

Laboratory facilities include the following:

- Room ventilation systems with air intakes and exhausts located strategically to avoid intake of contaminated air.
- Well-ventilated storerooms.
- Laboratory hoods and sinks.
- Other safety equipment including fire extinguishers, eyewash fountains and drench showers.
- Responsible storage and disposal of hazardous and non-hazardous waste.

B. Usage

The type and scale of work conducted must be appropriate for the physical facilities available and the room and local ventilation design.

C. Ventilation

General laboratory ventilation includes:

- Supply and exhaust air sufficient to ensure the comfort and health of personnel working in the laboratory, including the prevention of accumulation of toxic substances.
- The laboratory should be negatively pressured compared to non-laboratory spaces.
- Exhaust should be to the exterior of the building and the system should be designed to prevent re-entrainment by air intakes of chemicals exhausted.
- For general laboratory ventilation, provide 6 -12 room air changes per hour. General ventilation airflow should be relatively uniform throughout the laboratory. Areas of high or low velocity, or high or low static pressure, indicate a ventilation problem that should be reported.

Fume hoods are the primary method of ventilation for protection from toxic substances released into the laboratory. Hood flow rates are evaluated annually according to the University of Puget Sound Facilities Services Fume Hood Annual Certification procedure. A minimum of three linear feet of hood space per person should be provided.

Other local ventilation devices, such as ventilated storage cabinets, canopy hoods, and snorkel-type local exhaust, may be available as needed.

Modifications to ventilation systems are acceptable only after appropriate testing indicates adequate worker protection from airborne toxic substances. Modifications must be approved by Facilities Services and the Chemical Hygiene Officer. For more on fume hoods and ventilation, refer to the Prudent Practices in the Laboratory: Handling and Disposal of Chemicals."

D. Maintenance

General laboratory ventilation and equipment are maintained as follows:

- **Ventilation:** Facilities Services staff certify fume hoods on an annual basis. All repairs or modifications to fume hoods must be made through Facilities Services.

- **Safety Eyewashes and Showers:** All eyewashes, throughout the campus, are tested weekly by running the water for 3-5 minutes to ensure proper function and to clear rust and other debris by Facilities Services personnel. Additionally, Facilities Services personnel inspect and test safety showers for flow, pressure, temperature, and other identified parameters annually.

VII. GENERAL LAB HEALTH & SAFETY GUIDELINES AND PROCEDURES

The Chemical Hygiene Plan requires that laboratory faculty and staff understand and comply with its rules and procedures. Students also should be informed and guided to comply with procedures appropriate for their level of participation in various laboratories. See Section XII Training.

Following are some primary laboratory health and safety procedures applicable to all laboratories in which hazardous materials and/or scientific equipment are used. Additional procedures and guidelines will be provided by the Laboratory Supervisor.

A. Laboratory Health and Safety Procedures

- **REPORT ALL CAMPUS EMERGENCIES TO Security Services (253-879-3311).**
- Additionally, report all injuries, fires, fire extinguisher uses, and accidents immediately to Security Services and your Laboratory Supervisor.
- Comply with warning signs and labels.
- Know the location of the nearest and next nearest emergency showers, eyewashes, first aid kits, emergency exits, telephones, and fire alarm pull stations.
- Do not consume food, beverages or smokeless tobacco in laboratories. Application of cosmetics also is prohibited in laboratories.
- Wash hands after working with hazardous materials, even when gloves have been used.
- Dress appropriately. Long hair, neckties, and loose clothing should be tied back or otherwise secured. Bare feet, sandals, open-toed or perforated shoes are prohibited in laboratories that contain hazardous materials.
- Wear eye protection and other personal protective equipment appropriate to laboratory activities and as instructed by your Laboratory Supervisor.
- Use handling procedures appropriate to hazardous materials and equipment in use, and/or as instructed by your Laboratory Supervisor. This includes placement of materials in proper containers for storage or future disposal.
- Close hazardous material containers when not in active use.
- Perform only those experiments and procedures for which you are authorized by your Laboratory Supervisor.
- Ask your Laboratory Supervisor for clarification of procedures if you have questions before performing laboratory tasks.
- Do not work alone while performing laboratory work without prior permission from your Laboratory Supervisor and an appropriate plan for staying in contact.

B. Avoiding "Routine" Exposures

- Avoid smelling, and never taste, chemicals.
- Vent apparatuses with toxic chemicals, such as vacuum pumps, distillation columns, and other devices, into fume hoods.
- Inspect gloves and glove boxes for leaks before use.

- Do not allow release of toxic materials into "cold" or "warm" rooms because these rooms have contained and re-circulated atmospheres.
- NEVER mouth pipet any chemical in the laboratory or commence a siphon using mouth suction.

C. Accidents and Spills

Accidents: *Immediately notify Security Services (253-879-3311) so they can respond to provide first-aid, obtain and direct outside emergency responders if needed, and complete an incident report.* Faculty and staff (including student workers) must report all on-the-job accidents, hazardous material exposures, and incidents, and near miss accidents to their supervisor as soon as feasible.

Minor Spills: A minor chemical spill is one that the laboratory staff is capable of handling safely without the assistance of emergency personnel. For cleanup of a minor spill, consult the SDS for the chemical. Use existing spill kits with absorbents and protective equipment just for this purpose. Thoroughly clean-up all minor spills before leaving the scene, unless relieved by someone with more experience. Do not leave spills covered with absorbent materials or neutralizing agents.

Major Spills: A major spill, or uncontrolled release as defined by WAC 296-824-099, is a release where significant safety and health risks could be created. Releases of hazardous substances that are either incidental or could not create a safety or health hazard (i.e., fire, explosion or chemical exposure) are not considered to be uncontrolled releases.

Examples of conditions that could create a significant safety and health risk include:

(a) Large-quantity releases;
(b) Small releases that could be highly toxic, flammable or explosive;
(c) Potentially contaminated individuals arriving at hospitals; and
(d) Airborne exposures that could exceed a WISHA PEL or other published exposure limit and where employees are not adequately trained or equipped to safely control the release.

A major chemical spill should be cleaned up **only by** knowledgeable and experienced personnel, using appropriate PPE and equipment and proper disposal methods. Contact Security Services at 253-879-3311 to immediately report the spill location and nature of the spill and to obtain assistance. Additionally, notify the EHS Manager, who will assess the situation and determine response and cleanup requirements.

Note: mercury and hydrofluoric acid spills require special clean –up procedures. For assistance with these and other complex, large, or unknown spill substance/products, call the EHS Manager through the Facilities Help Desk (253-879-3713), after having first contacted Security Services at 253-879-3311.

All spills that result in employee exposure must be reported to your supervisor, Security Services, and the EHS Manager. The EHS Manager will evaluate the circumstances of the spill and potential for exposure to determine if a PEL may have been exceeded.

Eye contact: Use eyewash equipment to promptly flush eyes with water for 15 minutes. Seek medical attention. Immediately contact Security Services at 253-879-3311 and the EHS Manager through the Facilities Help Desk (253-879-3713) for an exposure evaluation.

Skin contact: Promptly remove any contaminated clothing and flush affected areas with water for 15 minutes. If symptoms of exposure persist after washing, contact Security Services at 253-879-3311 and seek medical attention immediately. Some chemical exposures may have a delayed adverse reaction. Always report incidents to your supervisor.

Ingestion: Call Security Services at 253-879-3311. Security Services will consult with Poison Control and seek instructions on container labels and/or SDS. Vomiting should not be induced unless specifically instructed by the SDS or another reliable source, such as the Poison Control Center (1-800-222-1222).

Inhalation: Call Security Services at 253-879-3311. Move to fresh air immediately. If an exposed person is unable to help her/himself, move her/him to a safe area and check breathing. If breathing has stopped, Security Services will perform CPR and obtain emergency medical assistance. Keep the affected person calm and comfortable.

D. Eating, Drinking, & Smoking

- Do not eat, drink, smoke, use smokeless tobacco, or apply cosmetics in or near areas where laboratory chemicals are present. Wash hands before conducting these activities.
- Do not eat or drink with utensils or glassware used for laboratory operations.
- Keep food and beverages in "food only" refrigerators.

E. Glassware and Equipment

- Handle and store laboratory glassware with care to avoid injury and equipment damage.
- Do not use damaged glassware. Place chipped beakers, flasks, test tubes, etc. in a broken glass receptacle.
- Do not use severely etched glassware for high or low-pressure work.
- Use extra care with Dewar flasks and other evacuated glass equipment. Shield or wrap them to contain chemicals and fragments should implosion or explosion occur.
- Use equipment for its designated purpose only.

F. Before Exiting the Laboratory

Thoroughly wash areas of exposed skin. Return all glassware, chemicals, and equipment to appropriate locations. Label secondary containers with, as a minimum, the name or identifier of the chemical, the hazard warning, and the hazards in either writing or using pictograms. The hazard warning and hazards can be determined from the SDS.

Write instructions for ongoing operations left unattended for several hours or overnight that include:

- Contents and hazards. Name of responsible party.
- Procedures for contacting the responsible party should a mishap occur.
- Provisions to contain any solid or liquid chemical released in the event of breakage.

Decontaminate bench spaces. At a minimum, wash the spaces with clean water. If possible contamination with toxic or corrosive materials exists, neutralize or use other appropriate decontamination methods. Note that decontamination methods should be determined prior to starting the project or lesson.

G. Horseplay

Avoid practical jokes, horseplay, or other behavior that might confuse, startle, or distract others in laboratories.

H. Personal Protection

Personal apparel: Confine long hair and loose dangling jewelry and clothing. Wear appropriate clothing and shoes at all times in the laboratory. Never wear sandals, perforated, open toed, or open heeled shoes in any laboratory.

Eye Protection: Appropriate eye protection (at minimum protective glasses) must be worn by all persons including visitors in areas where chemicals are stored or handled. If potential for splashes of liquid chemicals exists, ANSI-approved splash goggles must be worn.

Skin Protection: Where conditions warrant use, wear a lab coat and clothing adequate to protect the legs and arms from splashes and spills. After significant contamination, clean or discard laboratory coats. Do not bring lab coats home to wash them with personal laundry. Lab coats must be washed on site by university personnel and/or sent to a commercial cleaning service that is equipped to address potential contamination, and the service must be notified of the presence of the potential contamination. Appropriate PPE will be provided for each of the four main hazards that exist in individual laboratories; i.e. chemicals (by type), abrasions, cutting, and heat.

Wear appropriate gloves, especially when potential for contact with toxic or corrosive materials exists. Consult the manufacturer's SDS and/or a chemical resistance chart, as is included in Appendix A, to ensure the appropriate choice of gloves for use with each chemical.

Inspect gloves before each use. Replace gloves periodically, depending on frequency of use and permeability to the substance(s) handled. Rinse overtly contaminated gloves and carefully remove after use. **Note**: Because of latex allergy risks, disposable nitrile gloves have replaced latex gloves for general use in the labs.

Wear appropriate gloves whenever necessary to handle rough or sharp-edged objects and very hot or cold materials. Appropriate gloves for these situations may include cut-resistant, leather, welder's gloves, aluminum-backed gloves, and/or other insulated glove types. The glove should be matched to the application.

Protect your hands when working with tools and machinery with high rpm's such as a centrifuges or homogenizers. Power tools and machinery must have guards installed to prevent hands or other body parts from contacting the point of operation, power train, or other moving parts. To avoid injury from moving parts:

- Ensure that guards are always in place and used.
- Lock out machines or tools and disconnect the power before making repairs.
- Treat any machine without a guard as inoperative.
- Use caution when wearing gloves around high rpm machinery. Avoid wearing gloves around machinery. If gloves must be worn, to protect against a hazard such as cuts or temperature extremes, contact the EHS Manager for assistance and advice.

Following are common types of protective work gloves for particular hazards:

- Chemical Resistant Gloves (generally single-use, disposable) – protect hands from corrosives, oils, and solvents; typically made from rubber, neoprene, polyvinyl alcohol, vinyl, or nitrile. Composite gloves are also available for specialized applications. The most common type found on campus is nitrile.
- Fabric Gloves – generally used to improve grip when handling slippery objects and may help insulate hands from mild heat or cold; made of cotton or fabric blends. Not for use to protect against chemicals.
- Leather Gloves – protect against injuries from sparks, heat, cold, scraping against rough surfaces; use in combination with an insulated liner when working with electricity. Not for use to protect against chemicals.
- Metal Mesh Gloves or other cut-resistant gloves – protect hands from accidental cuts and scratches while working with cutting tools or other sharp instruments.
- Aluminized Gloves – insulate hands from intense heat when working with molten materials.
- Insulated gloves – may be used against either high-heat or cryogenic conditions.

In each case, the glove should be appropriately matched to the application. Contact the EHS Manager if you have a question or are uncertain about which glove to use.

Respiratory Protection: The University of Puget Sound uses engineering controls, such as fume hoods, to contain hazardous atmospheres. In the event of a spill or accident that creates a hazardous atmosphere, evacuate the building and contact Security Services at 253-879-3311.

Normal laboratory activities should not result in atmospheres requiring respirator use. If you feel a respiratory hazard exists, request an exposure evaluation, which may include air monitoring, from the EHS Manager.

Before anyone uses respirators on a voluntary basis for normal laboratory procedures, contact the EHS Manager. All voluntary wearers of respirators must be familiar with the University of Puget Sound's Voluntary Respiratory Protection Program and complete a medical examination, respirator fit testing, and training before wearing a respirator.

I. Planning

Review all hazard information before beginning work with any hazardous material. SDSs are a good source of information and are required for all hazardous substances. SDSs are available for reference through the Chimera system and may also be available in your laboratory. Contact the Laboratory Coordinator/Supervisor and/or Facilities Help Desk at 253-879-3713 if you need help getting an SDS.

For other sources of hazard, waste disposal, and laboratory safety information, see the references at the beginning of this document. If you have questions or require assistance, the EHS Manager may be contacted through the Facilities Help Desk.

Always plan protective procedures before beginning work. For example:

- Follow the task standard operating procedure (SOP). Use the recommended PPE.
- Have a supply of dry sand handy when working with water reactive materials.
- Use an explosion shield when appropriate.
- Use a glove bag with an inert atmosphere when using air reactive materials.
- Plan equipment positioning to ensure adequate bench space, and to prevent breakage of unsupported apparatus.
- Check the product SDSs for additional information if needed.
- Contact the EHS Manager if you have questions or require assistance.

J. Fume Hoods

Conduct all laboratory work in a fume hood, glove box, or similar device when:

- The work involves or may produce toxic chemical gases, vapors or dust. Or objectionable odors.

- Worker PELs or Action Levels may be exceeded.
- Temporarily storing certain types of toxic chemicals, particularly volatiles, including cylinders of toxic gases. In designated storage hoods, always leave the door slightly open (1-2") and the fan on.

Other use guidelines:

- If you are in doubt about the level of containment needed for your operation, ask your Laboratory Supervisor or contact the EHS Manager.
- Confirm adequate hood performance before use.
- Keep materials stored in hoods to a minimum.
- Keep the front 6 inches of hoods clear of all work and equipment. This minimizes the possibility of contaminants escaping from the hood.
- Any apparatus housed within hoods should fit completely inside.
- Operate hoods at a sash position that will provide splash protection for the user. Most University hood sashes are locked at 18 inches for optimum protection. Note that annual hood tests use this position to determine the effectiveness of the hood. If you will need to use a different sash height, contact the Facilities Help Desk at 253-879-3713.
- Leave the hood in the "on" position if toxic substances are stored within or if adequate general laboratory ventilation is uncertain.
- When working in a hood with two power settings, use the one marked “high” (green light).
- Avoid fans, window air conditioning units, or excessive movement that can cause air turbulence across the face of the hood.
- Place an “out of order” sign on hoods and contact the Facilities Help Desk at 253-879-3713 if you suspect hoods are not working properly.

K. Working Alone

Do not work alone in laboratories when conducting potentially hazardous procedures. Always have at least two trained and authorized people present when using highly toxic chemicals or one of unknown toxicity.

VIII. CHEMICAL PROCUREMENT, STORAGE, AND DISPOSAL

A. Choice of Chemicals

Carefully choose chemicals based on ventilation, fire codes, and PPE. Know the proper handling, special precautions, storage, and disposal of a substance before it is ordered.

The use of high toxicity chemicals (chemicals that pose a special risk or require special hazardous materials handling) is strongly discouraged, especially in teaching laboratories. In general, select the least toxic chemical for each laboratory procedure.

Simplify procedures in order to limit exposures and decrease the high cost of waste disposal.

Pay special attention to chemicals that form **organic peroxides** (see Appendix C). Contact the EHS Manager/Storeroom Coordinator for approval prior to ordering these chemicals. If they must be purchased/used, follow the procedures required by the EHS Manager.

If any substance requires special hazardous materials handling and/or disposal, consult with the EHS Manager before ordering.

B. Procurement

The Storeroom Coordinators and/or department will maintain information concerning the quantity and storage locations of chemicals. The Storeroom Coordinators will: inform the EHS Manager of hazardous materials being utilized, facilitate the distribution of SDSs, and keep hazardous materials inventories up to date.

C. Distribution

Before obtaining chemicals from storerooms, students, faculty and staff must read the SDSs to familiarize themselves with the associated hazards. Do not accept any container without an adequate identifying label.

When hand carrying chemicals, place the container inside another container or bucket. Always handle gas cylinders as if they were full. Use only approved gas cylinder carts to transport cylinders (other than small cylinders and lecture bottles). Before moving the cylinder, turn off the valve, remove the regulator, and replace the cap. Secure all gas cylinders with a strap, chain, or other restraining device during transport, storage, and use.

D. Storeroom Storage

General chemical storage plans should consider chemical incompatibilities. Use all appropriate means for safe storage including segregation, separation, and secondary containment. For example, segregate toxic substances and reactive chemicals in well-identified areas with local exhaust ventilation.

See Appendix B for suggested storage shelf patterns. Examine stored chemicals at least annually for deterioration and container integrity and replace as indicated.

Note again that **peroxide-forming chemicals** (see Appendix C) require special attention, even during storage. Label peroxide-forming chemicals as such and store them away from heat and sunlight. Test stored peroxide-forming chemicals annually for organic peroxides before each use.

E. Laboratory storage

The amounts of hazardous chemicals permitted in laboratories should be as small as practical and must comply with federal, state, and local safety and fire regulations.

Do not store hazardous chemicals on bench tops or above eye level (Prudent Practices in the Laboratory: Handling and Management of Chemical Hazards, Updated Version (Laboratory Safety, 2011). Follow the guidelines in Appendix B for segregating incompatible chemicals. Provide anti-roll-off lips on all shelves. Keep hazardous chemical storage cabinet doors shut. Use flammable storage and acid/base storage cabinets as indicated. Never store chemicals on the floor.

If possible, return unused chemicals to the storeroom.

F. Labeling Requirements of Hazardous Chemicals in the Laboratory

Chemical containers must always be labeled with one of the following labeling schemes:

1. Original Manufacturer Label: The original, manufacturer labels on hazardous chemicals that are entering the laboratory may not be removed or defaced. Containers should be labeled with the date received and the date opened.

2. Secondary Label: If a chemical is removed from its original container and placed into another container (e.g., beaker, flask, vessel) the following information must be present:
   a) Full name(s) and/or other identifier(s) of the chemical(s)
   b) Hazard warning (danger, warning) – from the SDS
   c) Hazardous properties of the chemical/solution (e.g., toxic, flammable, reactive), in words or using pictograms – from the SDS
   d) Date of preparation or transfer is also recommended if there is room on the container

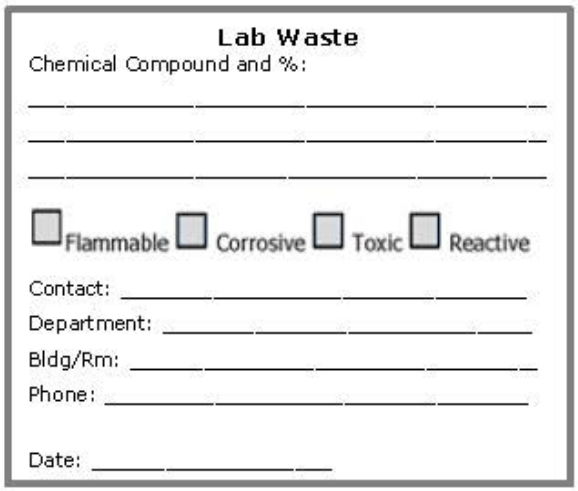
3. Waste Label: In accordance with the University's Laboratory Management Plan, all waste containers must have the following information affixed or attached to the container:
   a) The words "Lab Waste".
   b) Risk label that conveys information about the contents and hazards of the container (e.g., name or list of chemicals or hazard classes).

c) Information sufficient to make a Hazardous Waste determination (may be affixed or attached if necessary).
d) Accumulation Start Date of the container.

Note that, if the container is still in use, but is for the collection of waste, it may require BOTH a secondary label and a waste label. Ask your Laboratory Supervisor if you have a question.

G. Waste Disposal

Collect hazardous waste in clearly labeled containers. Keep a waste log that indicates the quantities of all chemical components. The label description should include the chemical name (no abbreviations), your department, and your location. Unlabeled chemical waste creates a potential hazard to lab staff and serious problems for waste disposal staff.



For any questions about hazardous waste collection and disposal, or more information, call the Chemistry Storeroom Coordinator (253-879-3350) or the EHS Manager through the Facilities Help Desk (253-879-3713).

IX. ENVIRONMENTAL MONITORING

Regular monitoring of airborne concentrations is not usually necessary in laboratories. Air monitoring may be appropriate, depending on the nature of the chemical, the method(s) by which it is used, the quantities used, and the regularity of use.

The University of Puget Sound will annually conduct an exposure evaluation as required by WAC 296-828-20010. Additionally, the EHS Manager must approve highly-hazardous chemicals prior to purchase. Either the annual evaluation or approval for use may require initial air monitoring. Highly-hazardous chemicals include the chemicals listed in Table 2 of WAC 296-828-100 and P-listed chemicals (listed by the EPA as "acutely toxic"), as well as select carcinogens, reproductive toxins, and chemicals with high degree of acute toxicity or highly hazardous physical properties, such as peroxide formers.

Otherwise, if there is reason to believe exposure levels for any substance may exceed the action level or PEL, contact the EHS Manager through the Facilities Help Desk (253-879-3713), for information and/or advice.

X. MEDICAL EVALUATIONS

Medical evaluations will be made available at a reasonable time and place and at no cost to the employee (including no loss of wages) in the following situations:

- A faculty, staff, or student worker develops signs or symptoms associated with laboratory exposure to a hazardous substance.
- Following any emergency situation that involves a significant hazardous exposure, such as a spill, leak, or explosion.
- When a medical provider recommends a follow-up evaluation.
- After exposure monitoring for any of the substances found in Table 2 of WAC 296-828-100 reveals exposures routinely over the action level (AL) or in the absence of an AL the PEL.

In the event that a medical evaluation is required, the EHS Manager will provide the Licensed Healthcare Provider (LHCP) with the following information before the medical evaluation is performed:

- The name of the hazardous chemicals to which the person may have been exposed.
- Any signs or symptoms of exposure.
- A description of the conditions under which the exposure occurred.
- The exposure monitoring results for the conditions, if available.

The EHS Manager will 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 person's risk for impairment from exposure to a hazardous chemical.
- A statement that the person has been informed of exposure-related medical results and conditions that require further examination or treatment.
- A written opinion that does not contain any medical information unrelated to the person's occupational exposures.

The EHS Manager will review LHCP's written opinion. If it contains any medical information unrelated to occupational exposures, it will be returned it to the LHCP and a revised version (without the additional medical information) will be retained.

XI. SIGNAGE

Prominent signage includes:

- Emergency postings and evacuation routes.
- Location signs indicating SDS, safety showers, eyewash stations, other safety and first aid equipment, fire extinguishers, exits, and areas where food and beverage consumption and storage are permitted or prohibited.
- National Fire Protection Association (NFPA) and Global Harmonized System (GHS) signs/symbols as appropriate for special or unusual hazards that could impact firefighters/first responders to an incident.

XII. WORKING WITH HIGHLY HAZARDOUS SUBSTANCES

Highly-hazardous chemicals include the chemicals listed in Table 2 of WAC 296-828-100 and P and U listed chemicals (listed by the EPA as "acutely toxic", https://rcrapublic.epa.gov/rcrainfoweb/action/modules/main/glossary/;jsessionid=87A6538C5B0D5F01631DBE60EF88C3ED?waste=&d-7106334-p=1), as well as select carcinogens, reproductive toxins, and chemicals with high degree of acute toxicity or highly hazardous physical properties, such as peroxide formers. Refer also to Section XIV, Definitions.

The EHS Manager will work with the department or laboratory to consult SDSs and WISHA or ANSI standards, as well as other appropriate references, to ensure that the appropriate procedures are being used and the necessary protective gear is in use. Avoid exposure to these toxic substances via various routes by using all reasonable precautions:

- Have at least two people present at all times.
- Always use fume hoods, glove boxes, proper PPE, such as chemically compatible gloves, long sleeves, goggles, and other equipment as recommended.
- Protect surfaces from contamination.
- Only use **mechanical** pipetting aids for all pipetting procedures; **never** pipetting by mouth.
- Wash hands and arms immediately after working with these materials.
- Report all accidents, incidents, and near misses (those unplanned events that did not result in injury, illness, or damage – but had the potential to do so) to your Laboratory Supervisor and file a University of Puget Sound incident/accident form.
- If you feel you may have been exposed, let your Laboratory Supervisor know, so that you may be sent for medical follow-up, or call Security Services (253-879-3311) if your concern is urgent.

As stated previously, highly hazardous chemicals (Section XII and XIV) must be approved before use by the EHS Manager. Additional requirements may include Controlled Area designation, the use of glove boxes or other more protective types of local exhaust ventilation, changes to general room ventilation, special handling and/or PPE requirements, decontamination procedures, exit procedures, and signage. In each case, if it is determined that the chemical must be used, the facility design considerations should first be addressed, after which an SOP addressing the specific requirements of the chemical and its use should be prepared.

XIII. TRAINING

Affected employees will be informed about the presence of hazardous chemicals at the time of initial assignment to a work area where hazardous chemicals are present and prior to situations involving a new exposure to hazardous chemicals.

Required training will address all of the following:

- Methods and observations for detecting the presence or release of hazardous substances, including monitoring conducted by the University, the presence and use of any continuous monitoring devices, and the 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, including appropriate work practices, emergency procedures, and PPE.
- Information on the contents of WAC 296-828 and where to find a copy.
- PELs found in chapter WAC 296-841, Respiratory hazards.
- Any recommended exposure levels for compounds without an exposure limit in the WISHA rules, as well as the Recommended Exposure Limits (RELs) 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), most recent edition.
- Signs and symptoms associated with exposures to hazardous chemicals used in the laboratory.
- Where to find a copy of the University's CHP, SDSs, and reference material on the hazards, safe handling, storage, and disposal of hazardous chemicals found in the laboratory.

Refresher training will be provided annually and as needed when there are changes to the Chemical Hygiene Plan.

XIV. DEFINITIONS

Action level. An airborne concentration of a hazardous substance that is 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 is not 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:

(a) Barrel.
(b) Bottle.
(c) Can.
(d) Cylinder.
(e) Drum.
(f) Reaction vessel.
(g) Storage tank.

Day. Any part of a calendar day.

Designated representative. Any one of the following:

(a) Any individual or organization to which an employee gives written authorization.
(b) A recognized or certified collective bargaining agent without regard to written employee authorization.
(c) 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. Any chemical which is classified as health hazard or simple asphyxiate in accordance with the Hazard Communication Standard, WAC 296-901-140.

Health hazard. A chemical which is classified as posing one of the following hazardous effects: Acute toxicity (any route of exposure); skin corrosion or irritation; serious eye damage or eye irritation; respiratory or skin sensitization; germ cell mutagenicity; carcinogenicity; reproductive toxicity; specific target organ toxicity (single or repeated exposure); or aspiration hazard. The criteria for determining whether a chemical is classified as a health hazard are detailed in WAC 296-901-14022, Appendix A—Health hazard criteria.

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.

Laboratory-type hood. A device located in a laboratory, enclosure on five sides with a moveable sash or fixed partially 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 are not compromised, and employees do not 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:

(a) Chemical manipulations conducted on a "laboratory scale";
(b) Multiple chemical procedures or chemicals are used;
(c) The procedures are not part of a production process, nor in any way simulate a production process; and
(d) "Protective laboratory practices and equipment" are available and are commonly used to minimize the potential for employee exposures to hazardous substances.

Licensed health care professional (LHCP). An individual whose legally permitted scope of practice allows him or her to provide some or all of the health care services required for medical evaluations.

Mutagen. Chemicals that cause permanent changes in the amount or structure of the genetic material in a cell. Chemicals classified as mutagens in accordance with the Hazard Communication Standard, WAC 296-901-140 must be considered mutagens for purposes of this section.

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. A chemical that is classified as posing one of the following hazardous effects: Explosive; flammable (gases, aerosols, liquids, or solids); oxidizer (liquid, solid, or gas); self-reactive; pyrophoric (gas, liquid, or solid); self-heating; organic peroxide; corrosive to metal; gas under pressure; in contact with water emits flammable gas; or combustible dust. The criteria for determining whether a chemical is classified as a physical hazard are in Appendix B of the Hazard Communication Standard, WAC 296-901-14024 and 296-901-14006 (definitions of "combustible dust" and "pyrophoric gas").

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 the reproductive capabilities including adverse effects on sexual function and fertility in adult males and females, as well as adverse effects on the development of the offspring. Chemicals classified as reproductive toxins in accordance with the Hazard Communication Standard, WAC 296-901-140 shall be considered reproductive toxins for purposes of this section.

Safety data sheet (SDS). 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 safety data sheet and label preparation, WAC 296-901-14012 and 296-901-14014.

Select carcinogen. Any substance meeting one of the following criteria:

(a) Regulated by WISHA as a carcinogen.
(b) Listed in the "known to be carcinogens" category in the latest edition of the *Annual Report on Carcinogens* by the National Toxicity Program (NTP).
(c) Listed in Group I (carcinogenic to humans) in the latest editions of the International Agency for Research on Cancer (IARC) Monographs.
(d) 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:
(i) After an inhalation exposure of six to seven hours a day; five days a week; for a significant portion of a lifetime to dosages of less than 10 mg/m3; **or**
(ii) After repeated skin application of less than 300 mg/kg of body weight per week; **or**
(iii) After oral dosages of less than 50 mg/kg of body weight per day.

Time-weighted average (TWA8). An exposure limit averaged over an 8-hour period that must not be exceeded during an employee's workday.

XV. POLICY HISTORY AND REVIEW

Author:	Facilities Services	
Review/Approval By:	Gaylen Nuckols (Environmental Health & Safety Manager - Facilities Services)	
Effective Date:	September 20, 2011	
Program Review:	Reviewed/updated by: David Hill and Michelle Copeland	Date: November 5, 2018
	Updates/changes, with rationale: General revision in response to questions raised in L&I inspection.	
	Reviewed/updated by: Alyce DeMarais and Gaylen Nuckols	Date: March 13, 2019
	Updates/changes, with rationale: Minor typographical errors, storage compatibility, definitions, EHS Manger contact info, Peroxide forming chemical information table	
	Reviewed/updated by:	Date:
	Updates/changes, with rationale:	

Appendix A: Chemical Resistance Guide

The CPC rating is based on a system designed and published by Forsberg (Reference: Forsberg and Keith (1997), *Chemical Protective Clothing Performance Index Book.)*
CPC ratings rely on both breakthrough times and permeation rates to establish a rating system for chemical protective clothing.[1] Standard breakthrough testing method uses ASTM F739-91 Normalized Breakthrough Times in Minutes and CPC Rating for Best Gloves Breakthrough detection times (BDT) are giving in minutes.

Chemical Protective Clothing Performance Index Rating Summary (CPC)

0 -------- Best safest selection for unlimited exposure (no breakthrough)
1 -------- Next best selection for unlimited exposure.
2 -------- Sometimes satisfactory (good for limited exposure).
3 -------- Poor choice (not for heavy exposure).
4 -------- Very poor (for splashes only).
5 -------- Not recommended

Best Manufacturing Company provided this information, which applicable only to Best gloves.

Chemicals by Class	**Neoprene**		**Nitrile**		**Rubber**		**PVC**		**Butyl**		**Viton**	
	BDT	CPC	BDT	CPC	BDT	CPC	BDT	CPC	BDT	CPC	BDT	CPC
Aliphatic Solvents												
Cyclohexane	21	2	9	0	55	5	13	3	ND	4	NR	0
Gasoline (Unleaded)	46	3	46	0	NR	5	22	3	NR	5	ND	0
Heptane	ND	0	ND	0	24	3	39	4	23	4	ND	0
Hexane	173	2	234	0	21	4	29	3	13	5	ND	0
Isooctane	ND	0	ND	0	57	3	114	3	56	4	ND	0
Kerosene	ND	0	ND	0	NR	5	ND	0	94	4	ND	0
Petroleum Ethers	99	2	ND	0	5	5	19	4	15	4	ND	0
Acids, Organic												
Acetic 84%	ND	0	240	5	ND	0	300	2	ND	0	ND	0
Formic 90%	ND	0	75	0	ND	0	ND	0	ND	0	120	0
Acids, Mineral												
Battery 47%	ND	0	ND	0	ND	0	ND	0	ND	0	ND	0
Hydrochloric 37%	ND	0	ND	0	ND	0	ND	0	ND	0	ND	0
Hydrofluoric 48%	ND	0	60	3	45	3	110	2	ND	0	185	1
Muriatic 10%	ND	0	ND	0	ND	0	ND	4	ND	0	ND	0
Nitric 70%	ND	0	NR	5	ND	0	240	5	ND	0	ND	0
Sulfuric 97%	ND	0	180	3	ND	0	210	5	ND	0	ND	0

Chemicals by Class	Neoprene		Nitrile		Rubber		PVC		Butyl		Viton	
Alcohols												
Amyl	ND	0	ND	0	ND	0	116	2	ND	0	ND	0
Butyl	ND	0	ND	0	ND	0	155	2	ND	0	ND	0
Cresols	ND	0	NR	5	371	2	ND	0	ND	0	ND	0
Ethyl	ND	0	225	4	ND	0	66	2	ND	0	ND	0
Methyl	226	1	28	3	82	2	39	4	ND	0	ND	0
Isobutyl	ND	0	ND	0	ND	0	ND	2	ND	0	ND	0
Aldehydes												
Acetaldehyde	21	3	NR	5	55	3	13	5	ND	0	NR	5
Benzaldehyde	93	3	NR	5	81	3	NR	5	ND	0	ND	0
Formaldehyde	ND	0	ND	0	ND	0	ND	0	ND	0	ND	0
Furfural	165	2	NR	5	ND	0	85	3	ND	0	298	3
Alkalis												
Ammonium Hydroxide	ND	0	240	3	120	3	60	4	ND	0	ND	0
Potassium Hydroxide	ND	0	ND	0	ND	0	ND	0	ND	0	ND	0
Sodium Hydroxide	ND	0	ND	0	ND	0	ND	0	ND	0	ND	0
Amides												
Dimethylacetamide	84	3	NR	5	29	4	51	4	ND	0	NR	5
Dimethylformamide	100	3	NR	5	ND	0	NR	5	ND	0	NR	5
N-MethylPyrrolidone	ND	0	34	3	ND	0	140	4	ND	0	NR	5
Amines												
Aniline	32	3	NR	5	1	4	71	3	ND	0	ND	0
Butylamine	NR	5	NR	5	45	3	15	3	45	3	NR	5
Diethylamine	23	5	60	5	60	5	107	4	30	3	9	5
Aromatic Solvents												
Benzene	15	5	16	4	NR	5	13	5	34	4	ND	0
Toluene	25	4	26	4	NR	5	19	4	22	4	ND	0
Xylene	37	4	41	4	NR	5	23	3	NR	5	ND	0
Chlorinated Solvents												
Carbon Tetrachloride	73	4	ND	0	NR	5	46	4	53	4	ND	0
Chloroform	23	4	6	5	NR	5	10	5	21	4	ND	0
Methylene Chloride	NR	5	4	5	NR	5	NR	5	20	4	113	3
Perchloroethylene	40	4	ND	0	NR	5	NR	5	28	4	ND	0
Trichloroethylene	12	5	9	5	NR	5	NR	5	13	5	ND	0

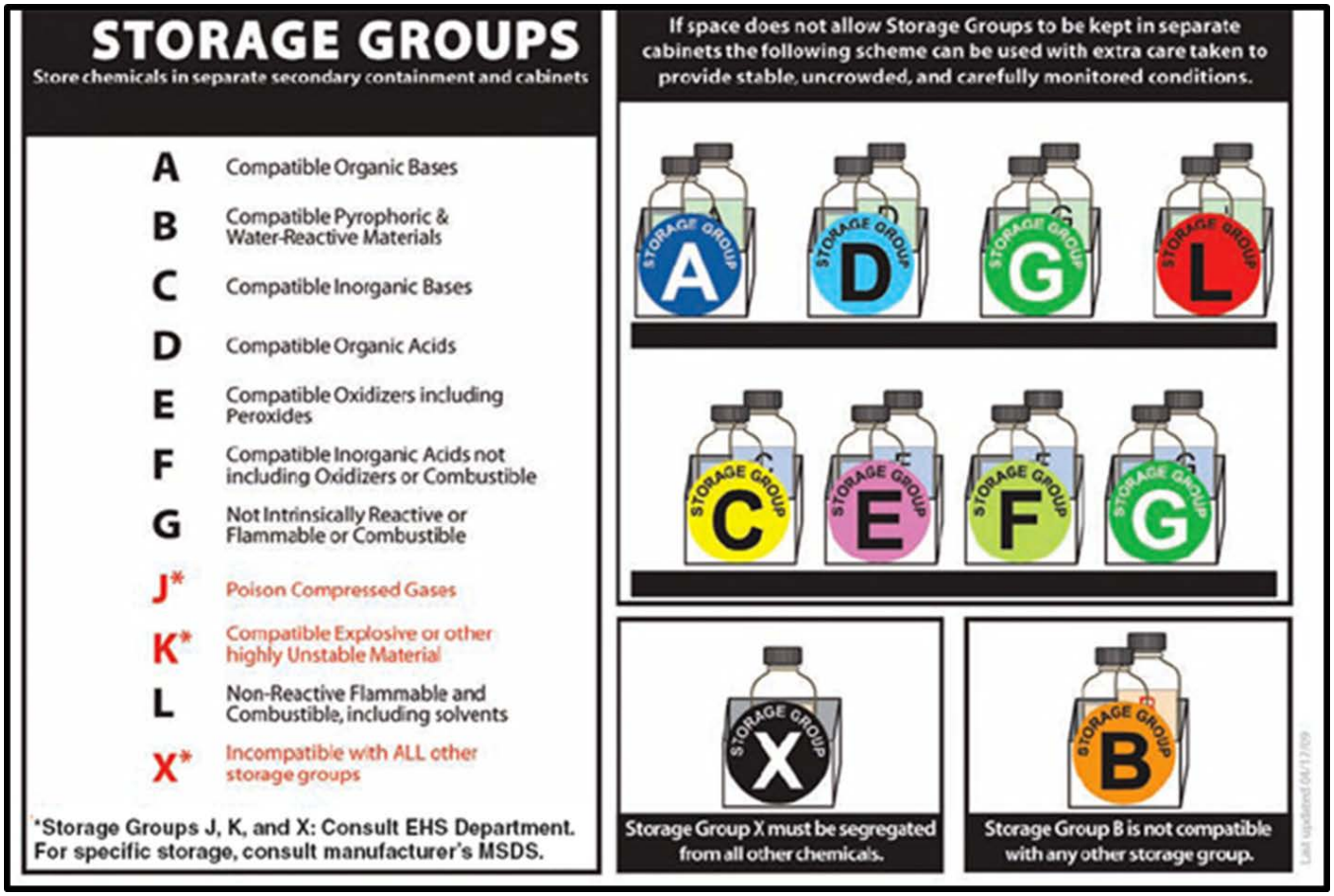
1,1,1-Trichloroethane	51	4	49	4	NR	5	52	3	72	4	ND	0
Chemicals by Class	**Neoprene**		**Nitrile**		**Rubber**		**PVC**		**Butyl**		**Viton**	
Esters												
Amyl Acetate	110	3	77	4	NR	5	NR	5	158	3	NR	5
Ethyl Acetate	12	5	33	4	11	5	14	5	19	5	29	5
Methyl Methacrylate	27	3	NR	5	77	3	NR	5	63	3	NR	5
Ethers												
Cellosolve Acetate	228	3	47	4	107	3	64	4	ND	0	NR	5
Ethyl Ether	12	5	33	4	11	5	14	5	19	5	29	5
Tetrahydrofura	13	5	5	5	NR	5	NR	5	24	4	NR	5
Gases												
Ammonia, Anhydrous	29	2	336	1	4	4	19	3	ND	0	ND	0
1,3-Butadiene	33	3	ND	0	25	3	24	3	473	2	ND	0
Chlorine	ND	0	ND	0	ND	0	360	2	ND	0	ND	0
Ethylene Oxide	21	4	17	5	1	5	1	5	189	2	48	4
Hydrogen Fluoride	210	2	1	5	142	1	1	5	ND	0	6	3
Methyl Chloride	84	1	ND	0	52	2	ND	0	ND	0	ND	0
Vinyl Chloride	7	4	ND	0	2	4	19	3	268	1	ND	0
Ketones												
Acetone	35	3	3	5	9	5	7	5	ND	0	NR	5
Methyl Ethyl Ketone	30	3	NR	5	12	5	NR	5	202	2	NR	5
MIBK	41	3	5	5	38	4	NR	5	292	2	NR	5
Nitriles												
Acetontrile	65	3	6	5	16	3	24	4	ND	0	NR	5
Acrylonitrile	27	3	NR	5	48	3	14	5	ND	0	55	4

"ND" indicates "non detectable." No breakthrough detected after eight hours. "NR" indicates "not recommended."

Appendix B: Suggested Shelf Patterns for Chemical Storage

For reasons of incompatibility, it is recommended not to store chemicals alphabetically. Some chemicals that can react violently with each other when stored in close proximity. If shelf space is a problem, place more than one family on a shelf separated by a physical divider or a 3" space between each family.

Prudent Practices in the Laboratory: Handling and Management of Chemical Hazards, Updated Version (2011) recommends storing chemicals in the following way.



Appendix C: Organic Peroxide List

Class A - Severe Peroxide Hazard

Spontaneously decompose and become explosive with exposure to air without concentration.

Butadiene (liquid monomer)	**Isopropyl ether**	**Sodium amide (sodamide)**
Chloroprene (liquid monomer)	**Potassium amide**	Tetrafluoroethylene (liquid monomer)
Divinyl ether	Potassium metal	**Vinylidene chloride**

Bold chemicals constitute the UC Class 1 Settlement Agreement list.

Class B - Concentration Hazard

Require external energy for spontaneous decomposition. Form explosive peroxides when distilled, evaporated or otherwise concentrated.

Acetal	Diethylene glycol dimethyl ether (diglyme)	4-Methyl-2-pentanol
Acetaldehyde	**Diethyl ether (ether)**	2-Pentanol
Benzyl alcohol	**Dioxanes**	4-Penten-1-ol
2-Butanol	**Ethylene glycol ether acetates (glyme)**	1-Phenylethanol
Cumene	**Furan**	2-Phenylethanol
Cyclohexanol	4-Heptanol	**Tetrahydrofuran (THF)**
Cyclohexene	2-Hexanol	Tetrahydronaphthalene (tetralin)
2-Cyclohexen-1-ol	**Methylacetylene (gas)**	**Vinyl ethers**
Decahydronaphthalene (decalin)	3-Methyl-1-butanol	Other secondary alcohols
Diacetylene (butadine, gas)	**Methyl cyclopentane**	
Dicyclopentadiene	**Methyl isobutyl ketone**	

Bold chemicals constitute the UC Class 2 Settlement Agreement list.

Class C - Shock and Heat Sensitive

Highly reactive and can auto-polymerize as a result of internal peroxide accumulation. The peroxides formed in these reactions are extremely shock- and heat-sensitive.

Acrylic acid	**Chlorotrifluoroethylene (gas)**	**Vinylacetylene (gas)**
Acrylonitrile	**Methyl methacrylate**	**Vinyladiene chloride**
Butadiene (gas)	**Styrene**	**Vinyl chloride (gas)**
Chlorobutadiene	**Tetrafluoroethylene (gas)**	**Vinyl pyridine**
Chloroprene	**Vinyl acetate**	

Bold chemicals constitute the UC Class 3 Settlement Agreement list.

Class D - Potential Peroxide Forming Chemicals

May form peroxides but cannot be clearly categorized in Class A, B, or C.

Acrolein	p-Chlorophenetole	4,5-Hexadien-2-yn-1-ol

Allyl ether	Cyclooctene	n-Hexyl ether
Allyl ethyl ether	Cyclopropyl methyl ether	o.p-Iodophenetole
Allyl phenyl ether	Diallyl ether	Isoamyl benzyl ether
p-(n-Amyloxy)benzoyl chloride	p-Di-n-butoxybenzene	Isoamyl ether
n-Amyl ether	1,2-Dibenzyloxyethane	Isobutyl vinyl ether
Benzyl n-butyl ether	p-Dibenzyloxybenzene	Isophorone
Benzyl ether	1,2-Dichloroethyl ethyl ether	b-Isopropoxypropionitrile
Benzyl ethyl ether	2,4-Dichlorophenetole	Isopropyl-2,4,5-trichlorophenoxy acetate
Benzyl methyl ether	Diethoxymethane	n-Methylphenetole
Benzyl-1-napthyl ether	2,2-Diethoxypropane	2-Methyltetrahydrofuran
1,2-Bis(2-chloroethoxyl)ethane	Diethyl ethoxymethylenemalonate	3-Methoxy-1-butyl acetate
Bis(2-ethoxyethyl)ether	Diethyl fumarate	2-Methoxyethanol
Bis(2-(methoxyethoxy)ethyl) ether	Diethyl acetal	3-Methoxyethyl acetate
Bis(2-chloroethyl) ether	Diethylketene	2-Methoxyethyl vinyl ether
Bis(2-ethoxyethyl) adipate	Diethoxybenzene (m-,o-,p-)	Methoxy-1,3,5,7-cyclooctatetraene
Bis(2-methoxyethyl) carbonate	1,2-Diethoxyethane	b-Methoxypropionitrile
Bis(2-methoxyethyl) ether	Dimethoxymethane	m-Nitrophenetole
Bis(2-methoxyethyl) phthalate	1,1-Dimethoxyethane	1-Octene
Bis(2-methoxymethyl) adipate	Di(1-propynl) ether	Oxybis(2-ethyl acetate)
Bis(2-n-butoxyethyl) phthalate	Di(2-propynl) ether	Oxybis(2-ethyl benzoate)
Bis(2-phenoxyethyl) ether	Di-n-propoxymethane	b,b-Oxydipropionitrile
Bis(4-chlorobutyl) ether	1,2-Epoxy-3-isopropoxypropane	1-Pentene
Bis(chloromethyl) ether	1,2-Epoxy-3-phenoxypropane	Phenoxyacetyl chloride
2-Bromomethyl ethyl ether	p-Ethoxyacetophenone	a-Phenoxypropionyl chloride
beta-Bromophenetole	1-(2-Ethoxyethoxy)ethyl acetate	Phenyl-o-propyl ether
o-Bromophenetole	2-Ethoxyethyl acetate	p-Phenylphenetone
p-Bromophenetole	(2-Ethoxyethyl)-a-benzoyl benzoate	n-Propyl ether
3-Bromopropyl phenyl ether	1-Ethoxynaphthalene	n-Propyl isopropyl ether
tert-Butyl methyl ether	o,p-Ethoxyphenyl isocyanate	Sodium 8-11-14-eicosatetraenoate
n-Butyl phenyl ether	1-Ethoxy-2-propyne	Sodium ethoxyacetylide
n-Butyl vinyl ether	3-Ethoxypropionitrile	Tetrahydropyran
Chloroacetaldehyde diethylacetal	2-Ethylacrylaldehyde oxime	Triethylene glycol diacetate
2-Chlorobutadiene	2-Ethylbutanol	Triethylene glycol dipropionate
1-(2-Chloroethoxy)-2-phenoxyethane	Ethyl-b-ethoxypropionate	1,3,3-Trimethoxypropene
Chloroethylene	Ethylene glycol monomethyl ether	1,1,2,3-Tetrachloro-1,3-butadiene
Chloromethyl methyl ether	2-Ethylhexanal	4-Vinyl cyclohexene
beta-Chlorophenetole	Ethyl vinyl ether	Vinylene carbonate
o-Chorophenol	2,5-Hexadiyn-1-ol	