Weber State University

Chemical Hygiene Plan

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1. INTRODUCTION

The Chemical Hygiene Plan (CHP) is put in place in response to the federal Occupational Health and Safety Administration (OSHA) regulation, Occupational Exposures to Hazardous Chemicals in the Laboratory (29 CFR 1910.1450) commonly referred to as the "**Laboratory Standard.**"

The CHP is designed to minimize the risks from potential hazards associated with the use of chemicals. Exposure to a chemical may cause damage or injury. Chemicals may be toxic, carcinogenic, flammable, corrosive, or reactive with water, air, or other material. Potential hazards should be identified from "cradle-to-grave," extending from procurement through storage, handling, and disposal of chemicals in the laboratory to protect all personnel from potential health hazards.

All personnel working in the laboratories, including employees, students, and visitors, are responsible for adherence to the CHP. This CHP is a companion to specific standard operating procedures (SOPs), and all laboratory workers must be made aware of procedure-specific relevant documents. New employees should receive safety training before beginning work with hazardous chemicals. The SOPs should be available to laboratory workers which are created and maintained by lab or instructors.

This document is not intended to be a comprehensive listing of all laboratory hazards or safe practices. Additional documents, requirements, and procedures may be necessary. For example, laboratories working with biological agents, animals, or radioisotopes must adhere to those specific plans and require additional training. Please contact WSU Environmental Health and Safety (EHS) for information on these programs.

2. CHEMICAL HYGIENE COMMITTEE

The committee members consist of the Chemical Hygiene Officer, the Department of Public Safety representative, Environmental Health and Safety representative, a University Fire Marshal representative, a representative from college/departments that use hazardous chemicals.

3. SCOPE AND APPLICATION

The CHP covers all the Weber State University (WSU) campus personnel that work with chemicals in any laboratory. This includes faculty, staff, laboratory managers, research students, teaching assistants, students, and visitors, depending upon their activities.

A chemical may pose a physical hazard if it is classified (or analogous to known materials) as:

- A flammable or combustible liquid
- A compressed gas
- An organic peroxide
- An explosive
- An oxidizer
- A pyrophoric, unstable, or reactive material

A chemical may present a health hazard if there is accepted scientific evidence that it presents acute or chronic health effects. Such chemicals include:

- Allergens
- Carcinogens
- Reproductive toxins (teratogens/mutagens)
- Corrosives
- Hepatoxins (liver)
- Neurotoxins (nervous system)
- Nephrotoxins (kidneys)
- Hematopoietic systems agents (blood)
- Agents which damage lungs, skin, eyes or mucous membranes
- Toxic agents

4. ROLES AND RESPONSIBILITIES

4.1 Lab supervisor, faculty instructor, faculty principal investigator

The laboratory supervisor, faculty instructor, or faculty principal investigator (PI) is responsible for the implementation of the CHP in his/her laboratory and shall:

- Post emergency contact information.
- Ensure that laboratory workers and students are trained and follow the CHP outlined in this document, and are informed on the location of reference materials on hazards, safe handling, storage, and disposal of chemicals, including Safety Data Sheets (SDSs).
- Communicate to the proper departments to ensure that the necessary protective and emergency equipment are available and that appropriate training has been provided.
- Ensure that periodic laboratory self-inspections are performed.
- Complete and maintain a chemical inventory.
- Maintain a physical presence for the duration of instructional laboratory sessions.
- Prepare lab-specific SOPs.
- Report and investigate all incidents and take immediate corrective action to prevent re-occurrence, e.g.:
    - Failure of any equipment used in the process, especially of safeguards such as chemical fume hoods.
    - Members of the laboratory staff become ill, suspect that they or others have been exposed, or otherwise suspect a failure of any safeguards.
- Know current legal requirements concerning regulated substances.
- Review and evaluate the effectiveness of your laboratory-specific chemical safety protocol at least annually and update as necessary.
- Apprise EHS Chemical Hygiene Officer (CHO) of lab relocations, closings, and new lab space assignments.
- Obtain prior approval from WSU EHS to proceed with a laboratory task when:
    - If radioactive materials will be used, consult with the Radiation Safety

Officer.
- Recombinant DNA of Biosafety Level 2 or greater will be used and biological material of risk Biosafety Level 2 or greater will be used.
- It is likely that exposure limit concentrations could be exceeded or that other harm is likely.
- New processes in which significant hazards, transient traffic control, and handling requirements are involved.

4.2 Laboratory employees are responsible for:

- Planning and conducting each operation in accordance with practices and procedures established in this CHP
- Using equipment only for its designed purpose
- Being familiar with emergency procedures, including knowledge of the location and use of emergency equipment for the laboratory, as well as how to obtain additional help in an emergency
- Knowing the types of protective equipment available and using the proper type for each procedure
- Being alert to unsafe conditions and actions and calling attention to them so corrections can be made as soon as possible

4.3 Chemical Hygiene Officer (CHO):

The CHO is an employee designated by the employer who is qualified by training or experience to provide technical guidance in the development and implementation of the provisions of the CHP. The CHO for the university is provided by the EHS department. The CHO shall:

- Assist supervisors, PIs, and other laboratory employees with the development and implementation of appropriate chemical hygiene procedures and practices, including providing consultation and information.
- Keep abreast of legal requirements concerning regulated substances and communicate any changes to supervisors, PIs, and laboratory employees.
- Maintain records, including training records.
- Coordinate with the Hazardous Materials Safety Specialist.
- Maintain guidelines for waste disposal.
- Conduct inspections and audits, including storage/laboratory areas, showers, and eyewash stations.
- Require attendance and training at safety meetings.

4.4 All Employees and Students must:

- Follow safe work practices, and, if they are unsure of what is the correct/safe way to perform a task or a job, they are to ask their instructor or teaching assistant, lab manager, or immediate supervisor or manager.
- Immediately report all unsafe equipment or tools to their instructor or teaching assistant, lab manager, or immediate supervisor or manager. This includes

reporting unsafe behavior of other workers if these workers are approached and remain unwilling to correct their unsafe actions or conditions.
- Uphold the safe work practices the CHP has established.
- Immediately inform their instructor or teaching assistant, lab manager, or immediate supervisor if they are injured or become ill on the job. The Department Chair must also be notified as soon as possible.

5. GENERAL PROCEDURES

The general rules for working in the laboratory are listed below. SOPs relevant to specific operations must also be reviewed prior to beginning those specific laboratory operations.

5.1 For chemicals with which they are working, all employees should know:

- The chemical's hazards, as determined from the SDS and other appropriate references
- Appropriate safeguards for using that chemical, including personal protective equipment
- How to properly store the chemical when it is not in use
- Proper chemical waste disposal procedures
- Proper personal hygiene practices
- Appropriate procedures for emergencies, including first aid, evacuation routes, and spill cleanup procedures

5.2 As part of the safety program, each lab must have a current chemical inventory.

5.3 Employees should avoid working alone.

Arrangements should be made between individuals working in separate laboratories outside of regular working hours to cross check each other periodically. An employee who is alone in the laboratory should not undertake experiments known to be greater than normal risk. The supervisor and the Pl should be aware of all activities conducted by students and student workers.

5.4 Personal hygiene guidelines must be followed by all lab personnel as follows:

- Wash promptly whenever a chemical has contacted your skin. For corrosive materials, flush for at least 15 minutes prior to seeking medical attention.
- Avoid inhalation of chemicals. Do not "sniff' to test chemicals.
- Do not use mouth suction for any pipetting. Pipetting aids must be used at all times.
- Do not bring food (including gum and candy), beverages, tobacco, or cosmetic products into chemical storage or use areas. Eating, drinking, and applying cosmetics is allowed in designated areas only.
- Smoking is prohibited in all university facilities.
- After handling hazardous chemicals, wash well with soap and water before leaving the laboratory. Avoid the use of solvents for washing skin. Solvents remove the natural protective oils from skin and can cause irritation and

inflammation. In some cases, washing with solvent may facilitate absorption of toxic chemicals.

5.5 Housekeeping

Housekeeping is directly related to safety and must be given importance of equal value to other procedures. Lack of good housekeeping reduces work efficiency and may result in accidents. Laboratory personnel must adhere to the following:

- Access to emergency equipment, showers, eyewashes, fire extinguishers, exits and circuit breakers should not be blocked or obstructed.
- Chemical containers should be regularly monitored for proper labeling and container integrity. Labels that are fading, falling off, or deteriorating must be promptly replaced. If abbreviations are used, they should be kept to a minimum and clearly identify the contents of the container as well as hazards associated with use; i.e., $HgCl_2$ / poison, HCl / corrosive, MeOH/flammable, H_20_2 /corrosive-oxidizer, nonhazardous buffer, etc. Improperly labeled or unlabeled chemicals make hazard identification and disposal difficult, and may create a hazard.
- All chemicals should be placed in their proper storage areas at the end of each workday. Liquids should be stored below solids.
- Each laboratory must have a puncture-resistant (e.g., cardboard) container designated explicitly for glassware disposal.
- Sharps (needles, scalpels, razor blades) must be disposed of in "sharps" containers.
- At the end of each workday, the contents of all unlabeled containers are to be considered waste and disposed of appropriately. Collection containers for wastes must be clearly labeled, including hazard identification.
- All work areas, especially laboratory bench tops, should be kept clear of clutter.
- All aisles, corridors, stairs, and stairwells shall be kept clear of chemicals, equipment, supplies, boxes, and debris.
- Overhead storage must be kept no closer than 18" to the ceiling for sprinkled rooms, 24" for non-sprinkled rooms.
- Food and drink for human consumption shall not be kept in the same refrigerator used to store chemicals and laboratory samples. In addition, eating and office areas must be clearly separated from laboratory and chemical storage areas.
- Spent containers shall be treated in the following manner:
    - For water-soluble solvent containers: triple rinse, deface the label, relabel as "empty," and dispose of with normal trash.
    - For non-water-soluble solvent containers: triple rinse using a solvent capable of removing the chemical. All rinsate must be collected in a hazardous waste disposal container. Deface the label, relabel it as "empty," and dispose of it with normal trash.

5.6 Protective clothing and equipment guidelines are as follows:

- Carefully inspect all protective equipment prior to use. Do not use defective equipment.
- Lab coats must be worn when the SOP supports its use.
- Eye protection (safety glasses, chemical-resistant goggles, or a face shield) shall be worn at all times in laboratories where chemicals are being used, including visitors. Ordinary prescription glasses are not considered effective eye protection unless they are ANSI approved and include the necessary side shielding. Chemical-resistant goggles or safety glasses large enough to cover prescription glasses while still eliminating gaps should be worn over prescription glasses.
- The wearing of contact lenses in the laboratory is very controversial. An individual wearing contact lenses must inform co-workers in the lab, so the lenses may be removed in the event of a chemical splash to the eyes. Consult with an optometrist prior to wearing them in the laboratory. Safety glasses or chemical-resistant goggles shall be worn over contacts at all times.
- When working with corrosive, toxic, allergenic, or sensitizing chemicals, rough or sharp-edged objects, very hot or very cold materials, gloves made of a material known to be resistant to permeation by the substance shall be worn. No one glove can protect against all hazards. Refer to a glove selection guide. Consult the manufacturer's performance chart or contact the CHO to determine the proper choice of glove material.
- Closed toe shoes must be worn at all times in the laboratory. Long pants must be worn when working with or around hazardous chemicals. Tight clothing, such as leggings, should be avoided, as spills may be held against the skin.
- Overly-loose and dangling clothing should not be worn in the laboratory, such as very loose trouser legs and sleeves. They may present a hazard during operations or by trapping chemicals.
- Clothing made of synthetic fibers should be avoided when working around flames and flammable materials.
- Long hair should be held in place behind the head.
- A full-body-length, non-permeable, chemical-resistant apron appropriate for the material being handled should be worn when the SOP supports its use.
- A proper respirator must be worn whenever exposure by inhalation is likely to exceed the action level or personnel exposure limit (PEL), and a fume hood is not accessible. Employees must be medically qualified, trained, and fit-tested prior to using a respirator. Consult your Pl and/or the CHO before doing any such work.

5.7 Lab Security

- Only those personnel that are trained and approved by the Lab Manager or Pl may work in laboratory facilities.
- Based on the laboratories' vulnerabilities, laboratories shall have appropriate access controls implemented.

6. CHEMICAL AND HAZARD IDENTIFICATION

Chemical manufacturers or distributors assess the physical and health hazards of each chemical they produce. This information is included in a safety data sheet (SDS) and, in part, on container labels.

The manufacturer's label should be kept intact. When a chemical is transferred to another container for storage, the new containers should be labeled with the product's name, the chemical constituents, and hazard warnings (unless for immediate use).

SDSs received with chemical shipments must be maintained and readily accessible to laboratory workers. SDSs for stored chemicals are available from the lab manager.

6.1 Chemical Storage

- Received chemicals shall be immediately moved to the designated storage area.
- Large glass containers shall be placed in carrying containers or shipping containers during transportation.
- The storage area shall be well-illuminated, with all storage maintained at or below eye level.
- Chemicals shall be segregated by hazard classification and compatibility in a well- identified area, with local exhaust ventilation.
- Highly toxic chemicals, or other chemicals with the potential to leak their contents after opening, shall be stored in unbreakable secondary containers.
- An “opened date” should be written on all containers which are being held in storage.
- The storage area shall not be used as a preparation or repackaging area.
- Storage of chemicals at the lab bench, in the fume hoods, or other work areas shall be minimized. The container size shall be the minimum for convenience. The amounts of chemicals at the lab bench shall be as small as practical. Chemicals in the workplace shall not be exposed to sunlight or heat.
- Stored chemicals shall be examined at least annually by the CHO and/or storage area manager for replacement, deterioration, and container integrity. The inspection should determine whether any corrosion, deterioration, or damage has occurred to the storage facility as a result of leaking chemicals.
- The CHO and/or laboratory manager shall conduct periodic inventories (at least annually) of chemicals in all storage areas. Unneeded items shall be properly discarded or returned to the storage area.

6.2 Segregation of Chemicals

Incompatible chemicals should not be stored together. Storing chemicals alphabetically, without regard to compatibility, can increase the risk of a hazardous reaction, especially in the event of container breakage. Table 1 is a recommended manner in which chemicals should be segregated. Questions regarding storage compatibility should be directed to the CHO.

Table 1. Recommended Segregation Within Inorganic Chemicals and Within Organic Chemicals in Storage	
Inorganic	**Organic**
Metals, Hydrides	Acids, Amino Acids, Anhydrides, Peracids
Acetates, Halides, Iodides, Sulfates, Sulfites, Thiosulfates, Phosphates, Halogens, Oxalates, Phthalates, Oleates	Alcohols, Glycols, Sugars, Amines, Amides, lmines, lmides
Amides, Nitrates (except Ammonium Nitrate*), Nitrites, Azides	Hydrocarbons, Esters, Aldehydes, Oils
Hydroxides, Oxides, Silicates, Carbonates, Carbon	Ethers, Ketones, Ketenes, Halogenated Hydrocarbons, Ethylene Oxide
Sulfides, Selenides, Phosphides, Carbides, Nitrides	Epoxy Compounds, lsocyanates
Chlorates, Bromates, lodates, Chlorites, Hypochlorites, Perchlorates, Perchloric Acid, Peroxides, Hydrogen Peroxide	Peroxides, Hydroperoxides, Azides
Arsenates, Cyanides, Cyanates	Sulfides, Polysulfides, Sulfoxides, Nitriles
Borates, Chromates, Manganates, Permanganates, Molybdates, Vanadates	Phenols, Cresols
Acids (except Nitric) (Nitric Acid is isolated and stored by itself.)	Dyes, Stains, Indicators
Sulfur, Phosphorus, Arsenic, Phosphorus Pentoxide	Organic miscellaneous
Inorganic miscellaneous	

*Ammonium nitrate is considered a DOT Class 5.1 oxidizer.

6.3 Flammable Liquids

Flammable liquids should be stored only in approved containers. Containers used

by the manufacturers of flammable liquids generally meet these specifications.

A flammable liquid storage cabinet is an approved cabinet that has been designed and constructed to protect the contents from external fires. Storage cabinets are usually equipped with vents plugged by the cabinet manufacturer. Since venting is not required by any code or by local municipalities and since venting may actually prevent the cabinet from protecting its contents, vents should remain plugged at all times. Storage cabinets must also be conspicuously labeled "FLAMMABLE - KEEP FIRE AWAY."

Flammable liquids must not be stored in a refrigerator unless that refrigerator has been manufactured, purchased, and maintained as a flammable safe (also sometimes referred to as "laboratory-safe" or "flammable material") refrigerator. Flammable liquids must not be stored in an "ordinary" household-type refrigerator. Standard household refrigerators may have internal parts, which could spark. Refrigerators must be prominently labeled as to whether or not they are suitable for flammable liquid storage.

Flammable liquids should be stored separately from strong oxidizers, shielded from direct sunlight, and away from heat sources.

Classifications of flammable liquids according to NFPA Code 45 are shown in Table 2.

Table 2. Flammable Liquids

Class	Flash Point (deg. F)	Boiling Point (deg. F)
IA	<73	<100
1B	<73	= or >100
IC	>73 and <100	

Individual flammable storage cabinets may not contain more than 60 gallons of Class I and/or Class II liquids, and not more than 120 gallons of Class Ill liquids. Maximum storage allowed for indoor storage areas is defined in OSHA 29 CFR 1910.106. Storage in inside storage rooms shall comply with Table 3.

Table 3. Storage Inside Rooms

Fire Protection Provided[1]	Fire Resistance	Maximum Floor Area (ft^2)	Total Allowable Quantities (gal/ft^2 floor area)
Yes	2 hr.	500	10
No	2 hr.	500	4

Yes	1 hr.	150	5
No	1 hr.	150	2

[1]Fire protection system shall be sprinkler, water spray, carbon dioxide, or other system.

6.4 Corrosive Chemicals

Materials are classified as corrosive if they are capable of rapidly eroding building materials or metals, or burn, irritate or destructively attack organic tissues such as skin, eyes, lungs and stomach.

Examples of commonly used chemicals that have corrosive properties:

Glacial acetic acid	Nitric acid	Bromine
Hydrofluoric acid	Potassium hydroxide	Chlorine
Sodium hydroxide	Fluorine	Hydrochloric acid
Sulfuric acid	Acetic anhydride	

Considerations for safe storage include the following:

- Acids and bases should be segregated for storage.
- Liquid corrosives should be stored below eye level.
- Mineral acids, including phosphoric, hydrochloric, nitric, sulfuric, and perchloric acid, can be stored in a cabinet designed for Corrosive Acids. These non-metallic cabinets have no internal metallic parts, acid-resistant coating, and a cabinet floor constructed to be able to contain spillage.
- Volatile acids, such as oleum or fuming nitric acid, should be stored either in an acid cabinet or in a vented cabinet, such as the fume hood base, particularly after they have been opened.
- Concentrated mineral acids can be very reactive, even with each other. Concentrated acids can even react vigorously with dilute solutions of the same acid, if mixed together rapidly. Different concentrated acids should be stored apart. If stored within the same cabinet, use of plastic trays, tubs or buckets works well to keep different acids apart within the cabinet.
- Organic acids (i.e. acetic) should be stored separately from mineral acids.

6.5 Compressed Gases

Compressed gases can be toxic, flammable, oxidizing, corrosive, inert or a combination of hazards. In addition to the chemical hazards, compressed gases may be under a great deal of pressure. The amount of energy in a compressed gas cylinder makes it a potential rocket.

Appropriate care in the handling and storage of compressed gas cylinders is essential, and include the following:

- Arrange a return agreement with suppliers prior to purchase.
- Ensure laboratory door placard is current each time gases are received.
- Cylinder contents must be clearly labeled. The color code does not constitute adequate labeling.
- Valve caps shall be in place any time that the cylinder is not connected to a regulator.
- Do not strike or allow cylinders to strike against one another.
- Use a cylinder cart and secure cylinders with a chain during transport.
- Do not accept cylinders that are damaged, not clearly labeled, or do not have a valve protection cap.
- Keep oxygen cylinders a minimum of twenty feet from flammable gas cylinders or combustible materials. If this cannot be done, separation by a non-combustible barrier at least 5 feet high having a fire rating of at least one-half hour is required.
- Components used for gases that could be incompatible should not be interchanged.
- Cylinders should have a current hydrostatic test date (typically less than five years old for steel and three years old for aluminum) engraved on the cylinder.
- All gas cylinders shall be secured upright with upper and lower restraints in racks, holders, or clamping devices. The lower restraint may be exempted only if impractical. When cylinders are grouped together, they should be individually secured and conspicuously labeled on the neck area.
- Do not place cylinders near heat, sparks, or flames or where they might become part of an electrical circuit.
- Label all cylinders when "Empty." All cylinders must be considered full unless labeled as empty by the user. Empty cylinders must be returned to the supplier and not accumulated.
- Cylinders should not be stored with a regulator attached. Secure the proper gas cap to the threaded portion on the top of the cylinder to protect the valve.
- Do not store full and empty cylinders together.
- Do not store cylinders in exit or egress routes.
- Store cylinders in a well-ventilated area.

6.6 Cryogens

- Containers and systems containing cryogens must have pressure relief mechanisms.
- Containers and systems must be capable of withstanding extreme cold without becoming brittle.
- Safety glasses or goggles must be worn when handling cryogens. A full-face protection shield and an impervious apron must be worn when there is a chance of splash or spray.
- Gloves must be rated to handle cryogens and be sufficiently large to be readily thrown off in case of a spill.

6.7 Controlling Chemical Exposure in Laboratories

There are four general methods for controlling one's exposure to hazardous substances:

1. Engineering Controls
2. Administrative Controls
3. Safe Work Practices
4. Personal Protective Equipment (PPE)

In the laboratory, these methods or a combination of them can be used to keep exposure below permissible exposure limits.

6.7.1 Engineering Controls

Equipment installed in the laboratory should be considered the primary method of controlling chemical exposure. All laboratory personnel should be familiar enough with the chemicals they are using to know what equipment should be used to prevent chemical exposure. The SDS will specify what engineering controls should be used when working with a specific chemical. Examples of engineering controls are:

- Fume hoods
- Elephant trunks
- Canopy hoods
- Glove boxes
- Sharp containers
- Use of wet methods to reduce generation of dust or other particulate or other particulate general dilution method

6.7.1.1 Fume Hoods

Laboratory ventilation is typically designed to provide a minimum of eight air changes per hour. However, this flow is not necessarily sufficient to prevent the accumulation of chemical vapors. A fume hood is used to control the exposure of the hood user and lab occupants to hazardous or odorous chemicals and prevent their release into the laboratory. A secondary purpose is to limit the effects of a spill by partially enclosing the work area and drawing air into the enclosure by means of an exhaust fan. This inward flow of air creates a dynamic barrier that minimizes the movement of material out of the hood and into the lab.

In a well-designed, properly-functioning fume hood, only about 0.0001% to 0.001% of the material released into the air within the hood actually escapes from the hood and enters the laboratory. The protection provided by laboratory fume hoods is dependent on the proper use of the

hood and maintenance of adequate airflow through the hood. The determination that a fume hood is necessary for a particular experiment should be based on a hazard analysis of the planned work. Such an analysis should include:

- A review of the physical characteristics, quantity, and toxicity of the materials to be used
- The experimental procedure
- The volatility of the materials present during the experiment and potential for PEL to be exceeded
- The probability of their release
- The number and sophistication of manipulations
- The skill and expertise of the individual performing the work

The level of protection provided by a fume hood is affected by the manner in which the fume hood is used. No fume hood, however well designed, can provide adequate containment unless good laboratory practices are used, as follow:

- Know the toxic properties of the chemicals with which you work.
- Be able to identify signs and symptoms of overexposure.
- Keep all chemicals and equipment 6 inches behind the sash during a procedure.
- Keep the sash completely lowered anytime "hands-on" experiments are not in progress or whenever the hood is on and unattended.
- The hood should not be utilized if it is not in working order.
- The hood is not a substitute for personal protective equipment. Wear gloves, safety glasses, etc., as appropriate.
- Visually inspect the baffles to be sure the slots are open and unobstructed.
- Do not block baffles. If large equipment is in the hood, put it on blocks to raise it approximately two inches so that air may pass beneath it.
- Do not use the hood as a storage cabinet.
- Keep the sash clean and clear.
- Clean all chemical residues from the hood chamber after each use. All electrical devices should be connected outside the hood to avoid sparks, which may ignite a flammable or explosive chemical.
- Operate the hood at a sash position that will provide splash protection for the user, e.g., 10 - 12 inch opening for hoods with vertical sliding (up and down) sashes and the sashes closed as much as possible for continuous air flow hoods with horizontal sliding (left and right) sashes. This helps to ensure

optimum protection when conducting operations in the hood.

- Avoid things which cause air turbulence across the face of the hood such as fans, window air conditioning units, or excessive movement.
- Exhaust hoods do not provide adequate protection for all operations involving toxic materials. A higher level of containment should be used for procedures where minor contamination can be serious. If you are in doubt about the level of containment needed for your operation, ask your Pl, Lab supervisor, or contact EHS.
- EHS will conduct biannual surveys of fume hoods to ensure adequate airflow is maintained through the hood face. Contact EHS if you suspect the hood is not working properly.

6.7.1.2 Snorkel/ Elephant Trunk

A snorkel /elephant trunk is a flexible duct or hose connected to an exhaust system. It can only capture contaminants that are very close to the inlet of the hose, typically less than a distance equal to one-half the diameter of the duct. Elephant trunks can effectively capture discharges from gas chromatographs, pipe nipples, or the end of tubing. However, the effectiveness of the elephant trunk should be carefully evaluated before they are used to control releases of hazardous substances.

6.7.1.3 Canopy Hoods

The canopy hood is not only the most common local exhaust system but also probably the most misunderstood piece of industrial ventilation equipment.

6.7.1.4 Gloveboxes

Unlike a chemical hood, gloveboxes are fully enclosed and are under negative or positive pressure. Gloveboxes are usually small units that have multiple openings in which arm-length rubber gloves are mounted. The operator works inside the box by using these gloves. Construction materials vary widely, depending on the intended use. Clear plastic is frequently used, because it allows visibility of the work area and is easily cleaned.

6.7.2 Administrative Controls

Administrative controls are changes in the method or process to reduce exposure. These include:

- Substituting a less toxic chemical
- Reducing the amount of the chemical being used

- Reducing the length of the exposure time
- Using plastic equipment instead of glass

All laboratory personnel are encouraged to look for and suggest changes in procedures to reduce exposure.

6.7.3 Safe Work Practices

Safe work practices are discussed in the Chemical Handling section of this document.

6.7.4 Personal Protective Equipment (PPE)

Personal protective equipment is discussed in the PPE section of this document.

7. CHEMICAL HANDLING AND USE

Each laboratory employee with the training, education and resources provided by supervision shall develop and implement work habits consistent with this CHP to minimize personal and coworker exposure to the chemicals in the laboratory. Based on the realization that all chemicals inherently present hazards in certain conditions, exposure to all chemicals shall be minimized.

7.1 Before you begin:

All laboratory personnel should observe the following rules:

7.1.1 Know the potential hazards and appropriate safety precautions before beginning work. Ask and be able to answer the following questions:

i) What are the hazards?
ii) What are the worst things that could happen?
iii) What do I need to do to be prepared?
iv) What work practices, facilities or PPE are needed to minimize the risk?

7.1.2 Know the location and how to use emergency equipment, including safety showers, eyewash stations and fire blankets.

7.1.3 Never block safety equipment or doors and keep aisles clear and free from tripping hazards.

7.1.4 Familiarize yourself with the emergency response procedures, facility alarms and building evacuation routes.

7.1.5 Know the types of PPE available and how to use them for each procedure.

7.1.6 Be alert to unsafe conditions and actions and bring them to the attention of your supervisor or lab manager immediately so that corrections can be made as soon as possible.

7.1.7 Prevent pollution by following waste disposal procedures. Chemical reactions may require traps or scrubbing devices to prevent the release of toxic substances to the laboratory or to the environment.

7.1.8 Position and clamp reaction apparatus thoughtfully in order to permit manipulation without the need to move the apparatus until the entire reaction is completed. Combine reagents in the appropriate order and avoid adding solids to hot liquids.

7.2 General Procedures

7.2.1 Avoid distracting or startling other workers.

7.2.2 Do not allow practical jokes or horseplay.

7.2.3 Avoid playing loud music/audio in the lab.

7.2.4 Do not wear earbuds while working in the lab.

7.2.5 Use laboratory equipment only for its designated purpose.

7.2.6 Do not allow visitors, including children and pets, in laboratories where hazardous substances are stored or are in use, or hazardous activities are in progress.

7.2.7 Do not prepare, store (even temporarily), or consume food in any laboratory. It is ok to store your water bottle in a backpack in the cubby/coat rack immediately inside the door.

7.2.8 Do not smoke in any chemical laboratory. Additionally, be aware that tobacco products in opened packages can absorb chemical vapors.l

7.2.9 Do not apply cosmetics when in the laboratory.

7.2.10 Never wear or bring lab coats, gloves, or jackets into areas where **food is consumed.**

7.2.11 Confine long hair and overly loose clothing in the laboratory. Wear shoes at all times. Open-toed shoes or sandals are not appropriate. Tight clothing such as leggings should be avoided. No bare midriffs are permitted.

7.2.12 Never taste a chemical. When potential hazards are known, check odors

only by gently wafting some of the vapor towards your nose.

7.2.13 Under no circumstances should mouth suction be used to pipette chemicals or to start a siphon. Use a pipette bulb or a mechanical pipetting device to provide a vacuum.

7.2.14 Report accidents or injuries to your lab manager/faculty/supervisor.

7.2.15 Clean up spills immediately (including water).

7.2.16 Turn off Bunsen burners or other heat sources when not in use, or unattended.

7.2.17 Wash well before leaving the laboratory after handling hazardous chemicals. Do not use solvents for washing skin.

7.2.18 Keep work areas clean and free from obstruction.

7.2.19 Do not block access to exits, emergency equipment, controls, electrical panels, etc.

7.2.20 Working alone should be avoided whenever possible. Supervisors shall be made aware of and approve all lab activities of students and student workers.

7.2.21 Check the condition of safety equipment, such as hoods, before starting work in the laboratory. If the equipment is not working, contact maintenance. Do not proceed until the equipment is repaired.

7.3 Transporting Chemicals

Spills and chemical exposure can occur if chemicals are transported incorrectly, even when moving chemicals from one part of the laboratory to another. To avoid these types of incidents, consider the following:

- Use a bottle carrier, cart or other secondary containers when transporting chemicals in breakable containers (especially 250 mL or more) through hallways or between buildings. Secondary containers are made of rubber, metal or plastic, with carrying handle(s), and are large enough to hold the entire contents of the chemical containers in the event of breakage. A variety of such containers are available from laboratory supply catalogs.
- Transport of hazardous chemicals in individual containers exceeding four liters between buildings is strongly discouraged.
- Transportation of hazardous chemicals **in personal vehicles** is **strictly forbidden.**
- When moving in the laboratory, anticipate sudden backing up or changes in direction by others. If you should stumble or fall while carrying glassware or

chemicals, try to project them away from yourself and others.
- The individual transporting the chemical should be knowledgeable about the hazards of the chemical and should know how to handle a spill of the material.
- When transporting compressed gas cylinders, the cylinder should be strapped in a cylinder cart and the valve protected with a cover cap. Do not attempt to carry or roll cylinders from one area to another.
- Transport chemicals and gas cylinders in freight elevators rather than passenger elevators, if available.
- Keep chemicals in their original packing when transporting, if possible.

7.4 Laboratory Equipment and Glassware

Each employee shall keep the work area clean and uncluttered. At the completion of each work day or operation, the work area shall be thoroughly cleaned and all equipment properly cleaned and stored.

In addition, the following procedures shall apply to the use of laboratory equipment:

- All laboratory equipment shall be used only for its intended purpose.
- All glassware will be handled and stored with care to minimize breakage; all broken glassware will be immediately disposed of in the broken glass container.
- Labels shall be attached to all chemical containers, identifying the contents and related hazards.
- Waste receptacles shall be identified as such and explicitly labeled regarding contents.

All laboratory equipment shall be inspected on a periodic basis and replaced or repaired as necessary.

7.5 Specific Procedures for Handling and Use

Chemical handling and use procedures specific to the classification of materials are outlined below.

7.5.1 Flammable Liquids

The main objective in working safely with class 1-A, 1-B, 1-C flammable liquids is to avoid the accumulation of vapors and to control sources of ignition, and shall be handled according to the following requirements:

- Control all ignition sources in areas where flammable liquids are used. Smoking, open flames and spark producing equipment should not be used.
- Whenever possible use plastic or metal containers or safety cans.
- When working with open containers, use a laboratory fume hood to control the accumulation of flammable vapor.

- Use bottle carriers for transporting glass containers.
- Transfer of flammable liquids from 5-gallon containers (or less) to smaller containers shall be conducted in a laboratory fume hood or an approved flammable liquid storage room.
- Flammable liquids must not be stored in a refrigerator unless that refrigerator has been manufactured, purchased, and maintained as a flammable safe (also sometimes referred to as "laboratory-safe" or "flammable material") refrigerator. Flammable liquids must not be stored in an "ordinary" household-type refrigerator.
- 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 ground straps for metallic or non-metallic containers can prevent static generation. Electrically bond metal containers when transferring flammable liquids from one to another. Bonding can be direct, as a wire attached to both containers, or indirect, as through a common ground system. When grounding non-metallic containers, contact must be made directly to the liquid, rather than to the container.
- Use equipment with spark-free, intrinsically safe induction motors or air motors to avoid producing sparks.
- Avoid using equipment with series-wound motors, since they are likely to produce sparks.
- Do not heat flammable liquids with an open flame. Steam baths, salt and sand baths, oil and wax baths, heating mantles and hot air or nitrogen baths are preferable.
- Minimize the production of vapors and the associated risk of ignition by flashback. Vapors from flammable liquids are denser than air and tend to sink to the floor level where they can spread over a large area.
- In the rare circumstance that static cannot be avoided, proceed slowly to give the charge time to disperse or conduct the procedure in an inert atmosphere.

7.5.2 Flammable Solids

Flammable solids often encountered in the laboratory include alkali metals, magnesium metal, metallic hydrides, some organometallic compounds, and sulfur. Many flammable solids react with water and cannot be extinguished with conventional dry chemical or carbon dioxide extinguishers. Use of flammable solids shall adhere to the following requirements:

- Ensure Class D extinguishers, e.g., Met-L-X, are available where flammable solids are used or stored.
- Sand can usually be used to smother a fire involving flammable solids. Keep a container of sand near the work area.
- If a flammable, water-reactive solid is spilled onto skin, brush off as much as possible, then flush with copious amounts of water.

- NEVER use a carbon dioxide fire extinguisher for fires involving lithium aluminum hydride (LAH). LAH reacts explosively with carbon dioxide.

7.5.3 Reactive Chemicals

Handle reactive chemicals with all proper safety precautions. This includes designating a separate storage area, monitoring periodically for degradation, and using appropriate personal protection. A reactive chemical is one that:

- Fits the OSHA DEFINITION OF "UNSTABLE" In 1910.1450(b): "unstable" (reactive) means a chemical which in the pure state, or as produced or transported, will vigorously polymerize, decompose, condense, or will become self-reactive under conditions of shocks, pressure, or temperature.
- Is ranked by the National Fire Protection Association (NFPA) as 3 or 4 for reactivity.
- Is identified by the Department of Transportation (DOT) as:
    - a class 5 oxidizer
    - a class A or B organic peroxide
    - a class A, B, or C explosive
- Violently reacts with exposure to water or air.

7.5.4 Peroxide Forming Compounds and Reactives

Certain chemicals can form dangerous peroxides on exposure to air and light. Since they are sometimes packaged in an atmosphere of air, peroxides can form even though the containers have not been opened. Peroxides may detonate with extreme violence when concentrated by evaporation or distillation, when combined with other compounds, or when disturbed by unusual heat, shock or friction. Formation of peroxides in ethers is accelerated in opened and partially emptied containers. Refrigeration will not prevent peroxide formation and stabilizers will only retard formation.

Peroxide formation may be detected by visual inspection for the presence of crystalline solids or viscous liquids, or by using chemical methods or specialized kits for quantitative or qualitative analysis. If you suspect that peroxides have formed, do not open the container to test since peroxides deposited on the threads of the cap could detonate.

- The following recommendations should be followed to control the hazards of peroxides. Know the properties and hazards of all chemicals you are using through adequate research and study, including reading the label and SDS.
- Inventory all chemical storage at least twice a year to detect forgotten items, leaking containers, and those that need to be discarded.

- Identify chemicals that form peroxides or otherwise deteriorate or become more hazardous with age or exposure to air. Label containers with the date received, the date first opened and the date for disposal as recommended by the supplier.
- Minimize peroxide formation in ethers by storing in tightly sealed containers placed in a cool place in the absence of light. Do not store ethers at or below the temperature at which the peroxide freezes or the solution precipitates.
- Choose the size container that will ensure use of the entire contents within a short period of time.
- Visually or chemically check for peroxides of any opened containers before use.
- Clean up spills immediately. The safest method is to absorb the material onto Vermiculite or a similar loose absorbent.
- When working with peroxidizable compounds, wear impact-resistant safety eyewear and face shields. Visitor specs are intended only for slight and brief exposure, and should not be used when working with peroxidizable compounds.
- Do not use solutions of potentially explosive peroxides in volatile solvents under conditions in which the solvent might be vaporized. This could increase the concentration of peroxide in the solution.
- Do not use metal spatulas or magnetic stirring bars (which may leach out iron) with peroxide forming compounds, since contamination with metals can lead to explosive decomposition. Ceramic, Teflon or wooden spatulas and stirring blades are usually safe to use.
- Do not use glass containers with screw-top lids or glass stoppers. Polyethylene bottles with screw-top lids may be used.

7.5.5 Corrosive Chemicals Including Acids and Bases

Materials are classified as corrosive if they are capable of rapidly eroding building materials or metals, or if they burn, irritate or destructively attack organic tissues such as skin, eyes, lungs and stomach. Examples of commonly used chemicals that have corrosive properties:

Glacial acetic acid	Nitric acid	Bromine
Hydrofluoric acid	Potassium hydroxide	Chlorine
Sodium hydroxide	Fluorine	Hydrochloric acid
Sulfuric acid	Acetic anhydride	

Safe handling procedures will vary with each operation and the type and concentration of the corrosive chemical. The following general guidelines should be followed:

- Open bottles or carboys slowly and carefully, wearing protective equipment to guard hands, face, and body.
- OSHA requires suitable facilities, such as a safety shower and eyewash, to be located within the work area. The American National Standards Institute (ANSI) recommends that the safety shower and eyewash be within 100 feet of the work area for quick drenching or flushing of the eyes and body.
- The eyes are particularly vulnerable. It is therefore essential that approved eye and face protection be worn in all laboratories where corrosive chemicals are handled. Gloves and other chemically resistant protective clothing should be worn to protect against skin contact according to SDS and or SOP recommendations.
- To avoid a flash steam explosion due to the large amount of heat evolved, slowly add acids or bases to water (and not the reverse).
- Adequate quantities of spill control materials should be readily available.
- Procedures requiring the use of concentrated acids and bases must be conducted in a fume hood.
- Never mix acid wastes with other materials such as solvents, metal-contaminated solutions, etc. Non-contaminated acid wastes can be easily disposed of by neutralization.
- Never dispose of acids or bases in the sanitary sewer system (i.e., down the drain) until neutralized (pH 6.0-8.0). Neutralization may be conducted in the laboratory when included as part of an experiment, and should ideally be conducted in a fume hood. The solution should then be poured slowly down the drain with copious amounts of water, i.e., leave the water running for approximately 5 minutes.
- Contact EHS for assistance with disposal of large quantities (more than 1 gallon or 1/2 pound) of acids and bases. Each laboratory should have access to a spill kit that includes acid and base neutralizer; follow spill response procedures. Never use combustible organic materials (sawdust, excelsior, wood scraps and shavings, paper, rags, or burlap bags) to absorb or clean up spillage.
- Nitric acid is particularly hazardous due to its effect on eyes, lungs, and skin. It is highly reactive with organic materials and acts as a strong oxidizer. Never use paper towels or other oxidizable materials to absorb a nitric acid spill. Goggles and gloves must be worn, and a fume hood used when handling.
- Perchloric acid has similar hazards as nitric acid and its use requires approval by EHS and the Department Chair prior to use. Dedicated hoods must be approved (there is a potential to produce metallic perchlorates from the condensed vapor, which may be explosive). Specific storage and waste disposal requirements must be in place.

- Hydrofluoric acid (HF) use requires approval by EHS and the Department Chair prior to use. Exposure to skin results in severe and deep tissue burns, and potential death. Calcium gluconate gel must be kept in any laboratory working with HF.

Corrosive solids, such as sodium hydroxide and phenol, can cause burns to the skin and eyes. Dust from corrosive solids can be inhaled and cause irritation or burns to the respiratory tract. Many corrosive solids, such as potassium hydroxide and sodium hydroxide, can produce considerable heat when dissolved in water. The following should be considered:

- Wear gloves and eye protection when handling corrosive solids.
- When mixing with water, slowly add the corrosive solid to water, stirring continuously. Cooling may be necessary.
- If there is a possibility of generating a significant amount of dust, conduct work in a fume hood.

7.5.6 Compressed Gases

Before using cylinders, read all label information and SDSs associated with the gas being used. The cylinder valve outlet connections are designed to prevent mixing of incompatible gases. The outlet threads vary in diameter; some are internal and some are external; some are right-handed and some are left-handed. Generally, right-handed threads are used for fuel gases.

The following guidelines apply:

- An SOP for the set up and use of a compressed gas cylinder should be established by each laboratory.
- Wear sturdy shoes when engaging in moving or transporting cylinders.
- When transporting a filled gas cylinder, the freight elevator should be used if possible. If there is no freight elevator, a standard elevator may be used. However, no other passengers may be allowed in the elevator car during the transport.
- Always transport cylinders with valve caps securely in place.
- Do not permit cylinders to strike each other violently. Cylinders should not be used as rollers for moving material or other equipment.
- Cylinder caps should be left on each cylinder until it has been secured against a wall or bench or placed in a cylinder stand, and is ready for installation of the regulator.
- Never tamper with pressure relief devices in valves or cylinders.
- Use only wrenches or tools that are appropriate to remove a cylinder cap or to open a valve.Keep the cylinder valve closed except when in use.
- Position cylinders so that the cylinder valve is accessible at all times.
- Only Compressed Gas Association (CGA) regulators are permitted for use with gas cylinders. Do not use adapters to interchange regulators.

- High-pressure (>5 bar) gas lines must be labeled. Color-coding is not allowed.
- Contents of the cylinder must be visibly labeled as installed, including hazard class (i.e., poison, flammable, inert, etc.). The label facing the wall is not acceptable.
- Ensure all high-pressure connections are tight via leak testing. Cylinders, connections, and hoses should be checked regularly for leaks. Use a flammable gas leak detector (for flammable gases only) or soapy water, or a 50% glycerin-water solution and look for bubbles. At or below freezing temperatures, the glycerin solution should be used instead of soapy water.
    - NOTE: When the gas to be used is a flammable oxidizing or highly toxic gas, the system should be checked first for leaks with an inert gas (helium or nitrogen) before introducing the hazardous gas.
- When a special wrench is required to open a cylinder or manifold valve, the wrench shall be left in place on the valve stem when in use; this precaution is taken so the gas supply can be shut off quickly in case of an emergency.
- Open cylinder valves slowly and away from the direction of people (including yourself). Never force a gas cylinder valve. If the valve cannot be opened by the wheel or small wrench provided, the cylinder should be returned; do not attempt to repair a cylinder valve or regulator yourself.
- No attempt shall be made to transfer pressurized gases from one cylinder to another, to refill cylinders, or to mix gases in a cylinder in the laboratory.
- Keep cylinder valves, regulators, couplings, hoses, and apparatus clean and free of oil and grease.
- Compressed gases must not be used to clean your skin or clothing.
- Never heat cylinders to raise internal pressure.
- Use flashback connectors and reverse-flow check valves to prevent flashback when using oxy-fuel systems.
- Good practice is to ensure the valve is closed tightly after each use.
- Do not use copper (>65%) connectors or tubing with acetylene. Acetylene can form explosive compounds with copper, silver, and mercury.
- All cylinders are to be considered full unless labeled as “empty” by the user. Do not leave an empty cylinder attached to a pressurized system. Empty cylinders must be returned to the supplier and not accumulated.
- Use compressed gases only in a well-ventilated area. Toxic, flammable, and corrosive gases should be carefully handled in a hood or gas cabinet. Minimum quantities of these gases should be kept on site.
- When discharging gas into a liquid, a trap or suitable check valve should be used to prevent liquid from getting back into the cylinder or regulator.

- Where more than one type of pressurized gas is in use, label gas lines. This is particularly important when the gas supply is not in the same room or area as the operation using the gases.
- Do not use the cylinder valve itself to control flow by adjusting the pressure.
- NEVER place acetylene cylinders on their side.
- Handle empty cylinders with the same care as full cylinders.

7.5.7 Cryogens

- Equipment must be kept clean, especially when working with liquid or gaseous oxygen.
- Mixtures of gases or fluids must be strictly controlled to prevent formation of flammable or explosive mixtures.
- Gloves must be rated for the cryogen being handled, and be sufficiently large to be thrown off in the event of a spill. In the event that gloves are unavailable, other adequately insulated items may be used.
- Since glass ampoules can explode when removed from cryogenic storage if not sealed properly, reheat cold sample containers slowly.

7.5.8 Radioactive Materials

- Use of radioactive materials at WSU is strictly controlled. Contact EHS and the Radiation Safety Officer for approval.

7.5.9 Biological Materials

- Use of biological materials at WSU is strictly controlled. Contact EHS if Biosafety Level 2 or greater materials. https://www.cdc.gov/training/QuickLearns/biosafety will be used.

8. PERSONAL PROTECTIVE EQUIPMENT (PPE)

Personal protective equipment (PPE) is special gear used to protect the wearer from specific hazards of a hazardous substance. It is a last resort protection system, to be used when substitution or engineering controls are not feasible. PPE does not reduce or eliminate the hazard, protects only the wearer, and does not protect anyone else.

PPE includes eye protection, gloves, respiratory protection, and protective clothing. The need for PPE is dependent upon the type of operations and the nature and quantity of the materials in use, and must be assessed on a case by case basis. Workers who rely on PPE must understand the functioning, proper use, and limitations of the PPE used.

8.1 Eye Protection

8.1.1 Safety Glasses and Chemical Splash Goggles

Safety glasses come in a variety of styles to provide the best fit and comfort, including some designed to fit over prescription glasses. Safety glasses must be form-fitting to the face with minimum gaps at the top, bottom and sides to protect from chemical splashes. Commercially available safety glasses look very much like normal glasses, but have lenses that are impact resistant and frames that are far stronger than standard street wear glasses. Safety glasses with proper impact and shatter resistance will be marked "Z87" on the frame or lens.

Safety glasses must have side shields and should be worn whenever there is the possibility of objects striking the eye, such as particles, glass, or metal shards. Safety glasses may not be appropriate for dusts and powders, which can get by the glasses in ways similar to those described above. Safety goggles are best used for this type of potential exposure.

Chemical splash goggles should be worn when there is potential for splash from a hazardous material. Like safety glasses, goggles are impact resistant. Chemical splash goggles should have indirect ventilation so hazardous substances cannot drain into the eye area. Some may be worn over prescription glasses.

8.1.2 Face Shields

Face shields are in order when working with large volumes of hazardous materials, either for protection from splash to the face or flying particles. Face shields must be used in conjunction with safety glasses or goggles.

8.1.3 Contact Lenses

Contact lenses may be worn in the laboratory, but do not offer any protection from chemical contact. Those wearing contact lenses must notify their coworkers, so in the event of a splash to the eyes, the lenses may be removed. If a contact lens becomes contaminated with a hazardous chemical, rinse the eye(s) using an eyewash and remove the lens immediately.

Contact lenses that have been contaminated with a chemical must be discarded. Safety glasses, goggles, and/or shield must still be worn.

8.2 Gloves

Choosing the appropriate hand protection can be a challenge in a laboratory setting. Considering the fact that dermatitis or inflammation of the skin accounts for 40-45% of all work- related diseases, selecting the right glove for the job is important.

Not only can many chemicals cause skin irritation or burns, but also absorption through the skin can be a significant route of exposure to certain chemicals. Dimethyl sulfoxide (DMSO), nitrobenzene, and many solvents are examples of chemicals that can be readily absorbed through the skin into the bloodstream, where the chemical may cause harmful effects.

Protective gloves should be worn when handling hazardous materials, chemicals of unknown toxicity, corrosive materials, rough or sharp-edged objects, and very hot or very cold materials. When handling chemicals in a laboratory, disposable latex, vinyl or nitrile examination gloves are usually appropriate for most circumstances. These gloves will offer protection from incidental splashes or contact.

When working with chemicals with high acute toxicity, corrosive concentrations, and handling chemicals for extended periods or immersing all or part of a hand into a chemical, the appropriate glove material should be selected based on chemical compatibility.

When selecting the appropriate glove, the following characteristics should be considered:

- degradation rating
- breakthrough time
- permeation rate

Degradation is the change in one or more of the physical properties of a glove caused by contact with a chemical. Degradation typically appears as hardening, stiffening, swelling, shrinking, or cracking of the glove. Degradation ratings indicate how well a glove will hold up when exposed to a chemical. When looking at a chemical compatibility chart, degradation is usually reported as E (excellent), G (good), F (fair), P (poor), NR (not recommended) or NT (not tested).

Breakthrough time is the elapsed time between the initial contact of the test chemical on the surface of the glove and the analytical detection of the chemical on the inside of the glove.

Permeation rate is the rate at which the test chemical passes through the glove material once breakthrough has occurred and equilibrium is reached. Permeation involves absorption of the chemical on the surface of the glove, diffusion through the glove, and desorption of the chemical on the inside of the glove. Resistance to permeation rate is usually reported as E (excellent), G (good), F (fair), P (poor) or NR (not recommended). If chemical breakthrough does not occur, then permeation rate is not measured and is reported ND (none detected).

For mixtures, it is recommended that the glove material be selected based on the shortest breakthrough time.

The following table includes major glove types and their general uses. All SDSs have a PPE section with recommendations:

Glove Material	General Uses
Butyl	Offers the highest resistance to permeation by most gases and water vapor. Especially suitable for use with esters and ketones
Neoprene	Provides moderate abrasion resistance but good tensile strength and heat resistance. Compatible with many acids, caustics, and oils.
Nitrile	Excellent general duty glove. Protects from a wide variety of solvents, oils, petroleum products, and some corrosives. Excellent resistance to cuts, snags, punctures, and abrasions.
PVC	Provides excellent abrasion resistance and protection from most fats, acids, and petroleum hydrocarbons
PVA	Highly impermeable to gases. Excellent protection from aromatic and chlorinated solvents. It cannot be used in water or water-based solutions.
Viton	Exceptional resistance to chlorinated and aromatic solvents. Good resistance to cuts and abrasions.
Silver Shield	Resists a wide variety of toxic and hazardous chemicals. Provides the highest level of overall chemical resistance.
Natural rubber	Provides flexibility and resistance to a wide variety of acids, caustics, salts, detergents and alcohols.

All gloves should be inspected for signs of degradation or puncture before use. Test for pinholes by blowing or trapping air inside and rolling them out. Do not fill them with water, as this makes the gloves uncomfortable and may make it more difficult to detect a leak when wearing the glove.

Disposable gloves should be changed when there is any sign of contamination. Reusable gloves should be washed frequently if used for an extended period of time.

While wearing gloves, be careful not to handle anything but the materials involved in the procedure. Touching equipment, phones, wastebaskets or other surfaces may cause contamination. Be aware of touching the face, hair, and clothing as well.

Follow the manufacturer's instructions for washing and caring for reusable gloves. Wash the exterior with soap and water before removing them.

Gloves should be removed avoiding skin contact with the exterior of the glove

and possible contamination. Disposable gloves should be removed as follows:

- Grasp the exterior of one glove with your other gloved hand.
- Carefully pull the glove off your hand, turning it inside-out. The contamination is now on the inside.
- Ball up the glove and hold in your other gloved hand.
- Slide your ungloved finger into the opening of the other glove. Avoid touching the exterior.
- Carefully pull the glove off your hand, turning it inside out again. All contamination is contained.
- Discard appropriately.

8.3 Respiratory Protection

A respirator may only be used when engineering controls, such as general ventilation or a fume hood, are not feasible or do not reduce the exposure of a chemical to acceptable levels. Since the use of a respirator is regulated by the OSHA Respiratory Protection Standard, respirator use at WSU is subject to prior review by the CHO according to the University Respiratory Protection Program..

Any worker who believes that respiratory protection is needed must notify the CHO for evaluation of the hazard and enrollment in the Respiratory Protection Program. This program involves procedures for respirator selection, medical assessment of employee health, employee training, proper fitting, respirator inspection and maintenance, and recordkeeping.

8.4 Protective Clothing

When the possibility of chemical contamination exists, protective clothing that resists physical and chemical hazards should be worn over street clothes. Lab coats are appropriate for minor chemical splashes and solids contamination, while plastic or rubber aprons are best for protection from corrosive or irritating liquids. Disposable outer garments (i.e., Tyvek suits) may be useful when cleaning and decontamination of reusable clothing is difficult. Appropriate fit is important, as overly large clothing may present a hazard.

8.5 Footwear

Closed-toed shoes that cover the entire foot should be worn at all times in laboratories where chemicals are stored or used. Chemical resistant overshoes or boots may be used to avoid possible exposure to corrosive chemicals or large quantities of solvents or water that might penetrate normal footwear (e.g., during spill cleanup).

9. WASTE DISPOSAL

Under no conditions shall volatile or harmful chemicals be disposed of down the laboratory drains. Harmful or volatile chemicals shall be defined as listed on the EPA Priority list.

Students, staff and faculty will place the waste chemicals in the designated waste containers. The waste will then be disposed of by state contracted waste handlers. Coordination of waste removal will be handled by the Office of Environmental Health and Safety.

9.1 Classification of Waste as Hazardous

Waste is considered hazardous if:

- It is on either of two lists (referred to as the P- and U-listed wastes) of specific chemical substances developed by the Federal Environmental Protection Agency (EPA) See https://www.epa.gov/hw/defining-hazardous-waste-listed-characteristic-and-mixed-radiological-wastes#PandU.
- It is on a list of nonspecific sources (referred to as the F-listed wastes) that includes a broad range of spent halogenated and non-halogenated solvents.
- It is on a list of specific sources that includes primarily industrial processes.
- It exhibits any of the following characteristics as defined by the EPA (definitions are abbreviated):
  - Ignitable
    - A liquid with a flash point less than 60° C(140°F)
    - Not a liquid and capable under normal conditions of causing fire through friction, absorption of moisture or spontaneous chemical changes
    - An ignitable compressed gas
    - An oxidizer
  - Corrosive
    - Aqueous and has a pH less than or equal to 2, or greater than or equal to 12.5
    - Liquid and corrodes steel at a rate greater than 0.250 inches per year at 55° C (131° F)
  - Reactive
    - It is normally unstable.
    - It reacts violently with water.
    - It forms potentially explosive mixtures with water.
    - It generates toxic gases, vapors or fumes when mixed with water.
    - Cyanide or sulfide wastes that generate toxic gases, vapors or fumes at pH conditions between 2 and 12.5.
    - It is capable of detonation or explosive decomposition if subjected to strong initiation or under standard temperature and pressure.
    - It is classified as a DOT explosive.
  - Toxicity Characteristic
    - If an extract of the waste is found to contain certain metals, pesticides or selected organics above specified levels (referred to as the D list)
    - If it is otherwise capable of causing environmental or health damage if improperly disposed (this is a judgment you must make based upon your knowledge of the material from the SOS or the literature)

All SDSs have a disposal section and should be consulted. Consulting the faculty supervisor, lab manager, and/or CHO is encouraged. If there are any questions about whether a waste is hazardous or not, the most conservative approach will be used and therefore it will be assumed it is hazardous.

9.2 Storage of Chemical Hazardous Waste

Containers of hazardous waste may be stored in an approved area of a laboratory. This area must be controlled by the faculty supervisors, lab manager or workers generating the waste. Any questions should be referred to the Office of Environmental Health and Safety.

State and federal regulations stipulate how waste generators store chemical waste and require the following:

- Any container used to store hazardous waste must be labeled with the words "Hazardous Waste" (regardless of its location) as soon as accumulation begins.
- Be sure that the container is compatible with the chemical waste.
- Use containers that are made of, or lined with, materials that will not react with, and are otherwise compatible with, the hazardous waste to be stored. For example, do not place hydrofluoric acid in glass. Often the original container is suitable.
- Waste containers must be closed at all times, except when being filled. Do not leave funnels in the containers.
- Be sure that containers in the waste storage area do not leak. The use of secondary containment, such as a tray, larger container or basin will reasonably contain any leak. If a leaking container is found, immediately clean up any spilled material according to established spill cleanup procedures and transfer the waste into a container that is in good condition.
- No more than one quart of an acutely toxic waste (P-listed wastes) or 55 gallons of other hazardous wastes may be stored (per waste stream) in the waste storage area. If this threshold quantity is reached, the worker must transfer the waste to a 180-day storage area.
- Like any chemical storage in the laboratory or work area, be sure to segregate the containers according to the type of waste.
- Waste stored near drains (floor, sink, cup sink) need secondary containment. If you have a sink or drain that is not in use, contact maintenance to explore possibilities for plugging or sealing the drain. Secondary containers must be compatible with the waste.

9.3 180-Day Storage Areas

Wastes stored in this area will be shipped to an off-site authorized commercial facility within 180 days from the accumulation date.

10. CHEMICAL SPILLS, RELEASES AND ACCIDENTS

Most spills are preventable. The following are some tips that could help to prevent or minimize the magnitude of a spill:

- Pre-planning is essential. Before working with a chemical, the laboratory worker should know how to proceed with spill cleanup and should ensure that there are adequate spill control materials available.
- Place chemical containers being used in a hood or lab bench area that reduces the possibility of accidentally knocking over a container.
- Keep all unused reagents in their appropriate storage area and keep your work area clean of needless equipment and clutter.
- Plan your movements. Look where you are reaching to ensure you will not cause a spill.
- Avoid transporting chemicals from the stockroom during periods of high traffic in the hallways, such as between classes.
- Transport chemical containers in a chemical carrier or cart.
- Place absorbent plastic-backed liners on bench tops or in fume hoods where spills can be anticipated. For volumes of liquid larger than what can be absorbed by liners, use trays.

10.1 Spill Response and Clean-up Procedures

In the event of a chemical spill, first, determine whether it is a major emergency spill or a minor spill. If it is considered a minor spill, the individual(s) who caused the spill is responsible for prompt and (if trained to do so) proper clean-up. Their responsibility is also to have spill control and personal protective equipment appropriate for the chemicals being handled readily available.

Category	**Size**	**Response**	**Treatment Materials**
Minor	Less Than 1 Liter	Chemical Treatment or Absorption	Neutralization or Absorption Spill Kit
Major	More Than 1 Liter	Call Public Safety (Ext. 6460)	Outside Help
Major	In an Immediate Danger to Life or Health; size does not apply	Call 911 and then Public Safety (Ext. 6460)	Outside Help
Major	If outside of a lab or an area where chemicals are usually used: Size does not apply	Call Public Safety (Ext. 6460)	Outside Help

The following are general guidelines to be followed for a chemical spill:

- Immediately alert area occupants and supervisor, and evacuate the area, if necessary.
- If there is a fire or medical attention is needed, contact Public Safety at 911.
- Attend to any people who may be contaminated. Contaminated clothing must be removed immediately and the skin flushed with water for no less than fifteen minutes.
- If a volatile, flammable material is spilled, immediately warn everyone, control sources of ignition and ventilate the area.
- Choose personal protective equipment, as appropriate to the hazards. Refer to the SDS or other references for information.
- Consider the need for respiratory protection. **The use of a respirator or self-contained breathing apparatus requires specialized training and medical surveillance. Never enter a contaminated atmosphere without protection or use a respirator without training. If respiratory protection is used, be sure there is another person outside the spill area in communication, in case of an emergency. If no one is available, contact Public Safety at 911.**
- Using the chart above, determine the extent and type of spill. If the spill is large, if there has been a release to the environment, or if there is no one knowledgeable about spill clean-up available, contact the CHO or Public Safety at ext 6460.
- Protect floor drains or other means for environmental release. Spill socks and absorbents may be placed around drains, as needed.
- Contain and clean-up the spill according to the table above.
- Loose spill control materials should be distributed over the entire spill area, working from the outside, circling to the inside. This reduces the chance of splash or spread of the spilled chemical. Many neutralizers for acids or bases have a color change indicator to show when neutralization is complete.
- When spilled materials have been absorbed, use brush and scoop to place materials in an appropriate container. Polyethylene bags may be used for small spills. Five gallon pails or 20-gallon drums with polyethylene liners may be appropriate for larger quantities.
- Complete a hazardous waste sticker, identifying the material as Spill Debris involving XYZ Chemical, and affix onto the container. Spill control materials will likely need to be disposed of as hazardous waste.
- Decontaminate the surface where the spill occurred using a mild detergent and water, when appropriate.
- Report all spills to your laboratory manager/faculty supervisor and the CHO. If necessary, the CHO may be required to contact Ogden City Water and Central Weber Sewer District.

11. SAFETY AND EMERGENCY EQUIPMENT

Appropriate safety and emergency equipment must be available, and in good working order. The CHO will schedule routine maintenance audits. Requirements include:

- Telephone numbers of emergency personnel, supervisors and other workers as deemed appropriate must be posted.
- Emergency evacuation routes are posted in all laboratories.
- All laboratory personnel should become familiar with the location of the safety equipment in the lab. This includes:
    - Fire extinguishers
    - Fire blankets
    - Safety showers
    - Drench hoses
    - Eye wash stations
    - Spill clean-up kits
    - First aid kits
- Location signs for safety and emergency equipment have been posted.

12. INFORMATION AND TRAINING

All personnel working with hazardous chemicals are required to read this CHP. In addition, they must also receive laboratory safety training when they are first assigned to a work area where hazardous chemicals are present and before assignments involving new exposure situations. General laboratory safety training is provided by the lab manager, PI, or research faculty when appropriate. More specific training for particular materials or operations in a particular work area, is provided by CHO, laboratory managers and/or research faculty supervisors.

12.1 Laboratory Safety Training

Laboratory safety training will be mandatory for all faculty, lab managers and staff. Initial training will take place within one month of hire. An annual refresher training session will be provided. These sessions will be offered regularly to accommodate everyone. Students handling chemicals in the labs will complete Laboratory safety training. Research students will also be required to attend the training. Research students will not have access to the laboratories until they have completed the training.

The Safety Training Should Include:

- An overview of the OSHA Laboratory Standard e-CFR Subpart z 1910. 1450 Appendix A, B (https://www.osha.gov/laws-regs/regulations/standardnumber/1910/1910.1450)
- The location and availability of the CHP
- Controlling chemical exposure
- Location and availability of SDSs
- Understanding Global Harmonized System (GHS)
- An explanation of permissible exposure limits
- Storage and transportation of chemicals
- The use, function, and selection of PPE
- Use of eyewashes, emergency showers and fire blankets

- Emergency procedures
- Spill response and clean-up procedures
- Hazardous waste disposal procedures

12.2 Training Records

The training records for all lab personnel will be stored in the respective colleges and available to the CHO to review at any time.

13. CHEMICAL PROCUREMENT

The decision to procure a chemical shall be a commitment to handle and use the chemical properly from initial receipt to ultimate disposal. Information on proper handling, storage and disposal shall be known to all involved personnel prior to the procurement of the chemical.

Chemicals utilized in the laboratory shall be those that are appropriate for the ventilation system. If the chemical is considered particularly hazardous, prior approval by the Department Chair and CHO may be required: see the Particularly Hazardous Substance (PHS) section of this document.

Personnel who receive chemical shipments shall be knowledgeable of the proper procedures for receipt and storage of the chemicals. Chemical containers shall not be accepted without accompanying labels, SDSs, and packaging in accordance with all appropriate regulations. All chemical shipments should be dated when received, opened, and put out of service. Locally purchased "household" chemicals, should be stored in accordance with their known chemical compatibilities.

14. WORKING IN THE LABORATORY

Research students who handle chemicals will not have access to their particular laboratory until they have received training and read both the CHP and supporting procedures specific to the activity to be completed. Research students should discuss in depth with their faculty mentor what procedures they are allowed to do unsupervised. Supervision and the Pl must be aware and fully approve of all activities of students and student workers.

14.1 Working Alone

Working alone in a laboratory should generally be avoided. If you are in a laboratory alone, make sure your supervisor, faculty mentor, or lab manager knows you are there. They should periodically check in with you.

14.2 Unattended Operations

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

- The faculty mentor or lab manager will review work procedures to ensure for the safe completion of the operation.

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

14.3 Critical Operations

In the event that a laboratory or a building has to be evacuated, it is possible that there may be a procedure/operation occurring that, if just abandoned, could result in catastrophic results (i.e. fire, explosion). All laboratory managers, faculty, and staff should identify any procedures they would deem as critical (based on the definition above) to be approved by the CHO and Department Chair. The following information should be included:

- The individual responsible for the operation
- The laboratory where the critical operation/procedure may be being done
- The critical operation/procedure
- Why it should be considered critical
- Those specific individuals that will need to stay to help perform the operation/procedure
- What additional safety procedure will be taken (i.e. additional PPE)
- What extra training will need to be provided to those who need to stay.
- Special training will be given to any individuals who may be needed to attend to the operation, including shut-down.
- Only those operations/procedures that have been pre-approved as "Critical" by the CHO and the Department Chair may be performed when evacuation is required.

It should be noted that:

- NO ONE will be required to stay if they do not want to.
- No one's personal safety should be jeopardized in order to perform the critical operation.
- To prevent the catastrophic result, the procedure will take less than a minute.
- If it is not safe to stay (even for a minute), evacuate!

15. CHEMICAL EXPOSURE DETERMINATION

OSHA establishes exposure limits for several hundred substances. Laboratory workers must not be exposed to substances in excess of the permissible exposure limits (PEL) specified in OSHA Subpart Z, Toxic and Hazardous Substances. PELs refer to airborne concentrations of substances averaged over an eight-hour day. Some substances also have "action levels" below the PEL requiring certain actions such as medical surveillance or routine air sampling.

The SDS for a particular substance indicates whether any of the chemicals are regulated through OSHA and, if so, the PELs for the regulated chemical(s). This information is also

available in the OSHA Table Z list of regulated chemicals.

15.1 Incident Reporting

In the event of any incident that results in a possible overexposure to a chemical, regardless of whether any signs or symptoms of exposure are noted or whether the laboratory worker seeks medical attention, the laboratory worker should notify their supervisor and document the incident. The resulting document must be submitted to the Chemical Hygiene Committee.

15.2 Exposure Monitoring

Exposure monitoring must be conducted if there is reason to believe that exposure levels for a particular substance may routinely exceed either the action level or the PEL. The faculty mentor, and laboratory managers may use professional judgment, based on the information available about the hazards of the substance and the available control measures, to determine whether exposure monitoring must be conducted. Materials which require monitoring under these conditions are listed in OSHA Regulations. If an employee would like to have an exposure assessment conducted, the CHO should be contacted. Exposure assessments and monitoring may be conducted by the CHO or University Industrial Hygienist. Documentation of exposure monitoring shall be kept and maintained as part of each employee's personnel record.

16. MEDICAL CONSULTATIONS AND EXAMINATIONS

Laboratory workers should seek medical attention under the following conditions:

- If the individual experiences signs or symptoms associated with a hazardous chemical to which he or she may have been exposed in the laboratory
- Where exposure monitoring reveals an exposure level routinely above the OSHA action level or permissible exposure limit
- Whenever a spill, leak, explosion or other occurrence result in the likelihood of a hazardous exposure to a laboratory worker.

The lab manager, and the CHO are responsible for establishing and maintaining an accurate record of any medical consultations and examinations provided to an employee.

16.1 Emergency Situations

Call 911. Be able to provide as much information as possible to the dispatcher:

- Location (address and building name)
- The nature of the exposure
- The chemical exposed to
- Injuries
- Number of patients
- Building evacuated or Shelter in place

16.2 Non-Emergency Situations

Provide the physician with the identity of the hazardous chemicals encountered and the conditions by which the worker was exposed. If available, the SDS should be provided to the physician. The Department Chair, lab manager or Pl, and the CHO must be notified.

17. PARTICULARLY HAZARDOUS SUBSTANCES

Particularly hazardous substances (PHS) are defined to include select carcinogens, reproductive toxins, and substances that have a high degree of acute toxicity (such as cyanides and dimethylmercury).

17.1 Select Carcinogens, Reproductive Toxins, Highly Acute Toxins

The procedures described in this section are mandatory when performing laboratory work with greater than 10 mg or 100 ml of any carcinogen, reproductive toxin, or substance that has a high degree of acute toxicity.

17.1.1 Definitions

- Select carcinogens: any substance defined as such by OSHA
- Reproductive toxins: chemicals which affect reproductive capabilities, including chromosomal damage (mutations) and effects on fetuses (teratogens).
- A highly acute toxin is any substance for which:
  - The median oral LD_{50} is less than or equal to 50 mg/kg when administered orally to albino rats, or
  - The median inhalation lethal concentration, LC_{50}, value is less than or equal to 200 ppm by volume of gas or vapor, or 2 mg/liter or less of dust, mist, or fume when administered continuously for one hour or less to albino rats, or
  - The median LD_{50} is less than or equal to 200 mg/kg when administered by continuous contact for 24 hours or less with the bare skin of albino rabbits.
- Designated area: a hood, glove box, portion of a laboratory, or an entire laboratory room, designated as the only area where work shall be conducted with quantities of select carcinogens, reproductive toxins, or highly acute toxins in excess of the limits specified above.

17.1.2 Designated Area

- Access to designated areas shall be restricted. Only trained employees will be allowed to work with chemicals in the designated area. All such persons will:
  - Use the smallest amount of chemical that is consistent with the requirement of the work to be done.
  - Use these chemicals in a hood with adequate airflow (face velocity

between 80 and 120 feet per minute) or other containment device, for procedures which may result in the generation of aerosols or vapors containing the substance.
- Use high-efficiency particulate air (HEPA) filters or high-efficiency scrubber systems to protect vacuum lines and pumps.
- Decontaminate designated areas before normal work is resumed there. This includes contaminated equipment.
- Remove any protective apparel, place it in an appropriately labeled container, and thoroughly wash hands, forearms, face, and neck on leaving a designated area.
- Prepare wastes for disposal in accordance with chemical waste disposal guidelines.
- Do not wear jewelry when working in designated areas since decontamination of jewelry may be difficult or impossible.

17.1.3 Select Carcinogens

Any substance which meets one of the following criteria:

- It is regulated by OSHA 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 1 ("carcinogenic to humans") by the International Agency for Research on Cancer Monographs (IARC) (latest editions).
- 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, five days per week, for a significant portion of a lifetime to dosages of less than 1O mg/m^3,
  - After repeated skin application of less than 300 (mg/kg of body weight) per week,
  - After oral dosages of less than 50 mg/kg of body weight per day.

17.1.4 Reproductive Toxins

These chemicals affect 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. The chemicals are classified as reproductive toxins in accordance with the Hazard Communication Standard (§1910.1200).

17.1.5 High acute toxicity

Any chemical that falls within any of the following categories:

- A chemical with a median lethal dose (LD_{50}) of 50 mg or less per kg of body weight when administered orally to certain test populations
- A chemical with a LD_{50} of 200 mg or less per kg of body weight when administered by continuous contact for 24 hours (or less if death occurs within 24 hours) to certain test populations
- A chemical with a median lethal concentration (LC_{50}) in air of 200 parts per million (ppm) by volume or less of gas or vapor, or 2 mg per liter or less of mist, fume, or dust, when administered to certain test populations by continuous inhalation for one hour, such concentration and/or condition are likely to be encountered by humans when the chemical is used in any reasonably foreseeable manner.

17.2 Working Safely with Particularly Hazardous Substances

The increased hazard risk associated with Particularly Hazardous Substances (PHS) calls for additionally strict operating procedures in the laboratory. Before using a particularly hazardous substance, an individual must provide documentation of the specific SOP for use of the substance. These procedures include the use of containment devices and PPE, decontamination procedures and procedures for safe removal of contaminated waste. Approval must be formally obtained from the Department Chair and the CHO.

17.2.1 Work Habits

- There should be no eating, drinking, smoking, chewing of gum or tobacco, application of cosmetics or storage of utensils, food or food containers in laboratory areas where PHS are used or stored.
- All personnel should wash their hands and arms immediately after the completion of any procedure in which PHS have been used and when they leave the laboratory.
- Each procedure should be conducted with the minimum amount of the substance, consistent with the requirements of the work.
- The laboratory worker should keep records of the amounts of all PHS used, the dates of use and the names of the users.
- Work surfaces, including fume hoods, should be fitted with a removable liner of absorbent plastic-backed paper to help contain spilled materials and to simplify subsequent cleanup and disposal.

17.2.2 Personal Protective Equipment

- PHS may require more stringent use of PPE. Check the SDS for information on proper gloves, lab clothing and respiratory protection.

- Proper PPE must be worn at all times when handling PHS.
- Lab clothing that protects street clothing, such as a fully fastened lab coat or a disposable jumpsuit, should be worn when PHS are being used. Laboratory clothing used while manipulating PHS should not be worn outside the laboratory area.
- When methods for decontaminating clothing are unknown or not applicable, disposable protective clothing should be worn. Disposable gloves should be discarded after each use and immediately after overt contact with PHS.

17.2.3 Ventilation/Isolation

- Most PHS work should be performed in a fume hood, glove box, or with another form of ventilation. If the chemical may produce vapors, mists or fumes, or if the procedure may cause generation of aerosols, use of a fume hood is required.
- A fume hood used for PHS must have an average face velocity of between 95 and 125 feet per minute. This measurement is noted on the hood survey sticker. If the hood has not been inspected within the past year, contact EHS for re-inspection before using the hood.
- A glove box should be used if protection from atmospheric moisture or oxygen is needed or when a fume hood may not provide adequate protection from exposure to the substance; e.g., a protection factor of 10,000 or more is needed.
- Highly toxic gases must be used and stored in a vented gas cabinet connected to a laboratory exhaust system. Gas feed lines operating above atmospheric pressure must use coaxial tubing.

17.2.4 Storage and Transportation

- Stock quantities of PHS should be stored in a designated storage area or cabinet with limited access. Additional storage precautions (i.e., a refrigerator, a hood, a flammable liquid storage cabinet) may be required for certain compounds based upon other properties.
- Containers must be clearly labeled.
- Double containment should also be considered. Double containment means that the container will be placed inside another container that is capable of holding the contents in the event of a leak, and provides a protective outer covering in the event of contamination of the primary container.
- Containers should be stored on trays or pans made of polyethylene or other chemically resistant material.

- Persons transporting PHS from one location to another should use double containment to protect against spills and breakage.

17.2.5 Vacuum Lines and Services

- Each vacuum service, including water aspirators, should be protected with an absorbent or liquid trap to prevent entry of any PHS into the system.
- When using volatile PHS, a separate vacuum pump should be used. The procedure should be performed inside a fume hood.

17.2.6 Decontamination and Disposal

- Contaminated materials should either be decontaminated by procedures that decompose the PHS to produce safe products or be removed for subsequent disposal.
- All work surfaces must be decontaminated at the end of the procedure or work day, whichever is sooner.
- Prior to the start of any laboratory activity involving any PHS, plans for the handling and ultimate disposal of contaminated wastes and surplus amounts of the PHS should be completed.

18. INSPECTIONS AND AUDITS

Maintenance and regular inspection of laboratory equipment are essential parts of the laboratory safety program. The CHO will conduct an audit of all phases of the CHP each year. Results will be provided to the department chairs, faculty, and the laboratory managers. Lab managers and faculty mentors are responsible for taking corrective action.

The laboratory audit checklist in appendix ( ) will be used to document the audit.

Eyewash fountains, and drench hoses will be tested quarterly and will be documented on tags attached eyewash fountains, and drench hoses.Safety showers will be tested biannually and documented on attached tags.

Fume hoods will be tested and documented annually.

OSHA requires that all fire extinguishers be visually inspected monthly. The following should be checked:

- Extinguisher is still charged.
- Safety pin is still in place.
- If the extinguisher has a hose, it is not cracked and still attached to the extinguisher.

- The annual certified inspection tag is attached and not expired.

In addition, all fire extinguishers must be inspected annually, by a certified inspector. An inspection tag is attached with the date and month the inspection was performed.

19. RECORDKEEPING

The following records will be maintained by the lab manager and reviewed by the CHO:

- Attendance at the laboratory training safety meeting
- New Particularly Hazardous Substances (PHS), Regulated, or Extremely Toxic chemical requests
- PHS requests
- Annual laboratory audit checklists
- All chemical exposure incidents
- All major spill reports
- All accident investigations
- Medical Evaluation records for employees exposed to hazardous chemicals and harmful physical agents will be maintained for the duration of employment plus 30 years per 29 CFR 1910.1020. (Documentation will be held by Human Resources.)
- Inventory and usage records for particularly hazardous substances (amounts of substances on-hand, amounts used and names of workers involved) shall be maintained for 5 years. (By Lab Managers and available to EHS)

20. DEPARTMENT/UNIT CONTRIBUTIONS TO THIS PLAN

Due to the diversity of chemicals used in the different laboratories and departments at Weber State University, each such department or unit will provide details that relate specifically to their activities. These details will be included as Appendix A of this plan. Each Department/Unit Appendix A contribution will be updated annually. The following should be addressed as well as any additional topics deemed appropriate for specific departments or areas:

Each department or unit subject to this CHP will prepare and maintain:

- A current inventory listing of all chemicals used, prepared, and maintained in the department.
- A separate list of Particularly Hazardous Substances (PHS) used. PHS may be designated on the current inventory form. (See section 18 for definitions)
- The locations of any areas in which PHS are used within a department or unit will be listed and included in Appendix A.
- Any special procedures or precautions that will be taken when using PHS.
- Procedures (if any) that require prior approval.
- Details of how laboratory or department-specific information and training will be provided to employees and research students.