

 BOISE STATE U N I V E R S I T Y Environmental Health & Safety Office	Chemical Hygiene Plan Version 1.4
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1.0 PURPOSE

Boise State University strives to provide a safe and healthy place for its faculty, staff, students and visitors. The Chemical Hygiene Plan (CHP) serves as guidance for working safely in BSU laboratories and serves as reference for many federal, state, and local regulatory requirements as well BSU policies. It by no means covers all regulatory requirements or BSU policies.

The CHP fulfills the requirements outlined by the [Idaho General Safety and Health Standards \(IGSHS\) 111 – “Laboratories and Chemical Storage Safety Rules”](#) and [29 CFR 1910.1450 “Occupational Exposure to Hazardous Chemicals in Laboratories”](#), which are enforced by the Idaho Division of Building Safety (DBS) and the Occupational Safety and Health Administration (OSHA), respectively.

The purpose of the CHP is to communicate general laboratory safety requirements and will help standardize practices across the university. It provides chemical safety guidance and describes proper practices, procedures, equipment, and facilities for faculty, staff, students, and visitors in BSU laboratories. This guidance will inform and help protect them from potential physical and health hazards presented by chemicals used in a laboratory and can help minimize exposure or reduce exposure to acceptable levels. It is essential Principal Investigators, supervisors, Laboratory Workers, and students to know and adhere to the provisions of this document.

1.1. Scope

The Chemical Hygiene Plan applies to all Boise State University laboratories. Chemical safety for other areas is covered under [Chemical Hazard Communication](#).

1.2. Lab Specific Chemical Hygiene Plan

Laboratories may develop their own chemical hygiene plan or laboratory safety manual, but it must be at least as stringent as all BSU written programs and comply with all regulatory requirements and BSU policies. EHS recommends using the BSU chemical hygiene plan for the lab as a reference guide and supplementing it with laboratory specific procedures and requirements.

2.0 RESPONSIBILITIES, AUTHORITY AND RESOURCES

2.1. Environmental Health and Safety (EHS)

The mission of Boise State University’s Environmental Health and Safety (EHS) department is to assist University colleges and departments in providing a safe and healthful workplace and to assist the University as a whole in maintaining compliance with environmental health and safety

regulations and guidelines and University policies. EHS responsibilities and authority are outlined in [BSU Policy 9140](#). In regard to the CHP, EHS:

1. Provides expert advice and consultation on environmental health and safety issues.
2. Performs workplace evaluations which may include air samples, swipes, or other tests to determine the amount and nature of airborne and/or surface contamination, and to extrapolate personnel exposure levels from that data.
3. Develops and provides general safety training.
4. Develops and maintains the Chemical Hygiene Plan and associated university level programs and documents.
5. Assists with the selection of engineering controls and personal protective equipment and their proper use.
6. Acts as a liaison with regulatory agencies on the local, state, and federal levels, as well as non-regulatory accreditation organizations.

EHS has the authority to stop any activity which is an immediate danger to the life and health of laboratory workers, employees, students, or the community or an immediate danger to the environment as outlined in BSU Policy 9140.

2.2. Laboratory Safety Officer (LSO)

The LSO serves as the University's Chemical Hygiene Officer, is a staff member of EHS, and is qualified, by training or experience, to provide technical guidance in the development and implementation of the safety and health standards in the CHP. The LSO coordinates:

1. The evaluation, review, and implementation of the University CHP.
2. Laboratory safety trainings and assists departments and colleges with meeting training requirements.
3. The provision of technical expertise to employees regarding laboratory safety and health issues and assistance to University departments, colleges, employees, and students in complying with the CHP.
4. The review of hazardous substance labeling, handling, storage, use, spill cleanup, decontamination and disposal, including standard operating procedures (SOPs) dealing with the safe use and disposal of these substances.
5. The review, as necessary, of new research protocols prior to initiation to identify the use of hazardous chemicals and assistance to principal investigators in developing proper measures to inform and protect laboratory workers.
6. Safety assessments of laboratories and storage areas and recommended follow-up activities.
7. Assistance to colleges, departments, safety committees and principal investigators in conducting their own routine assessments.
8. The review of the acquisition, operation, and maintenance of fume hoods, emergency safety showers, eyewashes, and fire extinguishers in all laboratories where chemicals are handled.
9. The disposal of hazardous waste generated in laboratories in accordance with University policies and written program along with federal, state, and local regulations.
10. The investigation of all reports of laboratory hazards incidents, chemical spills, and near-misses to prevent repeat occurrences.

11. The maintenance of records to ensure their availability to workers and administrative personnel.
12. The review and approval of the creation, modification, or closure of laboratories.
13. The investigation of exposure complaints or concerns for referral for medical consultation or performance of exposure monitoring.

2.3. Safety Committees

Safety committees are important bodies in extending the understanding and guidance provided by EHS across their respective entities. They are responsible for reviewing and providing guidance regarding safe operations of research and teaching laboratories and other facilities. Safety committee representatives are expected to meet on a regular basis to discuss safety issues and provide feedback on policies, programs, and procedures. They ensure that information discussed at the safety committee meetings is communicated to everyone in their labs. Safety committee responsibilities will be outlined in the Laboratory Safety Committee Policy. In regard to the CHP, each safety committee:

1. Provides recommendations and assistance with developing safe work practices, Standard Operating Procedures and job hazard analyses for department/college activities, which includes personal protective equipment requirements.
2. Develops suitable training documents and protocols as appropriate at the college, department and/or laboratory level.
3. Assists with compliance activities for the CHP and additional safety programs.
4. Reviews and makes recommendations in response to safety training reports, experimental protocols for hazard identification and safety requirements (as necessary), exposure evaluation requests and reports, availability of facility safety equipment, and emergency response.
5. Assists in conducting and reviewing accident/injury/illness investigations and provides recommendations.
6. Conducts and reviews operations and facility safety assessments on a regular basis.
7. Maintain communications with department/college staff, faculty, and students and EHS concerning the quality of the work environment. This includes indoor air quality, ergonomics, thermal comfort, etc.
8. Perform other safety related functions as may be assigned by the Administrative Head, Vice President of Research Administration, or recommended by EHS.

2.4. Department Chair

The Department Chair shall ensure the CHP and associated programs and policies are followed by personnel under their direction.

The Department Chair must:

1. Review compliance and discrepancies in safety performance of the department as necessary, and work toward resolution of such issues to ensure safe practices and techniques are being employed.
2. Review accident reports and make recommendations for future procedures or practices that shall minimize the repetition of that type of accident.

2.5. Principal Investigator

For this document, the Principal Investigator (PI) is a faculty or staff member who has overall responsibility for a laboratory and the research/education equipment, practices, procedures and techniques employed in that laboratory. The PI holds the responsibility of ensuring laboratory workers are working in a safe environment. They may designate some or all of the responsibilities to another individual (e.g. laboratory supervisor, laboratory safety coordinator), but the PI is ultimately responsible. The PI must:

1. Assure all work under their direction or performed in their laboratory is conducted in accordance with the CHP and other applicable University policies and programs.
2. Lead the development of suitable, specific training materials and protocols to allow safe practices for all of the activities within their lab.
3. Ensure Laboratory Workers are properly trained and understand procedures applicable to safety in their laboratories and work areas.
4. Document general and laboratory specific training.
5. Provide adequate engineering controls and personal protective equipment to laboratory workers and ensure their proper use.
6. Assign a laboratory safety coordinator to act as a point of contact for EHS and assist with safety assessments and other laboratory safety related issues.
7. Submit research protocols to EHS and applicable safety committees, as necessary, for review prior to commencing work.

2.6. Laboratory Safety Coordinator (LSC)

A Laboratory Safety Coordinator (LSC) LSC must be assigned to each research and teaching laboratory to act as a point of contact for EHS and Laboratory Workers regarding safety issues and assessments.

An LSC may be any laboratory worker associated with the laboratory including the PI.

2.7. Laboratory Worker

A Laboratory Worker is any faculty member, staff member, or student performing or supervising work in a BSU laboratory. This includes PIs. A Laboratory Worker is subject to the CHP and all its provisions and is responsible for following it. A Laboratory Worker must:

1. Understand and follow all laboratory safety-related policies, programs, procedures, and training received.
2. Know the physical and health hazards, handling procedures, and emergency response information for the chemicals or tasks they are handling or performing.
3. Understand the function and proper use of engineering controls.
4. Understand the function and proper use of all PPE and wear required PPE as necessary.
5. Promptly report all work-related incidents, injuries, and illnesses to EHS and their supervisor. Near misses, potential serious safety issues, and danger of environmental contamination must also be reported.
6. Contact the LSC, PI, safety committee, or EHS for further clarification if any of the above items are not clearly understood.

3.0 TRAINING REQUIREMENTS

All laboratory workers must read and understand the CHP and complete all required safety training. Applicable safety training must be completed prior to beginning any laboratory work.

It is the PI's responsibility to determine training requirements for their laboratory workers based upon their roles and activities in the lab and ensuring its successful completion. EHS can assist with determining training requirements. EHS may require additional training based upon their assessment.

3.1. General Laboratory Safety Training

The general laboratory safety training focuses on materials relevant to University laboratories in regard to University safety policies, programs, and procedures along with regulatory requirements. The training provides general knowledge pertaining to laboratory hazards and controls to minimize exposure.

3.1.1. Computer Based

Computer based training consists of web based modules covering various safety topics. Each college, department, and laboratory has a default level of modules which must be completed initially and annually. Additional modules may be required based upon the type of work each individual laboratory worker may conduct. Modules cover a broad range of topics such as biosafety, ethidium bromide, hazardous waste, compressed gases, and electrical safety. Assigned training modules must be completed annually.

3.1.2. Classroom

Class room based laboratory safety training is conducted by EHS. The training covers:

- Chemical Hygiene Plan (this document)
- Brief overview of lab safety regulations
- Hazard Communication (chemical identification and information)
- Safe handling practices and use of engineering controls
- Personal protective equipment
- Disposal of hazardous chemicals
- Emergency equipment location and operation
- Emergency response procedures

Sessions are typically held near the beginning of each semester including the summer session. A training schedule and information is available on the [BSU EHS website](#). Laboratory Workers must attend the next available session after becoming a Laboratory Worker. Laboratory Workers should discuss refresher frequency with their supervisor.

3.1.3. Additional Training

Laboratory Workers may be required to attend additional training based upon the work they conduct. The training frequency will be determined by the PI and EHS and must take into account regulatory requirements.

EHS can develop and perform additional training more specific to a group's needs. Please contact EHS for details.

3.2. Laboratory Specific Training

The PI is responsible for providing Laboratory Workers with safety instruction and information that is specific to their lab and associated tasks, and should include the review of laboratory standard operating procedures. The training may include knowledge based training and skill based assessments.

The PI must also identify hazardous procedures or tasks not covered in this document and inform laboratory workers of these hazards present in the lab. This information and instruction must be documented by the PI as job-specific training. Training documentation must be available for review by EH&S.

Safety instruction for the use of chemicals must satisfy the hazard awareness requirements listed below.

1. The name of the chemical and its hazardous component(s);
2. The health and physical risk(s) associated with the chemical;
3. Signs of release and symptoms of exposure;
4. How and when to use engineering controls and personal protective equipment;
5. Labeling and storage requirements;
6. Disposal procedures;
7. Emergency procedures for spills and exposures; and
8. [Laboratory specific operating procedures](#)

EHS can assist laboratories in providing this training during a staff meeting or other convenient time.

Laboratory specific training must be completed prior to beginning work. Refresher training must be done periodically as determined by the PI.

3.2.1. New Laboratory Workers

A Laboratory Worker new to a laboratory must be given an overview of the hazards and activities associated with the laboratory along with pertinent safety and emergency response information and procedures. The [New Laboratory Worker Safety Checklist](#) or an equivalent tool must be used for documentation.

3.3. Training Records

Responsibility falls upon the PI to maintain documentation for general and laboratory specific training. Documentation is essential to prove a laboratory worker was properly trained regarding the hazards and processes in their laboratory. Without documentation, a laboratory worker is not considered properly trained.

4.0 HAZARD IDENTIFICATION

4.1. Chemical Container Labeling

A chemical container label is the primary means for communicating the contents of a container and its hazard(s). Every container, including those just containing water and working containers, must be labeled to ensure employees and students are aware of its contents.

4.1.1. Original Container

Chemicals in original vendor containers must have labels indicating the chemical or product name and the vendor's name. Hazard warning signs or symbols should be prominently visible on the labels.

4.1.2. Laboratory Container

All containers of chemicals decanted from an original container or prepared in the laboratory must be labeled with the chemical or product name(s), concentration(s), and primary hazard(s). It should also be dated and include the responsible worker's or PI's name. This includes containers of reaction products or byproducts as well as separation processes such as distillations and extractions.

4.1.3. Expiration Date

Time sensitive chemicals (e.g. peroxide formers) must be labeled with an appropriate expiration date. Additional information is available in [SIOP - Peroxide Formers](#).

4.1.4. Pipe/Tubing Carrying Hazardous Materials

Pipes or tubing carrying a hazardous material from a source that is not readily apparent or in proximity to other pipes or tubing must be labeled. Warning signs along the course of the pipe or tubing may also be warranted. For example, a pipe carrying analytical gas from a compressed gas cylinder to another area should be labeled in several places along its length. Additional information is available in [SIOP - Flammable Gases](#) and [SIOP - Toxic Gases](#).

4.1.5. Waste Containers

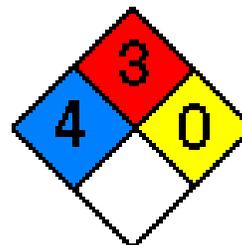
All containers of chemical waste must be labeled as outlined in the [Hazardous Waste Management Manual](#). A current copy of the HWMM must be available in the laboratory's safety manual.

4.2. NFPA Diamond

The National Fire Protection Association developed the NFPA diamond to communicate hazards to emergency responders but it can be used by anyone for this purpose. Its use ranges from small chemical containers to buildings.

Each color-coded diamond indicates a specific hazard:

- Blue diamond (left) Health Hazard
- Red diamond (top) Flammability Hazard
- Yellow diamond (right) Stability/Reactivity Hazard
- White diamond (bottom) Other Hazards



The blue, red, and yellow diamonds are assigned values ranging from 0 – 4. A value of 0 indicates minimal or no hazard and a value of 4 is the highest level of hazard that can be assigned. The white diamond is either blank or contains an abbreviation/symbol indicating the hazard.

- OX Oxidizer
- W Water reactive

4.3. Hazardous Material Identification System

The painting and coating industry developed the Hazardous Material Identification System (HMIS) to communicate hazard information surrounding the everyday use of hazardous materials. It is similar to the NFPA diamond with 0-4 ratings but with some slightly different definitions. HMIS also uses the white section to communicate personal protective equipment requirements represented by letters of the alphabet.

- Health Hazard (Blue)
- Flammability Hazard (Red)
- Physical Hazard (Yellow)
- Personal Protective Equipment (White)

Chemical Name	
HEALTH	<input type="text"/> <input type="text"/>
FLAMMABILITY	<input type="text"/>
PHYSICAL HAZARD	<input type="text"/>
PERSONAL PROTECTION	<input type="text"/>

4.4. Material Safety Data Sheets (MSDS)

An MSDS is a document prepared by a supplier to summarize the health and safety information associated with a product. Suppliers are required to provide an MSDS for each chemical they make or offer. As required by OSHA, each MSDS must contain the following information:

- Product identity
- Hazardous ingredients
- Manufacturer contact information
- Physical/chemical properties
- Physical and health hazards
- Exposure limits
- Engineering controls
- Work practices
- Personal protective equipment
- Emergency and first aid procedures
- Spill cleanup
- Special precautions

Additional information may be added to an MSDS at the manufacturer's discretion.

4.4.1. MSDS Retention and Access

Each laboratory must maintain an MSDS for every chemical compound or product, and every supplier of that compound or product, used in the lab - both current AND past use for a minimum of 30 years. For example, a laboratory using bleach from two suppliers must have a bleach MSDS from each supplier. Each laboratory must also maintain those MSDSs replaced by an updated version. Past or out-of-date MSDSs may be stored out of the work area if the laboratory implements a procedure for accessing them.

Current MSDSs must be readily accessible to all Laboratory Workers and emergency responders and located near the main laboratory exit or outside the laboratory in a non-laboratory area. At the present time, an MSDS may be kept electronically, but a paper copy **must** be kept to meet the accessibility requirement.

4.4.2. Obtaining an MSDS

Manufacturers and suppliers of chemical compounds and products are required to provide an MSDS for every product they offer. An MSDS typically accompanies a chemical shipment or mailed separately. Companies may be contacted via telephone or written request to obtain one, but many make their MSDSs available online or they may be requested via their websites. EHS can also assist in obtaining an MSDS.

4.5. Additional Sources of Information

The Chemical Hygiene Plan serves as a limited resource for information on specific chemicals, chemical hazard classes, and additional hazards. Detailed information is available for some specific topics as a [Safety Information and Operating Procedure \(SIOP\)](#). Contact EHS to suggest additional topics or request additional information.

The BSU EHS website contains information pertaining to chemical safety including links, written programs, training, and contact information for additional assistance.

Manufacturers may also have additional information available in regards to chemical safety.

Reference materials offer a wide range of topics and information. Many are available through the library and EHS.

4.6. Chemical Inventory

A current chemical inventory of the laboratory is necessary to inform Laboratory Workers of the current stock and potential hazards present in the area. It is also needed by emergency responders in case of a fire, chemical spill, or other incident. Each laboratory must maintain a current chemical inventory. The inventory must be broken down by individual container and include:

- Unabbreviated chemical or product name
- Concentration
- Product #
 - Only required for product names
- Manufacturer
- Chemical Abstract Service (CAS) Registry number
 - Only required for chemical names
- Quantity in container
- Quantity units
- Container Owner / PI
- Date inventory performed
- Person who conducted inventory
- Storage location

Contact EHS to obtain a suitable inventory template

The laboratory must keep a current hard copy of their chemical inventory near the main laboratory exit (preferably with their MSDS) or outside the laboratory in a non-laboratory area. The laboratory must submit a current chemical inventory to EHS on an annual basis.

4.7. Laboratory Signage

Rm 632		Micron Engineering Center College of Engineering Address: 1020 Manitou Street		BOISE STATE UNIVERSITY
Principal Investigator: Dr. Pickelstein				
				
				
TO REPORT ANY EMERGENCY SITUATION DIAL 9 1 1				
CONTACT	NAME	LOCATION	PHONE	
FOR ENTRY OR ADVISE	Dr. Pickelstein	MEC - 613	555-5555	
FOR ENTRY OR ADVISE				
EMERGENCY CONTACT	Dr. Pickelstein	MEC - 613	555-5555	
NON-EMERGENCY (24 HOUR)	UNIVERSITY SECURITY		426-1453	

EHS: 201-426-3699 Last Printed: Feb-09

4.7.1. Laboratory Safety Signage

Laboratories must have signage posted on or near the door that clearly identifies potential laboratory hazards and entry requirements. They are to remind laboratory staff and inform visitors of this information and aid the fire department or other emergency responders. The signage must also include the lab's emergency contact information, principal investigator, room number, and physical address. It may include general contact information as well.

EHS works with the laboratories to update signage on a regular basis. Laboratories must notify EHS of changes in laboratory hazards, entry requirements, and emergency contacts. The [Laboratory Safety Signage Form](#) is available on the EHS website.

An [explanation of the symbols](#) is available on the BSU EHS website or by contacting EHS.

4.7.2. Emergency Contact List

An emergency contact list must also be posted near laboratory telephones and on or near the laboratory door. The contacts must include applicable laboratory and college/department contacts, emergency response numbers, Security, and EHS. An [emergency contact template](#) is available on the EHS website. The template includes links to chemical manufacturers and technical information for spill response.

4.7.3. Safety Signage

Signage must be conspicuously posted indicating locating of eyewashes and safety showers. Signage is strongly recommended for fire blankets, fire extinguishers, spill kits, and any other safety equipment to identify its location. The signage must identify the equipment by name or an appropriate symbol.



Each laboratory sink must be posted with a sign indicating "Non-potable water" or similar language.

Contact your building coordinator or EHS for assistance in locating sources for this type of signage and its installation.

5.0 OCCUPATIONAL TOXICOLOGY

5.1. Routes of Entry

To evaluate the risks of adverse health effects from chemicals, one must be aware of the routes of entry into the body, duration of exposure, toxicity of the chemical, exposure limits, and odor threshold of the chemical. This section explains these principles and describes how to reduce chemical exposure.

5.1.1. Inhalation

Inhalation is the most frequent route of chemical exposure in the lab. Exposure by this route can produce poisoning by absorption through the mucous membrane of the nasal passage, mouth, throat, and lungs and can seriously damage these tissues. Inhaled gases or vapors may pass rapidly into the capillaries of the lungs and be carried into the circulatory system. Exposure can be minimized by keeping containers closed when not in use, proper storage of containers, and the use of engineering controls (e.g. fume hood). Respiratory protection may be necessary if engineering controls cannot be used or do not provide sufficient protection. Respirators must not be used in any area without prior approval by EHS.

5.1.2. Skin and Eye Contact

Contact with the skin is the second most frequent route of chemical exposure. A common result of skin contact is localized irritation. Many materials are absorbed through the skin quickly and may cause systemic poisoning. The main routes of entry for chemicals through the skin are the hair follicles, sebaceous glands, sweat glands, and cuts or abrasions of the outer layers of the skin. The follicles and the glands are abundantly supplied with blood vessels, which facilitate the absorption of many chemicals.

Skin and eye contact with chemicals can be avoided by the use of appropriate personal protective equipment.

5.1.3. Ingestion

Many of the chemicals used in the lab are extremely dangerous if they enter the mouth and are swallowed. In addition, many chemicals may damage the tissues of the mouth, nose, throat, lungs, and gastrointestinal tract producing systemic poisoning if absorbed through these tissues. To prevent entry of chemicals into the mouth, lab workers should wear gloves and wash their hands immediately after use of any chemical substance and before leaving the lab. Do not store or consume food and drinks in the lab. Mouth pipetting is strictly prohibited.

5.1.4. Injection

Exposure to chemicals by injection seldom occurs in the lab. However, it can inadvertently occur through mechanical injury from glass or metal contaminated with chemicals or when chemicals are handled in syringes. Use proper sharps handling practices. Broken glass or spilled sharps must be collected using mechanical means (e.g. broom and dustpan) and never with one's hands.

5.2. Exposure Assessment and Monitoring

EHS may be required to perform an exposure assessment of some laboratory work. An exposure assessment takes into consideration any hazardous materials in use, the task being performed, the work environment including engineering controls, administrative controls, and personal protective equipment. Monitoring may be necessary to assess exposure levels to these hazards.

Laboratory workers should contact their supervisor or EHS to discuss exposure concerns and request an assessment.

5.2.1. Exposure Limits

Exposure limits have been established to reduce exposure to "acceptable" levels. OSHA and DBS set regulatory exposure limits called permissible exposure limits (PEL). The American Conference of Governmental Industrial Hygienists (ACGIH) has developed recommended exposure limits called Threshold Limit Values (TLVs).

5.2.2. Frequency

Initial monitoring will be performed if there is reason to believe exposure levels for a substance could exceed the action level or permissible exposure limit. Monitoring may be necessary due to equipment or process changes.

Periodic monitoring will be performed if the initial monitoring exceeds applicable action limits or permissible exposure limits. Monitoring frequency will be established by EHS and based upon

the exposure level (current and previous monitoring) and any requirements outlined in applicable standard.

Monitoring may be terminated in accordance with the applicable standard.

5.2.3. Records

Laboratory workers will be notified of monitoring results in writing within 15 days after receipt of any laboratory results either individually or by posting in an appropriate location.

EHS and the CHO shall maintain records in accordance with the record keeping requirements of applicable OSHA and DBS standards.

5.3. Medical Surveillance

Medical consultation or examination shall be offered under the following circumstances:

- A lab worker develops signs or symptoms potentially associated with a hazardous chemical, which they may have been exposed to in the laboratory.
- Exposure monitoring reveals an exposure level above OSHA or DBS action limits or permissible exposure limits where the applicable standard requires such medical surveillance.
- An event occurs such as a chemical spill, leak, or explosion that results in the likelihood of a hazardous exposure.
- A lab worker is exposed to blood or other bodily fluids by a needle-stick, cut, or splash in the face.

5.4. Reporting Exposure

A Laboratory Worker who believes they have had an exposure should contact their supervisor and EHS for evaluation. The worker or supervisor must contact the [Office of Risk Management and Insurance](#) to determine required documentation to be submitted.

6.0 CONTROLLING HAZARDS

6.1. Hazard Minimization, Elimination, and Substitution

6.1.1. Hazard Minimization

Using smaller quantities of hazardous chemicals or substituting a less hazardous chemical reduces the risk of serious exposure or spill. See the [Hazardous Waste Management Manual](#) for additional waste reduction information. Consider the following possibilities:

- Substitute less hazardous chemicals
- Work on a smaller scale
- Order only what is needed
- Share chemicals when possible

6.2. Engineering Controls

Engineering controls eliminate or minimize exposure by removing a hazard or acting as barrier between a hazard and a worker. Engineering controls are typically more effective controlling hazards than administrative controls practices or personal protective equipment. They often require a higher cost initially; however, they may be more cost-effective in the long run. Engineering controls range in complexity and cost from something as simple as a sharps container to minimize needlesticks to an interlocking mechanism of an x-ray unit to minimize radiation exposure. In a laboratory, they are often used to minimize contact with a hazard due to chemical splash, explosion, or inhalation.

6.2.1. Local Exhaust Ventilation

Local exhaust ventilation is an engineering control used to reduce inhalation exposure. Common laboratory examples include glove boxes, extraction arms (snorkels), and fume hoods.

6.2.1.1. Glove Box

Glove boxes are complete enclosures used to perform work in a separate environment. A different environment may be necessary to control worker exposure or to protect the chemical itself (i.e. an inert atmosphere). Gloves secured to ports allow manipulation inside the unit. Depending on the type of work being conducted, the following may be required:

- Integrity testing – unit and gloves
- Sensor calibration
- Training
- Standard operating procedures

Contact EHS for additional information.

6.2.1.2. Biosafety Cabinet

Biosafety cabinets (BSC) are used to control exposure to biological aerosols and protect work materials from contamination utilizing a High Efficiency Particulate Air (HEPA) filter. HEPA filters do not capture chemical vapors. A BSC where the treated exhaust is returned to the laboratory cannot be used for procedures involving flammable liquids, volatile toxic or odorous chemicals with the exception of small quantities of alcohols used for decontamination. Most, if

not all, of the BSCs on campus exhaust treated air into the laboratory. Additional information is available through EHS.

6.2.1.3. Extraction Arm (Snorkel)

Extraction arms or snorkels are typically constructed of flexible ducting and connected to the exhaust ventilation system. They are useful for capturing vapors, fumes, and dust at the source of generation, and work well when designed properly for a given process and have an adequate flow rate. They are typically ineffective for any source beyond a distance of one half the ducting's diameter. Design or modification must be approved by EHS and Architecture and Engineering.

6.2.1.4. Fume Hood

The fume hood is the most common method of controlling inhalation exposures to hazardous substances in the laboratory. They are useful against fumes, mists, dusts, and vapors. Their use is recommended whenever handling hazardous materials and may be required to reduce exposure to levels below applicable exposure limits. One needs to consider the chemicals and quantities used for during a process.

Alarm

Some fume hoods are equipped with a low-flow alarm. The alarm is an indication the face velocity may be inadequate and not providing proper protection. Contact FO&M and EHS with any issues.

Baffle Controls

Some fume hoods are equipped with controls to adjust the baffles. Baffle adjustment is used to alter the airflow in the hood to better capture and remove air contaminants based upon the work in progress. Most uses involve the baffles opened equal amounts to capture materials released in the hood. However there are occasions where adjustment is beneficial. The use of a volatile low density chemical, hot plate or Bunsen burner may cause contaminants to rise quickly making the lower baffle rather ineffective. High density materials may result in contaminants gathering near the surface of the fume hood making the upper baffle ineffective. There are varying styles and types of baffle controls so it is important to be familiar with the hood used.

Emergency Shut Off

Some buildings are equipped with emergency shut offs for the fume hood exhaust system and differ from the alarm and purge controls mentioned above. The emergency shut offs are only to be used by Facilities Operations and Maintenance (FO&M) or the fire department.

Certification and Maintenance

Fume hoods certification is maintained by EHS and completed on an annual basis as indicated by a sticker on the fume hood. The sticker is typically found on the side of the sash indicating the height at which it was certified.

The certification process ensures the fume hood is functioning properly and maintains a minimum face velocity measured at the sash threshold of 80 feet per minute.

The grill at the bottom of the sash threshold must be kept clear and should be inspected regularly by the laboratory. The slot should be cleaned if necessary.

Any suspected fume hood malfunctions or issues must be reported to FO&M and EHS. Alterations must be coordinated and approved by FO&M and EHS. Any repair, relocation, or alteration requires recertification of the fume hood by EHS.

Minimizing Materials in the Fume Hood

In order for a fume hood to operate properly, adequate airflow is essential. An easy way to accomplish this is by minimizing the number and size of materials in a fume hood. Materials, such as large equipment, supplies or chemical containers, cannot be used in a fume hood if it prevents the fume hood from functioning properly. The most common issue stems from blocking the lower baffle, which reduces adequate flow at the sash and can disrupt airflow patterns. It may be possible to elevate the materials to maintain flow to the lower baffle. For large equipment, it is generally more effective to install a specially designed enclosure so the chemical fume hood can be used for its intended purpose. Contact EHS for assistance and assessment.

Sash Height

When working at the chemical fume hood, open the sash only as far as necessary to access the work area. The lowered sash helps contain contaminants in the hood and the smaller hood opening makes the hood less susceptible to room drafts and other external air disturbances. Sashes open too high can result in inadequate face velocity reducing its effectiveness. The certification sticker indicates the height at which it was tested and is the maximum working height.

When a fume hood is not in use, the sash should be lowered to within a few inches of the bench or air foil.

The sash can also help protect against splashes or projectiles from chemical spills or explosions. A lowered sash does not eliminate the necessity for appropriate personal protective equipment.

Additional Work Practices

- Work at least six inches behind the sash threshold.
- Never put your head (or face) inside an operating chemical fume hood to check on an experiment.
- Move slowly in and around fume hoods. Also be aware opening/closing doors can disturb the airflow.

Perchloric Acid Use

Perchloric acid must be used in a specifically designed and dedicated fume hood with a wash down system due to potential formation and build up of explosive perchloric acid salts. The fume hood cannot be used for any other purpose especially organic chemicals. Please see [SIOF – Perchloric Acid](#) for additional information or contact EHS.

6.3. Administrative Controls

Administrative controls mainly consist of policies, programs, training, and procedures which guide work and practices to reduce exposure by limiting duration, frequency and/or severity.

6.3.1. Written Documents

Written policies, programs, and procedures are used to document and communicate requirements and responsibilities. The University uses policies to outline high level objectives, responsibilities, and requirements. For example BSU Policy 9140 outlines the University's commitment to environmental health and safety and responsibilities of the University community. Programs, such as the CHP, provide guidance on specific topics typically applying to multiple departments which help guide compliance with University policy and regulatory requirements. Standard operating procedures communicate specific hazards, steps and requirements for equipment, processes and procedures.

6.3.1.1. Laboratory Specific Operating Procedures

Laboratories must establish and maintain operating procedures for equipment, processes, or procedures involving hazardous activities or materials. They are used to:

- Communicate to the Laboratory Worker the potential hazards, required hazard controls, and steps to complete a task safely and correctly.
- Satisfy regulatory requirements to document required engineering controls and personal protective equipment.
- Train laboratory workers in proper procedures making results more consistent between laboratory workers.

The need for a procedure is situation/risk dependent and final determination falls to the PI or Lab Supervisor.

Operating procedures must be part of [Laboratory Specific Training](#) and training/review must be documented.

Laboratories may document operating procedures as they wish or may use a Safety Information and Operating Procedure (SIOP) as discussed below.

6.3.1.2. Safety Information and Operating Procedure (SIOP)

EHS developed a tool to communicate laboratory hazards, safety information, and operating procedures called a Safety Information and Operating Procedures (SIOP). It can be used to communicate and share information regarding broad safety topics to specific equipment procedures.

EHS Use

EHS develops SIOPs for hazards, processes, and procedures applicable to multiple laboratories or departments or the campus as a whole. They provide general guidance and information relating to potential hazards, exposure controls, handling requirements, and proper procedures for a given topic.

College, Department, & Laboratory Use

A college, department, or laboratory may adopt an SIOP as their own operating procedure if it fits their specific process, or they can modify it to conform to their specific need. They may also use the template to develop their procedure.

SIOP Sharing

The idea behind the SIOP is not only to communicate hazard and procedure information, but to allow the sharing of this information across colleges, departments, and laboratories. This could create efficiencies and some standardization within BSU, a college, or department for certain hazards, operations or equipment use. EHS established an [SIOP website](#) to facilitate sharing and collaboration. It is not required to use the SIOP format or to post them to the site, but it is encouraged. Anyone with a BSU Google Apps account has the ability to access the site. Please visit the web site for additional information.

6.3.2. Work Practices

The information in this section applies to the majority of laboratory work or work areas. Information regarding specific chemicals, chemical hazard classes, and additional hazards may be available as an SIOP.

6.3.2.1. Prepare for Work with Hazardous Chemicals

1. Take the time to read and familiarize yourself with the Chemical Hygiene Plan and its appendices before handling any hazardous chemical.
2. Read the Hazardous Waste Management Manual, which contains information covering safe and proper disposal of hazardous chemicals.
3. Read applicable laboratory protocols or standard operating procedures, which should outline requirements for handling hazardous chemicals.
4. Know the nearest location of all safety equipment as well as the building's evacuation routes and meeting location.
5. Be familiar with the spill and exposure response procedures in the Chemical Hygiene Plan and the [Emergency Response Plan – Appendix E](#) (or similar information) located within the lab.
6. Become familiar with the health and physical hazards of the chemicals you will be handling.
7. For extremely hazardous chemicals or procedures, consider performing a “dry” run with a supervisor to familiarize you with the steps.

6.3.2.2. Minimize Routine Exposure

The following are general work practices designed to minimize exposure from routine work procedures:

- Work involving hazardous chemicals should be conducted in a chemical fume hood whenever possible.
- Do not smell chemicals to determine their identity.
- Never place your head inside of a chemical fume hood to check on an experiment.
- Change gloves regularly.
- Inspect gloves for tears, cracks, discoloration, and holes before and during use.
- Release of toxic chemicals or asphyxiants (e.g. chloroform, dry ice, nitrogen) in environmental rooms must be avoided. Air is recirculated in these rooms which may lead to a buildup of toxic materials or an oxygen deficient environment.
- Exhaust of an apparatus that may discharge toxic chemicals should be vented into a chemical fume hood, exhaust ventilation system, or filter.

- Storing, handling, or consuming food or beverages in laboratories, storage areas, refrigerators, environmental rooms, or laboratory glassware is prohibited.

6.3.2.3. Personal Hygiene

Personal hygiene in the laboratory can minimize exposure to hazardous chemicals. Some general guidelines for personal hygiene in the laboratory include:

- No eating, drinking, smoking, or applying cosmetics is allowed in laboratory areas. The use of contact lenses in the laboratory should be avoided in laboratory areas.
- Mouth pipetting of any substance is prohibited.
- Hands must always be washed before leaving the laboratory. Solvents must never be used to wash hands.
- Required, appropriate personal protective equipment (PPE) (e.g. lab coat, eye protection, gloves) must be worn in the laboratory whenever there is a potential for exposure to chemical or physical hazards. Please refer to laboratory specific requirements. Guidance for establishing PPE requirements is available in [SIOP – Laboratory PPE](#).
- PPE must not be worn in public areas such as bathrooms, offices, conference rooms, eating areas, and outdoors.
- Gloves must not be worn while touching doorknobs, light switches, telephones, or other common items unless required by the laboratory. Appropriate signage must indicate the PPE requirement.

6.3.2.4. Housekeeping

General guidelines for good housekeeping include:

- Areas around emergency equipment, showers, eyewashes, and exits must be kept clear.
- Areas around all circuit panels must be kept clear.
- All aisles, hallways, and stairs must be kept clear.
- All work areas should be kept clear of clutter.
- All chemicals should be returned to their proper storage area at the end of the day.
- Spills must be cleaned up promptly.

6.3.2.5. Transportation

Transportation of hazardous materials between campus buildings and off campus must be approved by EHS. This includes, but is not limited to transportation via vehicle, cart, or person. Prior approval is required to ensure proper containment is used, and for transportation on or across a public thoroughfare, DOT hazardous material shipping requirements must be met which may necessitate shipping papers, special labeling, packaging, placarding, or vehicle requirements.

EHS is responsible for removing hazardous chemical waste from all research laboratories. Hazardous chemical waste procedures are outlined in the [Hazardous Waste Management Manual](#).

6.3.3. Laboratory Safety Assessments

EHS conducts laboratory safety assessments of academic and research laboratories on an annual basis. It is a tool used to help BSU and its laboratories maintain compliance – both with regulatory requirements and BSU policies and programs. It covers common laboratory requirements focusing on areas such as:

- Chemical safety
- Hazardous waste
- Training documentation
- Personal protective equipment
- Emergency and safety information
- Emergency equipment
- Fire and life safety
- Engineering controls

A copy of the [Laboratory Safety Assessment form](#) is available on the EHS website.

EHS does its best to coordinate a time to conduct the assessment with the laboratory safety coordinator or principal investigator. EHS may perform surprise assessments as deemed necessary.

6.4. Personal Protective Equipment

Personal protective equipment (PPE) is worn to minimize exposure to potential hazards and must be worn when handling hazardous materials or performing potential hazardous activities in the laboratory. Appropriate PPE is based upon the potential hazards and risks associated with those hazards. Hazards and risks can be associated with the chemicals in use, quantities, and where and how they are used. They can stem from temperatures, pressures, or mechanical action applied to a material.

Eliminating unnecessary processes and substances must be the first method used to control hazards. Engineering controls (e.g. chemical fume hood) and administrative controls can be used to control hazards minimizing required PPE.

The PI for each laboratory, with the aid of EHS, is responsible for determining PPE requirements. PPE requirements must be documented by the laboratory in the form of either job hazard analysis or standard operating procedure. Refer to [SIOP – Laboratory PPE](#) for selection guidance.

The PI must ensure appropriate types and sizes of PPE are readily available, laboratory workers are properly trained in regard to use and maintenance, and laboratory workers comply with PPE requirements.

Workers and visitors must comply with laboratory PPE requirements.

Common laboratory PPE is discussed below. Keep in mind different or additional PPE may be required based upon the hazards and associated risks.

6.4.1. Hand and Forearm

6.4.1.1. Gloves

Gloves are required when handling hazardous chemicals or for protection from physical hazards such as against cuts, extreme temperatures, and abrasion. There is no glove currently available that will protect against all chemicals for all types of tasks. Many glove manufacturers have charts available to help determine the most appropriate glove material. Gloves come in a variety of materials, thicknesses, and cuff lengths. Glove selection must consider the chemicals in use, potential contact time, splash/splatter potential, and dexterity needs.

It is recommended to change thin disposable gloves once they become contaminated or on a regular interval. In some applications, thicker gloves may be reused, but they must be inspected regularly for nicks, punctures, other damage or signs of degradation and discarded when necessary.

Lab workers must remove at least one glove before leaving the immediate work site to prevent contamination of public areas (e.g., doorknobs, light switches, telephones, etc.).

Latex Allergy

Latex (i.e., several protein antigens) has been shown to be a sensitizer to some individuals. Sensitization occurs over time with increased symptoms. Exposure to the latex protein is greatly increased through the use of powdered latex. The use of powdered latex is highly discouraged. If a powdered glove is desired, a powdered nitrile glove is recommended.

6.4.1.2. Tyvek[®] sleeves

Tyvek sleeves provide greater forearm protection than a lab coat. Uncoated sleeves are fluid resistant and coated sleeves provide increased fluid protection. The sleeves must be worn over a lab coat or paired with other necessary body protection.

6.4.2. Body

Body protection may be necessary to protect against chemical splash/splatter or particulate which could cause injury or contamination of an individual or their clothing. It may also be necessary to protect a work area from outside contamination (e.g. clean room).

6.4.2.1. Lab Coat

A long-sleeved laboratory coat must be worn whenever infectious, chemical, or radioactive hazards exist assuming a similar or more protective level of PPE is not required. A lab coat, though not impervious, provides some protection against contact and contamination. Tyvek lab coats or coveralls may also be a suitable option and may offer added convenience since they are disposable.

Contaminated lab coats must be immediately removed and laundered or disposed of properly. Laundering must be done through a commercial laundry service. Home laundering is prohibited. Contact EHS for available commercial services.

6.4.2.2. Chemical Resistant Apron

Some chemicals or activities may require protection beyond a lab coat's capabilities due to splash/spatter potential and the hazardous chemical properties. It is important to select an apron compatible with the chemical in use and an appropriate thickness for adequate protection.

6.4.3. Eyes/Face Protection

The most common types of eye and face protection consist of safety glasses, safety goggles, and face shields. Each serve their own purpose, but all of them must meet requirements outlined in American National Standards Institute (ANSI) Z87.1. "Z87" must be imprinted on the equipment indicating it meets proper specifications.

6.4.3.1. Safety Glasses

Safety glasses must be worn, at a minimum, when handling small quantities of hazardous materials or where there is the potential of flying particulate. They must have side shields for added protection. They are adequate for handling small quantities of moderately hazardous materials with limited splash/spatter potential or materials of low hazard and flying particulate.

Regular prescription glasses do not meet the Z87.1 requirements. Over-the-glasses (OTG) safety glasses are available which fit over most prescription lenses and frames. A number of retailers offer prescription safety glasses. The frames are marked with Z87 and are fitted with polycarbonate lenses. Side shields are required and typically snap on the bows.

Visitors must wear safety glasses while work is underway in the laboratory. Visitors closely observing or participating in processes must wear all required PPE for the process.

6.4.3.2. Safety Goggles

Safety goggles must be worn when handling liquid hazardous materials with a reasonable potential for splash/spatter, injurious materials, or concentrated corrosives. Goggles fit tightly to the face minimizing liquid and vapor contacting the eye area. Vented and non-vented models are available. Vented goggles have some slits/holes, which reduce fogging but increases contact potential. Vented goggles may have direct or indirect venting. Direct venting models may be used for flying particulates, but are not recommended for chemical protection. Non-vented goggles fog easier but provide greater protection. An anti-fog coating is an important feature. Most prescription glasses fit under standard safety goggles.

Goggles provide better protection against large amounts of particulate compared to safety glasses.

6.4.4. Face Shield

A face shield helps protect the users face from splashes and flying particulate. A face shield is only considered supplementary eye protection so safety glasses or goggles must also be worn.

6.4.5. Leg and Foot

Laboratories should consider requiring leg protection such as pants or similar clothing when handling hazardous chemicals to minimize chemical contact with exposed skin. Leg protection must be required when handling corrosive or highly toxic liquids. Leg protection beyond regular clothing may be required for protection from hazards such as molten metal, heat, and cutting hazards.

Foot protection requirements must be based upon the hazards and potential exposure in each lab. Due to the materials being handled in most labs, closed toed shoes (covering the top and sides of the feet) are required. Additional foot protection may be required such as steel toe, leather, or slip-resistant shoes.

6.4.6. Respiratory Protection

Respirator use requires training, medical clearance, and fit testing. Respirators are not to be used in any area without prior approval of EHS. Contact EHS for additional information.

6.4.7. Additional Considerations

Additional or a different type of PPE may be necessary dependent upon the laboratory and associated activities. It is recommended laboratories designate minimum PPE for entry to work areas.

Contaminated PPE must be decontaminated or properly disposed. Contaminated PPE may require classification as hazardous waste. Please refer to the [Hazardous Waste Management Manual](#) or contact EHS.

7.0 EMERGENCY RESPONSE

The University outlines its emergency response policy and procedures in the [Emergency Response Plan](#) which includes Appendix E - Emergency Response Instructions. Emergency responders can be reached by dialing 911 or contacting Security at 426-1453. These numbers must be posted near a laboratory phone and on the corridor door.

All emergency response activities must be reported to your supervisor and EHS.

7.1. Emergency Equipment

In any emergency, it is critical that all staff members are familiar with the use and location of all emergency equipment. This includes fire extinguishers, fire alarms, safety showers, eyewash stations, first aid kits, and chemical spill kits.

The laboratory must maintain adequate clearance around emergency equipment to allow easy access and proper operation.

All emergency equipment should be on a preventive maintenance schedule. Fire alarms are tested periodically, and extinguishers are inspected monthly. FO&M tests safety showers and eyewash stations monthly unless laboratories have arranged for self-testing. Laboratories should activate their eyewashes on a weekly basis. If available, first aid kits must be properly equipped with unexpired supplies based upon occupancy.

7.2. Seeking Medical Treatment

7.2.1. 911

911 should be contacted for a serious medical emergency. If you are unsure of the seriousness of the situation, make the call. If emergency responders are deemed necessary, they will respond to the scene and assess the situation.

7.2.2. Emergency Room or Additional Care

7.2.2.1. Faculty Member, Staff Member, or Student Employee

A faculty member, staff member, or student employee requiring medical attention where emergency responders or their transport are not necessary should seek care through one of [St Luke's Occupational Health Clinics](#) or [St Luke's Emergency Room](#).

7.2.2.2. Students

Students should seek medical attention as determined by coverage of their insurance provider. Depending on the provider, students may be able to seek medical attention from the [University Health Services](#).

7.3. Chemical Exposure

The treatment of a chemical exposure takes precedent over spill cleanup, spill containment, or property damage including water damage from the use of an eyewash or safety shower.

If possible, obtain assistance to remove contaminated PPE and clothing and contact emergency responders if necessary.

Laboratories are recommended to have a set of scrubs or other such clothing in case a laboratory worker's clothes become contaminated.

Refer to [Section 5.4 Reporting Exposure](#) for reporting requirements.

7.3.1. Eye Contact

Eyes must be promptly flushed with water using an eyewash for 15 minutes following contact with any chemicals. The eyes should be held open as much as possible. Medical help should be sought immediately after flushing.

7.3.2. Skin Contact

The affected areas must be immediately flushed with water for 15 minutes. Once the flushing has started, contaminated PPE and clothing must be removed. Medical attention should be sought immediately after flushing.

7.3.3. Inhalation/Ingestion

Immediately contact emergency responders for guidance.

7.3.4. Contaminated sharps injury

The affected areas must be immediately flushed with water for 15 minutes. Once the flushing has started, contaminated PPE and clothing must be removed. Medical attention should be sought immediately after flushing.

7.4. Chemical Spill

7.4.1. Small Spill

A small spill is defined as a spill less than or equal to 200mL or 200 g AND not of an extremely hazardous substance AND within the cleaning capabilities and comfort level of the laboratory and Laboratory Workers.

If you are not sure or uncomfortable with the clean up, contact your supervisor and EHS for assistance.

- Inform others in the area of the spill.
- Turn off any gas burners without putting yourself in harm's way.
- Retrieve MSDS without putting yourself in harm's way.
- Review applicable MSDS and determine controls, PPE, and need for assistance.
- Put on necessary protective clothing (gloves, safety goggles or glasses, and lab coat).
- Cover small spills with absorbent towels.
- Clean spill area working from outside toward the center.
- Rinse spill area with water.
- Label and retain spill materials for EHS.
- Contact your supervisor and EHS and complete a [Spill Investigation Report](#).

7.4.2. Large Spill

A large spill is a spill greater than 200mL or 200 g OR any amount of an extremely hazardous substance OR beyond the cleaning capabilities or comfort level of the laboratory or Laboratory Workers.

- Inform others in the area of the spill.
- Turn off any gas burners without putting yourself in harm's way.
- Retrieve MSDS without putting yourself in harm's way.
- Evacuate the area.
- Close doors behind you.
- If deemed necessary or unsure of severity, immediately call 911. You may also pull a fire alarm.
- Contact your supervisor and then call EHS at 426-3999 and Security at 426-1453.
- Post warning outside the area and lock doors if possible to prevent re-entry.
- Complete a [Spill Investigation Report](#).

7.4.3. Spill Kit

Laboratories must have chemical spill kits available suited to the chemicals and quantities in their particular laboratories. Basic supplies should consist of appropriate absorbents, equipment, and PPE. A [basic supply list](#) is available on the EHS website. If necessary, contact EHS for assistance determining adequate supplies.

8.0 CHEMICAL STORAGE

Chemicals must be stored in an appropriate manner to ensure safety in the laboratory. Proper storage:

1. Protects flammables from ignition and heat,
2. Minimizes the potential of exposure to toxic materials, and
3. Segregates incompatible materials to prevent accidental mixing due to a spill, poor housekeeping, earthquake, fire, etc.

8.1. General Storage Guidelines

The following are guidelines for appropriate chemical storage:

- Incompatible chemicals must be segregated. See [SIOP – Chemical Storage Groups & Segregation Guidelines](#) for guidance.
- Hazardous materials must not be stored above eye level.
- Shelving used for chemical storage must have vertical lips.
- Chemicals must be stored in compatible containers.
- Containers must be securely closed.
- Hazardous liquids must be stored in secondary containment.
- Containers of time-sensitive chemicals (e.g. peroxide formers) which result in an increased risk must be dated upon receipt, again upon opening and disposed in accordance with [SIOP – Peroxide Formers](#).
- Refrigerators or freezers used for flammable liquid storage must be designed and rated for flammable liquid storage.
- Flammable liquids and volatile toxic materials must not be stored in cold rooms.
- Flammable liquid storage outside of a flammables cabinet must be less than or equal to 10 gallons.
- Class 1 Flammable liquids must be stored in safety cans single container's quantity is greater than one gallon.
- Chemical storage under and near sinks is restricted to bleach and compatible cleaning agents.
- Chemical storage areas must be clearly labeled with hazard information (e.g. flammable cabinet must be labeled "flammable" or similar).
- Compressed gas cylinders must be properly stored and secured. Reference applicable SIOPs.

8.2. Expired Chemicals

Any expired or out-of-date chemical must be properly disposed if it presents an increased safety risk over time such as peroxide formers and picric acid. The PI may choose to retain chemicals past their expiration if the chemical has no increased risk and it is properly stored. EHS strongly recommends disposal of expired chemicals if it is not needed in the foreseeable future.

8.2.1. Time-Sensitive Expired Chemical Disposal

Failure to dispose of time sensitive chemicals prior to their expiration date can result in increased disposal difficulty and cost. Depending on the chemical and its age, testing and disposal by an outside vendor may be required. In extreme cases, an explosive ordinance disposal unit (i.e. bomb squad) may be required. Costs associated with the testing and disposal of time-sensitive chemicals beyond their expiration date may be the responsibility of the laboratory and its department.

8.3. Specific Storage Requirements

Specific chemical storage requirements and segregation guidelines are covered in [SIOF – Chemical Storage Groups & Segregation Guidelines](#) and other SIOFs for specific hazard classes. Please contact EHS with any questions or concerns.

8.4. Security

Security measures must be in place to prevent theft or unauthorized use of hazardous materials. These materials must be stored in a secure location when no authorized person is present in the area. Examples include a locked cabinet or locked room door. In most instances a single barrier is sufficient; however, some materials may require additional barriers (i.e. locked cabinet in a locked room).

APPENDIX A: DEFINITIONS AND ABBREVIATIONS

Anesthetics/Narcotics

Anesthetics/narcotics depress the central nervous system. Many solvents (chloroform, ether) have an anesthetic effect.

Asphyxiants

Asphyxiants interfere with oxygen and/or availability and include the following:

- **Simple asphyxiants** may not normally be dangerous (e.g., nitrogen, argon, helium, or nitrous oxide), but if present in high enough concentrations, can displace oxygen in air and cause suffocation.
- **Chemical asphyxiants** chemically combine with oxygen carrying sites (carbon monoxide) or with oxygen utilization (cyanide).

Carcinogens

Carcinogens cause cancer through irreversible, uncontrolled growth of cells in an organ or tissue. It is believed that there is no known minimum dose that can remove all danger of cancer. Benzene is a known carcinogen.

Corrosives

Corrosives cause rapid death of the body cells they contact. Exposure may cause pain, burning, bleeding, and fluid loss. Corrosives include acids and bases. Due to the nature of bases and some acids, pain response may not be immediate upon exposure.

Division of Building Safety (DBS)

The Division of Building Safety, an entity of the State of Idaho, provides regulatory guidelines and performs regular building safety inspections.

Health Effects

- **Acute health effects** happen immediately after a chemical exposure. Effects are generally apparent and can often be easily traced to the exposure. Acute reactions are normally short lived and may be followed by recovery, although occasionally permanent damage occurs.
- **Chronic health effects** are not always obvious and onset of symptoms is gradual. It is much harder to trace the cause of a chronic effect, since the exposure could have been 20 – 30 years prior to the appearance of the effect.

Irritants

Irritants cause immediate pain or reddening of exposed areas. The most common sites of exposure are the eyes, skin, throat, and breathing passages. Their major long-term effect is scar tissue formation at the site of injury. Site of action depends on solubility. Examples include but are not limited to the following:

- Upper respiratory irritants - soluble gases such as ammonia, hydrogen chloride, and sulfur dioxide.
- Upper respiratory/lung tissue irritants - bromine, chlorine, cyanogen bromide, dimethyl sulfate, and ozone.
- Lung tissue irritants - poorly soluble agents such as nitrogen dioxide, phosgene, and arsenic trichloride.

Laboratory

In regard to the Chemical Hygiene Plan, a laboratory is defined as a place equipped for experimental study in a science or for testing and analysis and the procedures involved are not part of a production process, nor in any way simulate a production process.

Lethal Dose 50 (LD50)

LD50 is a dose sufficient to kill 50% of the population in an animal study. LD50 is used to convey chemical toxicity.

Mutagens

Some mutagens can affect the offspring due to parental exposures before conception takes place.

Occupational Safety and Health Administration (OSHA)

OSHA is part of the federal government and provides regulations and assistance for work place health and safety.

Permissible Exposure Limit

OSHA and DBS regulatory limits for inhalation which may consist of:

- **Time Weighted Average, 8 hour (TWA₈)** – Average concentration over an eight hour period.
- **Short Term Exposure Limit (STEL)** – Average concentration over a 15 minute interval.
- **Ceiling (C)** – Maximum concentration at any given time.
- **Action Level (AL)** – Average concentration over a specified time

Exceeding any of these levels for a chemical requires additional actions to be taken which may include additional monitoring, engineering controls, administrative controls, or PPE.

Personal Protective Equipment (PPE)

PPE is worn for protection against exposure to chemicals, projectiles, or other hazards. Examples include safety glasses, safety goggles, gloves, and lab coat.

Poisons

Poisons interfere with vital bodily processes. Examples include but are not limited to the following:

- Cyanide ions interfere with tissue oxidation by combining with cytochrome oxidase. Overdose leads to death by chemical asphyxiation.

- Arsenic compounds combine with enzyme sulfhydryl groups and interfere with enzymatic action.
- Methyl isobutyl ketone and acrylamide can cause peripheral neuropathy.
- Chromates, fluorides, and corrosive gases can be absorbed or particles can act as poisons.
- Silica and asbestos are considered poisonous particulates as they cause fibrosis (scar tissue formation) in the lungs which interferes with normal pulmonary functions.

Reproductive Toxins

Reproductive toxins are a broad class of chemicals that can:

- Affect the reproductive organs (e.g., atrophied testicles, enlarged breasts, etc.).
- Affect adult sexual functions (e.g., libido, fertility, menstruation, ovulation, etc.).
- Affect the offspring of males or females who were exposed by causing structural abnormality, functional deficiencies, altered growth, or death of the conceptus.

Sensitizers

Sensitizers do not harm the body upon first exposures, but can do so upon re-exposure, even at very low levels. Response is generally of an allergic nature, with skin, eye, or lung reactions. Examples are toluene diisocyanate (TDI) used to make urethane materials, epoxy resins, and formaldehyde.

Teratogens

Teratogens affect the developing embryo or fetus due to exposures in the womb. Exposure to teratogens during the first three weeks of pregnancy may result in severe damage or death of the embryo. Exposure to teratogens during weeks four through nine may result in birth defects since this is the period of organogenesis. Special precautions may be needed to ensure that exposures do not occur during these critical periods.

Threshold Limit Value

ACGIH recommended exposure limits for inhalation which may consist of:

- **Time Weighted Average, 8 hour (TLV-TWA₈)** – Average concentration over an eight hour period.
- **Short Term Exposure Limit (TLV-STEL)** – Average concentration over a 15 minute interval.

Working Container

A container with chemicals which will be used the same day it was added to the container.

