Laboratory Safety and Chemical Hygiene Plan

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Foreword

In 1970, the United States Congress established the right of workers to "safe and healthful working conditions" through the Occupational Safety and Health Act. This act created the Occupational Safety and Health Administration (OSHA). In July, 1994 the State of Ohio adopted and incorporated by reference many of the Federal OSHA standards through the Public Employee Risk Reduction Act, Ohio Revised Code 4167.07. This act and its subsequent rules (Ohio Administrative Code 4167-3-01) required Bowling Green State University and other state institutions to comply with all applicable OSHA standards.

The Laboratory Safety and Chemical Hygiene Plan has been established by Bowling Green State University to comply with Ohio's Public Employee Risk Reduction Act, the OSHA Occupational Exposure to Hazardous Chemicals in Laboratories Standard 29 CFR 1910.1450, and the OSHA Personal Protective Equipment Standards of 29 CFR 1910 subpart I. OSHA defines a Chemical Hygiene Plan as a written program developed and implemented by the employer which sets forth procedures, equipment, personal protective equipment and work practices that can protect employees from the health hazards presented by hazardous chemicals used in that particular workplace and meets the requirements of paragraph (e) of 29 CFR 1910.1450.

Certain safety and health hazards exist in the University laboratories and must be addressed. Everyone involved in any aspect of lab functioning has a legal and moral responsibility to act in such a way to reduce risks from potential hazards in the laboratory.

The Plan is designed to accommodate the wide variety of laboratory activities on campus and to minimize unnecessary burdens placed on departments or researchers. Recognizing the vast number of chemicals and procedures that may be used on the University campus, the Plan establishes general safe operating procedures and provides guidelines for the development of specific laboratory procedures. The responsibility for ensuring safety in the laboratory ultimately rests with the individual in charge of that laboratory.

Ensuring safety through health hazard reduction should be viewed as a good prudent professional practice, not as merely an additional administrative requirement. Risks can never be reduced to zero, but by practicing simple and safe laboratory procedures, they can be reduced dramatically. The intent of the Plan is to help laboratories reach a level of safety and risk minimization that is entitled to all workers.

Ohio Public Employment Risk Reduction Program

Ohio | Bureau of Workers' Compensation

Ohio Public Employment Risk Reduction Program

Safety and Health Protection on the Job It's The Law!

The Public Employment Risk Reduction Act ensures safe and healthy working conditions for Ohio's public employees.

Public employers shall provide a place of employment free from recognized hazards and be in compliance with the Public Employment Risk Reduction Program (PERRP) occupational safety and health standards, rules and regulations.

Public employees shall comply with the PERRP occupational safety and health standards, rules and regulations.

Complaints

- Any public employee or employee representative has the right to file a complaint with PERRP via fax or letter that describes unsafe or unhealthy conditions in his/her workplace. Names of public employees filing complaints will be kept confidential.

Refusal to Work

- A public employee acting in good faith has the right to refuse to work under conditions he or she reasonably believes present an imminent danger of death or serious harm. This applies if the condition does not normally exist or is not reasonably expected to occur during the course of the employee's regular duties. A public employee who refuses to work under such conditions **must** follow these steps.
  - Notify his or her immediate supervisor that the condition poses imminent danger.
  - Submit a written statement of the imminent danger to PERRP as soon as practical.

  There is, however, no right under the PERRP Act for an employee to refuse to work, unless the danger is one that a reasonable person under the circumstances would conclude an imminent danger exists.

Enforcement

- PERRP investigates job sites for unsafe and unhealthy conditions and practices at the request of a public employee, public employee representative or public employer.
- It issues citations requiring public employers to correct safety and health violations.
- A PERRP investigator may privately question a representative sample of employees and management about safety and health conditions in the workplace.

Citations

- If the investigation verifies a violation, PERRP will issue a citation. The public employer must then prominently post this citation in a conspicuous place where they customarily post such notices to their employees.

Reporting Fatalities/Multiple Hospitalizations

- A public employer must contact PERRP *within eight hours* of:
  - Death of any employee from a work-related incident;
  - Inpatient hospitalization of three or more employees from a single work-related incident.

Access to Records

- Employees have the right to copies of their medical records, and records of their exposures to toxic and harmful substances or conditions.

Discrimination

- Employers cannot discharge or otherwise discriminate against employees in any manner for filing a complaint or instituting any provision of the Act. Employees or their representatives may file discrimination complaints with the State Personnel Board of Review within 60 days of the discriminatory act.

Recordkeeping

- Public employers are required to maintain a PERRP 300P Log of injuries and illnesses.
- Public employers are required to submit a PERRP 300AP Summary of Work-Related Injuries and Illnesses to PERRP by Feb. 1 for the previous calendar year.
- Public employers must keep separate records for each establishment. On Feb. 1 of each year, the employer must post the PERRP 300AP at each establishment through April 30.

For More Information Contact:

Public Employment Risk Reduction Program (PERRP)
13430 Yarmouth Drive
Pickerington, Ohio 43147
Phone: 800-671-6858

Hearing Impaired: TTY/TDD 1-800-750-0750
Fax: 614-621-5754
www.bwc.ohio.gov

Under provisions of Rule 4167-4-01 of the Ohio Administrative Code, public employers must post this notice (or facsimile) in a conspicuous place where they customarily post such notices to their employees. Minimum reproduction size of this poster is 8 ½ x 14 inches. Alternatively, employers can give a copy of this notice to each employee at the time of hiring and at least annually thereafter.

Objective

The objective of the Plan is to provide safe and healthful working conditions in the laboratories of Bowling Green State University through education, awareness, and protective laboratory practices and equipment. The Plan is a baseline for safety procedures. It also provides guidance for developing safe practices for specific hazardous situations. This Plan should also be used in conjunction with all other applicable policies and procedures relating to the work performed in the laboratory.

Applicability

The Plan applies to all laboratories that can be defined as workplaces in which relatively small quantities of substances are used on a non-production basis. Where the Plan applies, it shall supersede for laboratories the requirements of BGSU's Hazard Communication Program.

Specifically, the Plan applies to "laboratory use of hazardous chemicals." Rooms are covered by the Plan if they meet the following four requirements:

- Chemical manipulations are carried out on a "laboratory scale" (means work with substances in which the containers used for reactions, transfers, and other handling are designed to be easily used and manipulated by one person);
- Multiple chemical procedures or chemicals are used;
- The processes involved are not production processes, nor in any way simulate a production process; and
- Accepted lab procedures, practices and equipment are used to minimize chemical exposure.

Responsible Parties

Department Chairs shall see that their department observes the general provisions of the Plan and that additional measures are developed for specific laboratory safety procedures when needed. Chairs are also responsible for identifying the individual(s) who are responsible for the adherence of laboratory safety procedures in the instructional laboratories. The individual(s) could be the instructor of each laboratory or one individual could be appointed for all laboratories. Responsible individuals shall be referenced as Principal Investigators.

Principal Investigators are responsible for everything that occurs in their laboratories including the adherence to safety procedures. This includes good laboratory practice and adherence to the general provisions of the Plan. They are also responsible for developing specific safety measures as needed for their research program and contacting the Department of Environmental Health and Safety for advice when needed.

Laboratory Employees are responsible for following all safety procedures, and for reporting any unsafe conditions or accidents to the Principal Investigator.

Chemical Hygiene Officer is responsible for providing technical guidance in the development and administration of the Plan and in coordinating its implementation. The Chemical Hygiene Officer is Bowling Green State University's Environmental Safety and Health Specialist.

Department of Environmental Health and Safety is responsible for disseminating the requirements of the Plan and for supporting the departments and investigators in achieving laboratory safety. Through the Chemical Hygiene Officer, the Department of Environmental Health and Safety will coordinate activities related to the Plan.

Standard Laboratory Procedures and General Overview

Behavior

- Behave professionally at all times.
- Do not engage in horseplay.
- Visitors to BGSU laboratories must be escorted by a faculty member at all times and must be provided personal protective equipment.
- Minors are not permitted inside BGSU laboratories without proper authorization.
- Animals are not permitted in the laboratories at any time. The only exception is for:
  - Service animals and service animals in training (documentation must be provided).
  - Research animals that are on an active animal research protocol.

Personal Attire

- Wear closed toe shoes in laboratories. Sandals and Crocs are not permitted.
- Long pants need to be worn at all times.
- Do not wear porous or absorbent watch straps in laboratories.
- Avoid excessively loose or baggy attire, which may include loose sleeves, long neckties, long unrestrained hair, and hanging jewelry.

Personal Hygiene

- Do not apply cosmetics in lab.
- Do not eat or drink in lab.
- Do not store food in lab refrigerators.
- Do not drink from eye wash station.
- Do not use lab glassware for holding food or drink.
- Avoid skin contact with chemicals.
- Wash hands often while in lab and thoroughly before leaving.
- Do not wear personal protective equipment (PPE) outside of the laboratory.

Chemical Handling

- Never smell or taste chemicals.
- Always assume a chemical is hazardous.
- Do not use chipped or broken glassware.
- Place chemicals back from the edge of shelves, tables or benches.
- Keep work area clear and uncluttered.
- Do not pipette by mouth.
- Use only the amount needed.
- Waste chemicals will be handled in accordance with the University's Hazardous Waste Management Plan.

Contact Lenses

- It is recommended that contact lenses not be worn inside laboratories. Contact lenses do not provide protection against exposure to chemicals and do not serve as eye protection.
- Individuals who wear contact lenses must wear proper eye and/or face PPE when working with chemicals.

Labeling

- Label hot surfaces.
- Do not remove or deface labels on incoming containers from manufacturers.
- Identify the chemical's name (written in full), health warnings associated with that chemical, and the fillers initials on labels for secondary containers.
- Label containers for immediate use, such as beakers and flasks, with the name of the chemical contents.
- Label all containers to avoid orphaned containers of unknown material.

Eye and Face Protection

- Only indirectly vented chemical splash goggles are to be worn for laboratory procedures requiring goggles.
- Safety glasses and goggles must conform to ANSI Z87.1.
- In the event of a chemical splash into the eye, flush with water for a minimum of 15 minutes and seek medical attention.
- Wash safety glasses, goggles, and face shields often with mild soap and water.

Gloves and Skin Protection

- Wear appropriate gloves and other protective gear (laboratory coats and aprons) to avoid skin contact with chemicals.
- Inspect gloves for tears before use. Do not use damaged gloves.
- Follow the glove use recommendations established by the glove manufacturer.
- Always consult the chemical's SDS first.
- Gloves must be removed before leaving the laboratory to prevent contamination in non-laboratory areas.

Safety Data Sheets (SDSs)

- Safety stations are available inside laboratories as a repository for SDS's and other safety documentation. A cover page inside a three-ring binder indicates if the SDS's are stored electronically or in hardcover.
- SDS's for all chemicals used in the laboratory shall be maintained in a readily accessible location for laboratory employees. SDS's can be kept on file on a computer located inside the laboratory or kept as a hard copy inside the laboratory.
    - SDS's can be accessed on a computer that is setup inside a laboratory. Can be accessed through the manufacturer's website or ChemWatch.

Working Alone

- Working alone inside a laboratory is strongly discouraged. However, if work must be performed while alone inside the laboratory, it is the responsibility of the PI to establish a check-in/check-out system for each laboratory.
- If working alone is necessary, no hazardous chemicals should be used.

Unattended Laboratory Experiments

- Any laboratory experiments that are in progress and left unattended must have information available on the experiment. Such as:
    - Name and contact information of researcher.
    - Date the experiment started and estimated stop time.
    - Chemical(s) that are used as part of the experiment.

Alarms

- Emergency response actions to fire alarms and tornados are available inside every BGSU building. Every individual should familiarize themselves with evacuation routes in the event of a fire and shelter locations in the event of a tornado.
- Emergency evacuation maps are posted throughout all buildings on campus.

Hazardous Procedures

- Inform co-workers when performing hazardous procedures.

Safety Inspections

- Review the results of monthly inspections, conducted by the laboratory's Principle Investigator or designee, and take corrective actions to correct deficiencies.
- Review the results of Environmental Health and Safety's laboratory evaluation and take corrective actions.
- Report all safety deficiencies to the Principal Investigator for the laboratory.

Electrical

- Do not remove the ground plug on three-prong electrical plugs. Do not modify or use in two-prong outlets.
- Electrical cords that are cracked and/or frayed must be repaired or the piece of equipment needs to be replaced.
- Use only approved (UL-/FM- listed) electrical equipment. Equipment labeled "Household Use" shall not be permitted.
- Extension cords are not to be used as a replacement for permanent wiring. Maximum of 90 days use (According to the Ohio Electric Code).
- Power cords shall not be run; above a drop ceiling, through a doorway, or across an aisle way.

Glass Disposal

- Glass products that are not contaminated with chemical residue, infectious material, or radioactive material may be disposed of inside a designated glass disposal container.
- Do not dispose of glassware that contains residual chemical material until it has been properly cleaned.
- Do not dispose of glassware that has been used for infectious material or radioactive material.
- When the glass disposal container is ¾ full, a work order should be submitted to Campus Operations for proper disposal and a replacement box. Information required on the work order: Building, Room number, and specifically state "Broken glass disposal box is full and needs disposed of. Replacement needed."

Sharps

- Dispose of broken glass and other sharps in appropriate, labeled containers.
  - If sharps are only chemically contaminated, it should be stated on the sharps container.
- If sharps are contaminated with bio-hazard material it needs to be placed inside of a sharps container that is labeled properly.
- If sharps are chemically contaminated and do not contain any bio-hazard material, then the bio-hazard sticker on a sharps container should be removed and the container needs to be labeled with the chemical constituents.

Laboratory Fume Hoods

- When working in the hood, position the bottom of the sash to be in line with the 100 feet per minute arrow located on the front of the hood. The arrow is located where proper airflow velocities are achieved at the hood's face.
- Set up work inside the hood at least six (6) inches from the face opening. This will avoid turbulence at the sash edge and provide greater protection.
- Separate and elevate each instrument. Use blocks or racks to elevate equipment one to two inches off the hood work surface so that air can easily flow around all of them with no disruption.
- Keep only items needed for ongoing operation inside the hood. Excess materials in the hood disrupt airflow and can act as a barrier or cause airflow to exit across the face of the hood. Keep the back-bottom slot clear at all times as it serves as an exhaust port for fumes and heat generated near the surface.
- Minimize traffic near and around the hood. A person walking past the hood can create competing air currents. Other cross drafts should be eliminated, such as open doors, open windows, or fans.
- Use extreme caution with ignition sources inside a fume hood. Ignition sources such as electrical connections and equipment, hot plates, controllers, and open flames will ignite flammable vapors or explosive particles from materials being used in the hood. All electrical equipment used inside a fume hood must be designed or certified as intrinsically safe, unless it can be absolutely established (and enforced) that flammable or explosive materials will not be used in a particular hood.
- Never put your head inside a hood while operations are in progress. The plane of the sash is the imaginary boundary that should not be crossed except to set up or dismantle equipment.
- Do not dismantle or modify the hood's physical structure or exhaust system without approval from the Department of Environmental Health and Safety. Modifications can result in a decrease in airflow and could make the hood less protective. Modifications can also have an impact on other fume hoods that are connected to the same exhaust fan.
- Do not use hoods for general chemical storage. Only chemicals that require ventilation while in storage may be stored in a hood specified for that purpose.
- Position gas phase or particle generating sources well within hood.

Maintenance

- Keep lab clean and uncluttered.
- Inspect and maintain laboratory equipment regularly.
- Report any chemical fume hood malfunctions to the Environmental Health & Safety Department.

Respiratory Protection

- Use respiratory protection to control exposure to hazardous chemicals when other control measures (i.e. lab hoods or general ventilation) are insufficient to reduce chemical exposures below the acceptable level. Any use of respiratory protection equipment must comply with BGSU's Respiratory Protection Program including medical clearance for use, training, and fit testing. If the use of respirators is only used on a volunteer basis, Appendix D of OSHA's Respiratory Protection Standard must be followed (see below).

Information When Voluntarily Using Respirators

Respirators are an effective method of protection against designated hazards when properly selected and worn. Respirator use is encouraged, even when exposures are below the exposure limit, to provide an additional level of comfort and protection for workers. However, if a respirator is used improperly or not kept clean, the respirator itself can become a hazard to the worker. Sometimes, workers may wear respirators to avoid exposures to hazards, even if the amount of hazardous substance does not exceed the limits set by OSHA standards. If a respirator has been provided for your voluntary use, or if you provide your own respirator, you need to take certain precautions to be sure that the respirator itself does not present a hazard.

You should do the following:

1. Read and heed all instructions provided by the manufacturer on use, maintenance, cleaning and care, and warnings regarding the respirators limitations.

2. Choose respirators certified for use to protect against the contaminant of concern. NIOSH, the National Institute for Occupational Safety and Health of the U.S. Department of Health and Human Services, certifies respirators. A label or statement of certification should appear on the respirator or respirator packaging. It will tell you what the respirator is designed for and how much it will protect you.

3. Do not wear your respirator into atmospheres containing contaminants for which your respirator is not designed to protect against. For example, a respirator designed to filter dust particles will not protect you against gases, vapors, or very small solid particles of fumes or smoke.

4. Keep track of your respirator so that you do not mistakenly use someone else's respirator.

Fire Protection

- Know fire procedures including evacuation routes and location of portable fire extinguishers. Contact the Department of Environmental Health and Safety for fire extinguisher training.

Phones and Emergency Numbers

- Post numbers to call in case of an emergency, including the phone number (office phone and home phone recommended) of the Principal Investigator for the lab.
- Have the BGSU Emergency Procedures Poster located by the phone.

Chemical Storage

- Only authorized laboratory employees shall have access to chemicals.
- Segregate incompatible materials to prevent contact with one another. Appendix D contains acceptable chemical storage methods to segregate incompatible materials.
- Separate boxes containing chemicals. Do not stack them.
- Use only explosion-proof refrigerators to store liquids that could produce explosive vapor concentrations.

Chemical Inventory

- A chemical inventory is required for every laboratory for BGSU.

- Chemical inventories for laboratories is managed through a web-based chemical inventory reporting system (BioRAFT ChemTracker). For ChemTracker training and instructional web-videos, please contact the Environmental Health & Safety Department.

Radiation Safety Program

- Information on the Radiation Program at Bowling Green State University can be found in the Radiation Safety Manual.

Laser Safety Program

- Information on the Laser Program at Bowling Green State University can be found in the Laser Safety Manual.

Flammable Solid and Liquid Storage

- The presence of flammable liquids in the laboratory presents a significant potential for fires and explosions in the laboratory.
- To minimize the potential for fires and explosions, flammable liquids must be stored in flammable safety cabinets.
    - Flammable storage cabinets do not need to be ventilated for fire protection. However, they can be ventilated to control odors.

Refrigerated Flammable Liquid Storage

- Using domestic refrigerators and freezers for storage of flammable material is prohibited. Flammable vapors can accumulate in domestic refrigerators and freezers. When flammable vapor accumulates to a specific level and a source of ignition is provided (a thermostat, light switch, etc.), a fire or explosion can result.
- Flammable liquids may only be stored in refrigeration equipment that is *explosion proof*, *explosion safe*, *laboratory safe*, or designated for *flammable material storage*. These refrigeration units must be approved by Underwriters Laboratory as acceptable to store flammable liquids.

Compressed Gas Cylinders

- Secure compressed gas cylinder to a wall or countertop by chain or strap in an upright position. This is to prevent cylinders from falling
- When cylinders are not in use, the protective cap must be in place. When cylinders are in use, a regulator valve must be in place.
- Cylinders must be transported on a hand cart where it can be secured by a chain.
- Identify status of cylinders as "full", "in-use", or "empty".

Peroxides and Peroxide Forming Chemicals

Peroxides can be highly reactive, powerful oxidizers, explosive, and highly flammable. There are generally three classes of chemicals that can form peroxides. The degree of explosion hazard depends on the the chemical, condition in which it is stored, and the conditions in which it is used.

Class A

Peroxidizable compounds which form explosive compounds without being concentrated.

- Divinyl Actylene
- Divinyl Ether
- Isopropyl Ether
- Potassium Amide
- Potassium metal
- Sodium Amide (sodamide)
- Vinylidene Chloride

Class B

Chemicals that present a peroxide hazard when they are concentrated via distillation or evaporation. Specific distillation and evaporation procedures must be performed.

- Acetal
- Cumene
- Cyclohexene
- Cyclopentene
- Cyclooctene
- Decalin
- Diacetylene
- Dicyclopentadiene
- Diethylene glycol dimethyle ether
- Diethyl ether
- Dioxane (p-dioxane)
- Ethylene glycol dimethyl ether (glyme)
- Ethylene glycol ether acetates
- Furan
- Methyl acetylene
- Methyl cyclopentane
- Methyl-*i*-butyl ketone
- Methyl Acetylene
- Methyl Cyclopentane
- Tetrahydrofuran
- Tetrahydronaphthalene
- Vinyl ethers

Class C

Unsaturated materials that may polymerize violently and hazardously due to peroxide initiation.

- Acrylic acid
- Acrylonitrile
- Butadiene
- Chlorobutadiene (Chloroprene)
- Chlorotrifluoroethylene
- Methyl methacrylate
- Styrene
- Tetrafluoroethylene
- Vinyl acetate
- Vinyl acetylene
- Vinyl chloride
- Vinyl pyridine
- Vinylidene chloride

Testing for the presence of peroxides

Class A, B, and C must be tested for the presence of peroxides every three months. The chemical must be either redated as safe if no perioxides are present or disposed of through the University's Hazardous Waste Program.

Aqueous Peroxide Test Method

1. Add 1 to 3 mL of liquid to be tested in an equal volume of acetic acid.
2. Add a few drops of 5% aqueous potassium iodide solution.
3. Stir. Do not let the mixture touch your skin.

The appearance of a yellow to brown color indicates the presence of peroxides.

A yellow color indicates a low concentration of peroxides (less then 100 ppm). A brown color indicates a high concentration of peroxides (greater then 100 ppm).

- Chemicals containing concentrations below 100 ppm may be treated to remove the peroxide contamination and stored for future use. Refer to the peroxide treatment section for details.
- Chemicals containing more then 100 ppm of peroxides must be disposed of immediately through the University's Hazardous Waste Program. Contact 372-2171 for more information.

Peroxide Test Strips

1. Use a peroxide test strip to test for the presence of peroxides.

    - Chemicals containing concentrations below 100 ppm may be treated to remove the peroxide contamination and stored for future use. Refer to the peroxide treatment section for details.

    - Chemicals containing more then 100 ppm of peroxides must be disposed of immediately through the University's Hazardous Waste Program. Contact 372-2171 for more information.

    - If you do not feel comfortable testing a chemical container for peroxides and would like to dispose of the container and its contents, please contact the Environmental Health and Safety Department for disposal.

Removal of peroxides

This procedure must only be used for chemical solutions that contain less then 100 ppm of peroxides. Solutions greater then 100 ppm must be disposed of through the University's Hazardous Waste Program.

Activated Alumina Column Removal.

1. Prepare a column of activated alumina.
2. Pour the peroxide containing solution through the column.
    – Do not allow the column to dry out while in use
3. Re-test for the presence of peroxides. If peroxides are still present, pass it through the column untill you can not detect them.
4. When the alumnia column is no longer effective at removing the peroxides, wash the column with 5% aqueous ferrous sulfate and discard the solution as hazardous waste.

Distillation and Evaporation Procedures

When using Class A, B, and C chemicals, this procedure must be used and integrated into protocols for these chemicals.

1. Test for the presence of peroxides.
    – if greater then 100 ppm, discard as hazardous waste
    – if less then 100 ppm, treat until you can not detect the presence of peroxides
2. Before distilling any Class C material, a suitable polymerization inhibitor must be added.

3. An explosion sheild must be used and placed between the evaporation or distillation process and the operator.
4. Safety goggles must be worn by the operator.
5. Evaporate or distill and leave at least 10% of the solution in the container. Most accidents occur when material is nearly a dry residue.
    - Use a boiling aid or magnetic stirrer before you use a nitrogen bleed to maintain ebullition.
    - In operations using higher boiling peroxidizable compounds under reduced pressure, an explosive mixture can result because the boiling temperature may be lower than the peroxide decomposition temperature. Contact the Environmental Health and Safety Department (372-2171) when preforming an operation of this type.

Inspections

Inspection of safety in the laboratories by the Principal Investigator, or an appointed designee, must be a monthly occurrence. Principal Investigator's, or an employee designated by the Principle Investigator, shall complete a 'Monthly Self Inspection Checklist' for each laboratory. The designee must be a member of the Principal Investigator's research group. By addressing potential hazards early, solutions can be simple, and accidents can be avoided.

Each lab will maintain a file of monthly inspections, which should be inserted in this section of the Plan. An inspection form is included in this section. Laboratory chemical fume hoods will also be evaluated on an annual basis. BGSU laboratory evaluations are conducted at least annually. These inspections are recorded digitally, therefore all reports will be sent to the PI and their Department Chair or Supervisor. All laboratory evaluations need to be addressed within the given time frame established in the system. Urgent items are to be completed in 7 days, intermediate hazard items are to be completed in 14 days, and long term/administrative Items are to be addressed in 30 days.

All updates and/or corrections should be documented by the PI in the digital system to ensure a follow-up inspection is scheduled by EHS. The inspection will include all the items listed below.

BGSU
Bowling Green State University

Environmental Health and Safety

Monthly Self Inspection Checklist

Building: _____ Room Number: _____

Principle Investigator: _____ Performed by: _____

Answer in the appropriate box for each month; Y = Yes, N = No, N/A = Not Applicable

Academic Year:	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	April	May	June	July
Is the Chemical Hygiene Plan Present in the laboratory?												
Are the Safety Data Sheets for all chemicals used in the laboratory present or accessible to laboratory workers?												
Does the laboratory have good housekeeping?												
Are emergency phone numbers prominently displayed in the laboratory?												
Is the laboratory's fire extinguisher present and maintained?												
Are laboratory chemical fume hoods operational?												
Are the laboratory chemical fume hoods kept free of chemical and equipment storage?												
Is the emergency shower station operational and tested within the last 12 months?												
Is the emergency eye wash station operational and tested within the last 12 months?												
Are sharps containers available?												
Are compressed gas cylinders secured?												
Are chemicals stored according to hazard class?												
Are chemicals stored off of the floor?												
Are aisles and emergency exits free of tripping hazards and stored chemicals?												
Are chemical containers stored on low shelving?												
Is the laboratory equipment adequately guarded?												
Is the laboratory free of frayed electrical cords and extension cords?												
Are the hazardous waste containers labeled and properly sealed?												

#	Question	Recommendation
	GENERAL	
1	Is personal protective equipment (PPE) being used where applicable and being maintained in good working order?	PPE shall be worn where required and maintained in good working order.
2	Chemical Hygiene Plan (CHP) present in the laboratory? Occupational Safety and Health Administration (OSHA) 29 CFR 1910.1450	Have the CHP readily accessible within the laboratory.
3	'Monthly Self Inspection Checklist' filled out and kept current? (BGSU Chemical Hygiene Plan)	The Monthly Self Inspection Checklist needs to be completed and kept up-to-date. (Can be found on the EHS Department website).
4	Does the laboratory have good housekeeping?	Maintain all laboratory areas in clean condition.
5	Food or drink are not consumed within the laboratory	Do not permit the consumption of food or drink within the laboratory.
6	Laboratory door(s) to hallway kept closed? National Fire Protection Association (NFPA) 45, Standards on fire protection for Laboratories Using Chemicals	Laboratory doors should remain closed at all times, except for personnel entering and exiting the laboratory.
7	Laboratory fire doors kept closed? National Fire Protection Association (NFPA) 45, Standards on fire protection for Laboratories Using Chemicals	Laboratory doors should remain closed at all times, except for personnel entering and exiting the laboratory.
8	Laboratory door locked if nobody is present inside the laboratory	If nobody is working inside the laboratory, door(s) must be locked.
9	Are there any Urgent safety matters that need addressed?	All urgent matters need to be addressed within 7 days.
10	Are there any Intermediate safety matters that need addressed?	All miscellaneous intermediate safety items should be addressed within two weeks.
11	Are there any long-term safety matters that need addressed?	All long-term safety items should be addressed within a month.
12	Is fall protection (guardrails, PPE, etc) adequate for the workspace?	Fall protection, such as guardrails, toeboards, and harnesses, etc. must be compliant with State and Federal regulations.
	SAFETY DATA SHEETS AND OPERATION PROCEDURES	
13	SDSs available in a location that is readily accessible (e.g. hard copy or computer) to BGSU employees? OSHA 29 CFR 1910.1200	Maintain SDSs within the lab or identify in the CHP where they are located.
14	Laboratory personnel know how to access SDS's? OSHA 29 CFR 1910.1200	Inform all lab employees where SDS's are located.

15	Standard operating procedures (SOP's) present for particularly hazardous substances (PHS's)? OSHA 1910.1450	SOP's must be present for each PHS present inside the laboratory.
	FIRE AND EMERGENCY PROCEDURES	
16	Emergency phone numbers prominently displayed in the laboratory or on the exterior of the laboratory door?	Emergency contacts and phone numbers need to be displayed in the laboratory or on the laboratory door.
17	Has the laboratory emergency contact signage been updated to reflect current personnel?	Ensure that emergency contacts are updated regularly to reflect individuals who are currently affiliated with laboratory activities.
19	Fire extinguisher present inside the laboratory? NFPA 10, Standard for Portable Fire Extinguishers	Contact the Campus Operations help desk (2-2251) to request a fire extinguisher.
20	Flammables kept from potential ignition sources?	Keep all flammable materials stored away from potential ignition sources.
21	Aisles, emergency exits, and corridors are free of tripping hazards and stored material?	Keep all aisles, emergency exits, and corridors in the laboratory free of tripping hazards and stored material.
	CHEMICAL STORAGE	
22	Chemicals stored according to hazard class (e.g. acids/acids, flammables/flammables, corrosive/corrosive, etc.)?	Do not store chemicals from different hazard classes together.
23	Chemical containers stored off the floor?	All chemical containers must be stored off the floor, unless stored inside a secondary containment and out of an aisle way.
24	Chemicals stored away from the edges of counters and shelves? (~1 - 2 inches)	All chemical containers must be stored away from edges of counters, cabinets, and shelves.
25	Chemicals stored on low shelves rather than on high, out-of-reach shelves?	Do not store chemicals on high, out-of-reach shelves.
26	Does the lab have more than 10 gallons of liquids having flash points below 140° F?	
27	Are flammable chemicals stored inside of a flammables cabinet?	Flammable chemicals should be stored inside an appropriate flammables cabinet when not actively being used.
28	Secondary chemical containers properly labeled?	All chemical containers, both primary and secondary, must be properly labeled.
29	Chemical storage cabinets labeled with the class of chemicals stored inside? (e.g. flammables, corrosives, oxidizers, etc…)	Cabinets utilized for chemical storage should be labeled with the class of chemical stored inside.

30	All chemical containers closed with a properly fitted cap?	Keep all chemical containers closed when not actively being used.
31	Chemical containers structurally sound?	Keep all chemicals in containers that are structurally sound.
32	Laboratory free of old/expired/unused chemicals?	Properly dispose of unused/expired chemicals from the laboratory.
33	Is the chemical inventory updated via BioRAFT ChemTracker?	Chemical inventories must be updated at least once every six months within the BioRAFT ChemTracker database. BioRAFT ChemTracker can be accessed by visiting the EHS homepage.
	HAZARDOUS WASTE	
34	Hazardous waste containers present?	Store all hazardous wastes in acceptable containers.
35	Hazardous waste containers removed in a timely manner?	Remove all hazardous waste from the laboratory in a timely manner.
36	Hazardous waste containers properly labeled?	Properly label all containers of hazardous waste.
37	Hazardous waste containers closed (except for when waste is being added)?	Unless actively adding waste, keep all containers of hazardous waste closed (no funnels).
38	Hazardous waste containers structurally sound?	Hazardous wastes need stored in containers that are structurally sound.
	MECHANICAL AND ELECTRICAL HAZARDS	
39	Laboratory free of electrical cords in poor condition i.e. frayed, cut, smashed, exposed wires, electrically taped, etc. and poorly positioned? NFPA 70, National Electric Code	Replace electric cords in poor condition.
40	Electrical panel unobstructed and easily accessible (36" all around)? NFPA 70, National Electric Code & OSHA 29 CFR 1910.303	Electrical panels need to be unobstructed and easily accessible at all times.
41	Laboratory free of daisy-chained power cords? OSHA 29 CFR 1910.303	Power strips/extension cords must not be plugged into subsequent power strips/extension cords.
42	Laboratory free of electric cords running under doors/carpet and through ceilings/walls? NFPA 70, National Electric Code & OSHA 29 CFR 1910.305	Rearrange cords to prevent these conditions.

43	All electrical outlets within six feet of a water source equipped with a Ground Faulty Circuit Interrupter (GFCI)? NFPA 70, National Electric Code	Please submit a Work Order to Campus Operations to retrofit outlets within six feet of a water source with GFCI capabilities.
44	Room free from extension cord use? NFPA 70E, National Electric Code	Extension cords are to be used on a temporary basis only, not to exceed 90 days of use.
45	Are electrical knockouts in place to prevent access and exposure to live electrical wires?	Submit a work order through Campus Operations to have all missing knockouts replaced. Only electrically authorized employees may perform this work.
46	Are BGSU Lockout-Tagout (LOTO) procedures being followed?	Lockout-Tagout procedures must be in accordance to the BGSU Lockout-Tagout Program.
47	Do electrical panel doors open and close properly?	All electrical panels shall be easily accessible and close properly.
48	Is lighting 7 foot or lower from a working surface guarded?	Lighting must be guarded with cage or lamp guard if 7 foot or lower from a working surface.
	COMPRESSED GAS CYLINDER HAZARDS	
49	Compressed gas cylinder adequately secured to prevent it from falling/tipping over? NFPA 45, Standards on fire protection for Laboratories Using Chemicals	Secure compressed gas cylinders.
50	Regulator or safety cap fastened to the compressed gas cylinder valve? OSHA 29 CFR 1910.101	If the compressed gas cylinder is in use it must have a regulator valve, and if not in use the cylinder must have a safety cap in place.
51	Was the compressed gas cylinder hydrostatically tested in the past five years (unless marked with a *, 10 years)?	All compressed gas cylinders must be hydrostatically tested every five years, unless marked with a *, in that case 10 years.
	CHEMICAL FUME HOODS	
52	Are chemical fume hoods kept free of clutter of equipment and appliances?	Excess equipment/appliances must not be stored in chemical fume hoods.
53	Are chemical fume hoods kept free of clutter of equipment and appliances?	Excess equipment/appliances must not be stored in chemical fume hoods.
54	Are laboratory hoods, used for chemical procedures, kept free of general chemical storage? NFPA 45, Standards on fire protection for Laboratories Using Chemicals	Chemical fume hoods must not be used for general storage of chemicals.

55	Have the laboratory hoods been evaluated within the past year?	All laboratory hoods must be operational in accordance with OSHA requirements.
56	Are laboratory hoods openings kept free of obstructions?	Openings of all laboratory hoods must not be obstructed.
	LABORATORY MATERIALS/EQUIPMENT	
57	Flammables Storage Cabinet present?	
58	Acid/Corrosive Storage Cabinet present?	
59	Secondary Containment Trays (Inside cabinets) present?	
60	Approved chemical refrigerator/freezer present?	
61	Ultra-Low Freezer present?	
62	Emergency shower station signage present?	
63	Emergency shower station activated regularly?	Activation Log can be found on EHS website.
64	Emergency shower station accessible?	
65	Emergency eyewash station signage present?	
66	Emergency eyewash station activated regularly?	Activation Log can be found on EHS website.
67	Emergency eyewash station accessible?	
68	Emergency drench hose signage present?	
69	Emergency drench hose activated regularly?	Activation Log can be found on EHS website.
70	Emergency drench hose accessible?	
71	Emergency Fire Blanket present?	
72	Emergency fire blanket accessible?	
73	First Aid Kits (Evaluated within the past year?)	First aid kits are to be inspected annually to ensure the proper items are available.
74	Contents of first aid kits current and up to date?	

Laboratory Specific Standard Operating Procedures

When working with a chemical that is hazardous and the safety procedures are not adequately addressed in the standard laboratory procedures, it is the responsibility of the individual Principal Investigators to develop safe procedures for specific chemicals and processes. In the standard operating procedure, procedures for chemical leaks and spills must be included. The procedure must include emergency contacts, emergency telephone numbers and other relevant information to properly manage chemical leaks and spills. All personal protective equipment must also be identified in the standard operating procedures. The Principal Investigator must be familiar with the chemicals, reactions, handling, and the associated hazards. Each Principal Investigator must include Laboratory Specific Standard Operating Procedures in this section of the Plan. Additional assistance in developing specific, safe operating procedures can be arranged through the Chemical Hygiene Officer.

A blank standard operating procedure (SOP) form (example on the next page) can be found on the Environmental Health & Safety website.

Bowling Green State University

Environmental Health and Safety

Standard Operating Procedure for: _____

Principle Investigator: _____ Building: _____ Room #:_____

For applications using _____, the material must be handled according to BGSU's General Standard Operating Procedures and these additional procedures:

Waste Minimization: Can this chemical be substituted for a less hazardous chemical? Yes:☐ No:☐

Process in which the chemical will be used:

Personal Protective Equipment required:

Designated Area for Use and Containment Devices

- All _____ work shall be done in the laboratory fume hood. The fume hood's sash must be in the position where a face velocity of 100 feet per minute is achieved. Use laboratory fume hood _____.

Special Handling Procedures and Storage Requirements:

Decontamination of Equipment and Area:

Removal of Waste

- Excess _____ and all waste material containing this compound must be placed in a glass container labeled with the chemical's name of "_____." Full containers of waste must be manifested and disposed of according to BGSU's Hazardous Waste Program.

Spill and Accident Procedures

- In the event of a spill, immediately vacate and secure the area. Contact Environmental Health & Safety at 2-2171 and _____ (the immediate supervisor).

Particularly Hazardous Substances (PHS)

Specific standard operating procedures are required for use of substances that are classified as particularly hazardous. These substances are select carcinogens, reproductive toxins, and substances that display a high degree of acute toxicity. The standard operating procedures must include:

- Establishment of a designated area for use;
- Use of containment devices such as laboratory fume hoods or glove boxes;
- Acceptable plans for safe removal of waste; and
- Establishment of procedures for decontamination of material, area, and workers that contact the substance.

Procedures with particularly hazardous substances where the above requirements may be inappropriate or unwarranted due to small concentrations used, small quantities of substances handled, chemical states, or physical properties, the Principal Investigator may request a hazard assessment to be conducted by the Chemical Hygiene Officer. The Chemical Hygiene Officer will assess the chemical operations to determine if there is a potential risk of significant exposure that would result in an adverse health effect.

The Principal Investigator will be required to write specific standard operating procedures when the results of the hazard assessment identify a risk of significant exposure.

For procedures where a risk of significant exposure does not occur based on the results of the hazard assessment, specific operating procedures are not required to be developed. However, the Standard Laboratory Procedures in this Plan must still be employed. The hazard assessment must be kept in the laboratory's Laboratory Safety/Chemical Hygiene Plan.

Additional care is required for any use of substances that are particularly hazardous. Substances of this type include select carcinogens, reproductive toxins, or substances that display a high degree of acute toxicity. Possible carcinogenicity and the source of the data (e.g. OSHA, National Toxicology Program, and International Agency for Research on Cancer) should be noted on the SDS.

Prior approval is required before beginning work using particularly hazardous substances. Approval must be obtained from the Principal Investigator.

Health Hazards

Toxic Substances:

All chemical substances are lethal to the human body, just how lethal depends on the chemical's toxicity, amount of the substance and the amount of exposure time.

Toxicity is an adverse health effect resulting from a chemical exposure; this can be subdivided into two main groups as shown below.

Acute Toxicity: Adverse health effects resulting from brief exposure to a chemical (e.g. seconds, minutes, hours). The effects generally involve short term, high concentrations and immediate results of some kind (illness, irritation, or death).

Chemicals that have acute health effects are described as toxic and highly toxic. It will only take a small amount of these chemicals to potentially cause death.

Chronic Toxicity: Adverse health effects resulting from long-term exposure to a chemical (e.g. months, years, decades). The effects involve long term, low concentrations and delayed results of illness or disease.

Chemicals that have chronic health effects are characterized by prolonged or repeated exposure measured in a duration of weeks, months, or years. Symptoms of exposure may not be immediately apparent.

Acutely Toxic Chemicals:

Substances that display a high degree of acute toxicity have the ability to cause a harmful biological effect after a single or short exposure. Any compound that meets the criteria of "highly toxic" in Table 1 must be used following strict safety precautions.

Table 1 - Acute Toxicity Hazard Level

Toxicity Rating	Oral LD_{50} (Rats, per kg)	Skin Contact LD_{50} (Rabbits, per kg)	Inhalation LC_{50} (Rats, ppm for 1 h)	Inhalation LC_{50} (Rats, mg/m^3 for 1 h)
Highly Toxic	<50 mg	<200 mg	<200	<2,000
Toxic	50 to 500 mg	200 mg to 1 g	200 to 2,000	2,000 to 20,000
Slightly Toxic	500 mg to 5 g	1 to 5 g	2,000 to 20,000	20,000 to 200,000

LD_{50}: The oral dose required to produce death in 50% of the exposed species.

LC_{50}: The air born concentration of a given substance that when inhaled over a period of time will kill 50% of the exposed species.

Table 2 shows the relationship between the LD_{50} values of test animals expressed as milligrams or grams per kilogram of body weight to the probable human lethal dose for a 70kg (150 lb) person.

Table 2: Probable Lethal Dose for Humans

Toxicity Rating	Animal LD_{50} (per kg)	Lethal Dose When Ingested by 70kg (150 lb) Human
Extremely Toxic	Less than 5 mg	A taste (less than 7 drops)
Highly Toxic	5 to 50 mg	Between 7 drops and 1 teaspoon
Toxic	50 to 500 mg	Between 1 teaspoon and 1 once
Slightly Toxic	500 mg to 5 g	Between 1 ounce and 1 pint
Practically nontoxic	Above 5 g	Above 1 pint

Substances that display a high degree of acute toxicity

Substances that display a high degree of acute toxicity have the ability to cause a harmful biological effect after a single or short exposure. Any compound that meets the criteria of "highly toxic" in Table 3, meets the criteria for handling as a Particularly Hazardous Substance.

Table 3 - Acute Toxicity Hazard Level				
Toxicity Rating	**Oral LD_{50} (Rats, per kg)**	**Skin Contact LD_{50} (Rabbits, per kg)**	**Inhalation LC_{50} (Rats, ppm for 1 h)**	**Inhalation LC_{50} (Rats, mg/m^3 for 1 h)**
Highly Toxic	<50 mg	<200 mg	<200	<2,000
Toxic	50 to 500 mg	200 mg to 1 g	200 to 2,000	2,000 to 20,000
Slightly Toxic	500 mg to 5 g	1 to 5 g	2,000 to 20,000	20,000 to 200,000

Any chemical that has a NFPA Health Hazard Rating of 3 or 4 is considered a substance that displays a high degree of acute toxicity. Table 4 lists examples of substances that display a high degree of acute toxicity.

Table 4 – Example of Chemicals with a High Degree of Acute Toxicity.

Acrolein	Nickel carbonyl
Arsine	Nitrogen dioxide
Chlorine	Osmium tetroxide
Diazomethane	Ozone
Diborane	Phosgene
Hydrogen cyanide	Sodium azide
Hydrogen fluoride	Sodium cyanide
Methyl fluorosulfonate	

Carcinogen

A carcinogen is a material that either causes cancer in humans or in animals. If a material causes cancer in animals, it is considered capable of causing cancer in humans.

If the chemical is believed to be a carcinogen, the SDS will list it in the Health Hazard Section under one of the following:

- NTP (National Toxicology Program)
- IARC (International Agency for Research on Cancer)
- OSHA (29 CFR Part 1910, Subpart X, Toxic and Hazardous Substances)

Select Carcinogen

A select carcinogen is any substance, which meets one of the following criteria:

- It is regulated by the Occupational Safety and Health Administration (OSHA) as a carcinogen; or
- 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); or
- It is listed under Group 1 ("carcinogenic to humans") by the International Agency for research on Cancer Monographs (IARC) (latest edition); or
- It is listed in either Group 2A or 2B by IARC; or
- It is listed under the category "reasonably anticipated to be carcinogens" by NTP.
- Table 1 lists some substances that meet the above criteria and are classified as Particularly Hazardous Substances. The list is not all-inclusive.

Select Carcinogens (*Continued*)

Table 5 – Examples of Select Carcinogens	
Acetaldehyde	Dimethyl sulfate
2-Acetylaminofluorene	1,4-Dioxane
Acrylamide	Ethyl carbamate (urethane)
Acrylonitrile	Ethylene dibromide
Aflatoxins	Ethylene oxide
4-Aminobiphenyl	Ethylenimine
Arsenic & certain arsenic compounds	Formaldehyde
Azathioprine	Hexamethylphosphoramide
Barium chromate	Hydrazine
Benzene	Melphalan
Benzidine	4,4'-Methylene-bis[2-chloroaniline]
Bis(chloromethyl)ether	α-Naphthylamine
1,4-Butanediol dimethylsulfonate (myleran)	β-Naphthylamine
Carbon tetrachloride	Nickel carbonyl
Chlorambucil	4-Nitrobiphenyl
Chloroform	*N*-Nitrosodimethylamine
Chloromethyl methyl ether	β-Propiolactone
Chromium & certain chromium compounds	**Styrene**
Cyclophosphamide	Thioacetamide
1,2-Dibromo-3-chloropropane	Thorium dioxide
3,3'-Dichlorobenzidine (and its salts)	Treosulfan
Diethylstilbestrol	Vinyl chloride
4-Dimethylaminoazobenzene	

Reproductive Toxins

Substances that affect the reproductive capabilities including chromosomal damage (mutations) and fetal effects (teratogenesis) are classified as Particularly Hazardous Substances.

Table 2 lists some substances that are classified as reproductive toxins.

Table 6 – Examples of Reproductive Toxins	
Arsenic & certain arsenic compounds	Ethylene oxide
Benzene	Lead compounds
Cadmium & certain cadmium compounds	Mercury compounds
Carbon disulfide	Toluene
Ethidium bromide	Vinyl chloride
Ethylene glycol monomethyl & ethyl ethers	Xylene

Chemicals that have a harmful effect on the adult male or female reproductive systems or on the developing fetus or child are called reproductive toxins. If a chemical is believed to a reproductive toxin, the SDS will list it in the Health Hazard Section.

Chemicals with Unknown Hazards

When a chemical with an unknown hazard is brought into or produced in the laboratory, the Principal Investigator must handle that chemical as a Particularly Hazardous Substance as defined by the Plan. The Principal Investigator must demonstrate that the chemical does not meet the definition of a Particularly Hazardous Substance. This determination must be documented and sent to the Chemical Hygiene Officer.

Physical Hazards

Flammable Liquid

A liquid is considered flammable when it gives off vapors readily ignitable at room temperature. A liquid with a flash point below 100° F (38° C) is classified as a flammable liquid.

Flash point: the lowest temperature at which a flammable liquid gives off sufficient vapor to form an ignitable mixture with air near its surface or within a vessel.

Combustible Liquid

A combustible liquid is a term used to classify certain materials with low flash points that ignite easily. The liquid is considered combustible if it has a flash point at or above 100° F (38° C) but below 200° F (93.3° C).

Compressed Gas

A compressed gas is a gas at normal temperature and pressure and contained under pressure as a dissolved gas or liquefied by compression or refrigeration.

Oxidizer

An oxidizer is a chemical that initiates or promotes combustion in other materials, thereby causing fire either of itself or through the release of oxygen or other gases.

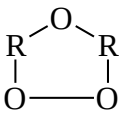
The following are examples of materials that are powerful oxidizing reagents:

Ammonium perchlorate	Dibenzoyl peroxide	Potassium chlorate
Ammonium permanganate	Fluorine	Potassium perchlorate
Barium peroxide	Hydrogen peroxide	Potassium peroxide
Bromine	Magnesium perchlorate	Propyl nitrate
Calcium chlorate	Nitric acid	Sodium chlorate
Calcium hypochlorite	Nitrogen peroxide	Sodium chlorite
Chlorine trifluoride	Perchloric acid	Sodium perchlorate
Chromium anhydride	Potassium bromate	Sodium peroxide

Explosive

Some substances are very sensitive to abrupt shock, high temperature, or to an ignition source. These substances are explosive because they produce a sudden, almost instantaneous release of pressure, gas, and heat when exposed to shock, high temperature, or an ignition source.

Below are functional groups that can be explosive in some compounds:

Acetylide	R—C≡C—Metal	Nitro	$R-NO_2$
Peroxide	R—O—O—R	Diazonium Salts	$R-\overset{\oplus}{N}\equiv N$
Azide	R—N=N=N	Ozonide	
Nitroso	R—N=O		

Ultraviolet Light

Ultraviolet light has the ability to interact with various macromolecules in the skin and eye and produce damage. Exposing the skin to ultraviolet light can cause erythema (redness of the skin), photosensitivity, and cancer. The IARC has found that ultraviolet light in all UV regions are probably carcinogenic to humans. The eye is also impacted from unprotected exposure to ultraviolet light. The cornea and conjunctiva absorb various wavelengths of ultraviolet light and can cause photokeratitis and photoconjunctivitis from acute exposures.

Organic Peroxides and Peroxide Formers

Chemicals containing the bivalent –O-O- structure, which is a structural derivative of hydrogen peroxide (H_2O_2) where one or both hydorgen atoms are replaced by an organic radical, are organic peroxides. These compounds are reactive and unstable because of shock, pressure, or temperature.

Peroxides can be highly reactive and flammable and powerful oxidizers. The oxygen-oxygen bond is a weak bond and can be cleaved from the energy generated by mechanical shock, heat, light, or chemical contact.

Average Bond Energies (kcal/mol)

C≡O 257	^{3}(O=O) 119	C—O 86	Br—Br 46
N≡N 226	O—H 111	C—C 83	N—N 39
C≡N 213	H—H 104	C—Cl 81	I—I 36
C≡C 200	H—Cl 103	C—N 73	O—O 35
C=O 179	N=N 100	H—I 71	
C=N 147	C—H 99	C—Br 68	
C=C 146	N—H 93	Cl—Cl 58	
H—F 135	H—Br 87	C—I 51	

Free radicals are formed from the broken oxygen – oxygen bond. The free radicals are highly reactive as well. A large amount of energy is released during the decompostion of the chemical.

$$R'OOR'' \xrightarrow[h\nu]{heat} R'O + OR''$$

There are generally three classes of chemicals that can form peroxides. The degree of explosion hazard depends on the the chemical and the condition in which it is stored and used.

Class A

Peroxidizable compounds that form explosive compounds without being concentrated.

Organic	Inorganic
Divinyl ether	Potassium metal
Divinyl actylene	Potassium Amide
Isopropyl ether	Sodium amide (sodamide)
Vinylidene	

Class B

Chemicals that present a peroxide hazard when they are concentrated via distillation or evaporation. Specific distillation and evaporation procedures must be performed.

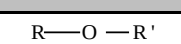
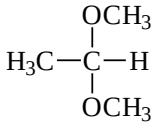
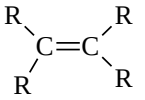
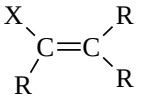
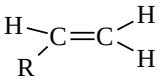
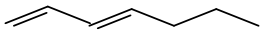
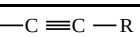
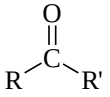
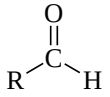
Acetal
Cumene
Cyclohexene
Cyclooctene
Cyclopentene
Diacetylene
Dicyclopentadiene
Diethylene glycol dimethyle ether
Diethyl ether
Dioxane (p-dioxane)
Ethylene glycol dimethyl ether (glyme)
Furan
Methyl acetylene
Methyl cyclopentane
Methyl-*i*-butyl ketone
Tetrahydrofuran
Tetrahydronaphthalene
Vinyl ethers

Class C

Unsaturated materials that may polymerize violently and hazardously due to peroxide initiation.

Acrylic acid
Acrylonitrile
Butadiene
Chlorobutadiene (Chloroprene)
Chlorotrifluoroethylene
Methyl methacrylate
Styrene
Tetrafluoroethylene
Vinyl acetate
Vinyl acetylene
Vinyl chloride
Vinyl pyridine
Vinylidene chloride

Certain classes of chemicals are more prone to forming peroxides than others. Here are some examples of chemicals and how likely they are to form peroxides.

Likelihood to form peroxides	Type of Chemical	Prefix or Suffix	Example
High	Ethers	Alkyl ether	
	Acetals		
	Olefines (Alkenes)	-ene	
	Halogenated Olefines (Halogenated alkenes)	-ene	
	Vinyl compounds	vinal -	
	Dienes	-diene	
	Alkynes	-yne	
	Alkybenzenes		
	Isoparaffins		
	Secondary alcohols	-anol	R-OH
	Keytones	-anone	
	Aldehydes	-anal	
	Ureas		
Low	Amides	-amine	RNH_2, R_2HN, R_3N

Testing for the presence of peroxides

Classes A, B, and C must be tested for the presence of peroxides every three months. The chemical must be either redated as safe if no perioxides are present or disposed of through the University's Hazardous Waste Program.

Aqueous Peroxide Test Method

1. Add 1 to 3 mL of liquid to be tested in an equal volume of acetic acid.
2. Add a few drops of 5% aqueous potassium iodide solution.
3. Stir. Do not let the mixture touch your skin.

4. The appearance of a yellow to brown color indicates the presence of peroxides. A yellow color indicates a low concentration of peroxides (less then 100 ppm). A brown color indicates a high concentration of peroxides (greater then 100 ppm).

    - Chemicals containing concentrations below 100 ppm, may be treated to remove the peroxide contamination and stored for future use. Refer to the peroxide treatment section for details.

    - Chemicals containing more the 100 ppm of peroxides must be disposed of immediately through the University's Hazardous Waste Program. Contact 372-2171 for more information.

Peroxide Test Strips
Use a peroxide test strip to test for the presence of peroxides.

- Chemicals containing concentrations below 100 ppm, may be treated to remove the peroxide contamination and stored for future use. Refer to the peroxide treatment section for details.

- Chemicals containing more the 100 ppm of peroxides must be disposed of immediatlly through the University's Hazardous Waste Program. Contact 372-2171 for more information.

Removal of Peroxides

This procedure must only be used for chemical solutions that contain less then 100 ppm of peroxides. Solutions greater then 100 ppm must be disposed of through the University's Hazardous Waste Program.

Activated Alumina Column Removal
1. Prepare a column of activated alumina.
2. Pour the peroxide containing solution through the column.
   – Do not allow the column to dry out while in use.
3. Re-test for the presence of peroxides. If peroxides are still present, pass it through the column until you can not detect them.
4. When the alumnia column is no longer effective at removing the peroxides, wash the column with 5% aqueous ferrous sulfate and disgard the solution as hazardous waste.

Distillation and Evaporation Procedures

This procedure must be used for Class A , B and C materials.

1. Test for the presence of peroxides.
   – If greater then 100 ppm, discard as hazardous waste.
   – If less then 100 ppm, treat until you can not detect the presence of peroxides.
2. Before distilling any Class C material, a suitable polymerization inhibitor must be added.

3. An explosion shield must be used by placing it between the evaporation or distillation process and the operator.
4. Safety goggles must be worn by the operator.
5. Evaporate or distill and leave at least 10% of the solution in the container. Most accidents occur when the material is nearly a dry residue.

    - Use a boiling aid or magnetic stirrer before you use a nitrogen bleed to maintain ebullition.
    - In operations using higher boiling peroxidizable compounds under reduced pressure, an explosive mixture can result because the boiling temperature may be lower then the peroxide decomposition temperature. Contact EH&S (372-2171) when preforming an operation of this type.

Implosion Hazards

Vacuum Work and Rotary Evaporators

Rotary evaporators under vacuum conditions can implode. Glass components of the apparatus should be wrapped with electical tape. The unit must be enclosed in a shield to guard against flying glass in the event of an implosion.

Radioactive Material

Use of radioactive material is prohibited by anyone who has not had the proper training and orientation. Direct any questions regarding the use of readioactive materials to the Radiation Safety Officer in the Department of Environmental Health and Safety (372-2171).

Normal research and instructional activities do not present a danger to individuals working in or visiting laboratories where radioisotopes are used. Individuals who use radioisotopes must follow the procedures outlined in the BGSU Radiation Safety Manual.

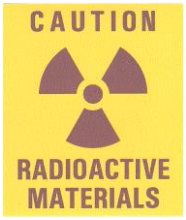


Figure 7: Radiation Area

Laboratories where radioactive materials are used are regularly monitored and checked for cleanliness by the BGSU Radiation Safety Officer. Labs that use radioactive materials have signs posted indicating they are being used. See figure 18.

Within the laboratories that use radioisotopes, specific locations are marked where such materials are stored or used. Typically, lab benches in these areas will be bordered with special tape (Figure 19) indicating that radioisotopes are used there, and these lab benches will be covered with special absorbent paper to collect any spills. Sinks where radioactive materials are disposed or prepared will also be marked with a sign to this effect. Special trash containers made from lucite plastic, which is effective for radiation shielding are also located in these laboratories.

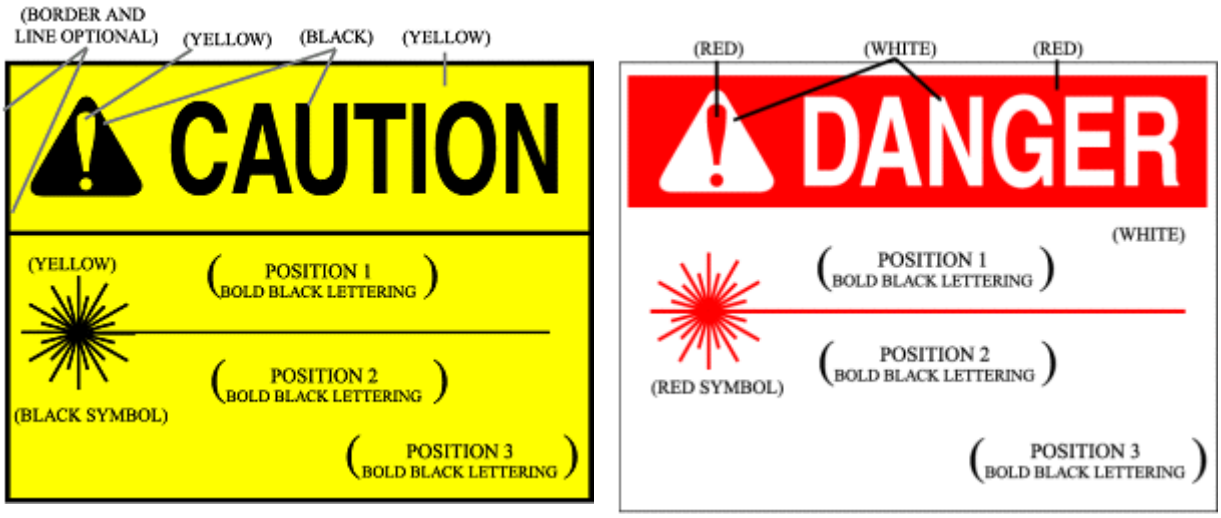
Figure 8: Radioactive Material Tape

While in a laboratory with radioactive isotopes:

- Do not eat, drink, chew gum, or apply cosmetics.
- Do not take water from a sink used for isotope disposal.
- Do not clean up laboratory benchs that are identified as areas of radioactive isotope usage.
- Do not remove radioactive waste from the laboratory.

Laser Hazards

There are many different types of lasers. The radiation from each laser is classified into one of four classifications. Each classification is based on the energy output of the laser and the health effects of exposure to a laser in the classification.



Position 1 Information in this location informs one of the special precautionary instructions and actions that need to be taken by a person entering the area where the laser is used.

Position 2 The type of laser in the area is identified here. (Nd:YAG, Helium-Neon, etc.)

Position 3 The class of laser or laser system is identified here. (Class 1, 2, 3a, 3b, 4)

Class	Description	Signal Word
1	These are typically used in laser pointers and CD players. They are low power lasers and a direct beam into the eye could not cause damage.	-
2	These lasers produce visible light and generate beams of less then 1 milliwatt. They are used in supermarket scanners. This class of lasers can be a hazard to the eye if a person stares directly into the beam and does not blink.	Caution
3a	These lasers have a typical power output of 1 to 5 milliwatts. This class of lasers can be a hazard to the eye if a person stares directly into the beam and does not blink. Direct viewing of the beam with focusing optical insturments can also cause eye damage.	Caution / Danger
3b	These lasers have a typcial power output of 5 to 500 milliwatts. Eye injury can occur from direct and reflected beam viewing.	Danger
4	These lasers have a typical power output of greater then 500 milliwattts. In addition to producing eye injuries, this class is capable of producing skin injuries from direct and reflected beams.	Danger

Biohazards

Guidelines for the laboratory use of biohazardous materials are available through the Center of Disease Control and Prevention (CDC). The publication *Biosafety in Microbiological and Biomedical Laboratories* (DHHS, 2009) identifies control measures that are appropriate for the safe use of microorganisms in the laboratory.

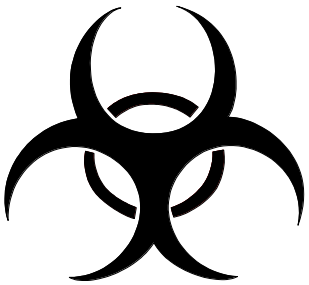
To order a hard copy of publication *Biosafety in Microbiological and Biomedical Laboratories*, contact the U.S. Government Printing Office. The stock number for this document is 017-040-00561-0.

Order by Phone:	between 8:00 a.m. and 5:30 p.m. EST at 1-202-512-1800 or 1-866-512-1800 (toll free)
Order by Fax:	at 1-202-512-2104
Order by the Internet:	http://bookstore.gpo.gov/

All research using biohazardous agents that involve recombinant DNA are required to follow BGSU policies and procedures as stated by the Office of Research Compliance and the Institutional Biosafety Committee (IBC). PIs who submit a protocol to the IBC to use a BSL-2 agent will be subject to a laboratory inspection of their space by Environmental Health and Safety and will need to have proper postings outside of their laboratory stating that their space works with biohazardous agents.

Environmental Health and Safety coordinates the inspection of biosafety cabinets for all spaces on campus. PIs and/or Departments must coodinate with Environmental Health and Safety prior to purchasing biosafety cabinets, or when taking an existing biosafety cabinet out of service, so that proper inventory can be taken.

Any biohazardous waste should take extra precautions to ensure proper treatment or disposal can occur. Biohazardous sharps should be stored in a sharps container with proper labeling. Other biohazardous waste should be in an appropriately rated biohazardous bag that is double-knotted when full. Both sharps and biohazardous bags are full when ¾ filled. Other rules and procedures can be instituted by campus autoclave or hazardous waste personnel at any given time.



Safety Data Sheet (SDS)

As part of the Hazard Communication Standard, OSHA requires that all chemicals within a department be accompanied by an SDS. An SDS is a written document describing the hazards associated with the chemical. It includes chemical and physical characteristics of the substance, fire and explosion hazard data, reactivity data, health hazard data, precautions for safe handling and use, and appropriate control measures. By implementing the safe handling precautions and control measures recommended by the manufacturer on the SDS, risks from chemicals can be greatly reduced. The specific sections required in a SDS include:

1. Identification

This section identifies the chemical on the SDS as well as the recommended uses. It also provides the essential contact information of the supplier. The required information consists of:

- Product identifier used on the label and any other common names or synonyms by which the substance is known.
- Name, address, phone number of the manufacturer, importer, or other responsible party, and emergency phone number.
- Recommended use of the chemical (e.g., a brief description of what it actually does, such as flame retardant) and any restrictions on use (including recommendations given by the supplier).

2. Hazard(s) Identification

This section identifies the hazards of the chemical presented on the SDS and the appropriate warning information associated with those hazards. The required information consists of:

- The hazard classification of the chemical (e.g., flammable liquid, category).
- Signal word.
- Hazard statement(s).
- Pictograms (the pictograms or hazard symbols may be presented as graphical reproductions of the symbols in black and white or be a description of the name of the symbol (e.g., skull and crossbones, flame).
- Precautionary statement(s).
- Description of any hazards not otherwise classified.
- For a mixture that contains an ingredient(s) with unknown toxicity, a statement describing how much (percentage) of the mixture consists of ingredient(s) with unknown acute toxicity. Please note that this is a total percentage of the mixture and not tied to the individual ingredient(s).

3. Composition/Information on Ingredients

This section identifies the ingredient(s) contained in the product indicated on the SDS, including impurities and stabilizing additives. This section includes information on substances, mixtures, and all chemicals where a trade secret is claimed. The required information consists of:

Substances

- Chemical name.
- Common name and synonyms.
- Chemical Abstracts Service (CAS) number and other unique identifiers.
- Impurities and stabilizing additives, which are themselves classified and which contribute to the classification of the chemical.

Mixtures

- Same information required for substances.
- The chemical name and concentration (i.e., exact percentage) of all ingredients which are classified as health hazards and are:
    - Present above their cut-off/concentration limits or
    - Present a health risk below the cut-off/concentration limits.
- The concentration (exact percentages) of each ingredient must be specified except concentration ranges may be used in the following situations:
    - A trade secret claim is made,
    - There is batch-to-batch variation, or
    - The SDS is used for a group of substantially similar mixtures.

Chemicals where a trade secret is claimed

- A statement that the specific chemical identity and/or exact percentage (concentration) of composition has been withheld as a trade secret is required.

4. First-Aid Measures

This section describes the initial care that should be given by untrained responders to an individual who has been exposed to the chemical. The required information consists of:

- Necessary first-aid instructions by relevant routes of exposure (inhalation, skin and eye contact, and ingestion).
- Description of the most important symptoms or effects, and any symptoms that are acute or delayed.
- Recommendations for immediate medical care and special treatment needed, when necessary.

5. Fire-Fighting Measures

This section provides recommendations for fighting a fire caused by the chemical. The required information consists of:

- Recommendations of suitable extinguishing equipment, and information about extinguishing equipment that is not appropriate for a particular situation.
- Advice on specific hazards that develop from the chemical during the fire, such as any hazardous combustion products created when the chemical burns.
- Recommendations on special protective equipment or precautions for firefighters.

6. Accidental Release Measures

This section provides recommendations on the appropriate response to spills, leaks, or releases, including containment and cleanup practices to prevent or minimize exposure to people, properties, or the environment. It may also include recommendations distinguishing between responses for large and small spills where the spill volume has a significant impact on the hazard. The required information may consist of recommendations for:

- Use of personal precautions (such as removal of ignition sources or providing sufficient ventilation) and protective equipment to prevent the contamination of skin, eyes, and clothing.
- Emergency procedures, including instructions for evacuations, consulting experts when needed, and appropriate protective clothing.
- Methods and materials used for containment (e.g., covering the drains and capping procedures).
- Cleanup procedures (e.g., appropriate techniques for neutralization, decontamination, cleaning or vacuuming; adsorbent materials; and/or equipment required for containment/clean up)

7. Handling and Storage

This section provides guidance on the safe handling practices and conditions for safe storage of chemicals. The required information consists of:

- Precautions for safe handling, including recommendations for handling incompatible chemicals, minimizing the release of the chemical into the environment, and providing advice on general hygiene practices (e.g., eating, drinking, and smoking in work areas is prohibited).
- Recommendations on the conditions for safe storage, including any incompatibilities. Provide advice on specific storage requirements (e.g., ventilation requirements)

8. Exposure Controls/Personal Protection

This section indicates the exposure limits, engineering controls, and personal protective measures that can be used to minimize worker exposure. The required information consists of:

- OSHA Permissible Exposure Limits (PELs), American Conference of Governmental Industrial Hygienists (ACGIH) Threshold Limit Values (TLVs), and any other exposure limit used or recommended by the chemical manufacturer, importer, or employer preparing the safety data sheet, where available.
- Appropriate engineering controls (e.g., use local exhaust ventilation, or use only in an enclosed system).
- Recommendations for personal protective measures to prevent illness or injury from exposure to chemicals, such as personal protective equipment (PPE) (e.g., appropriate types of eye, face, skin or respiratory protection needed based on hazards and potential exposure).
- Any special requirements for PPE, protective clothing or respirators (e.g., type of glove material, such as PVC or nitrile rubber gloves; and breakthrough time of the glove material).

9. Physical and Chemical Properties

This section identifies physical and chemical properties associated with the substance or mixture. The minimum required information consists of:

- Appearance (physical state, color, etc.);
- Upper/lower flammability or explosive limits;
- Odor;
- Vapor pressure;
- Odor threshold;
- Vapor density;
- pH;
- Relative density;
- Melting point/freezing point;
- Solubility(ies);
- Initial boiling point and boiling range;
- Flash point;
- Evaporation rate;
- Flammability (solid, gas);
- Partition coefficient: n-octanol/water;
- Auto-ignition temperature;
- Decomposition temperature; and
- Viscosity.

The SDS may not contain every item on the above list because information may not be relevant or is not available. When this occurs, a notation to that effect must be made for that chemical property. Manufacturers may also add other relevant properties, such as the dust deflagration index (Kst) for combustible dust, used to evaluate a dust's explosive potential

10. Stability and Reactivity

This section describes the reactivity hazards of the chemical and the chemical stability information. This section is broken into three parts: reactivity, chemical stability, and other. The required information consists of:

Reactivity

- Description of the specific test data for the chemical(s). This data can be for a class or family of the chemical if such data adequately represent the anticipated hazard of the chemical(s), where available.

Chemical stability

- Indication of whether the chemical is stable or unstable under normal ambient temperature and conditions while in storage and being handled.
- Description of any stabilizers that may be needed to maintain chemical stability.
- Indication of any safety issues that may arise should the product change in physical appearance.

Other

- Indication of the possibility of hazardous reactions, including a statement whether the chemical will react or polymerize, which could release excess pressure or heat, or create other hazardous conditions. Also, a description of the conditions under which hazardous reactions may occur.
- List of all conditions that should be avoided (e.g., static discharge, shock, vibrations, or environmental conditions that may lead to hazardous conditions).
- List of all classes of incompatible materials (e.g., classes of chemicals or specific substances) with which the chemical could react to produce a hazardous situation.
- List of any known or anticipated hazardous decomposition products that could be produced because of use, storage, or heating. (Hazardous combustion products should also be included in the Fire-Fighting Measures of the SDS.)

11. Toxicological Information

This section identifies toxicological and health effects information or indicates that such data are not available. The required information consists of:

- Information on the likely routes of exposure (inhalation, ingestion, skin and eye contact). The SDS should indicate if the information is unknown.
- Description of the delayed, immediate, or chronic effects from short- and long-term exposure.
- The numerical measures of toxicity (e.g., acute toxicity estimates such as the LD50 (median lethal dose)) - the estimated amount [of a substance] expected to kill 50% of test animals in a single dose.
- Description of the symptoms. This description includes the symptoms associated with exposure to the chemical including symptoms from the lowest to the most severe exposure.
- Indication of whether the chemical is listed in the National Toxicology Program (NTP) Report on Carcinogens (latest edition) or has been found to be a potential carcinogen in the International Agency for Research on Cancer (IARC) Monographs (latest editions) or found to be a potential carcinogen by OSHA

12. Ecological Information (non-mandatory)

This section provides information to evaluate the environmental impact of the chemical(s) if it were released to the environment. The information may include:

- Data from toxicity tests performed on aquatic and/or terrestrial organisms, where available (e.g., acute or chronic aquatic toxicity data for fish, algae, crustaceans, and other plants; toxicity data on birds, bees, plants).
- Whether there is a potential for the chemical to persist and degrade in the environment either through biodegradation or other processes, such as oxidation or hydrolysis.
- Results of tests of bioaccumulation potential, making reference to the octanol-water partition coefficient (Kow) and the bioconcentration factor (BCF), where available.
- The potential for a substance to move from the soil to the groundwater (indicate results from adsorption studies or leaching studies).
- Other adverse effects (e.g., environmental fate, ozone layer depletion potential, photochemical ozone creation potential, endocrine disrupting potential, and/or global warming potential).

13. Disposal Considerations (non-mandatory)

This section provides guidance on proper disposal practices, recycling or reclamation of the chemical(s) or its container, and safe handling practices. To minimize exposure, this section should also refer the reader to Section 8 (Exposure Controls/Personal Protection) of the SDS. The information may include:

- Description of appropriate disposal containers to use.
- Recommendations of appropriate disposal methods to employ.
- Description of the physical and chemical properties that may affect disposal activities.
- Language discouraging sewage disposal.
- Any special precautions for landfills or incineration activities

14. Transportation Information (non-mandatory)

This section provides guidance on classification information for shipping and transporting of hazardous chemical(s) by road, air, rail, or sea. The information may include:

- UN number (i.e., four-figure identification number of the substance)[1].
- UN proper shipping name[1].
- Transport hazard class(es)[1].
- Packing group number, if applicable, based on the degree of hazard[2].
- Environmental hazards (e.g., identify if it is a marine pollutant according to the International Maritime Dangerous Goods Code (IMDG Code)).
- Guidance on transport in bulk (according to Annex II of MARPOL 73/78[3] and the International Code for the Construction and Equipment of Ships Carrying Dangerous Chemicals in Bulk (International Bulk Chemical Code (IBC Code)).
- Any special precautions which an employee should be aware of or needs to comply with, in connection with transport or conveyance either within or outside their premises (indicate when information is not available).

15. Regulatory Information (non-mandatory)

This section identifies the safety, health, and environmental regulations specific for the product that is not indicated anywhere else on the SDS. The information may include:

- Any national and/or regional regulatory information of the chemical or mixtures (including any OSHA, Department of Transportation, Environmental Protection Agency, or Consumer Product Safety Commission regulations)

16. Other Information

This section indicates when the SDS was prepared or when the last known revision was made. The SDS may also state where the changes have been made to the previous version. You may wish to contact the supplier for an explanation of the changes. Other useful information also may be included here.

Obtaining Safety Data Sheets On-Line

The websites can only be accessed on campus. To access ChemWatch, visit the Environmental Health and Safety webpage and click on 'Safety Data Sheet Search' or 'ChemWatch'.

Safety data sheets for chemicals are available through the chemical manufactures website.

Labeling

The goal of proper chemical labeling is the identification of chemicals and their hazards. With properly labeled chemicals, unlabeled containers are avoided, keeping disposal costs low.

- Labels on incoming containers from manufactures shall not be removed or defaced.
- Labels on secondary containers (containers not intended for immediate use) shall identify the chemical's name and the hazard warnings (health and physical hazards) associated with that chemical.
- Containers for immediate use, such as beakers and flasks, must at a minimum be labeled with the name of the chemical contents.

Hazardous Materials Information System (HMIS)

The Hazardous Materials Information System (HMIS) is a color and number system. The system uses a color-coded square with four rows in which numbers are used to signal the degree of health hazard, flammability hazard, and reactivity hazard. A letter in the bottom row is used to indicate the personal protective equipment that should be used with the chemical. Refer to the HMIS Personal Protection Index. An asterisk (*) indicates chronic health hazards are associated with the chemical.

Hazard Rating	Health Hazard (blue)	Flammability Hazard (red)	Reactivity Hazard (yellow)
4 Severe Hazard	Substance considered highly toxic under OSHA's Hazard Communication Standard.	Substance considered a flammable liquid under OSHA's Hazard Communication Standard.	Substance that in itself is readily capable of detonation or explosive decomposition or explosive decomposition or explosive reaction at normal temperatures and pressures. This includes substances that are sensitive to localized thermal or mechanical shock at normal temperatures and pressures. Substance considered explosive under OSHA's Hazard Communication Standard.
3 Serious Hazard	Substance considered highly toxic under OSHA's Hazard Communication Standard. Substances can be severely irritating or corrosive to skin. Substances can be corrosive and cause irreversible destruction to eyes.	Substance considered a flammable liquid under OSHA's Hazard Communication Standard.	Substance that in itself is capable of detonation or explosive reaction, but that require a strong initiating source or must be heated under confinement before initiation. Substance considered explosive under OSHA's Hazard Communication Standard.
2 Moderate Hazard	Substance considered toxic under OSHA's Hazard Communication Standard. Substances moderately irritating and considered to be a primary skin irritant or sensitizer. Substances moderately to severely irritating to the eyes. May be reversible.	Substance considered a combustible liquid under OSHA's Hazard Communication Standard.	Substance normally undergoes a violent chemical change at elevated temperatures and pressures. Substance considered explosive under OSHA's Hazard Communication Standard.
1 Slight Hazard	Substance not considered toxic under OSHA's Hazard Communication Standard. Substances slightly or mildly irritating to the skin. Slightly or mildly irritating to the eyes and reversible within 7 days.	Substance considered a combustible liquid under OSHA's Hazard Communication Standard.	Normally stable material but becomes unstable at elevated temperatures and pressures. Substance considered explosive under OSHA's Hazard Communication Standard.
0 Minimal Hazard	Substance not considered toxic under OSHA's Hazard Communication Standard. Essentially non-irritating to the skin and eyes.	Substance will not burn. Substance not considered flammable or combustible under OSHA's Hazard Communication Standard.	Normally stable materials that do not react with water. Substance not considered explosive under OSHA's Hazard Communication Standard.

HMIS Personal Protection Index

A 	Safety glasses
B  + 	Safety glasses and gloves
C  +  + 	Safety glasses, gloves, and apron
D  +  + 	Face shield, eye protection, gloves, and apron
E  +  + 	Safety glasses, gloves, dust respirator
F  +  +  + 	Safety glasses, gloves, apron, and dust respirator
G  +  + 	Safety glasses, gloves, vapor respirator
H  +  + + 	Splash goggles, gloves, apron, and vapor respirator
I  +  + 	Safety glasses, gloves, dust and vapor respirator
J  +  + + 	Splash goggles, gloves, apron, dust and vapor respirator
K  +  +  + 	**Airline hood or mask, gloves, full suit, and boots**


A - Safety glasses


N - Splash goggles


O – Face Shield & Eye Protection


P - Gloves


Q - Boots


R- Apron

S – Full Suit

T – Dust mask

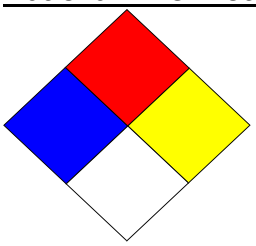
U – Vapor Respirator

W – Dust & Vapor Respirator

Y- Full Face Respirator

Z – Airline Hood or Mask

National Fire Protection Association



The National Fire Association (NFPA) has developed a color-coded number system called NFPA 704. The system uses a color-coded diamond with four quadrants in which numbers are used in the upper three quadrants to signal the degree of health hazard (blue), flammability hazard (red), and reactivity hazard (yellow). The bottom quadrant is used to indicate special hazards. The NFPA system is good for alerting personnel of the degree of hazard of the chemical and helpful in drawing attention to storage needs and the necessary emergency equipment needed. This system does not indicate chronic health hazards.

Hazard Rating	Health Hazard (blue)	Flammability Hazard (red)	Stability Hazard (yellow)
4 Severe Hazard	Substance considered highly toxic under OSHA's Hazard Communication Standard. Under emergency conditions, these substances can be lethal.	Substance considered a flammable liquid under OSHA's Hazard Communication Standard.	Substance that in itself is readily capable of detonation or explosive decomposition or explosive reaction at normal temperatures and pressures. This includes substances that are sensitive to localized thermal or mechanical shock at normal temperatures and pressures. Substance considered explosive under OSHA's Hazard Communication Standard.
3 Serious Hazard	Substance considered highly toxic under OSHA's Hazard Communication Standard. Under emergency conditions, this substance can cause serious or permanent injury.	Substance considered a flammable liquid under OSHA's Hazard Communication Standard.	Substance that in itself is capable of detonation or explosive decomposition or explosive reaction, but that require a strong initiating source or must be heated under confinement before initiation. Substance considered explosive under OSHA's Hazard Communication Standard.
2 Moderate Hazard	Substance considered toxic under OSHA's Hazard Communication Standard. Under emergency conditions, this substance can cause temporary incapacitation or residual injury.	Substance considered a combustible liquid under OSHA's Hazard Communication Standard.	Substance normally undergoes a violent chemical change at elevated temperatures and pressures. Substance considered explosive under OSHA's Hazard Communication Standard.
1 Slight Hazard	Substance not considered toxic under OSHA's Hazard Communication Standard. Under emergency conditions, this substance can cause significant irritation.	Substance considered a combustible liquid under OSHA's Hazard Communication Standard.	Normally stable material but become unstable at elevated temperatures and pressures. Substance considered explosive under OSHA's Hazard Communication Standard.
0 Minimal Hazard	Substance not considered toxic under OSHA's Hazard Communication Standard. Under emergency conditions, this substance would offer no hazard beyond that of ordinary combustible material.	Substance is not considered combustible or flammable under OSHA's Hazard Communication Standard. Substance that will not burn.	Normally stable material that does not react with water. Substance not considered explosive under OSHA's Hazard Communication Standard.

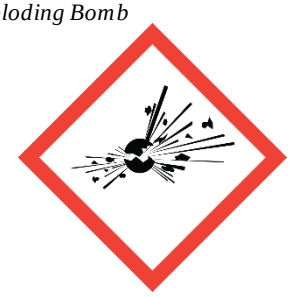
Special Hazards

 **Acid**	 **Alkali**
 **Biohazard**	 **Carcinogen**
 **Corrosive**	 **Use NO WATER**
 **Oxidizer**	 **Radiation Hazard**

Hazardous Communications Standard Pictograms

As of June 1, 2015, the Occupational Safety and Health Administration (OSHA) continues to update the Hazard Communication Standard (HCS) and will require pictograms on labels to alert users of the chemical hazards to which they may be exposed. Each pictogram consists of a symbol on a white background framed within a red border and represents a distinct hazard(s). The pictogram on the label is determined by the chemical hazard classification.

Pictographs of Chemical Hazards

<table>
<tr>
<td>Health Hazard
 
• Carcinogen
• Mutagenicity
• Reproductive Toxin
• Respiratory Sensitizer
• Target Organ Toxicity
• Aspiration Toxicity</td>
<td>Flame
 
• Flammables
• Pyrophorics
• Self-Heating
• Emits Flammables Gas
• Self-Reactives
• Organic Peroxides</td>
<td>Exclamation Mark
 
• Irritant (Skin and Eye)
• Skin Sensitizer
• Acute Toxicity (harmful)
• Narcotic Effects
• Respiratory Tract Irritant
• Hazardous to ozone layer (non-mandatory)</td>
</tr>
<tr>
<td>Gas Cylinder
 
• Gases Under Pressure</td>
<td>Corrosion
 
• Skin Corrosion/Burns
• Eye Damage
• Corrosive to Metals</td>
<td>Exploding Bomb
 
• Explosives
• Self-Reactives
• Organic Peroxides</td>
</tr>
<tr>
<td>Flame Over Circle
 
• Oxidizers</td>
<td>Environment
 
• Aquatic Toxicity</td>
<td>Skull and Crossbones
 
• Acute Toxicity (fatal or toxic)</td>
</tr>
</table>

Engineering Controls

Fume Hood

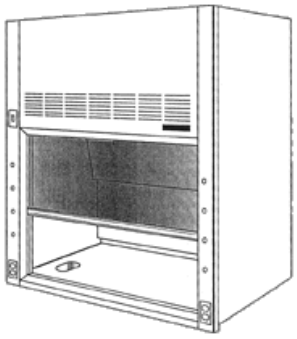


Figure 9: A Standard Hood

Purpose of a Fume Hood:

Fume hoods are chemical containment devices used to control chemical emissions (and resulting exposures). The chemical emission is controlled by enclosing and containing the vapor or gas in the hood.

Laboratory operations involving toxic materials must be conducted within a laboratory hood. This protects the laboratory workers while performing experiments that generate toxic emissions.

Face Velocities

To provide adequate control of the emissions, a fume hood must provide an average face velocity of 100 feet per minute. Air velocities exceeding 120 feet per minute (fpm) and below 80 fpm can cause eddie currents. The eddie currents can release the chemical emissions into the laboratory and expose individuals without warning (Figure 5).

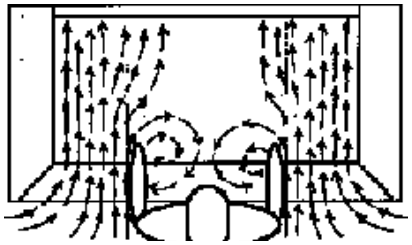


Figure 10: Overhead view of air flow patterns with a worker standing in front of a hood.

Auxiliary-air fume hoods

Found mainly in the Physical Science Laboratory Building and Overman Hall, auxiliary air hoods (Figure 6) were developed to reduce energy consumption.

They function by supplying outside air near the top and front of the hood face. This is to minimize the conditioned laboratory air from being exhausted through the hood.

Auxiliary air hoods do not exhaust the laboratory air. Do not rely on these hoods to be a source of exhaust ventilation for laboratory air.

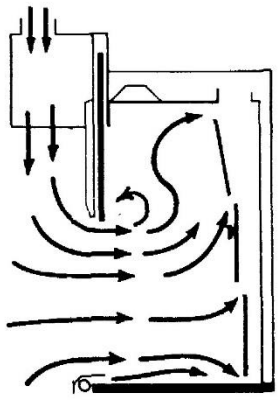


Figure 11: Cross section view of air flow with an auxiliary air hood.

Laboratory Fume Hood Components and Functions (Figure 12)

Airfoil: Located along the bottom and sometimes the edges, airfoils streamline airflow into the hood preventing turbulent eddies that can carry vapors out of the hood. Bottom airfoils also provide a space for room airflow when the sash is completely closed.

Baffles: Movable or adjustable partitions used to create slotted openings along the back of the hood body. Baffles help to keep a uniform airflow across the face of the hood, which eliminates dead spots and optimizes capture efficiency.

Sash: A movable and transparent piece of Plexiglas that closes or opens the face of the hood.

Work Surface: The area under the hood where apparatuses and pieces of equipment are placed.

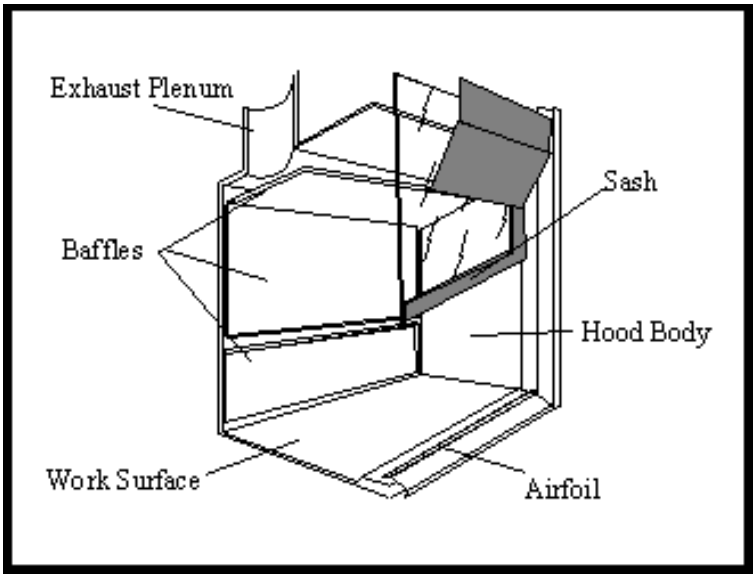


Figure 12: Components of a laboratory fume hood.

How to properly use a Fume Hood

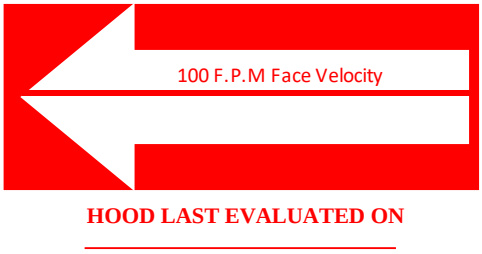


Figure 13: Sash Position Arrow

- Position the bottom of the sash to be in line with the 100 feet per minute arrow located on the side of the hood (Figure 13). The arrow is located where proper air flow velocities are achieved at the hood's face.

- Set up work inside the hood at least six inches from the face opening. (Figure 14) This will avoid turbulence at the sash edge and provide greater protection.

- Separate and elevate each instrument. Use blocks or racks to elevate equipment one to two inches off the hood work surface so that air can easily flow around all apparatuses with no disruption.

- Keep hood storage to an absolute minimum. Keep only items needed for ongoing operations inside the hood. Excess materials in the hood disrupt airflow and can act as a barrier or cause airflow to exit across the face of the hood. Keep the back bottom slot clear at all times as it serves as an exhaust port for fumes and heat generated near the surface.

- Minimize traffic near and around the hood. A person walking past the hood can create competing air currents. Other cross drafts should be eliminated, such as open doors or fans.

- Use extreme caution with ignition sources inside a fume hood. Ignition sources such as electrical connections and equipment, hot plates, controllers, and open flames will ignite flammable vapors or explosive particles that have generated inside the fume hood. All electrical equipment used inside a fume hood must be designed or certified as intrinsically safe, unless it can be absolutely established (and enforced) that flammable or explosive materials will not be used in a particular hood.

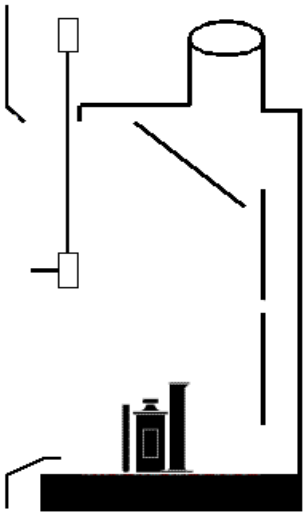


Figure 14: Glass wear located 6 inches in the hood.

- Never put your head inside a hood while operations are in progress. The plane of the sash is the imaginary boundary that should not be crossed except to set up or dismantle equipment.

- Do not dismantle or modify the physical structure or exhaust system without consulting the Department of Environmental Health and Safety first. Modifications can result in a decrease in air flow and could make the hood less protective.

- Clean up spills as soon as possible.

Emergency Rinsing Stations

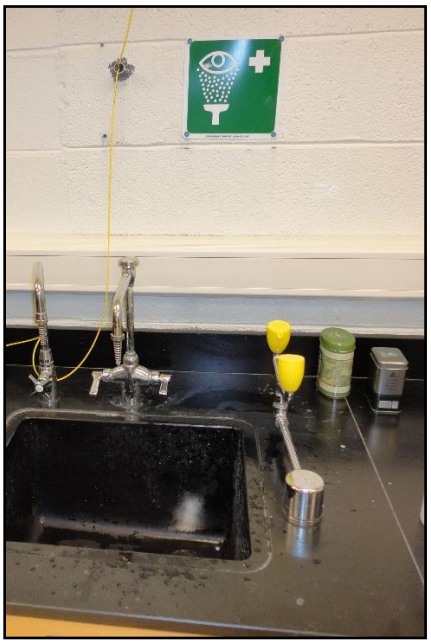
Eyewash Units

Emergency eyewash units (Figure 15) are to be used when harmful or corrosive substances enter the eyes. These units are either located on faucets of laboratory sinks, as stand-alone units, or as combination eyewash/shower units. When you receive your laboratory teaching assignment, locate these eye washes and become familiar with how they operate.

Figure 15: Eye wash fountain

If someone in the laboratory gets a chemical in their eye, follow this procedure:

- Get the person to the eye wash immediately.
- Wash the eyes with a large amount of running water. You may have to help the person by pulling their eyelids back, so the water can contact the eye.
- Continue washing the eye for 15 minutes.
- Have a person in the laboratory call 911 for emergency medical attention.



Examples of different types of emergency eyewash stations.

Shower Units

Showers are to be used when a chemical has been spilled extensively on the body.

If someone in the laboratory gets a chemical on their body, follow this procedure:

- Get the person to the shower immediately and pull the large release handle.
- While the shower is running, you may need to help the individual remove affected clothing. Do this as quickly as possible to reduce the contact time of the chemical on the skin.
- Continue washing the affected area for at least 15 minutes.
- Have a person in the laboratory call 911 for emergency medical attention.

Combination Eyewash and Shower Units

Combination units have both an eyewash and shower so they can be used together.

If an individual has a chemical in their eyes and on their body, follow this procedure:

- Get the person to this unit immediately and activate both units.
- While the shower and eye wash are running help the individual remove affected clothing and have someone else hold their eyes open.
- Continue washing the eyes and skin for at least 15 minutes.
- Have a person in the laboratory call 911 for emergency medical attention.

Examples of combination emergency eyewash/shower units

Drench Hose Stations

Drenching Hoses are available in some laboratories. These are to be used when a chemical has been spilled on the body.

If someone in the laboratory gets a chemical on their body, follow this procedure:

- Get the person to the drenching hose immediately and squeeze the handle.

- While the hose is running, help the individual remove affected clothing. Do this as quickly as possible to reduce the contact time of the chemical on the skin.
- Continue washing the affected area for at least 15 minutes.
- Have a person in the laboratory call 911 for emergency medical attention.

Examples of drench hose stations.

Administrative Controls

There are many other policies and procedures that may be relevant to laboratories or facilities on-campus. These can be viewed on the Department of Environmental Health and Safety or Risk Management webpage. Each specific policy provides specialized regulations, procedures, and training requirements for the laboratory. Some of these policies include (but are not limited to):

- Bloodborne Pathogens Plan
- Hazardous Waste Program
- Laser Safety Program
- Radiation Safety Program
- Volunteers @ BGSU

Personal Protective Equipment (PPE)

The personal protective equipment (PPE) that are required for a laboratory or a procedure should be outlined in the completed Standard Operating Procedure (SOP) forms. If you are publishing a SOP for a new laboratory procedure, the figure below may help as a resource to ensure that you are using the correct PPE.

Hazardous Material Handled in the Laboratory	Personal Protective Equipment Required and Recommended
Acids	
Small containers < 1 liter	Safety goggles, appropriate gloves, closed toe shoes required. Long sleeved lab coat recommended.
Large containers > 1 liter	Safety goggles, appropriate gloves, closed toe shoes, and a rubber apron required. If a potential for a splash is high, it is advised to use both a face shield and goggles.
Caustic Liquids	
Small containers < l liter	Safety goggles, appropriate gloves, closed toe shoes required. Long sleeved lab coat recommended.
Large containers > 1 liter	Safety goggles, appropriate gloves, closed toe shoes, and a rubber apron required. If a potential for a splash is high, it is advised to use both face shield and goggles.
Flammable liquids	Safety goggles, appropriate gloves, closed toe shoes required. Long sleeved lab coat recommended.
Dispensing from 5 gal containers	Safety goggles, appropriate gloves, closed toe shoes required. Long sleeved lab coat recommended. If the potential for a splash is high, it is advisable to use a face shield in addition to goggles.
Highly reactive liquid chemicals and high energy oxidizers	Safety goggles, appropriate gloves, closed toe shoes required. Long sleeved lab coat recommended. Face shield or body shield must be used in addition to protective eyewear during the reaction based on the scale of the reaction.

Liquids with high acute toxicity (poisons)	Safety goggles, appropriate gloves, appropriate impermeable apron, closed toe shoes. Long sleeve lab coat recommended. If the potential for a splash is high, use impermeable coveralls and a face shield in addition to goggles.
Liquids with high chronic toxicity (carcinogens and reproductive toxins)	Safety goggles, appropriate gloves, closed toe shoes required. Long sleeved lab coat recommended.
Other hazardous liquid chemicals (not included in the above categories)	Safety goggles, appropriate gloves, closed toe shoes required. Long sleeved lab coat recommended.

Waste Disposal

Drain Disposal:

With appropriate dilution (100 times the volume), there are certain organic and inorganic compounds that can be properly disposed of in the sanitary sewer system in quantities of approximately 100 grams at a time. As a general rule, water-soluble organic compounds with a boiling point <50° C should not be disposed of in the sanitary sewer system. The compounds identified below are water soluble to at least 3% and present a low toxicity hazard. The organic compounds listed on the following pages are readily biodegradable. Some chemicals suitable for drain disposal are:

Organic Chemicals

Alcohols

Alkanols with less than 5 carbon atoms
t-Amyl alcohol
Alkanediols with less than 8 carbon atoms
Glycerol
Sugars and sugar alcohols
Alkoxyalkanols with less than 7 carbon atoms
n-$C_4H_9OCH_2CH_2OCH_2CH_2OH$
2-Chloroethanol

Aldehydes

Aliphatic aldehydes with less than 5 carbon atoms

Amides

$RCONH_2$ and RCONHR with less than 5 carbon atoms
$RCONR_2$ with less than 11 carbon atoms

Amines

Aliphatic amines with less than 7 carbon atoms
Aliphatic diamines with less than 7 carbon atoms
Benzylamine
Pyridine

Carboxylic Acids

Alkanoic acids with less than 6 carbon atoms *
Alkanedioic acids with less than 6 carbon atoms
Hydroxyalkanoic acids with less than 6 carbon atoms
Aminoalkanoic acids with less than 7 carbon atoms
Ammonium, sodium, and potassium salts of the above acid classes with less than 21 carbon atoms
Chloroalkanoic acids with less than 4 carbon atoms

Esters

Esters with less than 5 carbon atoms
Isopropyl acetate

Those with disagreeable odor (i.e. dimethylamine, 1,4-butanediamine, butyric and valeric acids) should be neutralized and the resulting salts disposed of in a sanitary sewer drain after being diluted with water at least 1000 times the volume.

Ketones

Ketones with less than 6 carbon atoms

Nitriles

Acetonitrile
Propionitrile

Sulfonic Acids

Sodium or potassium salts of most are acceptable

Inorganic Compounds

Compounds of any ions listed below which are strongly acidic or basic should be neutralized before being disposed of in a sanitary sewer drain.

Cations	**Anions**
Al^{3+}	BO_3^{3-} , $B_4O_7^{2-}$
Ca^{2+}	Br^-
$Fe^{2+,3+}$	CO_3^{2-}
H^+	HSO_3^-
K^+	OCN^-
Li^+	OH^-
Mg^{2+}	I^-
Na^+	NO_3^-
NH_4^+	PO_4^{3-}
Sn^{2+}	SO_4^{2-}
Sr^{2+}	SCN^-
$Ti^{3+,4+}$	
Zn^{2+}	
Zr^{2+}	

Chemical Waste Collection

All containers used for the collection/storage of hazardous wastes must be structurally sound. The utilization of proper containers minimizes the potential for leakage and/or other releases into the environment. Whenever possible, the original container(s) need to be used. Container determination should be based on chemical characteristics of the waste material to be stored. For example, corrosive wastes should not be placed in a metal container.

Collection sites need to be established within the laboratory or other areas where hazardous wastes are generated. Waste containers should be conveniently located at these points as well. Individuals moving wastes to temporary storage sites must be knowledgeable of the relevant waste characteristics, waste handling guidelines, and appropriate spill control measures. Safety/spill control materials should also be readily available should a spill occur during transfer (see Spill Control Contingency Plan section).

> **NOTE:** Safety cans and other similar storage containers are available through various commercial outlets. Recycled containers for waste storage may also be used. Information on acceptable chemical containers can be obtained through the Hazardous Waste Coordinator.

Chemical Waste Labeling

Containers with missing or illegible labels are classified as "unknowns." Unknown chemicals that require disposal place an unnecessary and costly burden on the University. Testing of the chemical must be performed in order to determine the appropriate hazard category of the unknown waste. Therefore, all containers holding hazardous wastes must be properly labeled. Any container with a label that is not secure or is becoming illegible must be relabeled.

Containers containing chemical waste must be labeled according to these specifications:

- Waste chemicals that are in their original containers require only the words "hazardous waste" above the chemical name.

- All containers used for commingling of wastes must be labeled with the words "hazardous waste" and an identification of the contents. A preprinted label acceptable to the Hazardous Waste Coordinator is recommended.

    - Additional labels may be needed if numerous compatible wastes are placed into one container.

Faculty and Graduate Student Exiting Procedures

Individuals who work in a laboratory are responsible for following the Laboratory Closeout and Chemical Cleanout Procedures and Checklist. The intent of this checklist is to ensure that facilities used for laboratory purposes are eliminated of unknown chemical, physical, or radiation hazards upon the termination or transfer of personnel who no longer will be using the space.

All Principal Investigators (PIs) who are leaving the University or otherwise vacating their laboratory space are responsible for leaving laboratories in a state suitable for re-occupancy or renovation. These procedures should be followed to ensure compliance with BGSU guidelines and applicable federal, state, and local regulations. Not adhering to these rules and procedures defined in the checklist may result in the Department of Environmental Health and Safety to seek immediate action to remove excess chemicals following a PIs departure.

Note: Individual departments/PIs will be responsible to enforce these same procedures for researchers, such as graduate students, Post-docs, or visiting faculty/students.

X	Chemicals	Comments
	Label all chemicals and containers including "unknowns" with full chemical names.	Dispose of all unknowns, expired and outdated chemicals or materials no longer in use (Contact EHS at 2-2171).
	Redistribute unopened or unused chemicals to the other laboratories or stockrooms if they are not expired or past their shelf life.	If relocating chemicals to another lab, chemical inventory must be updated in BioRAFT ChemTracker.
	Package compatible chemical containers in secondary containment.	Use sturdy partitioned boxes, or polyurethane trays, and line with absorbent materials in the event of a spill.
	Clean and decontaminate benchtops, furniture, fume hoods, storage cabinets, freezers, refrigerators, and any other equipment or surfaces with soap and water or disinfectant, whichever is more appropriate.	
	Remove all labels and warning stickers.	
	Package and label all hazardous waste appropriately and contact EHS (2-2171) for proper transportation to Hazardous Waste Facility for disposal.	No chemicals should be disposed of in the trash, pouring them into sinks or drains, or by evaporating into chemical fume hoods.
	All controlled substances must be removed before vacating laboratory.	

X	Biohazard Materials	Comments
	Decontaminate and dispose of all biohazardous waste and sharps.	Autoclave and dispose of accordingly.
	Disinfect all biohazardous work surfaces and equipment (benchtops, fume hoods, storage cabinets, freezers, refrigerators, centrifuges, gloveboxes, and any other equipment or surfaces).	Use 10% bleach solution, or any other specific disinfectant listed under your IBC protocol, for: BSCs, incubators (drain water), centrifuges, refrigerators, freezers, water baths and any other small equipment labeled and/or used for biohazardous work.
	Remove all biohazardous labels and placarding.	
	Transfer biological agents.	If transferring biological agents to another lab, the lab must be approved to accept such material and the BioRAFT ChemTracker inventory must be updated.
	Collect biohazardous materials that cannot be autoclaved or sterilized in red biohazardous bags (carcasses, tissues).	Contact EHS at 2-2171 to schedule a waste pickup.
	Package all materials being transferred or moved in secondary containment.	Empty all beakers, flasks, evaporating dishes, and other containers that cannot be sealed with a cap.

X	Radiation	Comments
	Notify Radiation Safety Officer (RSO) to initiate decommissioning of a radiation lab.	
	Sort and package all radioactive materials for the move to a new area or disposal.	Cap all containers or bottles and use secondary containment.
	Decontaminate all surfaces, survey, wipe test all equipment and surfaces used with radioactive materials (refrigerators, freezers, benchtops).	Coordinate wipe test and decommissioning survey with EHS by contacting them at (2-2171). More decontamination may need to occur if wipe test levels are indicated three times above background.
	Remove all radiation signs, stickers, and postings.	
	Return all dosimeters (if terminating authorized user status).	Contact EHS at (2-2171) to pick up dosimeters.
	Appropriately package radioactive wastes per BGSU Radiation Safety Manual and schedule a waste pickup.	A waste pickup can be scheduled by contacting EHS at (2-2171).

Emergency Response and Procedures

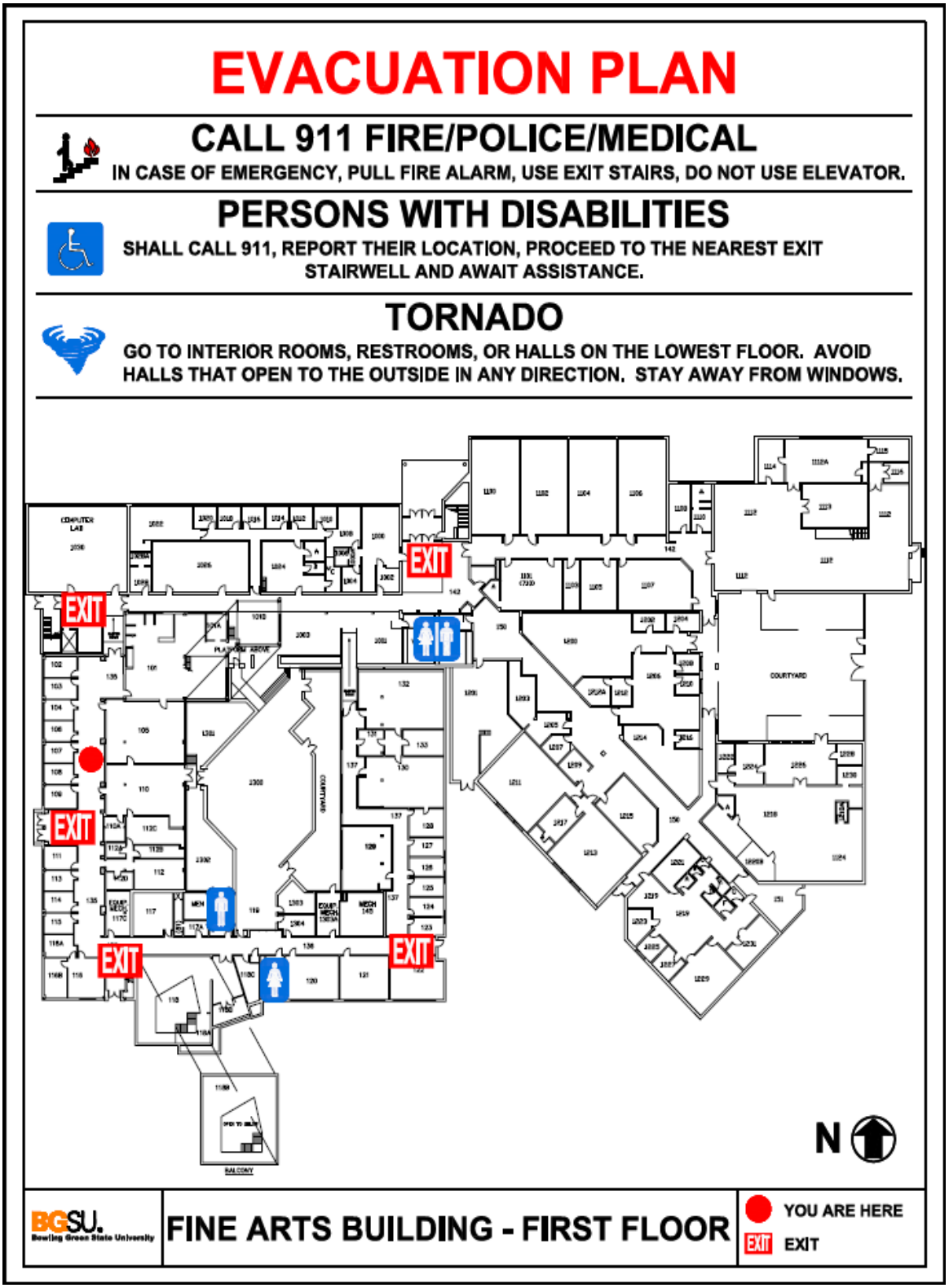
The most common resource for emergency information throughout campus is the BGSU Building Evacuation Plans located in each building (see below). Comprehensive BGSU Campus Emergency Procedures are posted on the BGSU Emergency Management & Response website. Specific emergency response procedures are listed for:

- Tornado and Severe Weather
- Fire
- Medical
- Hazardous Materials Incident
- Suspicious Object or Package
- Bomb Threat
- Hostile Intruder

It is important to note that 911 should be called during all emergencies. For non-emergencies, BGSU Campus Police's non-emergency line should be used.

For laboratory incidents, questions or training, Environmental Health and Safety can be contacted by email (envhs@bgsu.edu) or by phone (419-372-2171).

Bowling Green State University Building Evacuation Plans



Injury/Illness Reporting

When an accident occurs in the laboratory, it often results in an injury and sometimes an illness. These must be reported if they occur. Below are frequently asked questions about the Bowling Green State University Injury and Illness Report form.

1. Why must the form be completed?

   The form must be completed for compliance with a standard from the Occupational Safety and Health Administration. Completed forms also assist Environmental Health and Safety to keep up to date on hazards on campus. This information is used to help abate them.

2. When does the form need to be completed?

   The first page of the report must be completed and submitted within 24 hours of the occurrence of an accident. The second page of the report must be completed and submitted within 5 calendar days of the occurrence of the accident if the person injured or ill is a University employee. The accident may or may not result in an injury. Both forms must be completed in either case.

3. Who completes the form?

   The person who was injured or taken ill, a supervisor, or a witness can complete the form as long as it is a person who has precise knowledge of how the accident occurred. The information reported in Parts 1 and 2 must be of the person who was injured or taken ill. Witness information is reported in Part 4.

4. Where do I get a form to complete?

   All Injury and Illness reports should be filed using the electronic Injury/Illness Reporting Form tool on the Environmental Health and Safety webpage.

5. Who do I call if I have questions about the form?

   Contact the Environmental Health and Safety office at 372-2171.

6. Where does the form get sent to?

   The Injury/Illness form is directed to the Department of Environmental Health and Safety.

OSHA Lab Standard

1910.1450(a)

Scope and application.

1910.1450(a)(1)

This section shall apply to all employers engaged in the laboratory use of hazardous chemicals as defined below.

1910.1450(a)(2)

Where this section applies, it shall supersede, for laboratories, the requirements of all other OSHA health standards in 29 CFR part 1910, subpart Z, except as follows:

1910.1450(a)(2)(i)

For any OSHA health standard, only the requirement to limit employee exposure to the specific permissible exposure limit shall apply for laboratories, unless that particular standard states otherwise or unless the conditions of paragraph (a)(2)(iii) of this section apply.

1910.1450(a)(2)(ii)

Prohibition of eye and skin contact where specified by any OSHA health standard shall be observed.

1910.1450(a)(2)(iii)

Where the action level (or in the absence of an action level, the permissible exposure limit) is routinely exceeded for an OSHA regulated substance with exposure monitoring and medical surveillance requirements paragraphs (d) and (g)(1)(ii) of this section shall apply.

1910.1450(a)(3)

This section shall not apply to:

1910.1450(a)(3)(i)

Uses of hazardous chemicals which do not meet the definition of laboratory use, and in such cases, the employer shall comply with the relevant standard in 29 CFR part 1910, subpart Z, even if such use occurs in a laboratory.

1910.1450(a)(3)(ii)

Laboratory uses of hazardous chemicals which provide no potential for employee exposure. Examples of such conditions might include:

1910.1450(a)(3)(ii)(A)

Procedures using chemically-impregnated test media such as Dip-and-Read tests where a reagent strip is dipped into the specimen to be tested and the results are interpreted by comparing the color reaction to a color chart supplied by the manufacturer of the test strip; and

1910.1450(a)(3)(ii)(B)

Commercially prepared kits such as those used in performing pregnancy tests in which all of the reagents needed to conduct the test are contained in the kit.

1910.1450(b)
Definitions —

Action level means a concentration designated in 29 CFR part 1910 for a specific substance, calculated as an eight (8)-hour time-weighted average, which initiates certain required activities such as exposure monitoring and medical surveillance.

Assistant Secretary means the Assistant Secretary of Labor for Occupational Safety and Health, U.S. Department of Labor, or designee.

Carcinogen (see *select carcinogen*).

Chemical Hygiene Officer means an employee who is designated by the employer, and who is qualified by training or experience, to provide technical guidance in the development and implementation of the provisions of the Chemical Hygiene Plan. This definition is not intended to place limitations on the position description or job classification that the designated individual shall hold within the employer's organizational structure.

Chemical Hygiene Plan means a written program developed and implemented by the employer which sets forth procedures, equipment, personal protective equipment and work practices that (i) are capable of protecting employees from the health hazards presented by hazardous chemicals used in that particular workplace and (ii) meets the requirements of paragraph (e) of this section.

Emergency means any occurrence such as, but not limited to, equipment failure, rupture of containers or failure of control equipment which results in an uncontrolled release of a hazardous chemical into the workplace.

Employee means an individual employed in a laboratory workplace who may be exposed to hazardous chemicals in the course of his or her assignments.

Hazardous chemical means any chemical which is classified as health hazard or simple asphyxiant in accordance with the Hazard Communication Standard (§1910.1200).

Health hazard means a chemical that is classified as posing one of the following hazardous effects: Acute toxicity (any route of exposure); skin corrosion or irritation; serious eye damage or eye irritation; respiratory or skin sensitization; germ cell mutagenicity; carcinogenity; reproductive toxicity; specific target organ toxicity (single or repeated exposure); aspiration hazard. The criteria for determining whether a chemical is classified as a health hazard are detailed in appendix A of the Hazard Communication Standard (§1910.1200) and §1910.1200(c) (definition of "simple asphyxiant").

Laboratory means a facility where the "laboratory use of hazardous chemicals" occurs. It is a workplace where relatively small quantities of hazardous chemicals are used on a non-production basis.

Laboratory scale means work with substances in which the containers used for reactions, transfers, and other handling of substances are designed to be easily and safely manipulated by one person. "Laboratory scale" excludes those workplaces whose function is to produce commercial quantities of materials.

Laboratory-type hood means a device located in a laboratory, enclosure on five sides with a moveable sash or fixed partial enclosed on the remaining side; constructed and maintained to draw air from the laboratory and to prevent or minimize the escape of air contaminants into the laboratory; and allows chemical manipulations to be conducted in the enclosure without insertion of any portion of the employee's body other than hands and arms.

Walk-in hoods with adjustable sashes meet the above definition provided that the sashes are adjusted during use so that the airflow and the exhaust of air contaminants are not compromised and employees do not work inside the enclosure during the release of airborne hazardous chemicals.

Laboratory use of hazardous chemicals means handling or use of such chemicals in which all of the following conditions are met:

(i) Chemical manipulations are carried out on a "laboratory scale;"

(ii) Multiple chemical procedures or chemicals are used;

(iii) The procedures involved are not part of a production process, nor in any way simulate a production process; and

(iv) "Protective laboratory practices and equipment" are available and in common use to minimize the potential for employee exposure to hazardous chemicals.

Medical consultation means a consultation which takes place between an employee and a licensed physician for the purpose of determining what medical examinations or procedures, if any, are appropriate in cases where a significant exposure to a hazardous chemical may have taken place.

Mutagen means chemicals that cause permanent changes in the amount or structure of the genetic material in a cell. Chemicals classified as mutagens in accordance with the Hazard Communication Standard (§1910.1200) shall be considered mutagens for purposes of this section.

Physical hazard means a chemical that is classified as posing one of the following hazardous effects: Explosive; flammable (gases, aerosols, liquids, or solids); oxidizer (liquid, solid, or gas); self-reactive; pyrophoric (gas, liquid or solid); self-heating; organic peroxide; corrosive to metal; gas under pressure; in contact with water emits flammable gas; or combustible dust. The criteria for determining whether a chemical is classified as a physical hazard are in Appendix B of the Hazard Communication Standard (§1910.1200) and §1910.1200(c) (definitions of "combustible dust" and "pyrophoric gas").

Protective laboratory practices and equipment means those laboratory procedures, practices and equipment accepted by laboratory health and safety experts as effective, or that the employer can show to be effective, in minimizing the potential for employee exposure to hazardous chemicals.

Reproductive toxins mean chemicals that affect the reproductive capabilities including adverse effects on sexual function and fertility in adult males and females, as well as adverse effects on the development of the offspring. Chemicals classified as reproductive toxins in accordance with the Hazard Communication Standard (§1910.1200) shall be considered reproductive toxins for purposes of this section.

Select carcinogen means any substance which meets one of the following criteria:

(i) It is regulated by OSHA as a carcinogen; or

(ii) 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); or

(iii) It is listed under Group 1 ("carcinogenic to humans") by the International Agency for Research on Cancer Monographs (IARC) (latest editions); or

(iv) 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:

(A) After inhalation exposure of 6–7 hours per day, 5 days per week, for a significant portion of a lifetime to dosages of less than 10 mg/m^3;

(B) After repeated skin application of less than 300 (mg/kg of body weight) per week; or

(C) After oral dosages of less than 50 mg/kg of body weight per day.

1910.1450(c)
Permissible exposure limits. For laboratory uses of OSHA regulated substances, the employer shall assure that laboratory employees' exposures to such substances do not exceed the permissible exposure limits specified in 29 CFR part 1910, subpart Z.

1910.1450(d)
Employee exposure determination --

1910.1450(d)(1)
Initial monitoring. The employer shall measure the employee's exposure to any substance regulated by a standard which requires monitoring if there is reason to believe that exposure levels for that substance routinely exceed the action level (or in the absence of an action level, the PEL).

1910.1450(d)(2)
Periodic monitoring. If the initial monitoring prescribed by paragraph (d)(1) of this section discloses employee exposure over the action level (or in the absence of an action

level, the PEL), the employer shall immediately comply with the exposure monitoring provisions of the relevant standard.

1910.1450(d)(3)
Termination of monitoring. Monitoring may be terminated in accordance with the relevant standard.

1910.1450(d)(4)
Employee notification of monitoring results. The employer shall, within 15 working days after the receipt of any monitoring results, notify the employee of these results in writing either individually or by posting results in an appropriate location that is accessible to employees.

1910.1450(e)
Chemical hygiene plan -- General. (Appendix A of this section is non-mandatory but provides guidance to assist employers in the development of the Chemical Hygiene Plan).

1910.1450(e)(1)
Where hazardous chemicals as defined by this standard are used in the workplace, the employer shall develop and carry out the provisions of a written Chemical Hygiene Plan which is:

1910.1450(e)(1)(i)
Capable of protecting employees from health hazards associated with hazardous chemicals in that laboratory and

1910.1450(e)(1)(ii)
Capable of keeping exposures below the limits specified in paragraph (c) of this section.

1910.1450(e)(2)
The Chemical Hygiene Plan shall be readily available to employees, employee representatives and, upon request, to the Assistant Secretary.

1910.1450(e)(3)
The Chemical Hygiene Plan shall include each of the following elements and shall indicate specific measures that the employer will take to ensure laboratory employee protection;

1910.1450(e)(3)(i)
Standard operating procedures relevant to safety and health considerations to be followed when laboratory work involves the use of hazardous chemicals;

1910.1450(e)(3)(ii)
Criteria that the employer will use to determine and implement control measures to reduce employee exposure to hazardous chemicals including engineering controls, the use of personal protective equipment and hygiene practices; particular attention shall be given to the selection of control measures for chemicals that are known to be extremely hazardous;

1910.1450(e)(3)(iii)
A requirement that fume hoods and other protective equipment are functioning properly and specific measures that shall be taken to ensure proper and adequate performance of such equipment;

1910.1450(e)(3)(iv)
Provisions for employee information and training as prescribed in paragraph (f) of this section;

1910.1450(e)(3)(v)
The circumstances under which a particular laboratory operation, procedure or activity shall require prior approval from the employer or the employer's designee before implementation;

1910.1450(e)(3)(vi)
Provisions for medical consultation and medical examinations in accordance with paragraph (g) of this section;

1910.1450(e)(3)(vii)
Designation of personnel responsible for implementation of the Chemical Hygiene Plan including the assignment of a Chemical Hygiene Officer, and, if appropriate, establishment of a Chemical Hygiene Committee; and

1910.1450(e)(3)(viii)
Provisions for additional employee protection for work with particularly hazardous substances. These include "select carcinogens," reproductive toxins and substances which have a high degree of acute toxicity. Specific consideration shall be given to the following provisions which shall be included where appropriate:

1910.1450(e)(3)(viii)(A)
Establishment of a designated area;

1910.1450(e)(3)(viii)(B)
Use of containment devices such as fume hoods or glove boxes;

1910.1450(e)(3)(viii)(C)
Procedures for safe removal of contaminated waste; and

1910.1450(e)(3)(viii)(D)
Decontamination procedures.

1910.1450(e)(4)
The employer shall review and evaluate the effectiveness of the Chemical Hygiene Plan at least annually and update it as necessary.

1910.1450(f)
Employee information and training.

1910.1450(f)(1)
The employer shall provide employees with information and training to ensure that they are apprised of the hazards of chemicals present in their work area.

1910.1450(f)(2)
Such information shall be provided at the time of an employee's initial assignment to a work area where hazardous chemicals are present and prior to assignments involving new exposure situations. The frequency of refresher information and training shall be determined by the employer.

1910.1450(f)(3)
Information. Employees shall be informed of:

1910.1450(f)(3)(i)
The contents of this standard and its appendices which shall be made available to employees;

1910.1450(f)(3)(ii)
the location and availability of the employer's Chemical Hygiene Plan;

1910.1450(f)(3)(iii)
The permissible exposure limits for OSHA regulated substances or recommended exposure limits for other hazardous chemicals where there is no applicable OSHA standard;

1910.1450(f)(3)(iv)
Signs and symptoms associated with exposures to hazardous chemicals used in the laboratory; and

1910.1450(f)(3)(v)
The location and availability of known reference material on the hazards, safe handling, storage and disposal of hazardous chemicals found in the laboratory including, but not limited to, safety data sheets received from the chemical supplier.

1910.1450(f)(4)
Training.

1910.1450(f)(4)(i)
Employee training shall include:

1910.1450(f)(4)(i)(A)
Methods and observations that may be used to detect the presence or release of a hazardous chemical (such as monitoring conducted by the employer, continuous monitoring devices, visual appearance or odor of hazardous chemicals when being released, etc.);

1910.1450(f)(4)(i)(B)
The physical and health hazards of chemicals in the work area; and

1910.1450(f)(4)(i)(C)
The measures employees can take to protect themselves from these hazards, including specific procedures the employer has implemented to protect employees from exposure to hazardous chemicals, such as appropriate work practices, emergency procedures, and personal protective equipment to be used.

1910.1450(f)(4)(ii)
The employee shall be trained on the applicable details of the employer's written Chemical Hygiene Plan.

1910.1450(g)
Medical consultation and medical examinations.

1910.1450(g)(1)
The employer shall provide all employees who work with hazardous chemicals an opportunity to receive medical attention, including any follow-up examinations which the examining physician determines to be necessary, under the following circumstances:

1910.1450(g)(1)(i)
Whenever an employee develops signs or symptoms associated with a hazardous chemical to which the employee may have been exposed in the laboratory, the employee shall be provided an opportunity to receive an appropriate medical examination.

1910.1450(g)(1)(ii)
Where exposure monitoring reveals an exposure level routinely above the action level (or in the absence of an action level, the PEL) for an OSHA regulated substance for which there are exposure monitoring and medical surveillance requirements, medical surveillance shall be established for the affected employee as prescribed by the particular standard.

1910.1450(g)(1)(iii)
Whenever an event takes place in the work area such as a spill, leak, explosion or other occurrence resulting in the likelihood of a hazardous exposure, the affected employee shall be provided an opportunity for a medical consultation. Such consultation shall be for the purpose of determining the need for a medical examination.

1910.1450(g)(2)
All medical examinations and consultations shall be performed by or under the direct supervision of a licensed physician and shall be provided without cost to the employee, without loss of pay and at a reasonable time and place.

1910.1450(g)(3)
Information provided to the physician. The employer shall provide the following information to the physician:

1910.1450(g)(3)(i)
The identity of the hazardous chemical(s) to which the employee may have been exposed;

1910.1450(g)(3)(ii)
A description of the conditions under which the exposure occurred including quantitative exposure data, if available; and

1910.1450(g)(3)(iii)
A description of the signs and symptoms of exposure that the employee is experiencing, if any.

1910.1450(g)(4)
Physician's written opinion.

1910.1450(g)(4)(i)
For examination or consultation required under this standard, the employer shall obtain a written opinion from the examining physician which shall include the following:

1910.1450(g)(4)(i)(A)
Any recommendation for further medical follow-up;

1910.1450(g)(4)(i)(B)
The results of the medical examination and any associated tests;

1910.1450(g)(4)(i)(C)
Any medical condition which may be revealed in the course of the examination which may place the employee at increased risk as a result of exposure to a hazardous workplace; and

1910.1450(g)(4)(i)(D)
A statement that the employee has been informed by the physician of the results of the consultation or medical examination and any medical condition that may require further examination or treatment.

1910.1450(g)(4)(ii)
The written opinion shall not reveal specific findings of diagnoses unrelated to occupational exposure.

1910.1450(h)
Hazard identification.

1910.1450(h)(1)
With respect to labels and safety data sheets:

1910.1450(h)(1)(i)
Employers shall ensure that labels on incoming containers of hazardous chemicals are not removed or defaced.

1910.1450(h)(1)(ii)
Employers shall maintain any safety data sheets that are received with incoming shipments of hazardous chemicals, and ensure that they are readily accessible to laboratory employees.

1910.1450(h)(2)
The following provisions shall apply to chemical substances developed in the laboratory:

1910.1450(h)(2)(i)
If the composition of the chemical substance which is produced exclusively for the laboratory's use is known, the employer shall determine if it is a hazardous chemical as defined in paragraph (b) of this section. If the chemical is determined to be hazardous, the employer shall provide appropriate training as required under paragraph (f) of this section.

1910.1450(h)(2)(ii)
If the chemical produced is a byproduct whose composition is not known, the employer shall assume that the substance is hazardous and shall implement paragraph (e) of this section.

1910.1450(h)(2)(iii)
If the chemical substance is produced for another user outside of the laboratory, the employer shall comply with the Hazard Communication Standard (29 CFR 1910.1200) including the requirements for preparation of safety data sheets and labeling.

1910.1450(i)
Use of respirators. Where the use of respirators is necessary to maintain exposure below permissible exposure limits, the employer shall provide, at no cost to the employee, the proper respiratory equipment. Respirators shall be selected and used in accordance with the requirements of 29 CFR 1910.134.

1910.1450(j)
Recordkeeping.

1910.1450(j)(1)
The employer shall establish and maintain for each employee an accurate record of any measurements taken to monitor employee exposures and any medical consultation and examinations including tests or written opinions required by this standard.

1910.1450(j)(2)
The employer shall assure that such records are kept, transferred, and made available in accordance with 29 CFR 1910.1020.

1910.1450(k)

[Reserved]

1910.1450(l)
Appendices. The information contained in the appendices is not intended, by itself, to create any additional obligations not otherwise imposed or to detract from any existing obligation.

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