**Chemical Hygiene Plan (CHP)**

(OSHA Laboratory Standard)

**Ohio University**

**Russ College of Engineering**

[Insert lab/department name here]

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# PURPOSE

Ohio University wishes to ensure the protection of all laboratory employees from health and safety hazards associated with hazardous chemicals in the laboratory and to comply with the requirements of the OSHA Chemical Hygiene Standard and the Ohio Public Employee's Risk Reduction Act. This Chemical Hygiene Plan (CHP) is written to provide methods and requirements for all laboratory personnel to follow while working in the laboratories of Ohio University’s Russ College of Engineering.

# SCOPE

This CHP applies to all laboratory employees, and affiliated researchers, who perform laboratory scale operations involving hazardous chemicals within the Russ College of Engineering. Although the CHP deals specifically with chemical usage, there may be other hazards to consider such as physical, electrical, radiological, and infectious agents, which are not addressed in this plan. Furthermore, while this plan is primarily focused on proper chemical handling, usage, etc., several other critically important issues like safety system maintenance, employee training, medical treatment, and general laboratory practices are covered.

# DEFINITIONS

## Action Level

A concentration designated in OSHA 29 CFR 1910 for a specific substance, calculated as an 8-hour time weighted average (TWA), which initiates certain required activities.

## Chemical Hygiene Officer (CHO)

An employee who is qualified by training, or experience, to provide technical guidance in the development and implementation of the provisions of the CHP. In departmental plans, CHO refers to the department's chemical hygiene office. The campus-wide, CHO will be a member of Environmental Health and Safety (EHS).

## Chemical Hygiene Plan (CHP)

A written program developed and implemented which sets forth procedures, equipment, personal protective equipment (PPE), and work practices that are capable of protecting employees from the health hazards presented by hazardous chemicals used in the laboratory. This plan shall be reviewed and updated at least annually.

## Designated Area

An area which may be used for work with select carcinogens, reproductive toxins, or substances which have a high degree of acute toxicity. A designated area may be the entire laboratory, an area of a laboratory, or a device such as a chemical fume hood.

## Employee

An employee, for the purposes of the CHP, is any person who receives compensation, or other benefit, for work performed at Ohio University.

## Hazardous Chemical

A chemical for which there is statistically significant evidence based on at least one study conducted in accordance with established scientific principles that acute or chronic health effects may occur in exposed employees. The term health hazard includes chemicals which are carcinogens, toxic or highly toxic agents, reproductive toxins, irritants, corrosives, sensitizers, hepatotoxins, nephrotoxins, neurotoxins, agents which act on the hematopoietic systems, and agents which damage the lungs, skin, eyes, or mucous membranes.

## Laboratory

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

## Laboratory Scale

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 a single employee.

## Laboratory Use of Hazardous Chemicals

Handling or use of such chemicals in which all of the following conditions are met: chemical manipulations are carried out on a laboratory scale; multiple chemical procedures or chemicals are used; the procedures involved are not part of a production process, nor in any way simulate a production process, and; protective laboratory practices and equipment are available and in common use to minimize the potential for employee exposure to hazardous chemicals.

## Laboratory Worker

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

## Personal Protective Equipment (PPE)

Specially designed equipment worn to minimize exposure to hazards that cause serious workplace injuries and illnesses. Examples include safety glasses, hearing protection, respirators, lab coats/aprons, etc.

## Principal Investigator (PI)

The PI is responsible for the preparation, administration, and oversight of a research grant or project, including adherence to the CHP, personnel training, PPE is provided, safety inspections carried out, and project-specific safety plans are kept up to date.

## Reproductive Toxins

Chemicals that affect the reproductive capabilities, including chromosomal damage (mutations), and effects on fetuses (teratogenesis).

## Safety Data Sheet (SDS)

The SDS provides a standardized method for communicating the safe handling, storage, use, cleanup, and disposal of a chemical, as well as providing critical health information like the properties of the chemical, the health hazards associated with the chemical, and what PPE may be required.

## Select Carcinogen

Any substance that meets one of the following criteria:

* It is regulated by 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 editions); or it is listed in either Group 2A or 2B by IARC or under the category, reasonably anticipated to be carcinogens by NTP, and causes statistically significant tumor incidence in experimental animals in accordance with any of the following criteria:
	+ After inhalation exposure of 6-7 hours per day, 5 days per week, for a significant portion of a lifetime to dosages of less than 10 mg/m3; or
	+ After repeated skin application of less than 300 (mg/kg of body weight) per week; or after oral dosages of less than 50 mg/kg of body weight per day.

# RESPONSIBILITIES

## Department Chair

The Department Chair has oversight responsibility for chemical hygiene and shall provide continuing support for the departmental CHP.

## Principal Investigator

The Principal Investigator (PI) is responsible for chemical hygiene in their assigned laboratories. The PI, as the immediate laboratory supervisor, shall ensure:

* Laboratory employees know and follow chemical hygiene rules.
* Protective equipment is available, in working order, and used by personnel.
* Appropriate training has been provided and records kept.
* Facilities and training for use of any material being ordered are adequate.
* Inspections are conducted of emergency equipment, chemical hygiene, and housekeeping.
* Adequate health and safety provisions are made for any new initiatives, on a continuing basis with appropriate updates made to the CHP.

## Laboratory Worker

Each laboratory worker is responsible for planning and conducting all operations in accordance with this CHP and developing good personal chemical hygiene habits.

## Department and/or Laboratory Chemical Hygiene Officer

The Chemical Hygiene Officer (CHO) shall ensure:

* The development and implementation of chemical hygiene policies and practices in their respective laboratories.
* Monitor the procurement, use, storage, and disposal of chemicals used in the laboratory.
* Conduct and maintain appropriate audits.
* Know the current legal requirements concerning regulated substances.
* Develop, implement, and seek ways to improve the CHP.

## Russ College Safety Coordinator

The Safety Coordinator, in conjunction with EHS, shall perform annual inspections of all Russ College academic and research labs to evaluate lab safety compliance.

## Department of Environmental Health and Safety (EHS)

EHS shall ensure:

* Annual testing and certification of chemical fume hoods.
* Monthly visual inspection of fire extinguishers.
* Technical consultation and assistance with environmental monitoring needs.
* Management of respiratory protection program.
* Management of the institution-wide Chemical Hygiene and Lab Safety effort.

## Facilities Management, Fire Protection Shop

The Fire Protection Shop shall ensure the maintenance of all campus fire equipment and systems, including annual inspection, testing, and maintenance of all fire extinguishers.

# GENERAL LABORATORY PROCEDURES

## Behavior in the Laboratory

* Employees shall act in a professional manner at all times.
* Horseplay and practical jokes are not permitted.
* Do not work alone at a potentially dangerous activity.
* Laboratory visitors require special permission from the department chair, PI, or laboratory coordinator, and must be escorted by a laboratory employee. Visitors are the responsibility of that employee.
* Visitors shall observe all safety regulations required in the laboratory.
* Only well understood reactions should be permitted to run unattended. If left unattended, lights should be left on and an appropriate sign (with name and contact info) should be posted in front of the equipment left running unattended. Provisions for containment of toxic substances in the event of a utility service failure (such as power outage, or cooling failure) for an unattended operation must be established.
* Employees shall be made aware of the location and proper operation of laboratory safety equipment.
* Hands must be washed before using restrooms and/or before eating.
* Areas of exposed skin, *i.e.* forearms, should be washed frequently (at least before lunch and at the end of the day) if there is potential for contact with chemicals.

## Reduction of Exposure Risk

* Skin contact with chemicals should be avoided.
* Do not smell or taste chemicals.
* Never pipette by mouth; use a vacuum, a pipette bulb, or mechanical pipette.
* Always wear approved PPE in compliance with Ohio state law.

## Prohibited Activities

* Eating, drinking, handling contact lenses, smoking, and cosmetic application are not permitted in the laboratory.
* Food is not to be stored in a refrigerator which has been designated for storing chemicals, laboratory samples, or laboratory supplies.
* No glassware or utensils used for laboratory operations shall be used for storage, handling, or consuming food or beverages.
* Long hair and loose clothing shall be restrained to prevent them from becoming entangled in equipment.
* Use of open-toe shoes is prohibited; only substantial closed-toe shoes may be worn in the laboratory.
* Spills and accumulations of chemicals on work surfaces shall be removed as soon as possible using techniques that minimize residual surface contamination.
* Do not permit recognized hazards to remain uncorrected.
* Do not perform any unauthorized experiments.
* Do not wear personal protective equipment (especially gloves) outside the lab. Gloves must always be removed before exiting the lab. A contaminated glove should never touch a doorknob!

## Lifting Heavy Objects

* Lift heavy objects by bending at the knees. Use your legs, not your back.
* Never attempt to lift any load weighing more than 50 pounds by yourself.
* Hold heavy objects close to your body.
* Care should be taken when moving chemicals or other items due to the bump and spill potentials of hazardous chemicals in the laboratory.
* Contact EHS if ergonomic assessment is desired.

## Housekeeping

* Lab areas are to be kept clean and uncluttered.
* Contaminated glassware is not to be left out.
* All prepared solutions should be labeled with chemical name, concentration, user initials, and date. Appropriate warnings should also be included if solution is hazardous.
* All new chemicals should be labeled with the date of receipt, date of initial opening, and expiration date.
* Spills must be cleaned up immediately.
* Floors must be maintained dry at all times.
* Doorways and walkways shall not be blocked and must be at least 36” in width.
* Access to exits, emergency equipment, and utility controls shall never be blocked.
* Experimental apparatus no longer in use should be cleaned up, dismantled, and put away prior to beginning a new process or procedure.
* All chemicals should be placed back in their appropriate designated storage areas and not left out on a countertop or in a fume hood.
* Clutter in a laboratory setting is unacceptable. Clutter looks unprofessional and it is dangerous.

## General Lighting

Adequate lighting must be provided based on the table below:

|  |
| --- |
| Task Minimum Foot CandlesMicro analytical, critical or delicate operations, close work, etc. 70General analytical, routine analytical, physical testing 50Engine laboratories, equipment test areas, fume hoods 80 |

Contact EHS should you require an assessment of laboratory illumination levels.

# CHEMICAL ACQUISITION, DISTRIBUTION, AND STORAGE

## Acquisition of Chemicals

* All chemicals which are not already part of the existing chemical inventory for the laboratory must be approved by the PI or CHO prior to purchase and the following items must be addressed:
	+ Obtain, review, and comply with the product’s Safety Data Sheet (SDS),
	+ Proper storage and handling procedures,
	+ Proper disposal procedures,
	+ Proper personal protective equipment (PPE),
	+ Are facilities adequate to safely handle the material,
	+ Are personnel adequately trained to handle the material, and
	+ Do the hazards of the chemical, procedure, or material warrant a more significant review by a laboratory risk assessment team?
* Before a substance is received, those who will be involved with its use must be informed, and trained if necessary, regarding proper handling, storage, and disposal.
* Lubricants, cleaners, compressed gases, are considered chemicals and must be included within the chemical inventory.
* If the SDS is not already on file, it must be added to the SDS file and chemical inventory for the applicable lab within which it will be stored.
* No container should be accepted without an adequate identifying label. The label should include, at a minimum, the substance name, an appropriate hazard warning, and product address.
* Date of receipt, date container was opened, and expiration must be marked on the chemical container label.

## Identification

* All chemical containers must have a legible, firmly attached label showing the contents of the container.
* Labels on containers of hazardous chemicals shall not be removed or defaced.
* Chemical substances developed in the laboratory shall be assumed hazardous in the absence of other information.
* If a chemical substance is produced in the laboratory for another user outside the laboratory, the SDS and labeling provisions of the OSHA Hazard Communication Standard apply. An SDS must be written by the lab to accompany the substance.
* Contact EHS for assistance whenever sending proprietary substances outside the university or if trade secrets are involved.
* When reusing an old container to store a different material, the original label must be obliterated, and the new material properly identified.
* Any chemicals which are not properly identified will be disposed of immediately.

## Chemical Inventory

* A printing of the most recent chemical inventory for the laboratory must be provided in the appendix of this CHP and the master file maintained by the CHO. Changes to the inventory should be made to this master file.
* The chemical inventory, contained within the CHP, should be kept beside the primary egress of each laboratory space.
* All extremely hazardous substances must be reported to EHS.
* Individuals receiving, or exhausting, a chemical container are responsible for dating the container label and updating the master copy of the chemical inventory.
* The chemical inventory will be audited annually by the CHO, or designate, for accuracy. The date the audit was completed, and the initials of the auditor, must be provided on the chemical inventory.
* Chemicals which are not properly inventoried will be disposed of immediately.

## Storage

* Both the storage and working amounts of hazardous chemicals shall be kept to a minimum.
* Chemicals shall be stored in containers within which they are chemically compatible.
* Chemical reagents shall be kept in closed containers when not in use.
* Compressed gas cylinders must be secured at all times. Caps should be in place on cylinders when not in use.
* Incompatible chemicals should be segregated by class, *e.g*., flammables, acids, strong reactive chemicals, and toxics. Do not store alphabetically. Storage locations should be clearly labeled. Color-coded labeling systems can be useful to make these distinctions.
* Use secondary containers where necessary to segregate classes of chemicals.
* Provide storage of large containers on low shelves, store corrosives below eye level, and never store anything on the floor.
* Chemical storage rooms and buildings must be adequately ventilated.
* Give special attention to peroxide-forming chemicals while in storage.

## Restricted Chemicals

The use of radioactive sources and radiation producing equipment is regulated by the Nuclear Regulatory Commission, state governments, and the O.U. Radiation Safety Program. Policies and Procedures required by the O.U. Radiation Safety Program must be followed. All requests for radiation shall be approved through Environmental Health and Safety (EHS) before any radiation source or radiation-producing instrument is brought into the laboratory.

Any experiments involving materials covered under the O.U. Biosafety Program shall follow the Policies and Procedures of the Institutional Biosafety Committee (IBC). These include etiologic agents, infectious materials, human blood products and other potentially infectious materials, recombinant DNA products, direct research on chemical carcinogens and any other biological materials capable of causing human disease.

Researchers who desire to use any toxins regulated by the "Antiterrorism and Effective Death Penalty Act" (also called the Agent Transfer Law) must contact EHS for more information. OHIO University is not currently licensed for this research.

# CHEMICAL CLASSIFICATIONS & HAZARDS

## Flammable Liquids

*Hazards:*

* Vapor can form an ignitable mixture in air and can travel long distances while remaining invisible.
* Many flammable liquids are solvents and are potentially hazardous by inhalation.
* Skin contact should be avoided, irritation or skin absorption is possible with some chemicals in this group, causing dryness and cracking.
* Damage to the eyes range from minor irritation to severe permanent damage.
* A few flammable liquids can form unstable, potentially explosive peroxides.

*Storage:*

* Amounts stored in the laboratory outside a flammable materials cabinet are restricted to the quantity that will be used in one day. All flammables should be stored in a flammable materials cabinet when not in use.
* Storage cabinets for flammable materials should be designed appropriately and approved for flammable storage. Storage inside the cabinet should not exceed 60 gallons of Class I or Class II liquids or 120 gallons of Class III liquids.

*Controls:*

* Work in the chemical fume hood as much as possible.
* Transfer from drums only when both the drum and the safety can are grounded and bonded.
* All spills must be cleaned up immediately, with the spill area properly decontaminated.
* Emergency showers and eyewashes shall be used when skin or eye contact occurs. Get first aid attention immediately.

## Corrosive Chemicals

*Hazards:*

Contact with the skin, eyes, respiratory, or digestive tract causes severe irritation, tissue damage, or burns.

*Storage:*

* Always store concentrated acids and bases in appropriate drip trays or plastic carriers if used frequently.
* Always transport concentrated acids and bases in a plastic carrier.
* Always store oxidizing acids (nitric, sulfuric, perchloric) away from organic chemicals, paper, wood, or other flammables.
* Drip-tray residue must be removed daily.

*Controls:*

* Wear protective clothing.
* In case of splash: Flush affected area with large amounts of water for at least 15 minutes. Remove contaminated clothing and discard. Seek medical attention.
* Never add water to concentrated mineral acids or bases.
* When diluting concentrated acids or bases, add slowly to water and monitor heat buildup in the container.
* Always work with corrosive chemicals in a chemical fume hood.

## Reactive Chemicals

*Hazards:*

* *Water sensitive* materials react violently in the presence of water or moisture.
* *Pyrophoric* materials will ignite in air, moisture in the air, oxygen, or water at or below room temperature without additional heat, friction, or shock.

*Storage:*

* Follow label instructions and SDS for proper storage of water sensitive materials.
* Pyrophors must be stored in an atmosphere of inert gas or under kerosene; exclude air. Inert glove boxes are recommended.

*Controls:*

* Wear safety equipment.
* Read precautionary label, follow special hazard instructions.
* Use only in a chemical fume hood. Remove all nonessential items from the hood.

## Compressed Gasses

*Hazards:*

Compressed gas bottles contain gas under extreme pressure. Sudden release of this energy can cause serious injury and physical damage. Compressed gases may also be flammable, toxic, and corrosive.

*Storage:*

Compressed gas bottles must be stored in an upright position with caps in place and secured by a strap or chain to a solid base, stand, or rack. Storage of quantities of flammable compressed gases requires segregation of cylinders and specific storage methods per (29 CFR 1910.101 (b)).

* Separate oxygen from fuel gases by at least 10 feet or by a concrete wall.
* Properly label all cylinders.

*Controls:*

* Transport bottles with their protective valve cap in place and using a suitable tank carrier. Never move or transport a bottle with a regulator attached.
* Refer to the CGA number to ensure the appropriate fittings are used.
* Regulators and fittings must be appropriately specified for the gases used.
* Always use a regulator to reduce the pressure from the bottle.
* Always open valves slowly and cautiously with a regulator attached.
* Close main cylinder valves tightly when not in use.
* Do not permit gases of one type to contaminate another type.
* Do not let cylinder go completely empty.
* Return "empty" cylinders to storage, and clearly mark them as empty.
* Handle cylinders of compressed gases as potential explosives.
* Do not expose cylinders to temperatures higher than 50 °C.

## Carcinogens and Toxic Metals

*Hazards:*

Exposure by inhalation, ingestion, and possibly skin absorption can potentially induce carcinogenesis, mutagenesis, adverse reproductive outcomes, and other chronic or acute adverse health effects.

*Storage:*

The minimum quantity necessary should be kept on hand. Store in a specially designated area.

*Controls:*

* Design protocols to minimize chance of exposure.
* Wear appropriate protective clothing, chemical resistant gloves, and eye protection.
* Work in the chemical fume hood as much as possible.
* Spills should be cleaned up immediately, with the work area properly decontaminated.
* Promptly flush off spills on skin or clothing to prevent significant absorption via cuts in the skin.
* Primary research on known carcinogens is regulated by the OU IBC. Contact the IBC chair or the Biosafety Office at EHS for requirements. This does not include the occasional or incidental use of common lab carcinogens.

# WASTE DISPOSAL PROCEDURES

## General Guidelines

* Every laboratory worker has a responsibility to see that all wastes are disposed of properly.
* Waste disposal procedures must be in compliance with city, state, and federal regulations.
* The laboratory's waste streams include:
	+ Conventional trash (used disposable gloves, paper towels, Kimwipes, empty containers, etc.)
	+ Non-contaminated sharps and laboratory glass (syringe needles, Pasteur pipettes, etc*.*)
	+ Recycling (metal, aluminum, plastic, glass, etc.)
	+ Hazardous chemical waste

## Disposal of Empty Chemical Containers

* Follow all SDS and regulatory requirements for disposal of any residual chemicals from empty containers.
* In most cases, containers may be rinsed with water and drained down the sink. Complete three rinse cycles to ensure the container is clean.
* Remove, or obliterate, the label and mark the container “Empty.”
* If the container is glass, dispose of it as “broken glass” following the instructions below.

## Broken Glass

* Sweep up all broken glass immediately after breakage.
* Do not throw broken glass directly into conventional trash containers. All broken glass must be properly boxed first. Warning, the disposal of sharp or broken glass directly into a conventional trash container may injure an employee.
* All non-contaminated broken sharps and glass must be boxed up and sealed shut with tape. Mark box as “Non-contaminated Waste Glass Only,” or “Puncture Hazard” to alert handlers to the danger contained within.
* Small boxes of broken glass should be placed beside (not in) conventional trash containers for pickup. Large boxes of broken glass should be deposited directly into one of the large outside conventional trash dumpsters.

## Broken Devices Containing Mercury

* Some devices which may contain mercury include thermometers, manometers, and some motion activated switches.
* Wherever possible, replace mercury devices with nontoxic alternatives.
* Once a break occurs, clean up the area immediately.
* Do not touch mercury with your bare skin. Always were nitrile gloves.
* Use a mercury spill kit whenever possible. If not available, enclose broken pieces of glass in a sealed jar with a small amount of water over the mercury and follow the chemical waste packaging instructions for disposal by EHS.
* All labs containing mercury must have an appropriate mercury spill kit.
* Contact EHS if you require assistance cleaning up a mercury spill.

## Asphalt and/or Concrete

* Waste from these sources should be considered hazardous and must be disposed of properly. In most cases these materials may be recycled.
* Notify your CHO to determine if your asphalt and/or concrete waste should be set out for pickup by Ohio University campus recycling.

## Chemicals

* Chemical fume hoods shall not be used for disposing of volatile chemicals greater than 100 mL.
* Drains shall not be used for disposal of chemicals unless:
	+ It is part of a procedure or process of chemical manipulation,
	+ The chemical is water soluble,
	+ The chemical is compatible with the sanitary sewer constituents and the contents of the drain trap,
	+ It is legal to do so, and
	+ The chemical is heavily diluted by tap water.
* Chemical waste generators are responsible for preparing and packaging chemical waste in accordance with OU policies listed in the appendix.
* All hazardous chemical waste is to be removed by EHS, who is responsible for all regulatory compliance once the waste is removed from the generation site.
* Do not mix different chemical wastes; accumulate in separate containers for disposal.
* Empty chemical containers should be used for chemical waste collection and these containers should be labeled appropriately.
* All waste given to EHS for disposal must be identified. The cost of determining the identity of "unknowns" lies with the department. All departments are responsible for the proper disposal of any wastes left by faculty or staff who have left the university.
* Any person shipping hazardous chemicals from the site of generation must have specific training for safe transportation of those hazardous materials.
* Special waste disposal such as low-level radiation, infectious material, lead, asbestos, or other regulated waste should be disposed of per O.U. procedures and according to applicable state and federal regulations. Contact EHS for assistance.

# MAINTENANCE AND INSPECTIONS

When laboratory processes cannot be made intrinsically safe, the use of engineering controls are required. Engineering controls are used to isolate the employee from physical, chemical, and biological hazards and often come in the form of fume hoods and other ventilation devices. It is critical that engineering controls function properly for the safety of the all laboratory personnel and must be checked regularly. Additional safety devices, like PPE, eye wash stations, safety showers, etc. must also be regularly inspected.

## Inspections Performed by Laboratory Employees

* All Personal Protective Equipment (PPE), including safety glasses, gloves, lab coats, aprons, etc., will be inspected before each use.
* Ventilation and chemical fume hoods will be inspected before each use and verified operational. Hoods will not be used if audible/visible alarms are tripped.
* Laboratory hoods equipped with magnehelic gauges shall be evaluated to determine that the static pressure is at a predetermined setting marked on the gauge (red line) which indicates the hood is functioning properly.
* Before working in a lab space, verify all means of emergency egress are unobstructed and accessible.
* Access to the eyewash, safety shower, and fire extinguisher should be checked at the beginning of each shift.
* If adding or removing chemicals, update the chemical inventory for that space and adjust the SDS log accordingly.

## Inspections Performed by the local Laboratory Inspection Team

The laboratory inspection team will inspect the following items on a monthly basis:

* Eyewash stations
* Safety showers
* First aid kits
* Hearing protection stations
* Chemical spill kits

## Inspections Performed by Facilities Management

Facilities Management Life Safety Shop will inspect the following items annually:

* Fire extinguishers
* Fire doors
* Smoke detectors/fire alarms
* Fire suppression systems

## Inspections Performed by EHS

EHS will inspect the following items monthly:

* Fire extinguishers

EHS, or a contractor, will inspect the following items annually:

* Chemical fume hoods
* Ventilation hoods
* Eyewash stations
* Safety showers

EHS personnel may conduct surprise laboratory inspections at any time.

## Lockout/Tagout

* As per OSHA 29 CFR 1910.147 improperly functioning equipment, out of service equipment, and equipment under repair must be disabled in such a way to prevent the equipment from energizing and/or releasing hazardous energy which could injure an employee. This process is called Lockout/Tagout.
* The practice of Lockout/Tagout (LOTO) is required in all labs. LOTO ensures that dangerous equipment is secured and will not be energized until safe to do so.
* The use of LOTO kits (including locks and specialty tags) is required.
* Equipment that that has been locked and tagged must be reported to the laboratory coordinator, chair, or PI right away. The equipment is not to be restarted without the direct approval of the person, or persons, who locked it out.

# PERSONAL PROTECTIVE EQUIPMENT

The PI is responsible for the risk assessment and selection of Personal Protective Equipment (PPE) for employees working in their laboratory. Contact EHS for recommendations and technical advice on the need and selection of PPE, acquiring approved equipment, maintaining availability, and establishing cleaning and disposal procedures. All laboratory visitors must be issued adequate PPE.

## Eye Protection

* Safety glasses must meet the latest ANSI Z87.1 standard.
* Refer to OSHA 29 CFR 1910.133 for regulations on eye and face protection.
* Chemical safety goggles are required for employees who enter a laboratory and are exposed to an eye hazard as a result of work with chemicals.
* Chemical splash goggles are required when transferring or pouring acidic or caustic materials and must be worn over contact lenses.
* Face shields should be worn whenever grinding or cutting and are typically worn in combination with safety glasses.
* Before each use, eye and face protection is to be inspected for damage, *i.e*. cracks, scratches, or debris. If deficiencies are noted, the equipment should be cleaned, repaired, or replaced before use.

## Gloves

* Gloves must meet the latest ANSI/ISEA 105 standard.
* Refer to OSHA 29 CFR 1910.138 for regulations on hand protection.
* Chemical resistant gloves shall be worn whenever the potential for contact with hazardous materials exists. Refer to the SDS of the substance to be handled and the glove manufacturer’s specifications to ensure compatibility with the substance. For reference, a glove selection chart has been provided in the appendix.
* Change gloves frequently because any glove will eventually permeate the chemical it has been exposed to, even though the glove is “impermeable”.
* Gloves shall be removed before touching other surfaces (doorknobs, cabinet handles, phones, keyboards, laptops, etc.) and before leaving the lab.
* Heat resistant gloves shall be used for handling hot objects. Do not use gloves containing Asbestos. Always check the ratings to ensure compatibility.
* Abrasion resistant gloves must be worn when handling sharp objects, like broken glass, sheet metal, etc.
* Never wear leather or cloth gloves when handling chemicals.
* Before each use, gloves are to be inspected for damage and contamination, *i.e*. tears, punctures, cracking, discoloration. If deficiencies are noted, the gloves should be cleaned, repaired, or replaced before use.

## Footwear

* Safety shoes must meet the latest ANSI Z41 standard.
* Refer to OSHA 29 CFR 1910.136 for regulations on footwear protection.
* No open-toed shoes or sandals are to be worn by employees in the laboratory.
* All footwear worn in a laboratory must have a nonskid sole.
* Footwear with steel, or reinforced, toes should be worn if there is a potential for injury from heavy objects, i.e. handling drums, cylinders, etc.
* Footwear with metatarsal protection may be required for extreme drop hazards.
* Footwear with reinforced insoles may be required to protect from punctures.
* Electric hazard footwear may be required for employees who work with high voltage machines, circuits, and/or electric panels.
* Heat resistant footwear may be required for employees who work on hot surfaces, for example asphalt, heated machinery, or where fire is involved.
* Non-slip soles may be required for employees who work on wet floors.
* Work in remote forested areas require sturdy footwear with ankle support and a lugged sole for traction in a variety of terrain, like mud, streams, and rocks.
* Before each use, safety shoes are to be inspected for damage, deterioration, contamination, i.e. tears, punctures, discoloration. If deficiencies are noted, the shoes should be cleaned, repaired, or replaced before use.

## Clothing, Lab Coats, Aprons, and Vests

* When working with chemicals, laboratory clothing must meet the latest ANSI 103 standard for chemical protection. The selection of fabric/material is a key factor in determining the chemical resistance of the laboratory clothing.
* For additional information on determining the level of protection required, refer to the EPA Levels of Protection: Levels A, B, C, and D. These range from Level A full vapor protective body suits with full-face Self Contained Breathing Apparatus (SCBA) to Level D coveralls and/or safety glasses. The vast majority of work carried out within Russ College labs would be considered EPA Level D.
* Laboratory coats, or aprons, shall be worn by laboratory workers whenever there is potential for chemical exposure in the work area.
* Clothing must be cleaned regularly. If a spill occurs on the clothing, it must be decontaminated before reuse.
* Laboratory coats and aprons should not be taken to the employees’ home to clean, a professional cleaning service must be used. The commercial launderer of any contaminated work clothing shall be notified of any potential contaminating substances on the clothing before it is turned over to the cleaner.
* Disposable clothing (like Tyvek) is preferred when working with highly toxic materials, such as carcinogens, mutagens, or teratogens. Generally speaking, disposable clothing is easier to manage.
* Chemical protective clothing must be removed before leaving the work area.
* Shorts or short skirts are not to be worn by employees who work with chemicals.
* Work along roadways, airports, or construction sites require the use of high visibility vests, which must meet the ANSI 207 standard. Refer also to ANSI 107 for other high visibility safety apparel.
* Heat resistant clothing may be required for employees who work near hot surfaces, for example near furnaces, heated machinery, or where fire is involved.
* Work in remote forested areas require clothing suitable for protection from poisonous plants, insects, briers, etc.
* Before each use, clothing is to be inspected for damage, deterioration, contamination, *i.e*., tears, punctures, and discoloration. If deficiencies are noted, the clothing should be cleaned, repaired, or replaced before use.

## Hearing Protection

* Hearing protection must meet the latest ANSI S3.19 standard.
* Refer to OSHA 29 CFR 1910.95 for regulations on hearing protection.
* Hearing protection (earmuffs or plugs) is required whenever employees are exposed to 85 decibels dBA or greater as an 8-hr time weighted average (TWA).
* At the request of the CHO, or designate, EHS will conduct a noise survey to determine the need for a Hearing Conservation Program in high noise areas.
* Annual audiogram and other requirements of the hearing conservation program may apply for those who work in high noise areas.
* Hearing protection is to be inspected before each use for tears and contamination. If deficiencies are noted, the hearing protector should be cleaned, repaired, or replaced before use.

## Respirators

* Respiratory protection must meet the latest ANSI Z88.2 standard.
* Refer to OSHA 29 CFR 1910.134 for regulations on respiratory protection.
* Upon request, EHS will assess the need for respiratory protection.
* Respirators, both half-mask and full-face, are only to be used with permission from EHS for very specific purposes and under close monitoring from EHS.
* Employees who are issued a respirator must follow the requirements set forth in the Respiratory Protection Program, which includes: annual training, medical evaluation, fit testing, and maintenance. This program is maintained by EHS.
* Respirator filters must be carefully selected to protect the operator from specific chemical hazards. Filters are rarely exchangeable and filter media does expire.
* Respirators which are used for emergency response purposes must be inspected monthly and after each use as described by the Respirator Protection Program.
* The use of N95 Particulate filtering face masks are permitted without participation in the Respiratory Protection Program. However, the N95 designate indicates the mask will block at least 95% of very small (0.3 micron) particles. These masks are commonly worn to prevent the user from touching their face, not to protect from hazardous chemicals.

# VENTILATION

Properly designed, balanced, and operated ventilation systems are key to the health and welfare of every building occupant. Engineering controls using ventilated equipment, like vent hoods and fume hoods, typically work in conjunction with a building’s HVAC system to provide airflow into the laboratory space from non-laboratory areas and out to the exterior of the building through these ventilated devices (typically resulting in a negative room pressure) to ensure proper indoor air quality.

## Ventilation Hoods

* A ventilation (or vent) hood is a device for removing fumes, smoke, heat, steam, etc. from above a piece of equipment or work area.
* Vent hoods are typically ceiling or wall-mounted but will sometimes come in a snorkel configuration which allows the operator to more easily direct the exhaust to a specific or targeted location.
* Vent hoods are often found installed above furnaces and ovens. If using a portable heated device in a lab, it should be used under a vent hood.
* Vent hoods are not approved chemical fume hoods and do not provide adequate protection to lab personnel from exposure to chemical vapors.

## Chemical Fume Hoods

* A chemical fume hood is a device specifically designed to limit an operator’s exposure to hazardous chemicals, fumes, vapors, etc. through a series of baffles, sashes, and carefully directed airflow to minimize turbulence.
* Use of potentially hazardous chemicals should be confined to an appropriate fume hood as open bench top use could require evaluation of employee exposure for compliance with OSHA Permissible Exposure Limits (PEL’s).
* The sash of a chemical fume hood is to be lowered to within 6" of the floor of the hood when the hood is in use. It should be lowered to maintain effectiveness of the ventilation system and provide personal protection.
* All reactions that produce unpleasant and/or potentially hazardous fumes, vapors, or gases must be conducted within chemical fume hoods.
* Reactions with corrosive vapors must be conducted within a hood lined with corrosion resistant material.
* Any apparatus that may discharge toxic chemicals must be vented into a fully functional and operating chemical fume hood.
* Fume hoods should never be used for storing chemicals.
* Use of perchloric acid requires a specialized stainless steel or PVC fume hood equipped with an internal wash down system of the ductwork and internal hood surfaces. Contact EHS if perchloric acid use is required.
* Employee exposure to OSHA regulated substances shall not exceed the permissible exposure limits (PEL) specified in 29 CFR Part 1910, Subpart Z. Laboratory workers who have reason to believe exposure levels exceed the action levels, despite being conducted in a fume hood, should contact EHS for assistance to conduct the necessary environmental monitoring.
* Fume hoods should always remain on as they have been balanced to match the HVAC requirements of the room and are a key component of the laboratory exhaust system.

## Ductless Fume Hoods

* In the event a chemical fume hood is not available within the research space, a ductless fume hood may be used. Ductless fume hoods are designed to limit operator exposure through the use of a fan and internal filtration media which removes the hazardous chemical vapors used within them.
* The selection of filtration media must match the chemicals used. Failure to specify the correct filtration media could result in permanent injury or death. Always refer to the manufacturer’s specifications for filter identification.
* Filtration media must be replaced on a regular basis. Failure to replace the filtration media could result in permanent injury or death. The operator should always check the expiration date of the filter before using the ductless fume hood.
* The use of chemical fume hoods is preferred over ductless fume hoods.

## Biosafety Cabinets

* Biosafety cabinets are specifically designed to protect laboratory personnel, and the environment, from biological pathogens. Like chemical fume hoods, the airflow through the cabinet is designed to minimize turbulence to protect the operator. However, unlike chemical fume hoods, the exhaust from a biosafety cabinet is routed through HEPA filtration to remove hazardous materials before being vented to the environment.
* Biosafety cabinets are available in BSL Class I, II, or III and should be specified accordingly to meet the needs of the research.
* It is important to note, biosafety cabinets are not chemical fume hoods and cannot be used with hazardous chemicals. Likewise, chemical fume hoods are not suitable for containing biological materials. They look similar, but they are not!

## Other types of laboratory ventilation devices

There are many other types of ventilated devices including welding tables, paint booths, glove boxes, gas cabinets, etc. that may be used within the lab and/or shop space. Always refer to the manufacturer’s instructions when using these devices.

## Daily Inspections

Daily inspection of ventilation and chemical fume hoods is the responsibility of the laboratory personnel who use them and include:

* + Visually inspecting the hood area for improperly stored items or other visible blockages which may impede the hood’s performance.
* Visual confirmation through the differential pressure gauge, or magnahelic, that the hood is operating to the required capacity.
* Audible confirmation that the hood is running properly and that there are no odd sounds emanating from the fan or ductwork.
	+ An operator may test a fume or vent hood by generating smoke several inches in front of the sash with the sash in operating position and observe if all of the smoke is adequately captured. Smoke should also be generated at several points at and above the interior working space to identify any dead or turbulent locations.
	+ In the event a ventilation or fume hood fails inspection, discontinue using the hood, red tag the device, and contact EHS for further evaluation.

## Annual Inspections

Annual inspections of ventilation and chemical fume hoods is the responsibility of EHS and will include:

* The evaluation of the quality and quantity of ventilation upon installation and whenever a change in local ventilation devices is made.
* Capture velocity will be measured with a velocity meter. The capture velocity at the face of the hood should be 80 - 125 fpm for standard flow hoods. Velocity measurements must be taken with the sash raised to the marked position. The face velocity shall be determined by averaging the velocity of six readings taken in different areas of the fume hood face.
* Exhaust hoods should be smoke tested for fume hood containment per SEFA I-2002 Laboratory Fume Hood Recommended Practices.
* Hoods and their alarms should be checked for proper function.
* These annual tests will typically be contracted out to another agency with oversight from EHS. Once certified operational, hoods will be identified by an appropriate calibration sticker.
* Any repairs to the hood or the local exhaust system will be completed by Facilities Management. Once repairs are complete EHS will re-test the hood.

## Routine Maintenance

Routine maintenance of ventilation and chemical fume hoods is the responsibility of Facilities Management who will complete:

* Maintenance of the entire exhaust system,
* All local exhaust fan maintenance including lubrication, belt checking, fan blade deterioration, and speed check as recommended by the fan manufacturer,
* Inspection of all ductwork for corrosion, deterioration, and buildup of liquid or solid condensate, and
* The lubrication and verification of the proper operation of all dampers.

# EMERGENCY EQUIPMENT

All laboratories must provide emergency equipment and guidance suitable to address hazards present within the lab space. An up-to-date map of the room should identify the locations of all emergency equipment and be provided in the appendix for reference.

## General

Each laboratory employee shall be familiar with the location, application, and/or operation of the following equipment within their workspace:

* Fire extinguishers
* Fire alarms
* Fire doors
* Smoke detectors
* Safety showers
* Eye wash stations
* First aid kits
* Spill kits
* Chemical storage cabinets
* Emergency shut-off locations for all equipment

## Fire Extinguishers

* + - It is the responsibility of Facilities Management Life Safety Shop to select, maintain, and properly locate the fire extinguisher(s) within each laboratory.
		- Fire extinguishers should be provided within 30 feet of travel and located along normal paths of travel.
		- Access to the fire extinguisher must be maintained and the location should be conspicuously marked in an appropriate manner.
		- The fire extinguisher type and size must be selected for the appropriate hazards.
		- The PI, or CHO, is responsible for notifying EHS if changes within the laboratory require movement of the extinguisher, the need for a different type of fire extinguisher, or if an extinguisher is discharged or otherwise needs service.
		- Monthly fire extinguisher inspection conducted by EHS includes:
	+ Extinguisher(s) are in designated locations.
	+ Clear unobstructed access is maintained.
	+ The pin should be in place and attached with an unbroken wire.
	+ The indicator should be on full.
	+ There should be no indication of physical damage.
	+ Inspections are to be documented.
		- Annual fire extinguisher maintenance conducted by Facilities Management Life Safety Shop includes:
			* Complete and thorough examination, including the mechanical parts, the amount and condition of the extinguishing agent; and the agent's expelling device.
			* Maintenance is to be conducted by a qualified licensed individual.
			* Maintenance activities are to be documented.

## Fire Alarms

* It is the responsibility of Facilities Management, Life Safety Shop (or designate) to maintain and test fire alarms within each building on campus.
* The activation of a fire alarm will be accompanied by strobe lights and sirens.
* Fire alarms may be triggered manually by pull station or automatically by smoke, heat, or particulate detector.
* Fire equipment must never be obstructed.
* Semiannual fire alarm inspection conducted by Facilities Management, Life Safety Shop includes:
	+ Fire alarms should be conspicuously marked,
	+ Fire alarms should be activated to insure proper operation, and
	+ Inspections are to be documented.

## Fire Doors

* A fire-rated door (or fire door) is made of fire resistant materials and is a key component of a passive fire protection system used to reduce the speed by which fire or smoke spreads through a building.
* Fire doors should be provided as required per building codes, fire codes, and fire insurer's requirements.
* Fire doors must not be blocked open, and must be able to close properly.
* Some fire doors have asbestos inside them. Do not damage or penetrate the fire door or frame. Penetrations could provide a breakthrough point for fire or smoke.
* Fire doors with heat activated closures must be tested to assure proper working order.
* As per NFPA 80 5.2.4 fire doors must be checked annually to insure proper operation. Contact EHS if you suspect your fire door is not working properly.

## Smoke or Heat Detectors

* It is the responsibility of Facilities Management, Life Safety Shop (or designate) to maintain and test smoke and/or heat detectors within each building on campus. These inspections are typically performed by an outside contractor.
* Smoke detectors and heat detectors should be selected and installed for the appropriate hazards per building codes, fire codes and fire insurer's requirements.
* The detection system should be tested to assure proper working order per manufacturer's and/or fire insurer's instructions.
* Detectors must never be obstructed, blocked, or otherwise covered. Do not place objects within 18 inches of the ceiling.
* Annual smoke or heat detector inspection conducted by Facilities Management, Life Safety Shop includes:
	+ Clear unobstructed access is maintained,
	+ There should be no indication of physical damage to the detector,
	+ The detector should be isolated and suppression system shunted before test,
	+ Each detector must be tested individually and activated using an aerosol or other test medium, and
	+ Inspections are to be documented.

## Fire Suppression Systems

* It is the responsibility of Facilities Management, Life Safety Shop to maintain and test fire suppression systems within each building on campus.
* The PI, or CHO, is responsible for notifying EHS if changes within the laboratory require a re-evaluation of the existing fire suppression system.
* Annual inspections, carried out in accordance with manufacturer specifications, are conducted by Facilities Management, Life Safety Shop and include:
	+ All system components are checked for their physical condition,
	+ Activated and checked for appropriate response, and
	+ Inspections are to be documented.

## Safety Showers and Eyewashes

* It is the responsibility of EHS to ensure safety showers and eyewash stations meet the latest ANSI Z358.1 standard for design and performance requirements.
* It is the responsibility of the lab to inspect and test their safety showers and eyewash stations.
* Safety showers and eyewash stations should be located within the work area for immediate emergency use.
* Monthly safety shower and eyewash inspection conducted by the lab include:
	+ Clear unobstructed access is maintained,
	+ There should be no indication of physical damage to the shower or eye wash,
	+ Showers and eye washes must be flushed until water runs clear,
	+ Eye wash nozzles should be capped when not in use. These caps should fall away when activated and water should flow evenly from both nozzles, and
	+ Inspections are to be documented.
* Annual safety shower and eyewash inspection conducted by EHS include:
	+ Confirmation of clear unobstructed access,
	+ Confirmation of no physical damage to the shower or eye wash,
	+ Safety showers and eyewash stations are plumbed to a potable water source, between 60 and 95°F, and provide at least 15 minutes of flushing, and
	+ Inspections are to be documented.

## First Aid Kits

* It is the responsibility of the lab to provide adequate first aid supplies per OSHA 29 CFR 1910.151(b).
* The contents of the first aid kit should be suitable for the hazards in the lab.
* First aid kits should be suitable for the treatment of minor injuries or for short-term emergency treatment before medical assistance is available.
* At a minimum first aid kits should include an assortment of band aids, gauze, medical tape, and pain relievers but may include a variety of specialty supplies like burn creams for heat related injuries, cold compresses for contusions, etc.
* Inventory should be maintained such that a suitable stock of each item is available depending upon the occupancy of the room. Refer to latest ANSI guidelines.
* Monthly first aid kit inspection conducted by the lab include:
	+ Clear unobstructed access is maintained,
	+ All contents are available and in the proper quantities,
	+ Contents are not expired, and
	+ Inspections are to be documented.

## Spill Kits

* It is the responsibility of the lab to provide adequate spill control for all chemical, biological, and radioactive hazards identified within the lab.
* Common types of spill kits include universal spill kits for non-hazardous chemicals, chemical spill kits for hazardous materials, and oil spill kits for petroleum only spills.
* More specialized spill kits may be required when handling materials like large quantities of acids or bases, mercury, hydrofluoric acid, bloodborne pathogens, or radioactive materials for example.
* Some spill kits, like many of those for HF, include first aid creams to neutralize burns to the skin - it is very important that these creams be checked for expiration.
* Monthly spill kit inspection conducted by the lab include:
	+ Clear unobstructed access is maintained,
	+ All contents are available and in the proper quantities,
	+ Contents are not expired, and
	+ Inspections are to be documented.

## Chemical Storage Cabinets

* It is the responsibility of the lab to provide adequate storage of all chemicals within the laboratory.
* Flammable materials must be stored within specially built steel cabinets designed to limit the contents from contributing to a fire or explosion.
* The limit for a single flammable storage cabinet is 60 gallons of category 1, 2, or 3 flammable liquids.
* Acids and bases are often stored separately in dedicated cabinets, usually made of plastic or plastic lined. Never store acids and bases together in the same cabinet.
* Do not store chemicals directly on wood shelving. Avoid using wood shelving if possible. If chemicals must be stored on a wood surface, secondary containment must be used to separate the chemical from the wood surface.
* Chemicals must never be stored above eye level.
* Cabinet doors must always remain closed.
* Chemical storage cabinets do not require regular monthly inspection; however, any failures of the cabinet should be reported to the PI or CHO immediately.

## Emergency Shut-Off Locations

* Emergency shut off devices (emergency stops, e-stops, kill switches, service disconnects, etc.) are used to shut off equipment quickly in case of emergency.
* Emergency stop switches should be large, red in color, typically of the ‘mushroom’ style, and should be identified by signage.
* Service disconnects may also be used to kill power to and/or remove all sources of stored potential energy from the equipment or process.
* Switches should be installed in obvious locations and be unobstructed.
* Emergency shut off devices do not require regular monthly inspection; however, all operators should be aware of their locations and understand how to use them.

# EMERGENCY PROCEDURES

## Prevention

Prevention is necessary to ensure that emergencies do not occur. No emergency plan will do all things for all emergency situations. Preventive measures include employee training, facility inspection programs, and engineering design of hazardous materials processes. Laboratory risks include accidents or injuries, chemical releases, release of radioactive or infectious aerosols, fires, explosions, or other emergency situations. Therefore, risk assessment of laboratory processes and activities is key to emergency prevention.

## Artificial Intelligence (AI) and Machine Learning (ML)

Safety initiatives within the laboratory environment may be improved through the use of data collection, AI, and ML tools. These tools can be used to identify potential safety hazards quickly and easily within a new area of research, target safety responses/training to specific operators/researchers based on complex data collected, monitor and automatically react to a complex set of test parameters, and much more. However, it is imperative that a human, or preferably a team of humans, must always provide the final evaluation and approval of all safety systems and solutions.

## Hazard Specific Signage

Signage is a critical component of safety communications. Examples of common laboratory signage include: eye protection, hearing protection, footwear requirements, etc. which are often posted on the walls within the laboratory. Be aware of all signage posted within the lab space and adhere to those requirements. Some additional forms of signage may include:

* *Unattended Experiment in Progress* signage, which must be posted in any area where an unsupervised laboratory experiment is being carried out. This signage must include the researcher’s name and contact information, the advisor’s name and contact information, the date initiated, and the proposed conclusion date.
* *Sample Material* identification signage, which must always be posted on materials stored within the laboratory. This signage must include the contents of the sample, special handling requirements, researcher’s name and contact info, advisor’s name and contact info, the date created, and date to be disposed. Furthermore, Safety Data Sheets (SDS) must be made available within all laboratory spaces where materials are maintained.

## Power Outages

Power outages are an all-too-common occurrence and should be considered when evaluating potential system failures. Define in what ways a loss of power could affect the operation of the lab or test system. Determine if backup power is required.

## Injured Employee

All personnel should be trained how to respond should they, or a fellow employee, get injured during the course of their work. All personnel involved should practice simple ‘what if’ scenarios to recognize the severity of an injury before it happens and how best to treat the injured employee(s) when it does happen.

In situations where an individual, or individuals, almost get injured or observe a deficiency in a piece of equipment, building, or process they must report it to their supervisor immediately. This process, commonly called “Near Miss Reporting,” is a valuable tool to identify potential hazards before they become incidents and has proven to reduce the occurrence of workplace injuries.

If an injury has occurred, and there is any doubt whatsoever as to the urgency of the incident, call 911 immediately. All incidents, regardless of medical treatment, must be reported to the university using one of the following documents below:

* *OU Employee Incident Report* form shall be used to document incidents to any faculty, staff, or students who are being compensated for their work with the university.
* *OU Non-Employee Incident Report* form shall be used to document incidents to uncompensated students and/or visitors.

## Chemical Spills

Routine small-scale spills of hazardous materials may be handled by laboratory personnel so long as the laboratory worker is trained and equipped to do so. Large-scale spills may require special training and compliance with the OSHA Hazardous Waste Operations and Emergency Response Standard (HAZWOPER). Contact EHS immediately if there is any question regarding the operator’s ability to handle the spill.

## Hazardous Material Identification System

A Hazardous Material Identification System (HMIS) placard (see example below) is located immediately to the left or right of the primary ingress door to each laboratory. This placard provides the observer a numerical rating (from 0 to 4) of the hazardous materials contained within the lab space, a visual icon-based indication of the types of hazards, and any PPE which may be required before entry into the lab. The HMIS placard is a key reference for first responders before they enter a lab space so it must be updated each time new chemical is brought into or removed from the lab space.

Always familiarize yourself with any hazards that may be present within the laboratory space. Learn as much as possible about these chemicals by reading the labels of the chemical containers, reading the applicable SDS for each (should be located in the appendix of this plan or online, refer to literature in the library, and consult with your peers, PI, and CHO.

## Safety Response Guidelines

An emergency response team has not been established for Ohio University. Ohio University relies upon the local Athens Fire Department for any emergency response action. In the event of a fire, serious personal injury, or obvious major building incident, the fire alarm should be pulled immediately and 911 called from a safe location.

When an incident is judged to pose an immediate danger, refer to the bright yellow laminated *Russ College Engineering Department* *Safety Response Guidelines* (posted at the egress of each laboratory) and follow the call tree to notify the proper personnel. Please note, these postings are removable and may be taken with the caller so that notifications may be made from a more secure location.

# EMPLOYEE TRAINING

As per the Occupational Safety and Health Act of 1970, employers are responsible for providing a safe and healthful workplace. To that end, all laboratory workers shall be informed and trained regarding the hazards present in their designated work areas. The aim of the training program is to assure that all individuals at risk are adequately informed about the nature of the work in the laboratory, any associated risks from that work, and what to do if an incident occurs. This training shall be provided at the time of an employee's initial assignment to a work area where these hazards may be present.

All employees, or affiliates, who work within one of the Russ College engineering laboratories must undergo the general training requirements outlined below. It is the responsibility of the chair/director/PI to ensure that all employees are notified of these training requirements, and it is the employee’s responsibility to complete them. This training will be recorded and maintained by the CHO or designate. If not properly documented, then it will be assumed the employee did not complete this mandatory training. Failure to complete this training or to comply with the guidelines contained within this document may result in suspended laboratory access and possible termination.

## General Laboratory Training

A base level of training is required of all laboratory workers, or affiliates, before they are permitted to operate independently within a Russ College affiliated research laboratory. All employees are required to complete the general training below within their first two weeks of appointment:

* *Read and understand the laboratory’s Chemical Hygiene Plan*
* *Attend EHS Chemical Hygiene Training* (online)

Once these items are complete, the employee should see the CHO to ensure their training is properly documented.

## Apprenticeship Laboratory Training

Much of the day-to-day operational training carried out within the laboratories of the Russ College of Engineering are conducted through apprenticeship type arrangements where new laboratory workers are trained and monitored over the course of many weeks by more experienced senior employees. Training of this nature typically covers a wide range of innocuous analytical instruments and processes. It is critical that all new apprenticing employees maintain close communications with their advisor to determine when their apprenticeship training period is complete.

## Advanced Laboratory and/or Chemical Training

There may be situations where more in-depth employee training is required. For instance, laboratory workers who are asked to carry out more advanced laboratory research using hazardous materials may be required to undergo additional specialized training offered through an industrial expert or organization. Training requirements of this nature will be determined by the PI and the CHO with consultation from EHS. Training of this nature will be documented and maintained by the CHO.

## Russ College Safety Plans

A safety plan must be developed for any novel procedure, chemical process, or prototype system. The lead researcher, with close consultation from the PI, should develop this safety plan based on the template provided by the Russ College of Engineering which incorporates the key features of Design for Safety, Experimental Protocol development, Standard Operating Procedures (if required), and the critical function of Failure Modes and Effects Analysis to identify potential hazards. To be approved, the safety plan must be reviewed by the departmental safety officer (often the CHO) and possibly a Safety Review Committee should the hazard exceed an initial severity rating of 7. The successful development of a safety plan provides the research team with the highest level of training and review available. Please see the Russ College Safety Coordinator for assistance or to receive a copy of the template.

## Off-Site / Fieldwork Training

Employees may be called upon to conduct a portion of their work in a wide range of settings such as along a roadway, around an airport, within an active construction site, inside an industrial manufacturing plant, or even in the remote wilderness. Each of these environments presents its own set of unique hazards to the employee.

### Guidance for work around roadways, construction sites, and airports

Employees who carry out fieldwork on or around an active roadway, construction site, or airport require additional training to understand traffic control measures, signage, laws, and acceptable behaviors. According to the Bureau of Labor Statistics, fatalities associated with roadway construction make up the leading cause of death in the workplace. As such, always follow the following best practices below:

* Have a clear plan understood by all before approaching worksite.
* Whenever possible, employees should face oncoming traffic or oncoming worksite equipment while conducting their work.
* Before approaching a vehicle or piece of equipment, always get the driver’s attention and wait for it to come to a full and complete stop.
* Avoid crossing open lanes of traffic.
* Use the buddy system and always look out for one another. One person should always be watching out for the person who is working.
* Always remain alert while on the jobsite and look around frequently.
* Clear your mind of distracting thoughts and focus on your task.
* Listen for backup and equipment alarms.
* Never use your smart device while on duty unless it’s an emergency.
* Do not listen to music while working, you should always hear your buddy.
* Handheld radios may be required to communicate over long distances, again communication is key to your safety.
* Traffic moves quickly, never chase your hat, let it go!

Proper apparel and PPE are critical to the safety of the employee while working in the field. Employees should always dress appropriately and wear the following:

* Sturdy work boots (no sandals or tennis shoes)
* Long pants (no shorts, dresses, or skirts)
* Clothes should be tight fitting (no loose-fitting shirts, jackets, etc.)
* Hard hats compliant to ANSI Z89.1-1997 (not older than 5 years)
* High-visibility (HV) vest compliant to ANSI 107, Conspicuity Class 2
* Safety glasses compliant to ANSI Z87.1-2010

When administering traffic control, always refer to the Manual on Uniform Traffic Control Devices (MUTCD) which is the standard for all state and federal traffic applications. Follow these specifications and remember to:

* Use the appropriate traffic control devices required for the application and type of work to be completed.
* Always use standard traffic control devices which are clean and well maintained. The message should be clear and easily understandable.
* Always remove traffic control devices just as soon as they are no longer required.
* Homemade signs must never be used.

### Guidance for work within manufacturing sites:

Employees who carry out fieldwork at a manufacturing site will require training specific to that manufacturer’s site and/or their industry.

Manufacturers will typically require visitors to:

* Communicate with a pre-determined Point of Contact (POC)
* Check in with security, or visitor’s entrance, upon arrival
* Provide identification and wear visitor’s badge while onsite
* Be accompanied by a representative while onsite
* Perform work within designated work zones only
* Check out with security and return visitor’s badge when finished

Proper apparel and PPE are critical to the safety of the employee while working within a manufacturing facility. Employees should plan to dress appropriately by wearing the following:

* Sturdy closed toe shoes (steel toe may be required)
* Clothes should be tight fitting (no loose-fitting shirts, jackets, etc.)
* Safety glasses compliant to ANSI Z87.1-2010

### Guidance for work in the wilderness:

Employees who carry out fieldwork in the wilderness face a unique set of hazards. The remoteness of the worksite and duration of the work involved will determine the degree of preparedness required. Work will often be performed in areas where cellular service is unavailable.

Consider environmental conditions and prepare accordingly:

* Severe weather can lead to extreme temperatures and precipitation
* Extreme heat may lead to sunburn, heat stroke, and exhaustion
* Extreme cold may lead to shock, frostbite, and hypothermia
* Dermatitis from poisonous plants like poison ivy, oak, and sumac
* Attacks from animals like snakes, bear, mountain lions, and wolves
* Attacks from insects like spiders, scorpions, wasps, and ticks

Prepare ahead of time:

* Plan the route before you go and understand the terrain and conditions
* Plan out all equipment, tools, supplies, food, water, etc.
* Consider weather patterns for the region, prepare for the unpredictable. Check the weather forecast before you depart.
* Notify your supervisor/PI of your schedule and planned return date
* Understand your limits and remain within them

The selection of apparel and supplies is critical when working in sparsely populated rural areas where medical treatment is often unavailable. Consider the following carefully when planning your work:

* Synthetic clothing is recommended
* Shoes should be suitable for the terrain
* Map, compass, and GPS if backwoods navigation is required
* Take lots of water and food (always plan for longer)
* Take any necessary medications (always plan for longer)
* Consider taking critical items like a pocketknife, flashlight, whistle, fire starters, emergency blanket, and shelter even for day trips
* Consider first aid supplies (band aids, compress, snake bite, etc.)
* Consider protection from animals (bear spray, bear cans, etc.)

The client, partner, or sponsoring agency may require additional safety training beyond those called out in this plan. Whenever operating in a new work zone, the employee should attend a site-specific worker safety orientation where specific job-site hazards are identified, and applicable safeguards reviewed. Always check with the site lead to ensure you are covered. Always ask questions if you are unsure about anything on the worksite.

# MEDICAL TREATMENT PROGRAM

## Incidents

First aid kits are available for the treatment of most minor injuries. Additional medical assistance, if required, is located at Express Care or O’Bleness Hospital. If immediate critical attention is required, call 9-1-1. Emergency medical transport is available through Athens County Emergency Medical Services (ACEMS).

## Incident Reporting & Record Keeping

All incidents (injuries) and near misses (incidents which could have easily resulted in serious injury) shall be treated and must be reported to EHS immediately (within three workdays) using the appropriate *OU Employee Incident Report* form. A copy of the report should be retained by the employer and/or department so that a thorough investigation may be conducted. Typically, the CHO of the department will conduct the internal investigation and suggest corrective actions (if required).

All incident and illness records shall be kept by the EHS Department. These records will be maintained and reviewed periodically for trends and contributing factors.

## Medical Surveillance

All medical monitoring programs should be arranged through EHS. Medical surveillance, including medical consultation and follow-up, shall be provided under the following circumstances:

* + Where exposure monitoring is over the action level or Permissible Exposure Limit (PEL) if there is no action level for an OSHA regulated substance which has medical surveillance requirements.
	+ Whenever a laboratory employee develops signs or symptoms that may be associated with a hazardous chemical to which the employee may have been exposed in the laboratory.
	+ Whenever a spill, leak, or explosion result in the likelihood of a hazardous exposure, as determined by the PI, CHO, or EHS.
	+ For all employees assigned respiratory protection.

## Medical Examinations

All medical examinations shall be provided by a licensed physician or under direct supervision of a licensed physician, at no cost to the employee, without loss of pay, and at a reasonable time and place. Where medical consultations or examinations are provided, the examining physician shall be provided with the following information:

* + The identity of the hazardous chemical(s) to which the employees may have been exposed.
	+ A description of the conditions under which the exposure occurred including quantitative exposure data if available.
	+ A description of the signs and symptoms of exposure that the employee is experiencing, if any.

## Medical Reporting

Records from medical examinations, or consultations, provided to employees shall be maintained by Human Resources. These records are available per the requirements of CFR 1910.1020 “Access to employee exposure and medical records.” A written opinion from the examining physician will be provided to the CHO and shall include:

* + Recommendations for further medical follow up.
	+ Results of the examination and associated tests.
	+ Any medical condition that places the employee at increased risk of exposure because of a hazardous substance found in the workplace.
	+ A statement that the employee has been informed of the results of the examination or consultation.

# CHEMICAL HYGIENE PLAN REVIEW

This plan shall be reviewed and updated annually by the PI or CHO with oversight from the department chair and EHS as indicated on the cover page. The name of the reviewer and the latest revision date shall be noted on the cover page and within the document file name. It is the responsibility of the PI or CHO to notify all laboratory workers and affiliates of any changes to the CHP. A Change Log (provided in Section 18) has been provided to assist in the notification of changes to laboratory workers as a result of annual plan updates.

# REFERENCES

Code of Federal Regulations, 29 CFR part 1910 subpart Z. U.S. Government Printing Office, Washington, DC 20402 (latest edition). (Toxic and Hazardous Substances)

Code of Federal Regulations, 29 CFR part 1910.1450, "Occupational Exposure to Hazardous Chemicals in Laboratories".

Annual Report on Carcinogens, National Toxicology Program, U.S. Department of Health and Human Services, Public Health Service, U.S. Government Printing Office, Washington, DC 20402 (latest edition).

IARC Monographs on the Evaluation of the Carcinogenic Risk of Chemicals to Man, World Health Organization Publications Center, 49 Sheridan Avenue, Albany, New York 12210 (latest edition).

Code of Federal Regulations, 29 CFR part 1910.134, "Respiratory Protection".

Code of Federal Regulations, 29 CFR 1910.132 "Personal Protection Equipment General Requirements".

Code of Federal Regulations, 29 CFR part 1910.95,"Occupational Noise Exposure".

Code of Federal Regulations, 29 CFR part 1910.120,"Hazardous Waste Operations and Emergency Response".

Code of Federal Regulations, 29 CFR part 1910.147, "The Control of Hazardous Energy (Lock Out/ Tag Out)".

Code of Federal Regulations, 29 CFR 1910.1200, "Hazard Communication".

Handbook of laboratory Safety, Keith Farr, (latest edition), CRC Press.

Guidelines for Laboratory Design, DiBeradinis *et.al*. 1987, John Wiley & Sons.

Committee on Hazardous Substances in the Laboratory, Prudent Practices for Handling Hazardous Chemicals in the Laboratory, National Academy Press, Washington, D.C. 1981.

# CHANGE LOG

When Who What

5/20/20 Shy CHP updated for use as Russ College template

5/11/21 Shy No major additions or removals, only minor grammatical edits

6/14/22 Shy Sect 3. Added definitions for PPE, PI, and SDS

 Sect 9. Expanded Lockout/Tagout into subsection and defined

 Sect 10. Added ANSI & OSHA specifications and expanded

 Sect 15.1. Updated emergency response services info

5/24/23 Shy Filename removed from footer and links checked/updated

Sect 13.2 Added section for use of AI and ML in lab safety

# APPENDICES

APPENDIX A Web-Based Resources

APPENDIX B OU Chemical Waste Disposal Policy

APPENDIX C Glove Compatibility

APPENDIX D Emergency Equipment Map(s)

APPENDIX E Laboratory Chemical Inventory

APPENDIX F Safety Data Sheets (SDS)

**APPENDIX A**

WEB-BASED RESOURCES

Ohio University Facilities Management and Safety:

 [www.ohio.edu/facilities/safety](http://www.ohio.edu/facilities/safety)

Ohio University Research and Sponsored Programs (ORSP):

 [www.ohio.edu/research/orsp](http://www.ohio.edu/research/orsp)

Ohio Environmental Protection Agency (EPA):

 [www.epa.state.oh.us/](http://www.epa.state.oh.us/)

Ohio EPA – Hazardous Waste Compliance:

 [www.epa.ohio.gov/derr/compliance](http://www.epa.ohio.gov/derr/compliance)

United States Environmental Protection Agency (USEPA):

 [www.epa.gov/](http://www.epa.gov/)

Occupational Safety and Health Administration (OSHA): [www.osha.gov/](http://www.osha.gov/)

OSHA Laboratory Safety Chemical Hygiene Plan Fact Sheet

[www.osha.gov/Publications/laboratory/OSHAfactsheet-laboratory-safety-chemical-hygiene-plan.html](http://www.osha.gov/Publications/laboratory/OSHAfactsheet-laboratory-safety-chemical-hygiene-plan.html)

U.S. Electronic Code of Federal Regulations (e-CFR):

 [www.ecfr.gov/cgi-bin/ECFR?page=browse](http://www.ecfr.gov/cgi-bin/ECFR?page=browse)

Campus Safety, Health, and Environmental Management Association (CSHEMA):

 [www.cshema.org/](http://www.cshema.org/)

American Chemical Society (ACS):

 [www.acs.org/](http://www.acs.org/)

The Laboratory Safety Institute (LSI):

 [www.labsafety.org/](http://www.labsafety.org/)

Safety Data Sheets online through Chemical Safety:

 [www.chemicalsafety.com/sds-search/](http://www.chemicalsafety.com/sds-search/)

**APPENDIX B**

OU Chemical Waste Disposal Policy

Downloaded from:

<https://www.ohio.edu/facilities/safety/hazardous-materials/hazmat/chemical>

**1.0 INTRODUCTION**

The following guidelines are to be used for the safe handling and disposal of Hazardous Chemical Waste at Ohio University. No Radioactive Waste will be handled through this procedure. Consult the [Radiation Safety Handbook](https://www.ohio.edu/facilities/safety/radiation-safety/rad-saf-handbook) for the proper disposal of Radioactive Waste. No Biohazard or Asbestos Waste will be handled by this procedure. Consult the Biosafety Manual and Asbestos Manual (found on the [Program Documents](https://www.ohio.edu/facilities/safety/radiation-safety/rad-saf-handbook) page).

**2.0 CHEMICAL MANAGEMENT GUIDELINES**

See Policy procedure [here](https://www.ohio.edu/policy/44-104).

The responsibility for chemical waste identification, labeling, and packaging rests with the principal investigator or area supervisor. The principal investigator or area supervisor should follow all of the procedures in the guidelines and provide proper instruction to personnel under their supervision.

When ordering chemicals, minimize volumes by purchasing the smallest quantity of a chemical consistent with experimental protocol. Chemicals should be dated when received in a permanent and legible fashion. This procedure will aid in evaluating the hazard when a particular chemical becomes waste. Frequently chemical suppliers will attempt to sell more chemicals for less, please don't buy surplus chemicals. Surplus chemicals tend to end up in the chemical waste stream at a later date.

A. STORAGE OF CHEMICALS AND CHEMICAL WASTES

1. Chemicals should always be segregated according to [compatibility and hazard class](https://www.ohio.edu/facilities/safety/hazardous-materials/hazmat/compart-chemicals).
2. Excess or outdated chemicals should not be allowed to accumulate in any location to a point that would create an unsafe working environment for laboratory personnel. NOTE: Before disposing of excess chemicals, determine if any other researcher has a need for them.
3. Inventories of all chemicals in each laboratory should be conducted every year. Check for damaged labels, outdated chemicals, damaged containers, and [peroxide forming compounds](https://www.ohio.edu/facilities/safety/radiation-safety/lab-practices/peroxide).
4. Do not overfill containers.
5. Only mix [compatible wastes](https://www.ohio.edu/facilities/safety/hazardous-materials/hazmat/compart-chemicals).

**3.0 CHEMICAL DISPOSAL**

**3.1 Hazardous Wastes Generated in the Lab**

1. Identify your waste stream. Select a container for waste collection, ensuring that the container is appropriate for the waste stream. The waste must not weaken or destroy the container, and the container must have a sealable lid; for example do not use a metal container to store a corrosive mixture. Place the collection container into a secondary containment device; this is a tray or dish to collect spills or leaks. The secondary container must be able to contain the volume of the primary container.
2. Place a red hazardous waste sticker on the container. Fill out the contents, building and room number. Write a description of the type of waste to be collected (organic solvents, aqueous acids, etc.). Contact the Safety Department Hazardous Materials Manager to request the hazardous waste stickers (safety@ohio.edu).
3. Do not mix hazardous waste streams or hazardous and non-hazardous wastes.

1. Transfer waste to the container using a funnel to reduce spills. Ensure that the waste put into the container will not undergo further reaction causing hazardous pressurization of the container.
2. The cap must be used to seal the waste container except when the container is actively being filled.
3. Select a location for the container and secondary containment device where it can be easily accessed, but is not likely to be knocked over. If needed, store the waste in a chemical fume hood or in a cabinet.
4. Keep a list of chemicals that are added to the waste container. You can keep the list directly on the red sticker. Or you can keep the list elsewhere to be added to the sticker, or attached to the container, when the container is full. Waste containers MUST be removed when they are full. You must request that the waste be removed from your lab.
5. For waste removal to occur, you must:
6. Complete the information on the yellow sticker. Example of sticker shown below.

1. Complete [a Chemical Waste Disposal Form [Excel]](https://www.ohio.edu/sites/default/files/sites/facilities/chemwaste_form.xls)
2. Email or send the completed form to the Hazardous Materials Manager at safety@ohio.edu or through campus mail to Hazardous Materials Manager, Safety Department, University Service Center.
3. Please call the Facilities Management and Safety Work Center at 740-593-2911 to submit a work request for collection.
4. The Hazardous Materials manager will pick-up the waste from your area, and store it in an accumulation area until it can be removed from campus by hazardous waste contractors.
5. Being as complete as possible in identifying the waste on the sticker and forms helps to:
6. Ensure the Hazardous Materials Manager handles the waste properly.
7. Allow the disposal company to properly handle the material, recycle it when possible and treat it when necessary.
8. Keep costs down. Any unidentified waste must be tested prior to treatment or disposal.
9. Identify unidentified containers.
10. Call Nathan Rath at (740) 593-1685 for help.

**3.2 Disposal of Unwanted Chemicals**

**When to Dispose of Chemicals?**

- If the chemical is not wanted.
- If the expiration date on the container has passed.
- If the chemical has a change (separated, formed crystals, changed color, etc.) such that the chemical can no longer be used for its intended purpose.

To dispose of the chemicals please:

1. Label the container clearly and accurately with a yellow/orange hazardous waste label. Include the hazard information and the date.
2. Store the hazardous waste as outlined on the other side of this sheet.
3. Request that the Hazardous Materials Manager pick-up the waste by completing and submitting [a Chemical Waste Disposal Form [Excel]](https://www.ohio.edu/sites/default/files/sites/facilities/chemwaste_form.xls)

**4.0 HAZARDOUS CHEMICAL WASTE REGULATIONS**

* [Ohio Hazardous Waste Rules](http://www.epa.state.oh.us/dhwm/laws_regs.aspx)

**If the EPA inspects hazardous waste in your lab, what will they be looking for?**

►If any outside agency asks to inspect your lab: ask the agency to wait until there is a Safety Department representative, and call the Safety Department at 593-1666.◄

* Do you know what hazardous waste you generate?
* Has the following contact information been posted?
	+ Name and telephone number of emergency coordinator (OUPD 593-1911 & Safety Department 593-1666)
	+ Location of fire and spill control equipment
	+ Telephone number of local fire department (911)
	+ Are employees familiar with waste handling and emergency procedures?
* Are steps taken to minimize the possibility of fire, explosion, or any unplanned release of hazardous waste?
* For your waste storage areas (also called satellite accumulation areas)
	+ Are they near the point of generation?
	+ Are they under the control of the waste generator?
	+ Do they have closed containers that are compatible with their contents and well maintained?
	+ Are the containers marked with the words “hazardous waste” and other words identifying the contents?
	+ Containers handled in a manner to prevent rupture or leakage?
* Is the start of accumulation date on the container?

Here is a printable [emergency information sign [PDF]](https://www.ohio.edu/sites/default/files/sites/facilities/EmercontactstickerHW.pdf). Be sure to complete your area-specific information.

Questions regarding the chemical waste program should be addressed to the Environmental Engineer or call 740-593-1685.

**APPENDIX C**

Glove Compatibility

For reference:

Ansell Chemical Resistance Guide, 8th Edition

Downloaded from:

<https://beta-static.fishersci.com/content/dam/fishersci/en_US/documents/programs/scientific/brochures-and-catalogs/guides/ansell-chemical-resistance.pdf>

**APPENDIX D**

Emergency Equipment Map(s)

(Provide a map for each room showing all safety equipment locations and points of egress)

**APPENDIX E**

Laboratory Chemical Inventory

(Include chemical name, amount, date opened, location stored, company, hazards)

**APPENDIX F**

Safety Data Sheets (SDS)

(Provide SDS for all chemicals stored within the laboratory)