PURPOSE, SCOPE, AND APPLICABILITY
The University of Tennessee Health Science Center (UTHSC) is committed to providing a healthy and safe work environment for the campus community. This Chemical Hygiene Plan (CHP) establishes a formal written program for protecting laboratory personnel against health and safety hazards associated with exposure to hazardous chemicals. This plan is applicable to all UTHSC personnel (faculty, staff, students and visitors) handling hazardous chemicals in a laboratory setting on the Memphis campus. The CHP describes the proper use and handling procedures to be followed by faculty, staff, students, and visitors working with hazardous chemicals in laboratory settings. This procedure meets the requirements of a chemical hygiene plan, as defined by the U.S. Occupational Safety and Health Act (OSHAA) of 1970 and regulations of the U.S. Department of Labor including 29 CFR 1910.1450 “Occupational Exposure to Hazardous Chemicals in Laboratories” (the “Laboratory Standard”).

ABBREVIATIONS, ACRONYMS, AND DEFINITIONS

Chemical Hygiene Officer (CHO) – Individual with the responsibility as defined in the OSHA Laboratory Standard to implement the Chemical Hygiene Plan thus ensuring compliance with the regulatory requirements and maintaining a safe work environment.

Hazardous substance – Any substance capable of causing an acute or chronic health condition in humans or adversely impacting the environment. Substances that are considered physical hazards (flammable substances, explosives, shock sensitive, etc.) are included in the definition of a hazardous substance. The OSHA Hazard Communication Standard, 29 CFR 1910.1200 and the OSHA Hazard Communication Plan 29 CFR 1910.1450 are the two main standards that define a hazardous substance

Permissible Exposure Limit (PEL) – Individual delegated by the Laboratory Supervisor to have responsibility for lab safety and compliance and the authority to implement corrective actions within the lab. Since PIs or Lab Supervisors are responsible for the operation of the lab and manage the daily operations of the lab the PI continues to hold ultimate responsibility for the operation of the lab and is considered the Laboratory Supervisor.

The Laboratory Supervisor or PI must:
- Understand applicable environmental health and safety rules, including the contents of the CHP.
- Assess hazards in the laboratory, document this assessment, and instruct lab personnel to properly mitigate the risk associated with these hazards. This may be through the use of engineering controls (e.g. fume hood), administrative controls (e.g. work practices) or PPE.
- Establish SOPs to effectively control or reduce hazards associated with highly hazardous materials.
- Ensure that all laboratory personnel that work with hazardous chemicals receive appropriate training. This includes providing training for lab-specific hazards such as hazards and handling precautions for hazardous chemicals, proper use of equipment, etc.
- Maintain written records of lab-specific training (e.g., PPE training, review of IBC protocols, etc.).

SAFETY EQUIPMENT
- Emergency Eyewash and Showers
- Fire Extinguishers
- .....
• Ensure that appropriate personal protective equipment (PPE) and engineering controls (e.g., chemical fume hoods, biosafety cabinet) are made available, in good working order, and being used properly.
• Comply with regulatory requirements and institutional procedures.
• Enforce applicable safety procedures and ensure that the CHP is followed by personnel in the lab.
• Address findings identified during laboratory inspections.

LABORATORY PERSONNEL RESPONSIBILITIES
All laboratory personnel (e.g., employees, students, visitors) that use, handle, or store hazardous chemicals must:
• Work in a manner that minimizes exposure to hazardous chemicals.
• Understand and follow the requirements of this CHP.
• Comply with regulatory requirements, research protocols, institutional procedures, and SOPs applicable to work performed in the lab.
• Develop and practice good chemical hygiene and housekeeping.
• Recognize and understand hazards associated with materials present in their workplace.
• Properly use controls (engineering controls, administrative controls, and PPE) to mitigate the risk of hazards encountered in research labs.
• Use, maintain and understand the capabilities and limitations of PPE.
• Immediately report all accidents, near misses, and unsafe conditions as required by the CHP and RS102-Incident Reporting.
• Complete all required safety training.
• Participate in a medical surveillance program when required.
• Inform the Laboratory Supervisor of any work modifications ordered by a physician as a result of medical surveillance, occupational injury, or chemical exposure.

LABORATORY SAFETY OFFICER RESPONSIBILITIES
It is recommended that each Laboratory Supervisor identify a Laboratory Safety Officer to manage the routine operations of the lab’s safety program. The responsibilities of the Laboratory Safety Officer may include the following responsibilities:
• Provide training or direct new lab personnel to appropriate training resources.
• Ensure that the training is completed and properly documented.
• Enforce lab safety rules.
• Update hazardous chemical inventory.
• Flush emergency eyewash stations on a weekly basis.
• Report safety issues back to the Laboratory Supervisor when necessary.
• Act as a liaison with the Office of Research Safety Affairs to resolve safety issues within the laboratory.

NON-LABORATORY PERSONNEL/SUPPORT STAFF RESPONSIBILITIES:
Housekeeping and Facilities maintenance staff (support staff) may enter laboratories to perform routine tasks such as cleaning and equipment maintenance. Support staff may be assigned to a specific lab, or may be rotated to the post of support staff of each laboratory. Minimum PPE requirements for support staff working in a laboratory are long pants, closed-toe shoes, safety glasses and gloves. If additional PPE is required or if other unique safety requirements must be followed, it is the responsibility of laboratory personnel to notify support staff. These additional requirements should be clearly communicated to support staff. Posting the requirements on the lab door or somewhere else highly visible is recommended.

CHEMICAL HYGIENE OFFICER RESPONSIBILITIES:
The Chemical Hygiene Officer is responsible for implementing the CHP. The Director of the Office of Research Safety Affairs is the UTHSC Chemical Hygiene Officer. Individual departments or laboratories are encouraged to designate a Chemical Hygiene Officer for their department or lab. The Chemical Hygiene Officer must:
• Maintain this institutional CHP.
• Inform Laboratory Supervisors of health and safety requirements.
• Assist with the selection of appropriate safety controls (engineering controls, administrative controls, and PPE).
• Conduct periodic lab inspections and immediately take steps to abate hazards that may pose a risk to life or safety upon discovery of such hazards.
• Ensure that SOPs and hazard assessments have been performed.
• Perform exposure assessments upon request or when necessary and appropriate.
• Review the CHP and evaluate its effectiveness at least annually. Update the CHP as necessary.
• Assist with risk assessment or workplace hazard control plans upon request.

UNIVERSAL LABORATORY SAFETY PRACTICES
Certain laboratory safety practices apply to all laboratories or research areas where hazardous chemicals may be handled. These practices must be followed by all personnel working with such hazards and shall be enforced by the Laboratory Supervisor.
• Employees shall not eat, drink, smoke, or apply cosmetics within a laboratory.
• Employees shall not wear open toed shoes or perforated shoes.
• Employees shall not wear short-sleeved shirts or dresses that do not provide skin coverage to at least below the knee. Pant legs are preferred.
• Whenever feasible, employees should handle hazardous chemicals within a laboratory chemical hood.
• Employees shall not block access to exit doors, fire extinguishers, fire alarm pull stations, eyewash stations, emergency showers or other emergency equipment.
• Employees shall not leave laboratory experiments unattended.
• Employees shall wash hands after handling hazardous chemicals.
• Employees shall keep long hair (longer than shoulder length) tied back.
• Employees shall keep container sizes and quantities on hand as small as possible; such quantities shall be consistent with the rate of use. Employees should only purchase quantities necessary for experiments and procedures occurring in the immediate future.
• Employees shall keep work areas, where hazardous chemicals are handled, clean and uncluttered.

HAZARD COMMUNICATION
Hazard recognition is a fundamental component of chemical safety. UTHSC complies with the TOSHA Hazard Communication Standard to ensure that employees are properly informed about the hazards associated with the chemicals in their work area. Due to the variety of chemicals located across the campus it is the responsibility of supervisors to ensure that staff members are aware of the hazards associated with the chemicals in their work area. This shall be done through labeling, the maintenance of a hazardous chemical inventory, Safety Data Sheets, and training.

LABELING
Existing labels on incoming containers of hazardous chemicals, such as those provided by the manufacturer, shall not be removed or defaced unless the container has been emptied. If new contents are added the container must immediately marked to identify the contents. Containers present for longer than a single shift or under the control of more than a single person must be labeled. New hazardous materials must be labeled to identify their contents. Hazardous chemical containers shall be labeled, tagged or marked with the following information:
• Identity of the hazardous chemical or chemical product
• Appropriate hazard warnings, including words, pictures, and/or symbols, which provide general information regarding handling, storage, and other hazards of the chemicals. (The NFPA diamond hazard rating system is an acceptable means of describing the appropriate hazard warnings.)
• Do not use abbreviations, chemical formulae, or structure where using containers unless there is a complete and up-to-date legend (e.g., MeOH = Methanol) prominently posted in the lab.

CHEMICAL INVENTORY
Departments that handle, use or store hazardous chemicals are required to maintain an inventory of such chemicals. This inventory will be maintained on the EHS, Assistant online database accessible through the Office of Research Safety Affairs website. Laboratory Supervisors must review and update the chemical inventory as often as necessary to ensure its accuracy, but at least annually.
Generally, all hazardous chemicals, compressed gases, hazardous drugs, chemotherapy agents, contrast media, and other macromolecules must be listed in the hazardous chemical inventory. TOSHA defines a hazardous chemical as a substance (liquid, solid, gas, vapor, aerosol, fume, dust or mist) which is a physical hazard or a health hazard. A health hazard is 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. A health hazard may include chemicals which are carcinogenic, toxic or highly toxic agents, reproductive toxins, irritants, corrosives, sensitizers, hepatotoxins, nephrotoxins, neurotoxins, agents which act on the hematopoietic system, and agents which damage the lungs, skin, eyes, or mucous membranes. A physical hazard is a chemical for which there is scientifically valid evidence that it is a combustible liquid, a compressed gas, explosive, flammable, an organic peroxide, an oxidizer, pyrophoric, unstable (reactive) or water reactive.

Select items are exempt from being included on a hazardous chemical inventory:
• Food and beverages are exempt.
• The following pharmaceuticals are exempt:
  • Drugs when they are in their solid final form for direct administration to a patient (e.g., tablets, pills, and creams),
  • Over-the-counter drugs (not requiring a prescription), and
  • First aid kits (for employee use).
• Hazardous waste and radioactive materials are exempt.
• Biohazardous materials, culture media and blood culture bottles are exempt.
• Alcohol gel dispensers mounted on the wall or sitting on desks are exempt. However, if multiple containers of alcohol gel are kept in a central storage location, such containers should be listed on the inventory.
• “Articles” and “consumer products” are exempt. An “article” is any manufactured item other than a fluid or particle which, 1) is formed to a specific shape or design during manufacture, 2) has end use function(s) dependent in whole or in part upon its shape or design during end use, and 3) which under normal conditions of use does not release more than very small quantities, e.g., minute or trace amounts of a hazardous chemical.
and does not pose a physical hazard or health risk to employees. A “consumer product” is any article, or component part thereof, sold or distributed 1) for sale to a consumer for use in or around a permanent or temporary household or residence, a school, in recreation, or otherwise, or 2) for the personal use, consumption or enjoyment of a consumer in or around a permanent or temporary household or residence, a school, in recreation, or otherwise. Examples of exempt “articles” and “consumer products” include liquid paper, alkali bases, Sani-wipes, cleaning products (at an employee’s desk), and printer cartridges. Consumer products that are used in a manner that is consistent with how one would use such products at home are exempt. For example, Windex Cleaner kept at an employee’s desk for periodic cleaning of his/her desk is exempt. However, if a housekeeper uses Windex Cleaner multiple times per day for execution of his/her work duties, such cleaners should be included on the inventory.

SAFETY DATA SHEETS (SDS)

Labs must maintain SDS for the hazardous chemicals in their inventory either in a binder or on a computer where the files are readily accessible to employees while at work. SDS provide comprehensive information for the safe handling and storage of hazardous chemicals. They enable the employer to develop an active program of hazard communication and worker protection measures. Laboratory personnel should use SDS as a resource to obtain information about hazards and safety precautions. UTHSC provides access to SDS through the SDSOnline database accessible through the Research Safety Affairs website. Once accessed on the internet SDS must be saved on a computer or in a binder to ensure that they are accessible to employees. Work areas where employees do not have access to internet-connected computers must maintain hard copies of SDS for the hazardous chemicals handled in that area.

TRAINING

General hazard communication training is provided by Campus Safety and Emergency Management and is a component of the annual training requirement for all employees. This content includes labeling requirements, SDS access, and the recognition of warning signs such as GHS pictograms as required by OSHA. Work area supervisors are required to provide additional work area specific training on the hazards associated with chemicals present in each employee’s work area. This training must include, at a minimum, the health hazards associated with each chemical, the signs and symptoms of exposure, and appropriate actions to take in the event of an exposure.

LABORATORY HAZARD ASSESSMENT

Supervisors are responsible for assessing the workplace hazards. In accordance with OSHA Standard 29 CFR 1910.132 this assessment must be documented through a written certification that identifies the workplace evaluated; the person certifying that the evaluation has been performed; the date(s) of the hazard assessment; and, which identifies the document as a certification of hazard assessment. The Laboratory Hazard Assessment (shown in Figure 1) must be posted on the door to the laboratory work area and is available in Appendix A. If hazards are present, or likely to be present, the laboratory supervisor shall ensure employees utilize proper controls to limit exposures to such hazardous chemicals. Hazards are mitigated through the use of equipment controls (e.g., fume hoods, containment devices, ventilation, etc.), work practices, and/or personal protective equipment (PPE). When assessing hazards, supervisors should consider the following steps:

1. List the job tasks
2. Identify the hazards associated with each job task
3. Identify control(s) for each hazard
4. Implement control(s)
5. Educate affected employees
6. Evaluate effectiveness of the control(s).

Laboratory Supervisors are encouraged to consult with the Office of Research Safety Affairs when assessing procedures that may be deemed as highly hazardous. When completed by the Laboratory Supervisor or a representative from the Office of Research Safety the following form meets the criteria for a workplace hazard assessment. It may be obtained from the Office of Research Safety.

HIERARCHY OF CONTROLS

Employees are required to work in a manner that minimizes their exposure to hazardous chemicals. Laboratory safety controls are used to minimize the potential for exposure to these chemicals. Lab safety controls include engineering controls (e.g., fume hoods), administrative controls (e.g. work practices), and PPE. Elements of these three categories should be used in a layered approach to minimize employee exposure to hazardous chemicals. The hierarchy of controls prioritizes hazard mitigation strategies on the premise that the best way to control a hazard is to systematically eliminate it from the workplace or substitute a less hazardous technique, process, or material. If elimination or substitution are not feasible options, administrative controls, engineering controls, and PPE must be used to provide the necessary protection.

Laboratory employees are responsible for practicing good chemical hygiene at all times. To do this the employee must be familiar with the four routes of exposure in which hazardous substances can enter the body: inhalation, absorption, ingestion, and injection. Of these, the most likely routes of exposure in the laboratory are by inhalation or skin absorption. Many hazardous chemicals may affect people through more than one of these exposure routes, so it is critical that protective measures are in place for each of these exposure routes. For each laboratory procedure employees should evaluate the potential routes of exposure and apply the hierarchy of controls to mitigate the risk associated with that procedure.

ENGINEERING CONTROLS

Engineering controls eliminate or reduce exposure to chemical or physical hazards through the use or substitution of engineered machinery or equipment. Common forms of engineering controls often employed in the laboratory include equipment to isolate the operator or the process (e.g., use of a glove box when handling air- or water- sensitive chemicals); and use of forced ventilation systems (e.g., chemical fume hood, biological safety cabinet).

CHEMICAL FUME HOODS

Laboratory chemical hoods are designed to partially enclose processes and or equipment that generate air contaminants such as gases, vapors, fumes or particulates. Whenever possible, employees should handle hazardous chemicals within laboratory chemical hoods. The location of a laboratory chemical hood affects its effectiveness in capturing and/or containing air contaminants. Ideally, a laboratory chemical hood should be in an area of minimal traffic. When a person walks by a laboratory chemical hood, turbulence can be created near the hood face causing contaminants to be drawn outside the hood.

Laboratory chemical hoods shall be evaluated annually by the Office of Research Safety Affairs. The evaluation shall include a face velocity test, airflow visualization test, and airflow alarm assessment test. The evaluation procedure is contained within Appendix B: Laboratory Chemical Hood Evaluation Procedure. Each laboratory chemical hood shall be labeled with a sticker indicating the last successful evaluation date for such hood. Laboratory employees must contact Facilities or the Office of Research Safety when the chemical hood is not working properly or if the airflow monitor is in alarm.

If a chemical fume hood is required or recommended to be used, the following guidelines must be followed:

- Chemical fume hoods must be marked to indicate the proper sash position for optimum hood performance. The chemical fume hood sash should be positioned at or below this height whenever working with hazardous chemicals that could generate toxic gases, vapors, fumes, aerosols or particulates.
- Most chemical fume hoods are not intended to be used with the sash fully open. The sash should only be fully opened to add or remove equipment from the chemical fume hood. Although the sash provides some splash protection employees must wear eye protection when handling hazardous chemicals within the Fume hood.
- Only apparatus and chemicals essential to the specific procedure or process should be placed in the chemical fume hood. Excessive materials from previous experiments should be removed and stored in a safe location outside the chemical fume hood.
- Chemical fume hoods used for experimental work should not be used for chemical or equipment storage. Fume hoods used for chemical storage should only be used for storage; experimental work should not be conducted in these hoods.
• Never put your head inside of an operating chemical fume hood.

BIOSAFETY CABINETS (BSC)
A biosafety cabinet is a specific type of enclosed, ventilated laboratory workspace. These units are engineered to provide protection to personnel, the product being handled on the work surface and the environment. Biosafety cabinets are primarily used for protection used for safely working with materials contaminated with potentially infectious materials. They are primarily used to provide worker protection from infectious materials and to protect materials being handled on the work surface from contamination. Biosafety cabinets must be certified annually in accordance with the field certification procedures detailed in NSF/ANSI 49: Biosafety Cabinet Certification.

The Type A2 biosafety cabinet is the most common type on campus. This type of cabinet relies on HEPA filters to remove aerosols and particulates from the air and is not intended for use with hazardous gases or vapors. Applications that involve the use of chemicals should be conducted in chemical fume hoods.

LAMINAR FLOW CLEAN BENCH
A laminar flow clean bench is a partially enclosed bench designed to prevent contamination of the work surface. Air is drawn through a high efficiency particulate air filter and blown in a very smooth, laminar flow towards the user. The handling of laboratory animals on a laminar flow clean bench should also be avoided as it may increase researcher exposure to lab animal allergens.

PERSONAL PROTECTIVE EQUIPMENT
Supervisors shall assess the workplaces of their employees to determine if hazards are present, or are likely to become present, which necessitate the use of personal protective equipment (PPE). The Laboratory Supervisor will select and have each affected employee use the types of PPE that will protect the employee from the hazards identified in the hazard assessment. To promote the use of PPE, this equipment should be stored in a location close to the workplace location where it is to be used. Laboratory Supervisors shall establish clear policies to delineate when the use of PPE is required. For example, “staff members must wear a lab coat and eye protection when working at the lab bench.” The Office of Research Safety Affairs is available on request to assist with the selection or assignment of appropriate PPE.

Supervisors shall provide PPE training to employees required to use PPE. Training shall include the following:

- When PPE is necessary
- What PPE is necessary
- How to properly don, doff, adjust, and wear PPE
- Limitations of the PPE
- Proper care, maintenance, useful life and disposal of the PPE

Such training shall be provided before employees perform work requiring the use of PPE. Re-training is required under the following circumstances:

- Changes in the workplace render previous training obsolete
- Changes in the types of PPE to be used render previous training obsolete
- An affected employee demonstrates a lack of understanding of proper use of the PPE.

BODY PROTECTION (E.G., LAB COATS)
Each affected employee must wear protective clothing to protect the body from recognized hazards. Unprotected skin surfaces that are at risk of injury should be covered. Full length pants or a full-length skirt must be worn by all individuals that are occupying the laboratory area; shorts are not permitted. Lab coats, coveralls, aprons, or protective suits are required to be worn while working on, or adjacent to, all procedures using hazardous chemicals or infectious materials at biosafety level 2 or higher. Lab coats must be appropriately sized for the individual and properly fastened. Gloves are recommended to protect the full length. Lab coat sleeves must be of sufficient length to prevent skin exposure while wearing gloves. Flame resistant lab coats must be worn when using pyrophoric materials or flammable liquids or gases.

Lab coats should not be worn outside of the lab unless the individual is traveling directly to an adjacent lab work area. Lab coats should not be worn in common areas such as break rooms, offices, or restrooms. Each department is responsible for ensuring emergency services as needed to maintain the hygiene of laboratory coats. They may not be cleaned by staff members at private residences or public laundry facilities. Alternatives to laundering lab coats include routinely purchasing new lab coats for employees to replace contaminated lab coats, hiring a professional garment laundering service, or using disposable lab coats. Departments can also choose to purchase a washer and dryer and launder their own lab coats.

Eye and Face Protection
Laboratory personnel must wear eye protection when handling hazardous chemicals in the lab. All eye protection equipment must be American National Standards Institute (ANSI) approved and appropriate for the work being done.

Hand/Skin Protection
Employees must wear chemical protective clothing and/or gloves to minimize potential skin exposures to hazardous chemicals. No single glove or clothing article provides protection against all hazardous chemicals. Employees must also use gloves or protective clothing that provides puncture resistance and/or thermal protection. Manufacturers of protective clothing and gloves publish chemical protective clothing and puncture resistance data for their protective clothing and gloves. Chemical resistance data may include permeation, degradation and penetration information. For work with hazardous chemicals, the selected chemical protective clothing or gloves should resist permeation, degradation, and penetration by the respective chemicals.

SAFETY EQUIPMENT
Safety equipment is available to employees in the event of a hazardous chemical release or other incident. The specific operations conducted in a work area will determine what safety equipment should be available. This equipment must be properly maintained so that it is accessible and functional when needed. Access to safety equipment must not be obstructed. Maintenance of the safety equipment in the work area. This includes maintaining equipment in a clean and sanitary manner, replacing items as they are used or expire, or notifying Facilities if something is not functioning properly or if a fire extinguisher has been used and needs to be replaced.

EMERGENCY EYEWASH AND SHOWERS
All laboratories using corrosive chemicals must have immediate access to safety showers and eye wash stations. All lab personnel must be aware of the location and know how to properly use the safety shower and eyewash stations. Laboratory employees are responsible for flushing eyewash stations on a weekly basis. This will keep the system free of sediment and prevent bacterial growth that may be hazardous to employees. This flush should be documented on the Weekly Eyewash Inspection Form. Any operational deficiencies with emergency eyewash station must be reported immediately to Facilities. UTHSC maintains a procedure for Emergency Eyewash and Safety Showers.

FIRE EXTINGUISHERS
Fire extinguishers must be available in locations and in accordance with procedures detailed in Campus Safety and Emergency Management policy F53300 – Fire Prevention Plan. They must be located in locations that are free of clutter or obstruction in accordance with campus safety policy F53302 – Portable Fire Extinguishers. All laboratory personnel should be familiar with the location, use, and classification of the extinguishers in their laboratory. Ensure that the fire extinguisher being used is appropriate for the type of material on fire before attempting to extinguish any fire. A portable fire extinguisher is not required to extinguish fires that occur in the lab. These fires require a fire extinguisher of appropriate size for the fire. Fire extinguishers should not be used to extinguish any fire. Fire extinguishers are not required to extinguish fire that occur in the lab. If a fire occurs in the laboratory and is extinguished by
CORROSIVE CHEMICALS
Corrosive chemicals cause visible destruction and/or irreversible alteration of living tissue by chemical action at the site of contact. A corrosive chemical meeting one or more of the following criteria is considered "corrosive":
• Chemical is identified as corrosive on SDS
• Chemical is identified as corrosive on container label
• Chemical has a pH ≤ 2.0 or pH ≥ 11.5

Employees should handle corrosive chemicals within a laboratory hood. Employees are required to comply with the following work practices when handling corrosive chemicals:
• Employees shall not handle corrosive chemicals in work areas that do not have emergency eye wash and/or shower equipment
• The laboratory supervisor shall provide detailed instructions regarding appropriate personal protective equipment for tasks involving corrosive chemicals.

Peroxide-formers are a class of highly volatile, flammable, organic peroxides which form dangerous levels and used in glues and adhesives and peroxides. The peroxides formed are sensitive to shock and friction and can cause potentially explosive reactions. Examples of common laboratory reagents that fall into the category of peroxide-forming chemicals include diethyl ether, tetrahydrofuran, dioxanes and benzyl alcohol. Chemical containers with contents that have crystallized, have been tested and found to contain a peroxide concentration above 30 ppm, or that have been stored past their expiration date may be hazardous or may require special precautions to facilitate their safe disposal. Contents are presumed to have become reactive and require the temporary shutdown of the laboratory where the chemicals are contained, and other laboratories located adjacent to the route of disposal. This can be both an expensive and time-consuming process.

Laboratory personnel should purchase the smallest amount needed for an upcoming experiment. This will minimize quantities kept on site. Peroxide-formers should be stored in a flammable cabinets. Every individual container in a storage cabinet may exceed 5 gallons (20 liters) in capacity.

Due to their hazardous nature this class of compounds has a shelf-life while in storage. Laboratory personnel must follow the chemical manufacturer’s recommendations for the storage of these compounds. Peroxide-formers must be stored in a manner that minimizes exposure to air, light, heat, vibration, and shock. The container must be closed when not in use. They must also observe the chemical manufacturer’s expiration date. (In most cases this expiration date is less than 24 months from the date of purchase.) Peroxide-formers must be dated when received from the chemical manufacturer and dated again when the container is opened.

Before opening containers of peroxide-forming chemicals laboratory personnel must inspect the container and its contents. If the contents appear to have evaporated, crystals have developed, the material is discolored, or if the container has been damaged the container must not be used and the Office of Research Safety Affairs must be contacted by phone at ext. 8.6114 to arrange for disposal. Peroxide test strips must be available in laboratories where peroxide-forming chemicals are handled or stored. Laboratory personnel must test the peroxide concentration each time at least monthly or when the container is opened. If the test strip indicates that the peroxide concentration is greater than 30 ppm, the substance shall be re-stabilized and inhibited or the Office of Research Safety Affairs shall be notified immediately for disposal arrangements.

PERCHLORIC ACID
The handling of perchloric acid is particularly dangerous and should not be performed except by those specially designated for perchloric acid use. Perchloric acid is a highly reactive material when in contact with incompatible materials. It can explode on contact with many organics and can form potentially explosive metal perchlorates through contact with metals. It is also forbidden from transport in concentrations >72%. Perchloric acid is corrosive, acutely toxic, and preferentially unbreakable, containers. Containers of perchloric acid must be labeled with the dates of receipt and opening.

CARCINOGENS, REPRODUCTIVE HAZARDS AND ACUTELY TOXIC CHEMICALS
Carcinogens include, but are not limited to, chemicals that meet one or more of the following criteria:
• Regulated by OSHA as a carcinogen
• Listed in the National Toxicology Program Annual Report on Carcinogens as a known human carcinogen or reasonably anticipated to be a human carcinogen
• Listed by the International Agency for Research on Cancer as a human carcinogen, probable human carcinogen, or possible human carcinogen
• Listed by the National Institute for Occupational Safety and Health (NIOSH) as a potential occupational carcinogen

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• Listed on the manufacturer’s SDS as a human carcinogen or possible human carcinogen. Reproductive hazards include chemicals that may affect the reproductive health of men or women, the ability of couples to have healthy children. Reproductive hazards may cause problems such as infertility, miscarriage, and birth defects. Acutely toxic chemicals include those defined as toxic under the TOSHA Hazard Communication Standard and may be fatal or cause damage to target organs as a result of a single exposure or exposures of short duration. TOSHA defines a toxic chemical as one that meets one of the following characteristics:

  • Has a median lethal dose (LD50) of not more than 500 milligrams per kilogram of body weight when administered orally to albino rats weighing between 200 and 300 grams each.
  • Has a median lethal dose (LD50) of not more than 1,000 milligrams per kilogram of body weight when administered by continuous contact for 24 hours with the bare skin of albino rabbits weighing between two and three kilograms each.
  • Has a median lethal concentration (LC50) in air of not more than 2,000 parts per million by volume of gas or vapor, or not more than 20 milligrams per liter of mist, fume, or dust, when administered by continuous inhalation for one hour to albino rats weighing between 200 and 300 grams each.

Supervisors and their employees shall consider special provisions when handling carcinogens, reproductive hazards or acutely toxic chemicals. Whenever possible these materials should be handled within a chemical fume hood or other engineered enclosure. Additional provisions include the establishment of designated areas, use of appropriate personal protective equipment, decontamination procedures, and procedures for safe removal of contaminated waste. Laboratory supervisors should consider establishing Designated Areas for the safe storage and handling of select carcinogens, reproductive hazards, and acutely toxic chemicals. Supervisors should evaluate the need to establish a designated area based on the toxicity of the compound(s) being used, the potential for personal exposure, and potential for residual contamination. A fume hood, a section of a laboratory or an entire laboratory may be delineated as a Designated Area. When delineating a Designated Area, the area shall be marked with a sign or label with the following language “Caution – Designated Work Area – Select carcinogens, reproductive hazards, or substances of high acute toxicity may be present.”

Employees must regularly decontaminate work areas used for carcinogens, reproductive hazards, and acutely toxic chemicals. These areas must be cleaned with a suitable decontaminant. Refer to the SDS for decontamination procedures for specific chemical reagents. Supervisors and employees should be advised that hazardous drugs (e.g., antineoplastic agents, antiviral medications, tamoxifen, BrdU, cyclophosphamide, etc.) may not be suitably decontaminated with alcohol. A 1-10% bleach solution is the required surface decontaminant for many hazardous drugs. Empty containers used to hold carcinogens, reproductive hazards or acutely toxic materials can be discarded as conventional trash unless the contents were specifically identified as the EPA as U or P listed hazardous waste. In such situations the container itself must be discarded as hazardous waste or triple rinsed with a suitable solvent before being discarded. In such situations that rinsate must be discarded as hazardous waste. Materials used to clean spills of carcinogens, reproductive hazards or acutely toxic chemicals must be placed in an appropriate, sealable container, and discarded as hazardous waste.

COMPRRESSED GASES

Compressed gases are defined as gases that are contained in a receptacle at a pressure not less than 280 kPa at 20 °C or as a refrigerated liquid. The following general guidelines for storing compressed gases must be followed for all compressed gases and in all laboratories. Refer to UTHSC policy HMS200 Compressed Gas Safety for detailed requirements for the handling and storage of specific compressed gases.

• Cylinders that are in use, meaning there is a regulator attached, must be individually secured by a chain or strap to a fixed building structure or component.
• Cylinders that are not in use must be stored with the valve cap on and secured to protect the valve.
• The regulator must be replaced with a safety cap when the cylinder is not in use.
• The safety cap must be in place when a gas cylinder is moved. For large gas cylinders (>27 inches), an approved gas cylinder cart should be used to move it.
• Compressed gas cylinders (cylinders) must be stored in a secure, well-ventilated location, and in an upright position. Small cylinders such as lecture bottles are not required to be stored in the upright position; they can be safely laid down in a chemical cabinet. However, when lecture bottles are in use they should be secured and stored in an upright position if possible.
• All cylinders should be handled as if full and should never be completely emptied.
• Multiple cylinders may only be secured together if they are capped (not in use) in a compatible hazard class. Only capped cylinders can be secured with a single restraining device.

CHEMICAL WASTE

Hazardous waste is generally defined as waste that is dangerous or potentially harmful to human health or the environment. Hazardous waste regulations are strictly enforced by both the Environmental Protection Agency (EPA) and the Tennessee Department of Environmental Conservation (TDEC). The Laboratory Supervisor is responsible for managing hazardous waste in a safe and compliant manner. Chemical waste shall not be poured down the drain or discarded in the trash without specific approval of the Office of Research Safety Affairs. Waste materials that fall into one or more of the following categories are considered hazardous waste:

• Characteristic Wastes are wastes that exhibit one or more of the following properties:
  • Ignitable,
  • Corrosive,
  • Reactive, or
  • Toxic

• Listed Wastes are wastes from common manufacturing and industrial processes (F-listed), wastes from specific industries (K-listed), and wastes from commercial chemical products (U- and P-listed). Examples of U- and P-listed wastes sometimes handled in laboratories include phenol, nicotine, cyclophosphamide, warfarin, epinephrine, streptozotocin and other hazardous drugs. Empty containers of U- and P-listed materials must be handled as hazardous waste unless triple rinsed with a suitable solvent to remove any chemical residue. Rinsate used to clean waste containers must itself be discarded as hazardous waste.

• Universal Waste includes certain batteries (primarily rechargeable batteries such lithium, nickel-cadmium, nickel metal hydride, and mercury oxide), mercury-containing equipment (e.g., thermometers, thermostats), and certain lamps (e.g., fluorescent bulbs). Note: alkaline batteries and incandescent bulbs are not considered Universal Wastes and can be legally disposed of as trash.
• Mixed Waste consists of hazardous chemical waste mixed with radioactive waste. EPA-regulated hazardous waste should not be mistaken for biological or radioactive wastes.

WASTE DETERMINATIONS

All chemical constituents in a hazardous waste container must be identified by knowledgeable laboratory personnel. Not only is this required by the EPA, it also ensures that waste can be properly characterized and disposed of by the Office of Research Safety Affairs or Campus Safety, if there is uncertainty about the composition of a waste stream resulting from an experimental process, laboratory employees must consult the Laboratory Supervisor for assistance or the Office of Research Safety Affairs for assistance. In most cases, a careful documentation and review of the SDS for all chemical products used in the experimental protocol will result in accurate waste stream characterization. Information contained within an SDS pertinent to making a hazardous waste determination can be found in specifically Section 2, “Hazard Identification” and Section 13, “Disposal Considerations.” If the composition of a waste is unknown we may determine the Office of Research Safety may perform additional analysis on this material.

Hazardous waste containers in UTHSC laboratories are stored in satellite accumulation areas (SAA). SAAs are used to manage hazardous waste in laboratories and shops because doing so provides safe and effective means to accumulate hazardous waste before removal by Campus Safety. Additionally, SAAs provide the least restrictive regulatory option for the accumulation and storage of hazardous waste containers. The following SAA rules must be followed managing hazardous waste in a laboratory:

• All waste must be stored in containers.
• Containers must be in good condition and compatible with the waste they contain (no corrosive waste in metal containers).
• Containers must be kept closed except when adding or removing waste.
• Containers must be properly labeled.

WASTE LABELING

All waste must be properly labeled as soon the first drop of waste enters a waste container. Containers must be labeled and clearly marked with the words “Hazardous Waste,” list the chemical components of that waste, and identify the hazards associated with that waste. Hazardous waste labels are available on the Office of Research Safety website. These labels must be filled out in a percentage format as shown below.
• Containers must be stored at or near the point of generation and under the control of the generator of the waste (containers should remain in the same room they were generated in). A central waste collection room should not be established.
• The waste storage volume should never exceed 55 gallons per SAA.
• Containers should be segregated by chemical compatibility during storage (e.g., acids away from bases, secondary containment can be used as a means of segregation).
• Avoid halogenated and non-halogenated wastes in the same waste container.
• Avoid mixing incompatible waste streams in the same container (e.g., acids with bases, oxidizers with organic solvents) that will potentially create an exothermic reaction in the waste container.
• Collect all highly toxic, reactive, mercury and any exotic wastes (e.g., dioxin compounds, PCBs, controlled substances) separately even if they are chemically compatible with other waste streams. Failing to do so can result in costly disposal fees (e.g., mixing mercury with an organic solvent waste means that the entire waste stream must be treated as mercury waste).
• All spills and leaks must be cleaned up immediately.
• Spill clean-up waste must be bagged and discarded as hazardous chemical waste.

Waste Disposal Procedure

Campus Safety provides package services for all chemical waste generated at the campus. Requests a hazardous waste pickup by emailing labsafety@uthsc.edu and identifying the building and room number where the waste is located, the type of waste (e.g. methanol and stains), and the number of containers. Average turnaround time is 1-2 business days.

LIQUID CHROMATOGRAPHY WASTE

Liquid chromatography (LC) is an analytical technique used to separate, identify, quantify, and purify individual components of a mixture. This technique is very common in biological and chemical research. The most common type of LC at UTHSC is High Performance Liquid Chromatography (HPLC). UTHSC has numerous LC instruments located in campus laboratories. Since organic solvents (e.g., methanol, acetonitrile) are commonly used in the process, most LC waste is regulated by the EPA as hazardous waste. Consequently, all containers collecting LC waste be properly labeled and acceptable to place a waste line running from the lab container into an open waste container or it is acceptable to use foil or Parafilm® as a means of closure must remain closed while the LC is in operation.

HOUSEKEEPING

Housekeeping is a required element of the UTHSC laboratory safety program. A clean, well-maintained laboratory improves safety by preventing accidents and can enhance the overall efficiency of the work being performed. Observe the following laboratory housekeeping guidelines:

• Doorways and hallways must be free of obstructions to allow clear visibility and exit.
• The laboratory should be uncluttered without excessive storage of materials that could cause or support a fire (e.g., paper, cardboard, flammable liquids, etc.).
• Fire protection sprinklers must be unobstructed; a minimum of 18 inches of clearance is required below any sprinkler head.
• Do not store items that block fire extinguishers or eyewash and safety shower stations.
• Do not store items in front of electrical boxes/panels in the lab.

A routine cleaning schedule should be established. All work surfaces should be kept as clean as possible. All potentially chemically contaminated work areas (e.g., chemical fume hood deck, countertops) should be cleaned routinely (e.g., daily, weekly).
• For operations where spills and contamination are likely (e.g., agarose gel electrophoresis/ethidium bromide applications), cover workspaces with a bench paper or liner. The soiled bench paper should be changed on a routine basis or as needed.
• All chemical spills must be cleaned up immediately.
• Do not allow materials to accumulate in lab fume hoods and remove used tissues, foils, gloves, or other unnecessary objects immediately after use.
• Ensure that all waste (e.g., trash, chemically contaminated debris waste, etc.) is placed in the appropriate containers. Do not overfill waste containers.
• All equipment should be cleaned and returned to storage after each use.
• Equipment should be stored in a safe and orderly manner that prevents it from falling.
• Chemical containers must be clean, properly labeled, and returned to storage upon completion or usage.
• Avoid storing liquids above eye level.
• Do not store heavy or frequently used items on top shelves. Locate items used daily close to the work area.

EXPOSURE ASSESSMENT

Employees’ airborne exposures to hazardous chemicals shall be below limits set by TOSHA (Tennessee Occupational Safety and Health Administration), ACGIH (American Conference of Governmental Industrial Hygienists), NIOSH (National Institute for Occupational Safety and Health), and/or AIHA (American Industrial Hygienists). Employees shall use engineering controls and work practices to minimize exposures to airborne hazardous chemicals. Where engineering controls and work practices are not sufficient to maintain exposures below exposure limits, employees shall use respiratory protection to reduce exposures below such limits.

• Occupational Exposure Limits

TOSHA maintains the following types of exposure limits:

- Permissible Exposure Limit (PEL) - The PEL is an 8-hour time-weighted average exposure limit during a 40-hour work week, which shall not be exceeded.
- Short Term Exposure Limit (STEL) - The STEL is a 15-minute time-weighted average exposure limit, which shall not be exceeded during the work day.

NIOSH maintains the following types of exposure limits:

- Recommended Exposure Limit (REL) - The REL is a 10-hour time-weighted average exposure limit during a 40-hour work week, which should not be exceeded.
- Short Term Exposure Limit (STEL) - The STEL is a 15-minute time-weighted average exposure limit, which should not be exceeded during the work day.

AIHA maintains the following types of exposure limits:

- Workplace Environmental Exposure Level - Time Weighted Average (WEEL-TWA) - The WEEL-TWA is an 8-hour time-weighted average exposure limit during a 40-hour work week, which should not be exceeded.
- Workplace Environmental Exposure Level - Short Term Exposure Limit (WEEL-STEL) - The WEEL-STEL is a 15-minute time-weighted average exposure limit, which should not be exceeded during the work day.

TOSHA standards are enforceable by law. ACGIH, NIOSH and AIHA exposure limits are consensus standards and not enforceable by law. UTHSC generally uses the most stringent standard(s) for each hazardous chemical. NIOSH or AIHA as our institutional standard(s). Occupational exposure limits for specific chemical compounds can be found online in the NIOSH Pocket Guide to Chemical Hazards.

- Occupational Exposure Assessments

The Director of Research Safety Affairs maintains the occupational exposure assessment program. Exposures are categorized based on the following criteria:

- Nature of job task
- Quantity of hazardous chemical(s) handled
- Frequency of task
The contents of this Chemical Hygiene Plan

The annual Laboratory Safety training program covers the

students working in labs are strongly advised to attend in-

system and accessible through the Office of Research

Safety Affairs as an in-person class or as a computer-

refresher. This training is offered by the Office of Research

LABORATORY SAFETY TRAINING

Effective training is crucial to a successful laboratory safety program. It is the responsibility of Laboratory Supervisors to actively participate in the training process to ensure that all lab employees are effectively trained before any work is performed. All employees shall maintain a record of training provided online or through classes offered through that office.

The UTHSCHSA does not comprehensively address the hazards associated with specific experimental protocols or work areas. Supervisors must provide job-specific chemical safety training to employees. Such training shall include a discussion of the specific physical and health hazards associated with specific experimental protocols or work areas. Supervisors shall keep records of job-specific chemical safety training provided to employees. Such records shall include employee names, dates of training, and brief descriptions of the training. The Office of Research Safety shall maintain a record of training provided online or through classes offered through that office.

LABORATORY SAFETY TRAINING

All laboratory employees (graduate students, lab technicians/managers, post-docs, visiting scientists, etc.) shall complete Laboratory Safety training and an annual refresher. This training is offered by the Office of Research Safety Affairs as an in-person class or as a computer-based course provided through the UTHSC Blackboard system and accessible through the Office of Research Safety Affairs training website. New employees and employees working in labs are strongly advised to attend in-person training. The annual Laboratory Safety training program covers the following topics:

• The contents of this Chemical Hygiene Plan
• TOSHA requirements
• Hazard communication
• Detection of hazardous chemicals in work areas
• Exposure assessments
• Safe work practices
• Engineering controls
• Personal protective equipment
• Standard Operating Procedures
• Medical consultation
• Hazardous wastes
• Chemical spill response

WORK AREA SPECIFIC TRAINING

Laboratory supervisors shall provide work area specific training to ensure that employees are adequately informed about the hazards and procedures associated with the activities they are required to perform within their work area. This includes completing the hazard communication training for specific chemical hazards, SOP’s, proper use PPE, engineering controls and other potential hazards located in their work area. The general format for safety training to be provided along with each work activity is as follows:

• Identifying the hazards
• Signs or symptoms of exposure
• Mitigating the hazard (engineering controls, administrative controls, PPE)
• How to respond in the event of exposure

DOCUMENTATION

Supervisors shall keep records of job-specific chemical safety training provided to employees. Such records shall include employee names, dates of training, and brief descriptions of the training. The Office of Research Safety shall maintain a record of training provided online or through classes offered through that office.

EMERGENCY PROCEDURES FOR ACCIDENTS AND SPILLS

Chemical spills in the laboratory can pose a significant risk to human health and the environment. All lab personnel must be trained on how to respond to chemical spills in order to minimize risk. In general, chemical spills can be placed into one of two categories: nonemergency chemical spills, or emergency chemical spills.

NON-EMERGENCY CHEMICAL SPILL PROCEDURES

Non-emergency chemical spills are generally defined as spills involving a material, a quantity and in a location that the employee who noticed the spill should be able to absorb and collected using either either pads or some other absorbent material such as oil dry or kitty litter. Decontamination of the spill area should be conducted using an appropriate solvent (soap and water is often the most effective). Proper PPE must be worn and only trained personnel should conduct the cleanup after reviewing the SDS(s) (specifically Section 6, “Accidental Release Measures”) to obtain chemical-specific cleanup information.

EMERGENCY CHEMICAL SPILL PROCEDURES

Emergency chemical spills are spills of any hazardous material in a quantity or location that the employee has not been trained to handle. These spills are generally more than a liter in volume and involve a highly toxic or reactive compound, present an immediate fire or environmental hazard, or require additional PPE (e.g., respirator) and specialized training to properly cleanup. The following procedures should be followed in the event of an emergency chemical spill:

• Cordon off and immediately evacuate the affected area (make sure that all personnel in the area are aware of the spill and also evacuate).
• If chemical exposure has occurred to the skin or eyes, the affected personnel should be taken to the nearest safety shower and eyewash station.
• Dial 84.4444, which will contact the UTHSC Police Department (UTHSC PD). The UTHSC PD will contact the Office of Research Safety to initiate an emergency chemical spill response and clean-up. If the situation is, or could become an emergency (e.g., chemical exposure has occurred, a fire or explosion has occurred) the UTHSC PD will be able to contact the appropriate authorities (e.g., fire department, administration, etc.) to be prepared to provide the following information:
  • Name of person reporting
  • Any injuries or exposures
  • The location of the spill (building and room number).
  • The type of material(s) and approximate volume spilled.
  • Control measures already implemented.
  • Control access to the spill response team arrives. This can be done by closing doors, posting signs or otherwise preventing personnel from entering the vicinity of the spill or areas where toxic vapors may be present.

CHEMICAL SPILL KITS

Each laboratory must have a spill response kit available for use. Lab spill kits can either be purchased from a vendor or created by lab personnel, but each spill kit should be equipped to handle small spills of the most common hazards in the laboratory. Each spill kit should contain cleanup materials that should be in the kit include:

• Absorbent materials such as pads, booms, oil dry or kitty litter.

• Neutralizing agents (e.g., Spill X) for acids and/or bases if high volume of acids and/or bases are stored in the laboratory.
• Containers such as drums, buckets, and/or bags to containerize spilled material and containize debris generated during the cleanup process.
• PPE such as gloves, safety glasses and/or goggles, lab coat or apron, chemical-resistant booties.
• Caution tape or some other means to warn people of the spill.

EXPOSURE RESPONSE

Employees shall be informed how to respond to exposures as part of the hazard communication training associated with the specific hazards that they encounter in their work area. This shall include first aid information such as that provided in the first aid section of a SDS. Incidents must also be reported in accordance with the procedure described in the Office of Research Safety policy RS-102: Incident Reporting.

Accidents/injuries and hazardous agent exposures must be reported to a supervisor immediately.

In a medical emergency that is life-threatening or results in serious bodily injury, employees must call 911 or go to the nearest hospital emergency room. The employee’s supervisor or a family member should call the CorVel 24- hour medical advice line at 877.787.8878 or as directed by the incident.

For non-emergency injuries, employees and their supervisor must call the CorVel 24-hour nurse line at 1.866.245.8588. A nurse will determine if your injury will require self-care, or urgent care and provide you with the nearest authorized medical provider.

If the injury only requires self-care, this would be an incident only claim and no further action would be needed with CorVel.

When medical treatment is needed, supervisors must make a follow-up phone call to CorVel. Failure of the supervisor to call CorVel and complete the First Notice of Loss will result in the department being fined by the State.

On the University of Tennessee Risk Management website, there are links to the “Incident Report,” “Lost Time/Return to Work Calendar,” and “Employee and Supervisor Instructions” forms. When warranted by the nature of the incident or injury completed by employee’s and their supervisor. Once completed, form must be forwarded to your campus HR/WC representative.

Every event must be made to report the incident within 48-hours of becoming aware of the incident.

Concerns related to health, safety and compliance in research may be reported by contacting the Office of Research Safety at 448.614 or emailing labsafety@uthsc.edu.
MEDICAL CONSULTATION

Employees must notify their Laboratory Supervisor of all injuries and illnesses regardless of the magnitude. If the injury is serious and presents an emergency situation, dial 8.4444 and emergency. In a medical emergency that is life-threatening or results in serious bodily injury, employees must call 911 or go to the nearest hospital emergency room. The employee’s supervisor or a family member must call the CorVel 24-hour nurse line at 1.866.245.8588 to report the incident.

For non-emergency injuries, employees and their supervisor must call the CorVel 24-hour nurse line at 1.866.245.8588. A nurse will determine if your injury will require self-care, or urgent care and provide you with the nearest authorized medical provider. If the injury only requires self-care, this would be an incident only claim and no further action would be needed with CorVel. When medical treatment is needed, supervisors must make a follow-up phone call to CorVel within 48 hours of the incident. Failure of the supervisor to call CorVel will result in the department being fined by the State.

Employees, who work with hazardous chemicals, have an opportunity to receive medical consultations and/or examinations from the Occupational Health Office under the following circumstances:

- Exposures that cause an employee to experience signs or symptoms associated with a hazardous chemical.
- Airborne exposures to hazardous chemicals that exceed occupational exposure limits
- Exposures resulting from a spill, leak, explosion, or other occurrence.

Medical consultations and examinations are performed by or under the direct supervision of a licensed healthcare practitioner.