



CHEMICAL HYGIENE PLAN

I. Introduction

- a. Scope:
 - i. The goal of the Chemical Hygiene Plan is to protect students, staff, and visitors from potential health hazards associated with the handling, use, and storage of hazardous chemicals in teaching and research laboratories.
- b. Emergency Response Information:
 - i. Any emergency:
 - a. For any emergency, dial 911 or University police at 372-3234.
 - ii. Non-Life-Threatening:
 - a. If circumstances allow calling without endangering human life, notify University Police at 372-3234.
- c. Safety Contacts:
 - Coordinator, Environmental Health and Safety: Brent Carter, 372-3881
 - Coordinator, Environmental Health and Safety: Sarah DiFurio, RBP, CHMM, 372-3587

d. Definitions:

Action level- Concentration designated in 29 CFR 1910.1450(b) for a specific substance, calculated as an eight (8)-hour time-weighted average, which initiates certain required activities such as exposure monitoring and medical surveillance.

Carcinogen- (see select carcinogen).

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

Chemical Hygiene Plan- The Tennessee Tech University Chemical Hygiene Plan will cover all laboratories on the Tennessee Tech University campus that present any chemical, radiological, biological, and/or physical hazards.

Combustible liquid- Any liquid having a closed cup flashpoint at or above 100 deg. F (37.8 deg. C). Combustible liquids are referred to as Class II or Class III liquids.

- Class II liquids- flash points at or above 100 deg. F (37.8 deg. C) and below 140 deg. F (60 deg. C).
- Class IIIA liquids- flash points at or above 140 deg. F (60 deg. C) and below 200 deg. F (93.4 deg. C).

- Class IIIB liquids- flash points at or above 200 deg. F (93.4 deg. C).

Compressed Gas: The OSHA Hazard Communication Standard 29 CFR 1910.1200 defines a compressed gas as a gas or mixture of gases having, in a container, an absolute pressure exceeding 40 psi at 70 deg. F (21.1 deg. C); or a gas or mixture of gases having, in a container, an absolute pressure exceeding 104 psi at 130 deg. F (54.4 deg. C) regardless of the pressure at 70 deg. F (21.1 deg. C); or a liquid having a vapor pressure exceeding 40 psi at 100 deg. F (37.8 deg. C) as determined by ASTM D-323-72.

Designated Area- 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 laboratory hood or glovebox.

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

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

Explosive- Chemical that causes a sudden, almost instantaneous release of pressure, gas, and heat when subjected to sudden shock, pressure, or high temperature.

Flammable: Chemical that falls into one of the following categories:

- Aerosol, flammable means an aerosol that, when tested by the method described in 16 CFR 1500.45, yields a flame protection exceeding 18 inches at full valve opening, or a flashback (a flame extending back to the valve) at any degree of valve opening;
- Gas, flammable means that a gas that, at ambient temperature and pressure, forms a flammable mixture with air at a concentration of 13 percent by volume or less; or
- A gas that, at ambient temperature and pressure, forms a range of flammable mixtures with air wider than 12 percent by volume, regardless of the lower limit;
- Liquids having closed cup flash points below 100 deg. F (37 deg. C) and vapor pressures not exceeding 40 psi (276 kPa) (2.76 bar) at 100 deg. F (37° deg. C).

Flammable liquids are referred to as Class 1 liquids.

- Class IA liquids - flash points below 73 deg. F (22.8 deg. C) and boiling points below 100 deg. F (37.8 deg. C).
- Class IB liquids - flash points below 73 deg. F (22.8 deg. C) and boiling points at or above 100 deg. F (37.8 deg. C).
- Class IC liquids - flash points at or above 73 deg. F (22.8 deg. C) and below 100 deg. F (37.8 deg. C).
- Solid, flammable means a solid, other than a blasting agent or explosive as defined in 29 CFR 1910.109(a), that is liable to cause fire through friction, absorption of moisture, spontaneous chemical change, or retained heat from manufacturing or processing, or which can be ignited readily and when ignited burns so vigorously and persistently as to create a serious hazard. A chemical shall be considered to be a

flammable solid if, when tested by the method described in 16 CFR 1500.44, it ignites and burns with a self-sustained flame at a rate greater than one-tenth of an inch per second along its major axis.

Flashpoint- The minimum temperature at which a liquid gives off a vapor in sufficient concentration to ignite when tested as follows:

- Tagliabue Closed Tester (See American National Standard Method of Test for Flash Point by Tag Closed Tester, Z11.24 - 1979 (ASTM D 56-79)) - for liquids with a viscosity of less than 45 Saybolt Universal Seconds (SUS) at 100 deg. F (37.8 deg. C), that do not contain suspended solids and do not have a tendency to form a surface film under test; or
- Pensky-Martens Closed Tester (See American National Standard Method of Test for Flashpoint by Pensky-Martens Closed Tester, Z11.7 - 1979 (ASTM D 93-79)) - for liquids with a viscosity equal to or greater than 45 SUS at 100 deg. F (37.8 deg. C), or that contain suspended solids, or that have a tendency to form a surface film under test; or
- Setaflash Closed Tester (see American National Standard Method of test for Flash Point by Setaflash Closed Tester (ASTM D 3278-78));
- Organic peroxides, which undergo autoaccelerating thermal decomposition, are excluded from any of the flashpoint determination methods specified above.

Hazardous chemical- Substances for which there is statistically significant evidence based on at least one study conducted in accordance with established scientific principles that acute or chronic effects may occur in exposed persons. Such chemicals include but are not limited to carcinogens, toxic or highly (acutely) toxic agents, reproductive toxins (mutagens and teratogens), irritants, corrosives, sensitizers, neurotoxins, and agents that damage the lungs, skin, eyes or mucous membranes.

- [Appendices A and B of the Hazard Communication Standard \(29 CFR 1910.1200\)](#) provide further guidance in defining the scope of health hazards and determining whether or not a chemical is to be considered hazardous for purposes of this standard.

Laboratory- Facility where the laboratory use of potentially hazardous materials or chemicals occurs. It is a workplace where relatively small quantities of hazardous chemicals are used on a non-production basis.

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

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

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

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

- Chemicals are handled in the course teaching or research activities;
- Multiple chemical procedures or chemicals are being used;
- Protective laboratory practices and equipment are available and in common use to minimize the potential exposure to hazardous chemicals.

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

SDS (Safety Data Sheet)- Safety Data Sheet, document providing both workers and emergency personnel with the proper procedures for handling chemical(s) described by that document.

Organic Peroxide- An organic compound that contains the bivalent -O-O- structure and which may be considered to be a structural derivative of hydrogen peroxide where one or both of the hydrogen atoms has been replaced by an organic radical.

OSHA: Occupational Safety and Health Administration. Refer to 29 CFR 1910.1450 for the OSHA Laboratory Standard.

Oxidizer- Chemical, other than a blasting agent or explosive as defined in § 1910.109(a), that initiates or promotes combustion in other materials, thereby causing fire either of itself or through the release of oxygen or other gases

PEL- Permissible Exposure Level based upon an 8-hour day as established by OSHA.

Personnel- Any students, staff, faculty, or visitors authorized to conduct or observe work in a laboratory.

Physical hazard- 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.

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

Reproductive toxins- Chemicals which affect the reproductive capabilities including chromosomal damage (mutations) and effects on fetuses (teratogenesis).

Select Carcinogen- Any substance which 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;
 - 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.

TLV- Threshold Limit Value based upon an 8-hour day as established by the American Conference of Governmental Industrial Hygienists (ACGIH).

Unstable (reactive)- A chemical which is the pure state, or as produced or transported, will vigorously polymerize, decompose, condense, or will become self-reactive under conditions of shocks, pressure or temperature.

Water-Reactive- A chemical that reacts with water to release gas that is either flammable or presents a health hazard.

II. Basic Rules

- a. Eye Protection:
 - i. All persons will wear eye protection at all times in a laboratory. Goggles or safety glasses with side and top shields will be considered acceptable eye protection.
 - ii. Goggles are required for activities with hazardous chemicals that can generate a splash.
- b. Eating, drinking, smoking, using smokeless tobacco, applying cosmetics:
 - i. Do not engage in these and similar actions in laboratories where hazardous substances are handled or stored. Do not store food or beverages in laboratories.
 - ii. Note: To prevent potential absorption of chemicals by tobacco, do not store tobacco products for personal use in laboratories in which hazardous chemicals are handled or stored.
- c. Personal Protective Equipment (PPE):
 - i. Persons in laboratories shall wear clothing that is compatible with the substances being handled. Confine long hair and loose clothing. Do not wear sandals, flip-flops, or other open-toed shoes that allow any portion of the feet to be uncovered. Students working with hazardous chemicals must have

exposed skin covered (arms, legs, feet) and will not wear shorts, tank tops, etc. Students will wear a lab apron or lab coat when handling hazardous chemicals.

- ii. Garments contaminated with hazardous materials:
 - 1. Do not remove garments contaminated with hazardous materials from the building for laundering. Personnel shall remove potentially contaminated personal protective equipment (gloves, lab coats, etc.) prior to leaving the laboratory and handle it appropriately to prevent the potential spread of contamination outside the laboratory or building.
- iii. Gloves:
 - 1. Personnel will wear gloves of appropriate material when the potential for contact with toxic or corrosive materials exists. In general, do not use natural rubber or cloth gloves for handling hazardous chemicals. Nitrile gloves are recommended in most cases. Some chemicals can permeate protective gloves in a very short time without visible degradation of glove material. Inspect gloves before each use to ensure no physical damage (cuts, swelling) is present. If appropriate, wash them before removal. Replace gloves periodically, as needed. If gloves become visibly wet with a chemical and show signs of softening, swelling, stretching, discoloration, etc., discard the gloves immediately. Good practice calls for disposing of gloves after each use.
 - 2. Take care not to allow gloved hands to inadvertently transfer biological, chemical, and/or radiological contamination to clean surfaces such as door knobs, books, notes, etc.
- d. Portable Media Players:
 - i. Do not use any type of personal media player, with or without earphones or headphones, while working in a laboratory. Use of such devices could prevent personnel from hearing essential procedural or safety instructions.
- e. Mouth Pipetting:
 - i. Never use mouth suction for pipetting or siphoning. Use mechanical pipetting devices, such as pipette bulbs or autopipettes.
- f. Working Alone:
 - i. Working alone with hazardous chemicals is prohibited. If using hazardous chemicals and/or working in a laboratory during normal working hours, personnel should ask other faculty or staff to check on them periodically. Undergraduate and graduate students shall never work alone if using hazardous chemicals. TTU recommends that staff do not perform potentially hazardous duties by themselves outside normal class hours; however, occasionally doing so may be necessary. Faculty working alone after normal class hours (approximately 8:00 am to 6:00 pm Monday through Friday) should notify campus police (372-3234) or another faculty member.

III. Ventilation

- a. General:
 - i. Ventilation provides a source of air for breathing and makeup air for local ventilation devices. It is not intended as primary protection from toxic substances released into the laboratory. The general ventilation system should

avoid the intake of contaminated air whenever possible. Vent vacuum pumps, distillation columns, chromatographs, etc., which may discharge toxic amounts of hazardous chemicals, into a local exhaust or chemical fume hood system whenever possible.

- b. Laboratory Fume Hoods:
 - i. Provide adequate hood space for persons working with hazardous chemicals. Verify that the hood exhaust system is working before using a hood. For example, attach a simple "flow indicator" (strip of tissue about 1" wide and at least 4" long) with tape to the bottom of the hood sash. Always work at least six inches back into the hood (six inches beyond the sash line) and keep the sash line between your body and your work. Keep the sash as low as possible to maximize face velocity into the hood and to serve as a primary barrier in case of a splash or spill. Keep materials and equipment in hoods to a minimum since they can create turbulence and disrupt the laminar flow that is necessary for worker protection. Keep the lower baffle unblocked and fully open.
 - ii. If personnel can detect odors released from materials in the hood area, then the hood may not be functioning properly; notify supervision and post warning signs not to use the hood. Do not work in an inoperative hood until it has been repaired and verified to be in proper working order.

IV. Housekeeping

- a. Work Areas:
 - i. Keep all work areas free of obstructions. Deposit waste in appropriate receptacles. Instruct all lab personnel about the different kinds of waste generated and appropriate methods for disposal. Keep surfaces clean of spilled liquids and solids. Clean areas after use or at the end of each work day.
- b. Access:
 - i. Never block access to exits, emergency equipment, utility controls and other safety equipment (e.g., safety showers, eye washes, and fire extinguishers).
- c. Hallways and Stairways:
 - i. Do not use hallways and stairways as storage areas. Keep all hallways and stairways free of obstructions.

V. Access

- a. Access to any laboratory space is to be controlled by the supervisor or Faculty member.
- b. Doors must be closed and locked when no one is in the laboratory.
- c. TTU Facilities and IT personnel are permitted access to laboratory spaces. An effort should be made by the Facilities and IT personnel to contact the supervisor prior to entering the laboratory space.
 - i. Emergency access by Facilities and IT personnel to a laboratory space does not require contact prior to entering the laboratory space. An effort should be made by Facilities and IT personnel after the incident requiring emergency access has been completed to contact the supervisor or Faculty member.

VI. Maintenance

- a. All Equipment:

- i. Inspect all equipment regularly for wear and deterioration. Repair or replace all defective equipment prior to further use. Maintain a written log of equipment inspections. Inspect equipment and facilities regularly and insure that necessary maintenance is performed. Develop an adequate lockout system to prevent injury from equipment during maintenance procedures. If applicable, coordinate maintenance operations and logs with Facilities.
- b. Fume Hoods:
 - i. EHS or an approved vendor will check fume hoods. Fume hoods will be checked at least once a year as well as following installation, filter changes, or maintenance activities. The check should include measuring the air velocity by making a traverse with an anemometer or velometer in the face plane of the hood with the sash at the practical work opening width. The average should be at least 100 linear feet per minute and the velocity at each point should not vary by more than 15 percent from the average.

VII. Guarding and Shielding

- a. Provide adequate guards for all mechanical equipment, such as vacuum pumps, heating mantles, and centrifuges, to prevent access to electrical connections or moving parts. Use safety shielding for any operation having the potential for an explosion or to minimize exposure to a potential hazard. Ensure that centrifuges are equipped with a cover lock which does not release until spinning has stopped.

VIII. Glassware

- a. Tubing should be fire polished or rounded and lubricated prior to insertion into rubber stoppers. Use only glassware designed for vacuum work if reduced internal pressure is required. Wrap glass vacuum dewars with tape to prevent flying glass if implosion occurs. Use hand protection when picking up broken glass. Glassware with small chips should be fire polished to smooth them out or discarded.
- b. Uncontaminated broken glassware shall be disposed of in a cardboard box labelled as "broken glassware." Tape the box closed when finished adding the broken glassware and dispose of in the dumpster.
- c. Chemically contaminated broken glassware shall be disposed of as per the [TTU Hazardous Waste and Satellite Accumulation Area Guide](#).
- d. Do not pressurize conventional laboratory glassware.

IX. Flammable Liquids

- a. Restrict flammable liquids in the work area to as small a quantity as possible. Store all flammable liquids in approved safety cans or flammable liquids storage cabinets.
- b. Label all containers to denote flammable contents.
- c. Areas where flammable materials are stored and used shall be equipped with adequate fire extinguishing equipment (Class ABC or BC).
- d. Protect glass containers of flammable liquids from breakage as much as possible.
- e. Use a secondary container when transporting chemicals.
- f. Do not use an open flame to heat a flammable liquid or to carry out a distillation process under reduced pressure. If an open flame is required for other operations, remove all flammable substances from the immediate area. Remember that fire can travel some distance along a vapor path from an open flame to the vapor source.

- g. When volatile materials are present, use only non-sparking explosion-proof electrical equipment such as explosion-proof refrigerators.

X. Explosive Hazards

- a. Organic Peroxides:
 - i. Organic peroxides, as a class, are low-power explosives that are hazardous because of their extreme sensitivity to shock, sparks, or other forms of accidental ignition.
 - ii. All organic peroxides are highly flammable, and fires involving peroxides should be approached with extreme caution.
 - iii. Use only the smallest amount of peroxides possible.
 - iv. Date all chemicals when received and dispose of old chemicals in accordance with the TTU Hazardous Waste Management and Satellite Accumulation Area Guide.
 - v. Clean up all spills immediately by adsorbing onto vermiculite. The sensitivity of most peroxides to shock and heat can be reduced by dilution with inert solvents such as aliphatic hydrocarbons.
 - vi. Avoid solutions of peroxides in volatile solvents since solvent vaporization might lead to increased peroxide concentration.
 - vii. Use ceramic or wooden spatulas, never metal, to handle peroxides. Avoid friction, grinding and all forms of impact near peroxides (especially solid ones).
 - viii. Do not use glass containers that have screw-cap lids or glass stoppers. Polyethylene bottles that have screw-cap lids may be used.
 - ix. To minimize the rate of decomposition, store peroxides at the lowest possible temperature but not below the temperature at which the peroxide freezes or precipitates.
 - x. Peroxides in solid form are extremely sensitive to shock and heat.
 - xi. Perform all laboratory experiments employing peroxides or peroxide containing solvents behind a shield and with all other recommended precautions.
- b. Picric acid:
 - i. Picric acid with <10% water presents a potential explosive hazard. Damp picric acid is white; dry picric acid is yellow. Handle dry (yellow) picric acid bottles with extreme caution.
 - ii. Check all supplies of picric acid monthly for color and add water as necessary. Limit the amount of acid to minimum required.
 - iii. Maintain a record of the date of receipt of the supply and properly dispose of unused acid before it degrades with time to an unsafe condition.
 - iv. Label all storage areas and containers to indicate the contents and caution against disturbing.
 - v. Do not store acid in proximity with materials such as oxidizable materials, metals (particularly finely divided) and alkaloids.
 - vi. Store containers in a well-secured area equipped with adequate ventilation. Avoid excessive movement or concussion of picric acid containers.
 - vii. Wear appropriate protective equipment when handling the acid to include chemical gloves, laboratory aprons, eye protection, etc.

- viii. Do not open a container if the acid appears dry. If crystals roll over each other, this may indicate sufficient dryness to be hazardous.
 - ix. Do not attempt dilution of acid unless through familiarization of the safe procedure to be applied has been performed.
 - x. Picric acid is a corrosive material that requires standard acid handling safety precautions.
 - xi. Spills of picric acid must be properly cleaned up as soon as possible and the residue properly disposed.
 - 1. If a spill occurs in the sink, flush with copious amounts of water. If the spill is on the counter or floor, cover with sand/soda ash mixture.
 - 2. To clean glassware and equipment contaminated by picric acid, thoroughly wash with a mild bicarbonate solution, followed by a strong soap solution. Regard empty, cleaned containers and equipment as regular waste material.
 - 3. Additional training and documentation is required for work with picric acid. Review the [Guidelines for Work with Picric Acid](#).
- c. Perchloric Acid:
- i. Perchloric acid solutions in contact with oxidizable or combustible materials or dehydrating and reducing agents may result in fire or explosion.
 - ii. Limit the amount of acid to minimum required.
 - iii. Store perchloric acid bottles in a glass or ceramic dish large enough to contain the entire contents of the bottle.
 - iv. The use of plastic coated safety bottles is strongly recommended.
 - v. When acid has been removed from a bottle, the outside should be rinsed.
 - vi. All glassware contaminated with perchloric acid should be thoroughly rinsed.
 - vii. Perform laboratory reactions in a fume hood constructed of non-corrosive material and equipped with a water spray wash-down system capable of decontamination in conjunction with safety shields.
 - viii. Exhaust ducts should take the shortest, non-directional change route to an exterior discharge.
 - ix. Decontaminate the system prior to any repair work.
 - x. Contact of perchloric acid solutions with strong dehydrating agents such as concentrated sulfuric acid may result in the formation of explosive anhydrous perchloric acid.
 - xi. In wet combustion with perchloric acid, treat the sample first with nitric acid to destroy easily oxidizable substances.
 - xii. Keep perchloric acid away from incompatible organic chemicals.
 - xiii. Acid spills should be washed up immediately, using large quantities of water with repeated mopping up and final rinsing of the mopped up material.
 - 1. Neutralize any acid residue before the final disposal.
 - xiv. Use only electric hot plates for heating perchloric acid solutions and do not allow the solutions to become anhydrous.
 - xv. Inspect perchloric acid at least monthly and properly dispose of any acid that shows signs of contamination or discoloration.
 - xvi. Any procedure or condition that causes perchloric acid to become more concentrated than 72% should be considered potentially hazardous.
- d. Unstable Functional Groups:

- i. In general, compounds containing the following functional groups tend to be sensitive to heat and shock:

Acetylide	Nitroso
Azide	Ozonide
Diazo	Peroxide
Haloamine	

- ii. Compounds containing nitro groups may be highly reactive, especially if other substances such as halogens are present. Treat perchlorates, chlorates, nitrates, bromates, chlorites, and iodates, whether organic or inorganic, with respect, especially at higher temperatures.
- iii. Be as familiar as possible with the hazardous properties of the chemicals with which you are working.

XI. Compressed Gases

- a. Compressed gases can present both mechanical and chemical hazards at the same time. Compressed gases contain a large amount of potential energy, making a compressed gas cylinder a potential torpedo or fragmentation bomb. The reactivity and/or toxicity of gases can present additional hazards. High concentrations of "harmless" gases such as nitrogen can cause asphyxiation. Handling compressed gases and the associated cylinders, regulators, and tubing requires careful procedures.
- b. Cylinder Contents:
 - i. Identify gas cylinder contents with decals, stencils, or glued or wired-on tags. Do not accept or use a cylinder that lacks the proper identification. Determine the hazardous properties of a gas (such as flammability, toxicity, chemical activity and corrosive effects) before using the gas. Utilize adequate safety precautions at all times.
- c. Protective Valve Caps:
 - i. Keep protective valve caps on cylinders at all times, except when containers are connected to dispensing equipment. Do not use cylinders as rollers, supports or for any other purpose than to contain the contents as received. Do not drag, roll, or slide gas cylinders. Use a suitable hand truck for transporting large cylinders. Secure the cylinders to the hand truck with a chain or belt. When a cylinder has been positioned in its place for use, secure it to a wall, a bench or some other firm support, or cylinder stand. Protect cylinders from exposure to damp ground, sunlight or other high temperatures, precipitation, direct flame, electrical currents, corrosives, physical damage, etc.
- d. Empty and Full Cylinders:
 - i. Store empty and full cylinders separately. Strong negative pressure can occur when an empty cylinder is mistakenly attached to a pressurized system. Mark empty cylinders to show they are empty. Never assume that a cylinder labeled "empty" is indeed empty regarding opening of the valve or leaving it unsecured. When returning cylinders, close the valve before shipment and leave some positive pressure in the cylinder.
- e. Flammable gas cylinders:

- i. Ground cylinders containing flammable gas and bond them to the equipment they serve to control static electricity.
- f. Size and total number of cylinders:
 - i. Keep both the size and number of cylinders present as small as possible. Toxic, flammable and corrosive gases should be used with local exhaust ventilation (such as a fume hood) whenever possible.
- g. Traps or suitable check valves:
 - i. Use a trap or check valve when discharging gas into a liquid to prevent liquid from entering the regulator and cylinder.
- h. Different types of gases stored:
 - i. Group gases stored at the same location by types of gas and the gases arranged in accordance with the appropriate groups as much as possible. For example, keep oxidizers away from fuel gases. Do not store cylinders near readily ignitable substances or other combustibles. Flammable gases must be protected from sources of ignition such as open flames, arcing electrical equipment, smoking, static electricity, mechanical friction, etc. Post signs in areas in which flammable gases are present identifying the substances and appropriate precautions.
- i. Exits, stairways:
 - i. If possible, do not store cylinders in areas normally used or intended for safe exit from the facility. If possible, cylinders should not be located in areas accessible to the general public when possible and should be protected against tampering.
- j. Matching Equipment:
 - i. Use cylinders only with appropriate matching equipment for the contents. Do not force the connection or use homemade adapters. Do not use a cylinder without an appropriate pressure regulator. Close cylinder valves when not in use. Do not stop the flow from a cylinder overnight by backing off on the regulator. Even the best quality regulators can malfunction and allow pressure buildup.
- k. Cylinder Filling:
 - i. Never attempt to refill a cylinder by connecting to one of a higher pressure. Only vendors should refill cylinders.
- l. Valve Access:
 - i. Place cylinders so that the cylinder valve is accessible at all times. Cylinder valves should be opened slowly. The valve should only be opened to the extent necessary to produce the desired flow, never fully opened against the stop. Never open the valve on an unregulated cylinder.
- m. Cylinder Discharge Lines:
 - i. If the possibility of flow reversal exists, install an approved check valves to prevent inadvertent contamination of cylinders that are connected to a closed system.
- n. Regular Testing:
 - i. Inspect and test periodically all equipment used with compressed gases and maintain records. If a leak is suspected, locate the leak using detection techniques appropriate to the gas or equipment involved.

- o. Additional training and documentation is required for work with compressed gases. Review the [Compressed Gases and Cryogenic Liquids SOP](#).

XII. Cryogenic Liquids

- a. Cryogenic liquids present a number of hazards about which personnel should be properly trained. Do not transfer liquefied gases from one container to another for the first time without the direct supervision and instruction of someone experienced in the operation.
- b. Fire/Explosions:
 - i. Never use liquid nitrogen or liquid air to cool a flammable mixture in the presence of air because oxygen can condense from the air and lead to a potentially explosive condition.
 - ii. Provide adequate ventilation to prevent the build-up of vapors of flammable gases such as hydrogen, methane, and acetylene or inert gases, such as nitrogen or helium.
 - iii. Keep equipment scrupulously clean to avoid hazardous conditions on contact with cryogenic fluids, especially oxygen.
- c. Pressure:
 - i. Do not fill cylinders and other pressure vessels used for the storage and handling of liquefied gases to more than 80% of capacity. This action prevents the possibility of thermal expansion and the resulting bursting of the vessel by hydrostatic pressure.
- d. Embrittlement of Structural Materials:
 - i. Use appropriate impact-resistant containers that have been designed to withstand extremely low temperatures.
- e. Contact With and Destruction of Living Tissue:
 - i. Even very brief contact with a cryogenic liquid can cause tissue damage resembling that of thermal burns. Prolonged contact may result in blood clots that have potentially serious consequences. In addition, surfaces cooled by cryogenic liquids can cause severe damage to the skin.
 - ii. Recommended personal protective equipment (PPE) when handling cryogenic liquids includes full face protection, impervious apron or coat, cuffless trousers and high-topped shoes. Use gloves that are impervious to the fluid being handled and loose enough to be tossed off easily. Appropriate dry gloves should be used when handling dry ice. Slowly add dry ice "chunks" or cubes to any liquid portion of the cooling bath to avoid foaming over.
- f. Asphyxiation:
 - i. As cryogenic liquids warm and become airborne, they may displace oxygen to the point that personnel may experience oxygen deficiency or asphyxiation. Provide good ventilation around cryogenic liquids. For this same reason, personnel should not lower their heads into a dry ice chest since carbon dioxide is heavier than air, and suffocation can result.
- g. Additional training and documentation is required for work with cryogenic liquids. Review the Compressed Gases and Cryogenic Liquids SOP.

XIII. Ionizing Radiation Hazards

- a. Post appropriate signage at each entrance to an area containing an ionizing radiation source(s). Follow established guidelines/standards regarding the storage, use and management of radioactive material and restrict such activities to approved areas.
- b. All users of radioisotopes and sources of ionizing radiation must be approved prior to work. Users imply consent to some exposure above natural background radiation levels.
- c. Maintain high cleanliness and housekeeping standards in radiological work areas to prevent accidental intake into the body or transfer outside the work area.
- d. Always wear appropriate gloves and wash hands and arms thoroughly on leaving the area.
- e. Use double containers (e.g. scintillation vial inside a beaker) for storage. Line work surfaces with adsorbent paper. Dispose of waste in containers labeled "Radioactive Waste."

XIV. Reactive Chemical Hazards

- a. Water Reactive Chemicals:
 - i. Laboratory procedures may use chemicals that react violently with water. The danger associated with these chemicals frequently comes from the formation of potentially explosive or flammable gases (e.g. hydrogen). Extreme caution should be exercised when handling water reactive chemicals.
 1. Some Water Reactive Chemicals:

Alkali Metals

Potassium metal (K)	Sodium (Na)	Lithium (Li)	Alkali Metal Hydrides
Lithium aluminum hydride (LiAlH ₄)	Sodium borohydride (NaBH ₄)	Sodium hydride (NaH)	Potassium hydride (KH)
Calcium hydride (CaH ₂)	Alkali Metal Amides	Silver amide (Ag ₂ NH)	Cuprous nitride (Cu ₃ N)
Cadmium amide (Cd(NH ₂) ₂)	Lead amide (PbNH)	Sodium amide (NaNH ₂)	Potassium amide (KNH ₂)

Metal Alkyls

Alkylolithiums	Aryllithiums	Trialkylaluminums
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Halides of Non-Metals

Boron trichloride (BCl ₃)	Boron trifluoride (BF ₃)	Phosphorus trichloride (PCl ₃)	Phosphorus pentachloride (PCl ₅)
Silicon tetrachloride (SiCl ₄)	Sulfur monochloride (S ₂ Cl ₂)		

Inorganic Acid Halides

Phosphorus oxychloride (OPCl ₃)	Sulfur chloride (S ₂ Cl ₂)	Anhydrous Metal Halides	Aluminum chloride anhydrous (AlCl ₃)
Titanium tetrachloride (TiCl ₄)	Zirconium tetrachloride (ZrCl ₄)	Stannic chloride (SnCl ₄)	

Others

Phosphorus pentoxide (P ₂ O ₅)	Calcium carbide (CaC ₂)	Organic acid halides and hydrides of low molecular weight
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ii. Precautions:

1. Protect containers of water reactive chemicals from physical damage and ensure they are tightly sealed during storage. Periodically verify that adequate separation from all sources of water.
2. If electrical equipment is located in areas where larger quantities of the chemicals are stored, it should be of an approved, explosive-proof type.
3. Wear appropriate personal protective equipment including chemical goggles, face shields as warranted, gloves, aprons, etc.
4. Control all possible ignition sources in storage and handling areas.
5. Separate water reactive chemicals from incompatible chemicals such as organic metals, other combustibles, chlorinated hydrocarbons, etc. Store those chemicals, such as lithium and sodium, submerged in Kerosene or other inert oils.
6. Clean up all spills immediately and properly dispose of the residue.
7. Make a Class D fire extinguisher available where water-reactive materials are stored or handled.

b. Pyrophoric Chemicals:

- i. Pyrophoric chemicals react violently on exposure to air leading to spontaneous ignition. Exercise extreme caution when handling pyrophoric chemicals. Use only air-tight, undamaged containers. Follow all recommended storage guidelines from the supplier.
- ii. Do not handle except in an inert atmosphere.
- iii. Wear appropriate personal protective equipment to include chemical goggles, face shields as warranted, gloves, aprons, etc.
- iv. Avoid contact with incompatible materials. Areas within the laboratory containing air reactive chemicals should be posted to alert emergency response and other authorized personnel.
- v. Some Pyrophoric Chemicals:

Grignard Reagents	(RMgX)	Metal Hydrides	Sodium hydride (NaH)
Lithium aluminum hydride (LiAlH ₄)	Metal Alkyls and Aryls	(RLi)	(RNa)
(R ₃ Al)	(R ₂ Zn)		

Non-Metal Hydrides

Diborane (B ₂ H ₆)	Phosphine (PH ₃)	Arsine (AsH ₃)	Other boranes
Metal Carbonyl	Nickel tetracarbonyl (Ni(CO) ₄)	Iron Pentacarbonyl (Fe(CO) ₅)	Cobalt carbonyl (Co ₂ (CO) ₈)

Non-Metal Alkyls

(R ₃ B)	(R ₃ P)	(R ₃ As)
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Alkali Metals

Sodium (Na)	Potassium (K)	Metal Powders (Particularly when finely divided)	Aluminum (Al)
Cobalt (Co)	Iron (Fe)	Magnesium (Mg)	Palladium (Pd)
Platinum (Pt)	Tin (Sn)	Zinc (Zn)	Zirconium (Zr)

Others

White Phosphorus

XV. Safety Equipment and Procedures

- a. First Aid:
 - i. All accidents involving an injury need to be reported to your supervisor. Please review [TTU Human Resources](#) procedures for documentation of accidents involving students, visitor, staff, and faculty.
 - ii. It is recommended, but not required to keep adequate first aid supplies in each teaching laboratory that contains or uses hazardous chemicals.
 - iii. Immediately flush chemicals burns with copious amounts of water for at least 15 minutes.
 - iv. All laboratory personnel and students shall have access to emergency equipment, a fire alarm, and telephone for use in an emergency.
- b. Personal Protective Equipment (PPE):
 - i. Wear a lab coat, eye protection, gloves, respirators, etc. as appropriate for the degree of hazard present in the laboratory.
 - ii. Responsible faculty members must perform risk assessment for the proper selection of PPE and assume responsibility for the proper selection and maintenance of PPE.
 - iii. Inform all personnel of PPE requirements and train them in the proper use of PPE.
 - iv. Regularly check all PPE for integrity and maintain it in clean, functional order.
 - v. Make PPE readily available for use at all times with storage areas designated by signs or labels.
 - vi. All personnel and students must wear eye protection (splash goggles or safety glasses) at all times in laboratories where hazardous chemicals are used or stored, or processes present a significant potential for eye injury.
 - vii. Contact lens wear is not encouraged but may be determined by responsible faculty members.
- c. Respirator Use:
 - i. Prior to wearing or selecting any respirator, you must first contact EHS to be enrolled in the [TTU Respiratory Protection Program](#).
- d. Emergency Safety Equipment:
 - i. Ensure all laboratory personnel are familiar with the emergency safety equipment and procedures.
 - ii. All lab workers are expected to know the locations of fire alarm pulls, fire blankets, safety showers, eye washes, spill clean-up kits and emergency exits.
 - iii. Eyewash stations are required in areas that utilize hazardous chemicals or materials/equipment that might cause a significant eye injury.

- iv. Provide safety showers in areas that utilize hazardous chemicals or materials/equipment which might require drenching to remove the hazard from an individual.
 - 1. The exemption of the requirement for having a safety shower is if the safety shower is located in an area where the overall hazard of the laboratory would be increased by the presence of a shower unit coupled with existing instrumentation (i.e. electrical shock hazard due to the presence of instrumentation, etc.). In this case, a shower in an adjacent area may be used.
- e. Fire Extinguishers:
 - i. Provide readily accessible fire extinguishers that are charged and regularly inspected. IF DISCHARGED, contact EHS at 372-3227 to get the extinguisher serviced and returned.
- f. Laboratory safety equipment:
 - i. Appropriate university personnel will inspect lab safety equipment and furnishings such as showers, eyewashes, hoods, glove boxes, vacuum pumps, electrical outlets and cords, etc. at least annually or according to appropriate standards.
- g. Spill Control and Procedures:
 - i. If a potentially hazardous spill occurs, immediately notify EHS at 372-3227 or University Police at 372-3234. All labs with hazardous chemicals must have a chemical spill kit applicable to the chemicals within the laboratory.
 - ii. Recommended chemical spill kits should contain: sodium bicarbonate or commercial acid neutralizer; vermiculite; citric acid or commercial caustics neutralizer, rubber gloves, pH papers, safety glasses/goggles, rubber boots and several "area closed" signs.
 - 1. Containment pillows and/or socks may be substituted for use in spill containment.
 - 2. Personnel involved in cleaning a chemical spill must utilize appropriate protective equipment and supplies.
- h. Evacuation:
 - i. Follow established procedures to evacuate the building in case of emergency. Possible reasons for evacuation include but are not limited to fire, major chemical spills, severe weather, and bomb threats.
- i. Signs and Labeling:
 - i. Designate all safety equipment, hazardous chemical storage and use areas, labs with unusual hazards (e.g. high magnetic fields), etc. with appropriate signage.
 - ii. Laboratory door signage can be obtained from EHS.

XVI. Precautions for Working with Hazardous Materials

- a. Precautions and Approvals:
 - i. Handle carcinogens, genotoxins, reproductive toxins and chemicals with a high degree of acute toxicity using special precautions to minimize exposure risks.
 - ii. Use and store no more of these chemicals than is absolutely necessary.
 - iii. Work with these chemicals only in a functional fume hood, glove box, or other suitable containment system.

1. All personnel will use HEPA filtration to protect fume hood exhausts, vacuum lines, etc.; decontaminate the area after use; and dispose of waste per instructions from the TTU Hazardous Waste Management and Satellite Accumulation Area Guide.
- iv. Pregnant women must consult with their personal Physician prior to working with mutagens or teratogens.
- b. Chemicals of High Chronic and Acute Toxicity:
 - i. Chemicals of high chronic toxicity will show delayed, usually irreversible effects after repeated exposure, while chemicals of high acute toxicity will show quick, sometimes reversible effects after a single short exposure. Use these chemicals in a controlled access laboratory.
 - ii. Decontaminate any equipment before removing it from the laboratory or dispose of it as hazardous waste. Refer to the [Surplus Disposal Guide](#) for additional information. Remove and dispose of protective clothing when leaving the laboratory.
- c. Carcinogens:
 - i. Follow all precautions outlined in Safety Data Sheet (SDS) when working with known or suspected carcinogens.
- d. Teratogens and Mutagens:
 - i. Teratogens and mutagens can affect a developing embryo or fetus or adversely alter the DNA of an exposed person. Common chemicals suspected of being mutagens and teratogens include:

Benzene	Vinyl Chloride	Hydrogen Sulfide	Toluene
Formaldehyde	Carbon Disulfide	Xylene	Dimethylformamide
Carbon Monoxide	Aniline	Dimethyl Sulfoxide	Nitrates
Nitrobenzene	N,N-Dimethylacetamide	Nitrites	Phenol
PCB	Lead	Mercury	Nitrous Oxide
Formamide			

- e. Allergens and Embryotoxins:
 - i. When handling allergens and embryotoxins, wear appropriate PPE, work in a functional fume.
- f. Acute Respiratory Hazards:
 - i. Use chemicals that are acute respiratory hazards only with adequate ventilation, never in a confined space.
- g. Corrosive Chemicals:
 - i. Corrosive chemicals include strong acids, strong bases, dehydrating agents, and oxidizing agents. They cause damage to skin, respiratory tissue, and eyes.
 - ii. Flush exposed skin with water for at least 15 minutes, and then seek immediate medical attention.
 - iii. Use nitrile gloves, rubber aprons, and face shields/goggles when handling bulk quantities of corrosive chemicals.
 - iv. Have spill control materials readily available.
 - v. Store corrosives in as close to floor level as possible, preferably in corrosion-resistant trays. Use a secondary container for transporting corrosive chemicals.

XVII. Chemical Management

- a. Chemical Storage:
 - i. Store chemicals in alphabetical order only if they are in compatible chemical categories.
 - ii. Take precautions not to store oxidizing agents and other reactive chemicals close to interactive agents.
 - iii. Minimize chemical storage areas.
 - iv. Do not store chemical on bench tops and in hoods.
 - v. Do not store food in chemical storage refrigerators.
 - vi. Chemicals, especially liquids, should never be stored on the floor.
 - vii. Large bottles (2.5L or larger) should not be stored above the bench top.
 - viii. Do not store reagents, solutions, glassware, or other equipment in hoods.
- b. Chemical Inventory:
 - i. Update the chemical inventory annually as per the [Chemical Inventory Standard Operating Procedure](#).
- c. Transport of Chemicals:
 - i. Use appropriate safety equipment (such as lab carts, safety buckets, and gas carts for gas cylinders) while moving chemicals within and between laboratories and storage areas.
 - ii. Use the elevator to move large containers, gas cylinders, and dewars between floors.
- d. Container Labelling (Chemicals from Manufacturer/Commercial Product):
 - i. Hazardous chemicals in the laboratory must be properly and adequately labeled. PIs and or Laboratory Managers must assure that all chemicals have labels with legible writing that indicate as per the [OSHA Hazard Communication Standard](#):
 1. Name of contents (the label must be written in English using acceptable IUPAC chemical names).
 2. Health and Physical Hazard associated with the material (NFPA hazard warnings, corrosive, oxidizer, acid, alkali, radiation, etc. Each and every container must have an accurate label.
 - ii. Abbreviations are acceptable on labels only if the laboratory maintains an abbreviation document clearly visible and in the vicinity of the container that indicates the chemical name represented by the abbreviations.
 - iii. Hand-written labels must specify the name of the chemical(s), CAS number (if known), the person(s) responsible, and the date the chemical was generated.
 - iv. Containers that do not have appropriate labels will be considered waste, segregated from active storage areas, and shall be disposed at the earliest opportunity.
 - v. Name and address of the chemical manufacturer or distributor must also be on the label.
 1. If a container arrives without the manufacturer's label, an appropriate label must be affixed to it. Labels must not be removed, except under the following conditions:
 2. Container is immediately relabeled.

3. Chemical in the container is removed, a new type of chemical is placed in the container, and the container relabeled with the identity of the new chemical.
- e. Special Labeling Practices:
- i. Research samples and chemicals developed in the lab (samples) must be managed responsibly. Samples often accumulate in labs for years and are difficult to identify and dispose of and can create unsafe and non-compliant conditions if not managed properly.
 - ii. If you transfer the chemical into a secondary container and do not use it immediately, it must be labeled with:
 1. The required information from the original container label OR the product identifier AND general information regarding the chemical hazards that, together with other information available, will provide employees with specific information regarding physical and health hazards.
 - iii. Chemicals that are time-sensitive or that produce peroxides must be dated indicating the date storage began.
 - iv. If samples are consolidated for storage (e.g., vial boxes), it is not always necessary to label every sample container. For example, a box containing sample vials which are all in the same hazard class (e.g., miscellaneous compounds with hazardous properties) can have one label on the outside of the box stating "Product A-Phenol Derivatives" or a similar description. A label such as the one shown below can be used to identify consolidated samples, and should only be used on a temporary basis. This type of information communicates the hazards to emergency responders, as well as gives EHS the information necessary for proper disposal.

<u>Chemical Description:</u>		
Product A-		
Phenol derivatives		
<u>Generators Name:</u>		
Jane Smith		
<u>Date:</u>		
October 1 2015		
<u>Circle the Hazards that apply:</u>		
CARCINOGEN	<input checked="" type="checkbox"/> CORROSIVE	EXPLOSIVE
FLAMMABLE	TOXIC	OXIDIZER
<input checked="" type="checkbox"/> IRRITANT	REACTIVE	NON-HAZ
OTHER: _____		

- v. If the chemical substance is produced for another user outside of the lab, the Laboratory Supervisor must comply with the OSHA Hazard Communication Standard including the requirements for preparation of SDSs and container labeling.
- vi. If the hazard(s) of a sample/product is unknown, the PI/Faculty/Laboratory Supervisor must attempt to determine whether it is hazardous or not. Assume all samples are toxic unless otherwise demonstrated. This can be accomplished by literature review or reviewing the hazards of other similar compounds. At a minimum, the PI/Faculty/Laboratory Supervisor should be able to determine if a chemical is flammable, corrosive, oxidant, or reactive. Contact EHS for assistance with identifying the hazards of samples.
- vii. The following requirements apply to samples developed in the laboratory:
 1. All samples must be kept closed except when in use.
 2. Storage in beakers or flasks should be temporary. If temporarily storing samples in beakers or flasks, a cork, Parafilm®, or some other closure device must be used.
 3. Stockpiling unusable samples is not an acceptable practice. All samples that are no longer necessary must be properly disposed of in a timely manner using the TTU Hazardous Waste disposal program.
 4. Samples must be stored according to the primary hazard class; this should be done to the best of your ability considering the properties that are known or assumed such as toxicity.
- f. Safety Data Sheets (SDS):
 - i. SDS's for chemicals must be accessible at all times.
 - ii. Refer to the OSHA Hazard Communication Standard (29 CFR 1910.1200), and the TTU Hazard Communication Program for more information.

XVIII. Interdepartmental Chemical Transfers

- a. TTU recognizes that some departments may require small amounts of chemicals from another department. Faculty members (or their designated representatives) must present a SDS for the desired chemical prior to receiving that chemical. This ensures that the faculty members (or their designated representatives) are aware of any hazards associated with transport, use, and storage of that chemical.
 - i. An inter-departmental transfer (IDT) form may need to be completed.

XIX. Medical Surveillance

- a. Criteria for Reasonable Suspicion of Over-Exposure:
 - i. Personnel who encounter a spill of hazardous chemicals, experience direct skin or eye contact with hazardous chemicals, or exhibit symptoms of exposure may have been over-exposed.
- b. Signs and Symptoms:
 - i. Personnel who exhibit signs and symptoms of over-exposure should seek treatment at Cookeville Regional Medical Center Emergency Room (931) 528-2541 or Satellite Med Urgent Care and Family Practice (931) 528-7312. Following treatment, contact CorVel (as per Workers Compensation requirements). If exposure is not life-threatening, contact CorVel first then seek treatment as recommended.

- ii. Notify EHS at 372-3227.
- c. Medical Examinations and Consultations:
 - i. University Employees:
 - 1. The University will provide all employees who work with hazardous chemicals an opportunity to receive medical attention as warranted and in compliance with Section (g) "Medical Consultation and Medical Examinations" of Tennessee Occupational Safety and Health Administration (TOSHA) "The Occupational Exposure to Hazardous Chemicals in the Laboratory Standard" (29 CFR 1910.1450).
 - 2. Employees are encouraged to review and become familiar with the specifications.
 - ii. Non-University Employees and Students:
 - 1. Non-University employees and students shall bear the expense for medical surveillance and treatment in the event of an accidental exposure to a hazardous chemical. These individuals may contact Human Resources to request access to filing appropriate claims for compensation pursuant to the guidelines set forth by the Tennessee Claims Commission.

XX. Medical Records

- a. The University will maintain medical records as per state and federal regulations.

XXI. Training

- a. Faculty/Supervisor:
 - i. All faculty/supervisor members will complete a risk assessment of the work being conducted within their research and teaching laboratories.
 - ii. When working with hazardous chemicals, all faculty/supervisor members shall complete at a minimum the on-line training modules in fire extinguishers, lab safety, RCRA, and right-to-know (HazCom12) available from EHS. Refer to the [Training Matrix](#) for other applicable training modules.
 - iii. Site-specific training documentation is required once, and must be updated each time a new hazard is present.
 - iv. Online training shall be completed annually.
 - v. All faculty/supervisor members are ultimately responsible for ensuring all staff and/or students within their research or teaching laboratories are appropriately trained on the hazards.
 - 1. Please refer to your departmental procedures for keeping copies of training records. These records must be available for regulatory review.
- b. Teaching Assistants (TA), Research Assistant (RA), paid students, and unpaid student workers within the lab:
 - i. Based upon the findings of the risk assessment by the faculty/supervisor member, the TA, RA, and paid student employees will be required to take training.
 - ii. Site specific training documentation is required once, and must be updated each time a new hazard is present.
 - iii. Online training shall be completed annually.
 - 1. Refer to the Training Matrix for applicable training modules.

- c. Students in class:
 - i. All students will be given basic safety instructions at the initial meeting of their respective lab sections. These instructions should be pertinent to each respective lab.
 - ii. It is recommended to have written safety procedures incorporated into the experimental procedures.
 - iii. No documentation is required.

XXII. Waste Disposal

- a. Unwanted chemicals or waste chemicals must be disposed of according to the TTU Hazardous Waste Management and Satellite Accumulation Area Guide.

XXIII. References

Oak Ridge National Laboratory, "Chemical Hygiene Plan, Rev. 4" 2005
National Research Council, "Prudent Practices in the Laboratory: Handling and Disposal of Chemicals" 1995
University of Tennessee-Knoxville, "The Laboratory Chemical Hygiene Plan" 2005
University of Tennessee-Chattanooga, "Chemical Hygiene Plan" 2005
University of Alabama, "Chemical Hygiene Plan and Laboratory Guide" 2000
40 CFR 262.214- EPA Laboratory Management Plan
29 CFR 1910.1450- OSHA Lab Standard
29 CFR 1910.1200- OSHA Hazard Communication Standard
OSHA 29 CFR 1910.120 (Hazardous Waste Operations and Emergency Response)
EPA 40 CFR Parts 260-279
Tennessee Code Annotated (1200-01-11; 0400-12-01)

XXIV. Training documentation: Chemical Hygiene Plan

It is the responsibility of each laboratory manager or Faculty member to ensure that all personnel who work with, generate, or otherwise come into contact with hazardous chemicals (including hazardous waste) receives adequate familiarization training on the requirements this Chemical Hygiene Plan covers. Each worker must thoroughly understand the rules and regulations associated with handling hazardous chemicals before any duties requiring them to come into contact with such materials are assigned to them.

This sheet is to be maintained in the laboratory with the training documentation for personnel, and provided upon request.

BY MY SIGNATURE BELOW, I ACKNOWLEDGE THAT I AM THOROUGHLY AWARE OF AND UNDERSTAND THE RULES AND REGULATIONS ASSOCIATED WITH THE CHEMICAL HYGIENE PLAN AS COVERED IN THIS MANUAL. FURTHERMORE, I AGREE TO COMPLY WITH THESE RULES IN MY WORKPLACE.

Last	First	T number	Signature	Date

