CHEMICAL HYGIENE PLAN

PRODUCED BY ENVIRONMENTAL HEALTH AND SAFETY IN COOPERATION WITH THE DR SEMMES SCHOOL OF SCIENCE

Contents

Purpose

The Chemical Hygiene Plan (CHP) is a written program stating the policies, procedures, and responsibilities that protect workers from the health hazards associated with hazardous chemicals used in that particular workplace (OSHA, 29 CFR 1910.1450). Trinity University views the safety and welfare of employees, students, and visitors as integral to carrying out the educational mission of the institution. The university will comply with federal, state and local safety regulations and will develop documented comprehensive plans, regulations, procedures and programs in support of safety of the university community.

Introduction

The CHP shall be readily available to all laboratory personnel, and upon request, other regulatory agencies. The CHP will supersede, for laboratories, the requirements of all other OSHA health standards in 29 CFR part 1910, Subpart Z.

For any OSHA health standard, only the requirement to limit employee exposure to the specific permissible exposure limit shall apply for laboratories, unless that particular standard states otherwise.

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

Uses of hazardous chemicals that do not meet the definition of laboratory use, and in such cases, personnel must comply with the relevant standard in 29 CFR part 1910, Subpart Z, even if such use occurs in a laboratory.

The Chemical Hygiene Plan must include each of the following elements:

- Standard operating procedures relevant to safety and health considerations to be followed when laboratory work involves the use of hazardous chemicals;
- Criteria that personnel will use to determine and implement control measures to reduce employee and student exposure to hazardous chemicals including engineering controls, administrative controls (i.e. hygiene practices), and personal protective equipment. Particular attention shall be given to the selection of control measures for chemicals that are known to be extremely hazardous;
- A requirement that fume hoods and other protective equipment are functioning properly and specific measures that shall be taken to ensure proper and adequate performance of such equipment;
- Provisions for employee and student information and training;
- Designation of personnel responsible for implementation of the Chemical Hygiene Plan including the assignment of a Chemical Hygiene Officer;
- Provisions for additional employee and student protection for work with particularly hazardous substances. These include "select carcinogens," reproductive toxins and substances that have a high degree of acute toxicity. Specific considerations shall be given to the following provisions which shall be included where appropriate:
    - Establishment of a designated area;
    - Use of containment devices such as fume hoods or glove boxes;
    - Procedures for safe removal of contaminated waste; and
    - Decontamination procedures.

The Chemical Hygiene Plan will be reviewed and evaluated annually, and updated as necessary.

Responsibilities

Health and safety within the laboratory ultimately lies with each individual who works in a laboratory; however, the Principal Investigator, faculty member, and laboratory supervisor are responsible for promoting a safe work environment through appropriate training and guidance specific to their lab. This includes the use, handling, containment and disposal of all hazardous chemicals as outlined in the CHP, and training laboratory personnel in the hazards specific to their designation.

Environmental Health and Safety (EHS):

- Establishes policies, recommendations, and guidelines.
- Develops and provides training programs designed to meet regulatory requirements.
- Provides consultation in providing health and safety information to personnel.
- Maintains the campus Chemical Hygiene Plan.
- Designates the Chemical Hygiene Officer

Principal Investigator, faculty member, laboratory supervisor, and laboratory staff:

- Complies with and enforces all standards, policies, procedures and referenced material to include the use, handling, containment and disposal of all hazardous chemicals as outlined in the CHP.
- Trains employees and students in the hazards and equipment specific to their designation.
- Informs EHS when a new activity may introduce new hazards or materials (e.g. chemical, biological, or controlled substances).
- Provides safety equipment to be used when necessary.
- Reports all hazardous material spills greater than 1 liter as soon as possible to Trinity University Police.
- Reports all injuries to Trinity University Police.
- Labels, tags, and marks each chemical.

Laboratory Personnel (Student):

- NEVER conducts experimental procedures alone in a laboratory.
- Complies with all established safety procedures and policies.
- Maintains awareness of the potential risks associated with assigned duties.
- Attends required training classes.
- Takes all necessary safety precautions pertinent to their job duties.
- Wears appropriate PPE.
- Informs their immediate supervisor or EHS of any unsafe conditions.
- Reports all injuries in the lab to the immediate supervisor.
- Reports to their immediate supervisor of any change in their health status if there is a possibility it may be work-related.

Control Measures

Engineering Controls

Engineering controls are the first line of defense to protect laboratory workers by reducing exposure to certain hazards. Examples of engineering controls include chemical fume hoods, biological safety cabinets and ventilated storage cabinets. **If you notice that any of the abovementioned engineering are malfunctioning, you must contact your supervisor immediately so a Facilities Services work order can be generated.**

Emergency Controls

Fire extinguishers and safety showers

Principle Investigators and Laboratory Supervisors are required to instruct new personnel in the location of fire extinguishers, safety showers, and eyewashes before they begin research in the laboratory. All laboratories should be outfitted with fire extinguishers. All fire extinguishers

should be mounted on a wall in an area free of clutter or stored in a fire extinguisher cabinet. All personnel should be familiar with the location, use, and classification of the extinguishers in their laboratory.

Personnel are **not** required to extinguish fires that occur in their work areas. It is not recommended that faculty, staff or students use fire extinguishers unless they have attended a Fire Extinguisher Training Session provided by EHS. Any time a fire extinguisher is used, no matter for how brief a period, EHS must be notified for inspection and recharge.

Every laboratory where the use of materials that are either corrosive or that otherwise present a significant skin/eye contact or absorption hazard must have access to an unobstructed safety shower and eyewash facility that meets the requirements of OSHA regulations 29 CFR 1910.151(c). If an eyewash or safety shower needs to be repaired, contact Facilities Services (210-999-8413) and provide the location of the defective equipment.

Environmental Health and Safety will conduct inspections of all fire extinguishers and safety shower/eyewash stations. However, it is prudent for laboratory personnel to conduct routine monitoring of them as well.

Personal Hygiene, Habits, and Practices

Personal hygiene in the laboratory is directed mainly toward the prevention of occupationally acquired disease or physical injury. However, it can raise the quality of laboratory work by reducing possibilities for contamination of experimental material. Habitual adherence to good practices provides a margin of safety in situations where the hazard may be unrecognized.

The following guidelines are standard operating procedures:

- Food, candy, gum, beverages, and tobacco for human consumption must not be stored or consumed inside the laboratory or animal rooms.
- Drinking fountains outside the laboratory should be the sole source of drinking water.
- Refrigerators in laboratories are for experimental materials only. Food for human consumption must be stored only in refrigerators specifically designated for that purpose.
- Do not use laboratory equipment for food preparation. Do not use empty food containers for laboratory materials or samples.
- Shaving or brushing teeth is not permitted in laboratories. Toothbrushes, razors, toiletry supplies, and cosmetics should only be used in designated areas outside the laboratory after thoroughly washing the hands and face or showering.
- Keep hands away from the mouth, nose, eyes, face and hair when working in the laboratory.
- Books and journals should be used only in clean areas if possible.
- Personal handkerchiefs should not be used in the laboratory. Disposable tissues should be available in laboratories and change rooms.
- Shorts and sandals are prohibited from being worn in all laboratories.

Laboratory Housekeeping

- Laboratories must be managed and well maintained as a safe work environment. General housekeeping is important when it comes to safety. Housekeeping staff provides limited services such as emptying the regular trash receptacles. Therefore, it is the responsibility of the Principal Investigator and lab workers to practice good housekeeping techniques on a regular basis.
- These best management practices will keep laboratories organized and provide a safe workplace:
    - Keep laboratory benches clear of clutter.
    - Keep all hazardous chemical containers clearly labeled and stored in approved areas such as underneath fume hoods, or in flammable storage cabinets.
    - Keep large boxes of supplies off of floors and bench tops.
    - Perform routine clean-outs to remove all unwanted chemicals, equipment, or supplies. **Broken or unwanted equipment must be cleared with EHS prior to relocation. Unwanted, expired, or spent chemicals must be disposed of appropriately through EHS. Ensure all waste materials (i.e. chemical, biological) are disposed of according to EHS guidelines**.
    - Promptly clean up spills. Hazardous material spills must be reported to Trinity University Police and Environmental Health and Safety.

Personal Protective Equipme

Personnel must be aware of the specific hazards in their lab; which will determine the level of PPE that must be worn in the laboratory.

To determine the level of PPE to be used, laboratory personnel must:

- Know the concentration and quantity of chemicals being used.
- The potential hazards of the chemical.
- Routes of exposure.
- The grade or material of PPE.

Availability of Personal Protective Equipment

A variety of PPE is available to protect laboratory workers from hazards in the work environment. At a minimum, all employees and students who work with **hazardous chemicals in any laboratory** shall wear the following:

- Closed toe shoes (no sandals);
- Long pants or skirts (no shorts);
- Lab coat, apron or gown depending on lab work being conducted. Contact EHS for clarification.
- Safety glasses or goggles; and
- Gloves (nitrile, or other appropriate gloves).
    - It is mandatory for gloves to be worn during situations where exposure to hazardous materials (i.e. chemical, biological, and radiological) is imminent. Protection of the employees and students from hazards is top priority. Additionally, one should regularly change gloves when contamination has occurred. One should always take steps to avoid the spread of contamination. Therefore, gloves must always be removed upon exit from any laboratory or other areas where hazardous materials are used, processed, or stored. Please dispose of all used gloves in the approved waste container. It is extremely important that all public areas are kept clean at all times.
    - Gloves will not be worn while doing the following activities:
        - Upon exiting laboratories. However, one gloved hand is okay **only** if you are able to transport the material safely in a cart or approved container. Contact EHS for clarification.
        - Opening any doors (e.g. labs, restrooms, stairwells, lecture halls, etc.);
        - Walking through public hallways;
        - Using elevators;
        - Using telephones; or
        - Using water fountains.

Carts

When transporting hazardous materials through the public corridors use secondary containment such as a clean plastic tub or a cart as a means to safely move these materials from one area to another.

Lab carts should have a lip to protect containers from tipping over during transport. Do not carry samples or hazardous materials directly in your hands. Secondary containment not only provides protection for the worker, but also provides a means of containment in case of accidental spills or breakage. Non-compliance with this policy should be reported to EHS.

Additional PPE may be necessary, depending on the procedures and exposure risks involved. Always refer to the SDS for recommended PPE for specific chemicals. It is the

responsibility of each worker to wear the appropriate PPE when necessary and to talk with your supervisor if questions arise regarding additional PPE that may be needed.

EHS may perform exposure assessments as a means to determine additional PPE requirements.

Training on use of Personal Protective Equipment (PPE)

Training on use and maintenance of PPE are the responsibility of the Principal Investigator or Laboratory Supervisor. Use of most PPE requires very minimal instruction and maintenance. However, specialized equipment such as respirators require additional training to include a medical evaluation; fit test; instruction on how to don and remove a respirator; routine cleaning; and choosing the right type of filter per OSHA 29 CFR 1910.134. A fit test will identify the proper size for the worker. This will help in determining which respirator can provide maximum protection from exposure to hazardous materials. Do not wear any respirator (e.g. N95, half-face or full-face respirator) without completing a fit test. **The Department of Environmental Health and Safety will assist all employees who are required to wear a respirator as part of his or her job duties.**

Evaluations

Environmental Health and Safety will conduct scheduled laboratory evaluations depending on the potential risks of each laboratory. EHS will implement guidelines set forth by the *OSHA Laboratory Standard (29CFR1910.1450 Appendix A), EPA, TCEQ, and NFPA*. The purpose of a lab evaluation is for personnel to ask questions with respect to lab safety to comply with the federal and state regulations. Deficiencies annotated during an evaluation will be discussed thoroughly with personnel so appropriate action is taken.

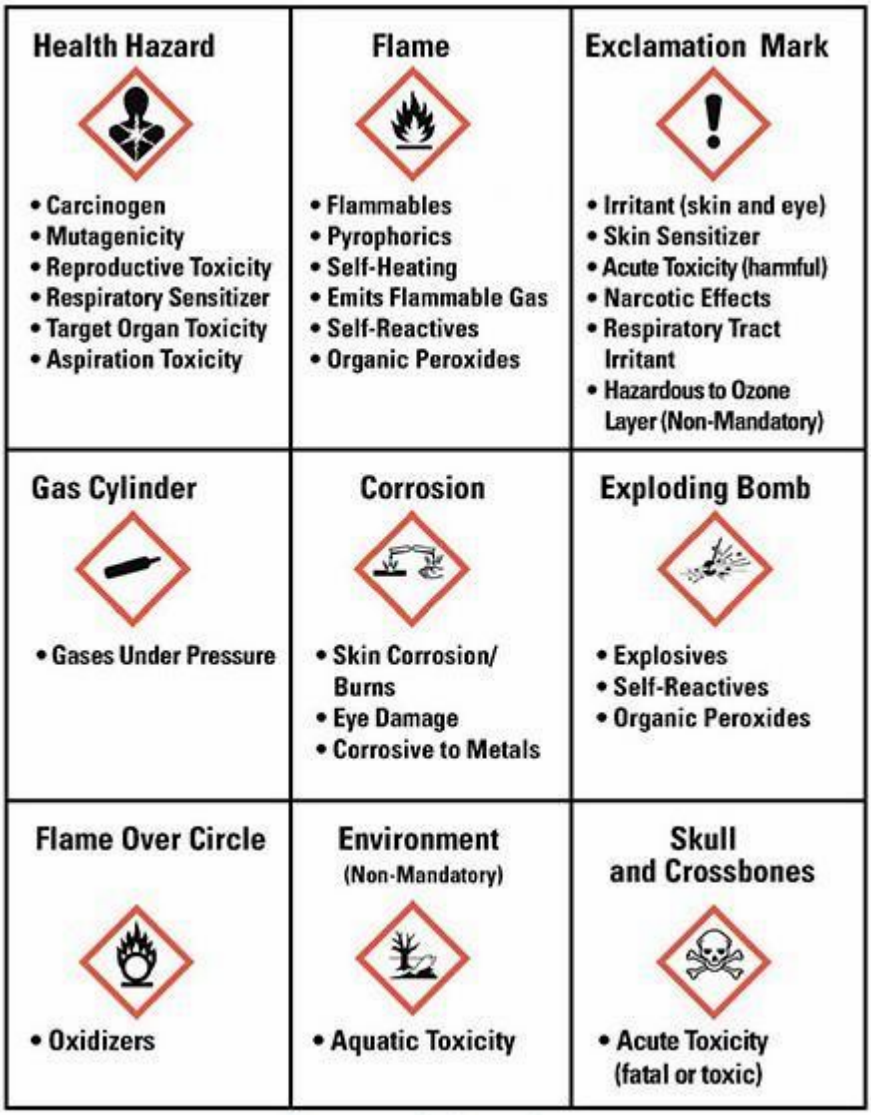
Escalation Process for Deficiencies

- Deficiencies will be reported to PI, faculty member, or laboratory supervisor who will have 30 days to correct.
- If not corrected within 30 days the department chair will be notified.
- If not corrected within 30 days of chair notification the Dean of Science, Engineering, and Mathematics will be notified.

Global Harmonization Classification System

The Global Harmonization System (GHS) includes criteria for the classification of health, physical and environmental hazards, as well as specifying what information should be included on labels of hazardous chemicals as well as safety data sheets. Adopted by the United Nations in 2003, it consists of 9 classification systems consisting of pictograms, hazard statements, and signal words.

The following symbols (*as seen in figure 2*) will be displayed on safety data sheets and chemicals.



University laboratories or facilities presenting a hazard will have laboratory signage at the entrance to each lab or space. (*See figure 1*). The purpose of the sign is to caution individuals of the potential risks the workspace may present. During the laboratory evaluation and review of chemical inventory, EHS will designate the hazard severity of each workspace.

NFPA

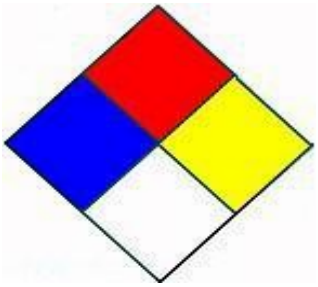
Trinity University uses a NFPA based hazard identification system or labels with equivalent information. Signs, placards, operating procedures, or other such written materials may be used in place of affixing labels to individual stationary process containers as long as the alternative method identifies the applicable container(s) and conveys the required information on a label. If this information is kept in a written format, it must be readily accessible to the employees in their work area.

NFPA label components are as follows:

- The diamond-shaped label contains four colored squares, with a number or symbol appearing in each square.
- There are four categories of hazards identified by this system—health, flammability,

reactivity, and special hazard.

- The degree of severity is indicated numerically by five divisions; zero indicating minimal hazard up to four, severe hazard.



Health = Blue

4=Severe Hazard- Can be lethal.

3=Serious Hazard- Can cause serious or permanent injury.

2=Moderate Hazard- Can cause temporary incapacitation or residual injury.

1=Slight Hazard- Can cause significant irritation.

0=Minimal Hazard- Would offer no hazard beyond that of ordinary combustible materials.

Fire = Red

4=Severe Hazard- Materials that will rapidly or completely vaporize at atmospheric pressure and normal ambient temperature.

3=Serious Hazard- Liquids and solids that can be ignited under all ambient temperature conditions.

2=Moderate Hazard- Materials that must be moderately heated or exposed to relatively high ambient temperatures before ignition can occur

1=Slight Hazard- Materials that must be preheated before ignition can occur.

0=Minimal Hazard- Materials that will not burn

Reactivity = Yellow

4=Severe Hazard- Readily capable of detonation at normal temperatures and pressures.

3=Serious Hazard- Capable of detonation, with a strong initiating source.

2=Moderate Hazard- Readily undergo violent chemical change at elevated temperatures.

1=Slight Hazard- Normally stable, but can become unstable at elevated temperatures.

0=Minimal Hazard- Normally stable.

Special Hazards = White


Materials that demonstrate unusual reactivity with water


Materials that possess oxidizing properties


Radioactive Hazard


Corrosive


Acid


Alkali

Employees that need hazmat training for shipping and receiving will also need to understand the DOT labeling systems pictured below (*see figure 3*).

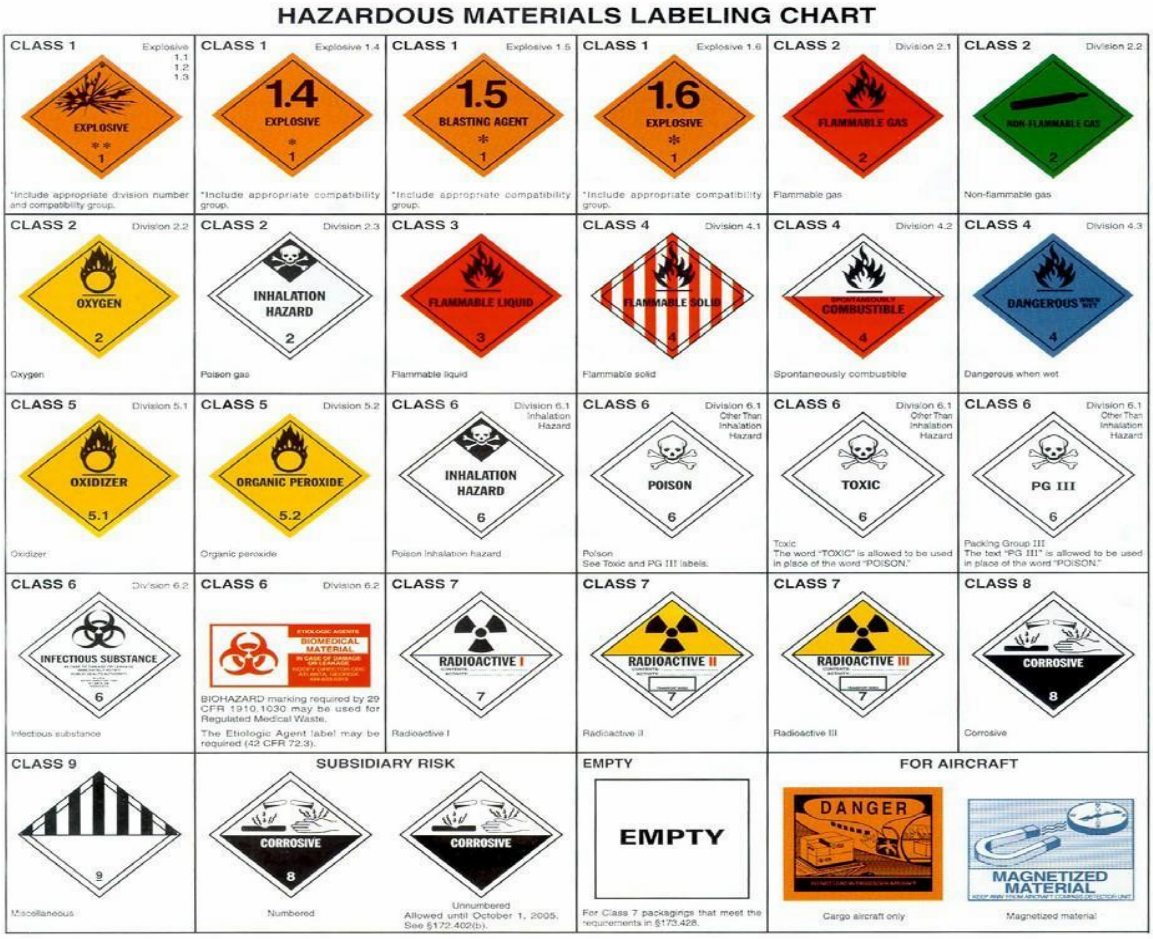


Figure 3

Waste

Under **NO** circumstances can any chemical be discarded in the regular trash. Containers that are empty and have no more than 2.5 mL of chemical residue remaining on the bottom of the container must be triple rinsed. Empty containers of acutely hazardous chemicals must be triple rinsed with an appropriate solvent prior to disposal. The waste solvent must be disposed of as hazardous waste. An alternative is to dispose of the entire container, along with any remaining contents, as a hazardous waste. Please contact EHS for assistance in handling this waste. Prior to commencing work with highly toxic materials, which may pose a significant threat to human health or the environment, contact EHS so an appropriate disposal plan may be arranged.

Hazardous Waste

Hazardous Chemical Waste

Hazardous waste is regulated by the Texas Commission on Environmental Quality (TCEQ). Federal EPA regulations also govern aspects of hazardous waste management. These hazardous waste regulations are part of the Resource Conservation and Recovery Act (RCRA).

EHS manages the shipment and disposal of all hazardous waste generated on campus. Each laboratory employee must comply with the requirements and all applicable regulations. A regular pick-up service is provided to teaching and research laboratories. Personnel are responsible for identifying waste, labeling it, and storing it properly in the laboratory. The PI/Laboratory Supervisor is responsible for coordinating the disposal of all chemicals from their laboratories prior to closing down laboratory operations.

The following rules must be complied with for EHS to arrange for pickup:

- Submit a pickup form online (https://docs.google.com/forms/d/e/1FAIpQLSc729YcteYG_n-JpC-oYN4GS8MmmOtlt49RrSDoHqdIsr6j0w/viewform) for tracking and auditing purposes. Upon receipt, EHS may contact the submitter if there are any specific questions regarding the material to be collected.
- Each container must be clearly labeled.
- Package materials in plastic waste containers, or other containers specifically designed for the material.
- Incompatible materials shall be segregated. Examples of incompatible materials are: acids/bases, organics/oxidizers, and flammable liquids/oxidizers. Unknowns and high hazard materials such as cyanides, organic peroxides, pyrophorics, water reactives and explosives shall be packaged separately regardless of quantity. If you have specific questions on the proper disposal of hazardous materials or wastes, contact Jake Hernandez at jhernan9@trinity.edu. For general questions, you may email EHS at ehs@trinity.edu

If you think you may have an outdated reagent, contact EHS prior to submitting a request for pickup.

Biohazardous Waste

Regulated medical waste (RMW) is commonly referred to as biohazard waste. It is important to note that RMW is regulated by the Department of Transportation, and therefore we must adhere to the following procedures below, regarding the proper disposal of RMW.

The following items are defined as biohazardous waste and may be disposed of in a regulated medical waste (biohazard) box:

- Waste from animals that have been intentionally exposed to pathogens, or body parts that have been exposed to recombinant DNA.
- Synthetic or recombinant DNA/RNA waste.
- Bulk human blood or products and human body fluids.
- PPE or culture dishes that have been contaminated with a biohazard.
- Pathological waste.
- Sharps must be placed in a sharps container. The sharps container must be properly shut prior to adding in a regulated medical waste container.

To request or submit a request for regulated medical waste, go to:

https://docs.google.com/forms/d/e/1FAIpQLSexS7srx2V48ZQ7yOzE7Xp6vyxo0kEugBJz8QK1lM41OQZtXg/viewform

Selection of Waste Containers

- In selecting a waste container, the compatibility of the waste with the container should be the primary concern. If there are any questions please consult with EHS to prevent

costly errors.

- Unbreakable containers should be used whenever feasible.
- Large quantities of flammable liquids should be collected in 10L safety carboys (See figure 5). HDPE (high-density polyethylene) are best because of their high resistance to many types of chemicals. It is best not to fill these containers more than 2/3 full. This allows for easier transfer. Glass containers in which some solvents are purchased are suitable for one time collection of waste and will not be returned. Use these containers only for the same solvents that they originally held. Continued re-use of these containers is discouraged. Safety carb ction of solvent waste suitable for bulk disposal are encourag

Figure 5

Storage

The hazardous waste storage area in each laboratory must remain under the control of the individuals producing the waste. This means that it should be located in an area that is supervised and is not accessible to the public.

1. Hazardous waste containers must be labeled at all times.
2. Waste must be collected and stored at or near the point of generation.
3. The maximum amount of flammable solvents allowed to be stored in a laboratory outside a flammable storage cabinet is 40L; this amount also includes waste solvents.
4. All hazardous waste containers in the laboratory must be kept closed when not in use.
5. Hazardous waste streams must be compatible and must be compatible with the containers that they are stored in.
6. Hazardous liquid waste containers must be stored in secondary containment at all times.
7. Containers must be in good condition with leak-proof lids.
8. Containers must be less than 90% full.

Segregation

All hazardous materials must be managed in a manner that prevents spills and uncontrolled reactions. Stored chemicals and waste should be segregated by hazard class. *See Chemical Compatibility Chart*.

Examples of proper segregation are:

- Segregate acids from bases.
- Segregate oxidizers from organics.
- Segregate cyanides from acids
- Segregation of waste streams should be conducted in a similar manner to segregation of chemical products.

Incompatible Waste Streams

Mixing incompatible waste streams, or selecting a container that is not compatible with its contents, is a common cause of accidents in laboratories and waste storage facilities. Reactive mixtures can rupture containers and explode, resulting in serious injury and property damage. All chemical components and their waste byproducts must be compatible for each waste container. Waste tags must be immediately updated when a new constituent is added to a mixed waste container.

Universal Waste

Mercury or Lead containing bulbs (i.e. fluorescent, halogen, metal halide, high or low Pressure sodium, mercury vapor, incandescent).

Facilities Services collects and stores regulated lamps in containers or packages that are structurally sound, adequate to prevent breakage, and compatible with the contents of the lamps. Such containers and packages remain closed and will lack evidence of leakage, spillage or damage that could cause leakage under reasonably foreseeable conditions. Each lamp or a container or package in which such lamps are contained may be labeled or marked clearly with one of the following phrases: "Universal Waste-Lamp(s)," or "Waste Lamp(s)," or "Used Lamp(s)."

Universal waste thermostats (i.e., each thermostat), or a container in which the thermostats are contained, may be labeled or marked clearly with any one of the following phrases: "Universal Waste-Mercury Thermostat(s)," or "Waste Mercury Thermostat(s)," or "Used Mercury Thermostat(s)".

Universal Waste L

A universal waste b be labeled or marked clearly with ttery(ies), " or "Waste Battery(ies)

Accumulation Time Limits

Universal waste can be stored for no longer than one year from the date the universal waste is generated, or received from another handler, unless for the purpose of accumulation of such quantities of universal waste as necessary to facilitate proper recovery, treatment, or disposal.

Other examples of Universal Waste include:

Lead acid batteries (i.e. car batteries, nickel-cadmium, and most rechargeable batteries)

There may be confusion when determining the disposal of Nickel-cadmium and many rechargeable batteries.

Alkaline batteries do not meet the definition of universal waste and may be discarded as solid waste (trash) without special requirements.

Hazardous Waste Mixing in Reference to Used Oil

Mixtures of used oil and hazardous waste shall be managed in accordance with characteristic waste requirements.

The rebuttable presumption for used oil applies to used oil managed by generators. Under the rebuttable presumption for used oil, used oil containing greater than 1,000 ppm total halogens is presumed to be a hazardous waste and thus must be managed as hazardous waste and not as used oil unless the presumption is rebutted. However, the rebuttable presumption does not apply to certain metalworking oils/fluids and certain used oils removed from refrigeration units.

Used Oil Storage

Used oil generators are subject to all applicable Spill Prevention, Control and Countermeasures in addition to the requirements of this section of the CHP.

Containers and aboveground tanks used to store used oil must be:

- In good condition (no severe rusting, apparent structural defects or deterioration); and
- Not leaking (no visible leaks).
- Must be labeled or marked clearly with the words "Used Oil."
- Fill pipes used to transfer used oil into underground storage tanks at generator facilities will be labeled or marked clearly with the words "Used Oil."

Upon detection of a release of used oil to the environment that is not subject to technical standards and corrective action requirements for owner and operators of underground storage tanks, personnel shall perform the following cleanup steps:

- Stop the release;
- Contain the released used oil;
- Clean up and manage properly the released used oil and other materials;
- If necessary, repair or replace any leaking used oil storage containers or tanks prior to returning them to service; and
- Contact Environmental Health and Safety

Controlled Substances

Controlled substances are regulated through the Drug Enforcement Agency (DEA) and users must register with the agency. Controlled substances cannot be treated as hazardous chemicals with respect to disposal, and therefore must not be discarded as hazardous waste.

Removal or Disposal of Laboratory Equipment

All laboratory equipment and potentially contaminated laboratory furniture must be "cleared" prior to removal, relocation or disposal. **Please note this is only for laboratory-related items.** Equipment or furniture that has been used or contaminated with biological materials must be

decontaminated with a 10% (1:10, 1-part bleach to 9-parts water) dilution. All exposed surfaces of the item must be wiped down with bleach solution. All other equipment or furniture may be decontaminated with a mild detergent, or soap and water.

Equipment or furniture that may have come in contact with radioactive material(s), contact the Radiation Safety Officer at 210-999-8364.

Equipment or furniture that may have come in contact with a radioactive material(s), contact the Radiation Safety Officer at 210-999-8364.

Laser equipment must be cleared by EHS prior to disposal or removal.

Hazardous Materials Spills and Releases

Accidents and Spills

Eye Contact: Promptly flush eyes with water for a prolonged period (15 minutes) and seek medical attention.

Ingestion: Encourage the victim to drink large amounts of water.

Skin Contact: Promptly flush the affected area with water and remove any contaminated clothing.

Inhalation: Immediately remove individual(s) from the area and seek fresh air.

If you come across a hazardous material spill or believe it might be a hazardous spill first identify what type of spill it is. Hazardous material spills are divided into two major types:

- Minor Spill - A hazardous material spill of less than 1 liter in volume of an agent that you are properly equipped and trained to safely handle appropriately.
    - Inform supervisor and others in the area about the spill.
    - Restrict further access to the area.
    - Do not enter the spill area alone.
    - Use proper personal protective equipment appropriate for the spill agent.
    - Neutralize or secure the spill using absorbent material.
    - Dispose of the spill-cleanup material as hazardous waste.
    - Do not attempt to clean, disinfect, or absorb spill materials without proper emergency response training and equipment.

- Major Spill - A hazardous material spill greater than 1 liter in volume or an agent that you are not adequately equipped or trained to safely handle appropriately.
    - Inform the supervisor and others in the area about the spill.
    - Restrict further access to the area and secure the area.
    - Do not attempt to clean, neutralize, or disinfect major spills.
    - Await emergency response from the Trinity University Police department and EHS.
    - Remain outside the spill area to report to responders of the spill agent.

FOR MAJOR SPILLS, MERCURY SPILLS, OR INJURIES CONTACT TUPD IMMEDIATELY!

Compressed Gases and Cryogenic Liquids

The use of compressed gases and cryogenic liquids present many safety issues for laboratory staff and support personnel. This section will identify the hazards associated with compressed gases and cryogenic liquids, regulations issued by OSHA and NFPA regarding gas cylinder storage and handling, outline safety features for approved cylinders and cryogenic containers, and provide users with guidelines regarding safe use of these materials.

Compressed Gases

Proper training on safe handling and use of compressed gas cylinders and cryogenic liquids is critical for all employees and students who work with or around these materials.

- Hazards: The hazards associated with compressed gases include physical hazards such as explosion or rupture of cylinders, and health hazards such as oxygen displacement or the toxic effects of certain gases.
- Regulatory requirements: The Compressed Gas Association (CGA) has several publications regarding safe handling of compressed gases. OSHA also has regulations regarding compressed gases, as outlined in 29 CFR 1910.101.
- Inspection of cylinders:
    - All compressed gas cylinders should be visually inspected upon arrival to

laboratories.
    - Verify the contents of the cylinders. All cylinders must be labeled at all times.
    - Label all cylinders as to whether they are full, empty, or in use.
    - If a leak is detected, do not attempt to repair it. Contact the supplier.
- Storage of cylinders:
    - Secure cylinders at all times to prevent tipping, falling or rolling by using straps or chains connected to a wall bracket or other fixed surface, or by using a cylinder stand. Straps and chains must be at ⅔ of the height of the cylinder.
    - Store cylinders in a cool, dry, well-ventilated, fire-resistant area.
    - Do not store cylinders in public corridors or stairwells.
    - Cylinders should be segregated by hazard.
    - Oxidizers must be stored separately from flammable gases.
    - Empty cylinders should be stored separately from filled cylinders.

For further information regarding cylinders, please contact EHS.

- Handling of cylinders:
    - Close valves for cylinders when not in use. Valves of empty cylinders must also be closed.
    - Cylinders (filled, partially filled, or empty) shall be transported using an approved cart or carrying device and must be securely fastened to the moving device so that accidental dislodgement does not occur.
    - Valves must be removed and protective caps secured in place prior to moving cylinders.
    - Valves should be closed prior to moving cylinders.
    - Empty cylinders should be removed from laboratories promptly.

Liquid Nitrogen

This section discusses the potential hazards associated with cryogenic fluids, and outlines safety guidelines for handling, storage and transportation of liquid nitrogen.

- Hazards: The hazards associated with liquid nitrogen include the extremely low temperature (-320°F), asphyxiation (oxygen displacement), and explosion or rupture of containers.
- Regulatory requirements: The Compressed Gas Association (CGA) has several publications regarding safe handling of liquid nitrogen. NFPA 55*, Standard for the Storage, Use, and Handling of Compressed Gases and Cryogenic Fluids*, outlines requirements for storage, use and handling of these materials.
- Inspection and labeling of cryogenic containers and liquid nitrogen cylinders:
    - Visually inspect all containers upon arrival.
    - Inspect all valves, including vent valve, liquid valve, pressure relief valve, and rupture disk.
    - All cylinders or containers must be properly labeled at all times. Department of Transportation (DOT) marking must be affixed to all cylinders.

- Label all cylinders as to whether they are full, empty, or in use.
- Portable cryogenic containers shall be marked in accordance with CGA C-7, *Guide to the Preparation of Precautionary Labeling and Marking of Compressed Gas Containers*.
- All DOT-4L/TC-4LM liquid cylinders shall have product identification visible from all directions with minimum 51 mm (2 in.) high letters.
- Visible hazard identification signs shall be provided in accordance with NFPA 704, *Standard System for the Identification of the Hazards of Materials for Emergency Response*, at entrances to buildings or areas in which cryogenic fluids are stored, handled, or used.
- Container inlet and outlet connections, liquid-level limit controls, valves, and pressure gauges shall be identified by one of the following methods:
    - A permanent tag or label identifying their function.
    - A schematic drawing that indicates their function and designates whether they are connected to the vapor or liquid space of the container.
    - When a schematic drawing is provided, it shall be attached to the container and maintained in a legible condition.
    - Hissing sounds from a liquid nitrogen cylinder is normal. Pressure build-up will be released through a pressure relief device.
    - If a leak or spill is detected, do not attempt to repair it. Contact the supplier for assistance.

Storage of Cryogenic Containers

- Approved cryogenic containers shall be designed to hold low temperature, liquefied gases and made of materials that can withstand the rapid changes and extreme differences in temperature encountered in working with liquefied gases. They shall be built to withstand normal operating pressures and shall be either open or protected by a vent or other pressure-relieving device that permits vapors to escape. Only vent tubes and stoppers supplied with these containers shall be used.
- Store containers in a cool, dry, well-ventilated area. Oxygen monitors can be installed in areas where ventilation is not adequate.
- Do not store containers or cylinders in public corridors or stairwells.
- Handling and dispensing of liquid nitrogen and cryogenic liquids
- Always use appropriate safety equipment, including cryogenic gloves, face shield and eye protection.
- Containers (filled, partially filled, or empty) shall always be stored in the upright position.
- Liquid nitrogen and other liquefied gases shall be dispensed into and transported in approved cryogenic containers only. Use only approved containers or dewars. Do not use open pail-type containers.
- Empty cylinders should be removed from laboratories promptly. Contact supplier for removal of empty liquid nitrogen cylinders.
- Cryogenic containers transported on laboratory carts shall be secured to the cart to

prevent accidental tip-over.

Training

EHS will provide employees with guidance and training so that they are aware of the potential hazards and/or chemicals present in their work area.

Such information shall be provided at the time of an employee's initial assignment to a work area where hazardous chemicals are present and prior to assignments involving new exposure situations. The frequency of refresher information and training will be determined by Environmental Health and Safety.

Employee training includes:

- Methods and observations that may be used to detect the presence or release of a hazardous chemical in the work area.
- The physical and health hazards of the chemicals in the work area.
- The measures employees can take to protect themselves from these hazards, including appropriate work practices, emergency procedures, and personal protective equipment to be used.
- The details of the hazard communication program, including an explanation of the labeling system and the safety data sheets, and how employees can obtain and use the appropriate hazard information.
- Where an employee's job tasks include ordering, packaging, loading, unloading, handling, or preparing for the transportation any hazardous materials, that employee will be given further instruction when applicable to job task on the Hazardous Materials Table and Special Provisions, Shipping Papers, Marking, Labeling, Placarding, and Emergency Response Information.
- Employee training will be given initially upon receiving such a job task.

Employees shall be informed of:

- The contents of this standard and its appendices which shall be made available to employees;
- The location and availability of Trinity University's Chemical Hygiene Plan;
- The permissible exposure limits for OSHA regulated substances or recommended exposure limits for other hazardous chemicals where there is no applicable OSHA standard;
- Signs and symptoms associated with exposures to hazardous chemicals used in the laboratory; and
- The location and availability of known reference material on the hazards, safe handling, storage and disposal of hazardous chemicals found in the laboratory including, but not limited to, Safety Data Sheets received from the chemical supplier.

Additional Training Requirements for DOT HazMat Employees

Each hazmat employee is provided with general awareness/familiarization training designed to provide familiarity with DOT's hazardous materials requirements, and to enable the employee to recognize and identify hazardous materials consistent with the hazard communication policy.

Function-specific training

Each hazmat employee is provided with function-specific training concerning requirements of the hazardous materials regulation which are specifically applicable to the functions the employee performs.

Each hazmat employee receives safety training concerning:

- Emergency response information.
- Measures to protect the employee from the hazards associated with hazardous materials to which they may be exposed in the workplace, including specific measures Trinity University has implemented to protect employees from exposure.
- Methods and procedures for avoiding accidents, such as the proper procedures for handling packages containing hazardous materials.

Each hazmat employee must receive training that provides an awareness of security risks associated with hazardous materials transportation and methods designed to enhance transportation security. This training must also include a component covering how to recognize and respond to possible security threats.

Additional training requirements for those who come in contact with hazardous waste must be provided by EHS. This training may include classroom instruction in the handling, storage, and disposal of hazardous waste, in addition to:

- Communications or alarm systems;
- Response to fires or explosions;
- Response to ground-water contamination incidents and
- Shutdown of operations.

Supplemental site-specific training, also called **Laboratory Specific Training** should be given by the Principal Investigator or Area Supervisor for all employees who work with hazardous chemicals within the first 30 days of employment so that knowledge is kept current. Training is performed as needed and documentation is maintained for 5 years. The training session should cover interpretation of SDS's, safe handling, storage, and disposal procedures for specific chemicals used in their immediate area. Additionally, emergency response procedures and first aid treatment should be discussed. Staff must take part in an annual review of the initial training.

Recordkeeping

A record of current training, inclusive of the preceding three years, is created and retained by Trinity University for as long as that employee is employed by Trinity University as a hazmat employee and for 90 days thereafter. The record includes:

- The employee's name.
- The most recent training completion date of the employee's training.
- A description, copy, or the location of the training materials used to conduct the training. (Training material will be kept with Environmental Health and Safety).
- The name and address of the person providing the training.
- Certification that the employee has been trained and tested.

Training records of current personnel must be kept indefinitely with Trinity University. Training records on former employees must be kept for at least three years from the date the employee last worked at Trinity University. Personnel training records will accompany personnel transferred within the University.

Records of training are maintained with the following information: employee name, most recent completion date of training, description of training, and certification that the employee has been trained according to regulation.

Employee Exposures

The university will establish and maintain for each employee an accurate record of any measurements taken to monitor employee exposures and any medical consultation and examinations including tests or written opinions required according to 29 CFR §1910.1020.

Monitoring

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

Employee Exposure determination-Chemical Hygiene:

- Shall measure the employee's exposure to any substance regulated by a standard that requires monitoring if there is reason to believe that exposure levels for that substance routinely exceed the action level (or in the absence of an action level, the PEL).
- If the initial monitoring prescribed discloses employee exposure over the action level (or in the absence of an action level, the PEL), the Trinity University shall immediately comply with the exposure monitoring provisions of the relevant standard.
- May terminate monitoring in accordance with the relevant standard.

- Must, within 15 working days after the receipt of any monitoring results, notify the employee of these results in writing either individually or by posting results in an appropriate location that is accessible to employees.

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

- Capable of protecting employees from health hazards associated with hazardous chemicals in that laboratory and
- Capable of keeping exposures below the permissible exposure limit.

Chemical Inventories

Chemical inventories, managed by Chemical Stockroom Personnel, must be updated at least annually by July 31. Copies of chemical inventories will be kept for 30 years per OSHA 29 CFR 1910.1020.

Safety Data Sheets (SDS)

SDS's will be made available to all employees electronically or by hard copy if electronic access is unavailable. SDS must be available until the chemical is no longer stored at Trinity University.

Laboratories and work spaces must:

- Obtain an SDS from the chemical manufacturer or importer before any chemical is put into use.
- Provide SDS's that are readily accessible during each work shift to employees in their work area(s). However, each department is also required to maintain their own copies and electronic versions.

EHS must:

- Keeps a copy of each manifest signed in accordance with 40 CFR 262.23(a) for three years or until EHS receives a signed copy from the designated institution which received the waste. This signed copy must be retained as a record for at least three years from the date the waste was accepted by the initial transporter.
- Keeps record of any test results, waste analyses, or other determinations made in accordance with 40 CFR 262.11 for at least three years from the date that the waste was last sent to on-site or off-site treatment, storage, or disposal.
- Provides the State of Texas copies of how the waste was treated, stored, and disposed.
- When shipping hazardous waste, includes a Land Disposal Restriction form with the manifest.

- If the final copy is not received, conducts an investigation and submit an exception report.
- Keeps an accurate record of waste content.
- Provides a contingency plan for waste releases at Trinity University.
- Inspects weekly all hazardous waste containers in storage and maintains those inspection records.

Chemical Safety Handbook/Chemical Hygiene Plan

Revisions of the Chemical Hygiene Plan will be kept on file for 5 years past supersede date with Environmental Health and Safety. All laboratory areas must have a copy of the most current version of the Chemical Hygiene Plan accessible to all personnel.

Laboratory Safety Evaluations

Records of safety evaluations performed by Environmental Health and Safety will be maintained indefinitely.

Animal Laboratory Safety

The Animal Care and Use Program covers all animals used in research and teaching at Trinity University. This program comprises the Animal Care and Resources Center (ACRC), the Animal Research Committee (ARC), Environmental Health and Safety and the various researchers (PI's) and professors working with animals. This program is designed to assure compliance with the Animal Welfare Act, the Public Health Service (PHS) Policy and with the United States Department of Agriculture's (USDA) standards of care and use of animals. The ARC in accordance with local, state and federal law and the Guide For The Care and Use of Laboratory Animals conducts program oversight. All research and teaching projects involving animals must be reviewed and approved by the ACRC prior to beginning the project. The Animal Care and Resources Center comprises the animal holding facility, research spaces and the office of the facility supervisor. All aspects of animal care and husbandry are located within this facility. Students and employees who care for and use animals in research face several occupational health and safety risks which include the possibility of allergic reactions, animal related injuries such as bites, zoonoses, and exposure to hazardous material. It is the ACRC's responsibility to maintain the highest level of care possible in accordance with all laws and policies that govern the use of animals in research and teaching. For further information, please contact Dr. Troy Murphy, PhD, Chairman of the ARC by email at tmurphy@trinity.edu or by phone at 210-999-8916.

Access

For large-scale studies, special facilities with restricted access are required.

Administration of the toxic substance

When possible, administer the substance by injection or gavage instead of in the diet. If administration is in the diet, use a caging system under negative pressure or under laminar airflow directed toward HEPA filters.

Personal Protection

When working in the animal room, wear specific, approved-for-use chemical resistant gloves, fully buttoned laboratory coats or jumpsuits. If needed because of incomplete suppression of aerosols, other apparel and equipment (i.e. shoe and head coverings, respirator) will be required.

Occupational Health and Safety Program

The Occupational Health and Safety Program is designed to prevent unnecessary occupational injury or illness in the work environment and maintain safe working conditions for people working with or around laboratories and wild animals. Federal regulations mandate that all persons having contact with animals in research be enrolled in an Occupational Health and Safety Program (OHSP). All staff, faculty, and students who have direct contact with animals must be enrolled in the OHSP prior to beginning work with animals. For specific information on Trinity University's Occupational Health and Safety Program, please contact Cassandra Ochoa, Animal Care and Resources Center Supervisor at 210- 999-7266 or cmartin7@trinity.edu.

Appendix A

Carcinogens

The Occupational Safety and Health Administration (OSHA) has compiled lists of carcinogenic chemicals. These lists are not meant to be all-inclusive but rather, serve as a source for P.I. 's in determining which chemicals may require approval for use and storage in the laboratory.

1,2-Dibromo-3-chloropropane	Beta-Propiolactone
1,3-Butadiene	Bis-Chloromethyl
2-Acetylaminofluorene	Ether Cadmium
3,3'-Dichlorobenzidine	Coke oven emissions
4-Aminodiphenyl	Ethylene Oxide
4-Dimethylaminoazobenzene	Ethyleneinine
4-Nitrobiphenyl	Formaldehyde
Acrylonitrile	Inorganic Arsenic
Alpha-Naphthylamine	Methyl Chloromethyl
Asbestos	Ether
Benzidine	Methylene Chloride
Beta-Naphthylamine	Methylenedianiline
	N-Nitrosodimethylamine
	Vinyl Chloride

Although only a limited number of chemicals are carcinogens, they are found among all chemical classes and may present a number of hazards separate from their toxicity. Thus in any research laboratory where workers handle a wide variety of chemicals some are likely to be carcinogenic. Institutional policies are cognizant of the following considerations:

- Carcinogens can be controlled using established laboratory procedures.
- Emphasis should be placed on engineering controls and good work practices.
- Carcinogens must be viewed individually and the biological, chemical and physical properties of each compound must be considered.

- These guidelines below should be taken into consideration for all laboratories using carcinogens and other highly toxic chemicals:
- Access to laboratories is limited to technical staff assigned to the research program and the necessary support staff.
- Work should be performed in a suitable safety cabinet or other containment device depending on the nature of the experiment.
- A glove box, Class II biological safety cabinet or chemical fume hood should be used for handling pure carcinogens, including the preparation of stock solutions for in vitro procedures or for work with concentrated carcinogen solutions.
- Work with organic solvents and toxic or corrosive chemicals, including neutralization procedures should be done in a fume hood.
- A hand washing facility must be available.
- Carcinogens should be stored in a clearly posted storage area preferably separated from other laboratory chemicals.
- Stock bottles should be labeled with the full chemical name or a widely recognized substitute and should bear the warning "Potential Cancer Hazard" (NIH Guidelines), "Cancer Suspect Agent" (29CFR1910.1017, (l)) or "Chemical Carcinogen."
- Work surfaces should be protected with absorbent, plastic-backed bench paper.

Asphyxiants

Chemical asphyxiates prevent or interfere with the uptake and transformation of oxygen. Examples include carbon monoxide, which prevents oxygen transportation, and hydrogen cyanide, which inhibits enzyme systems and interferes with the transportation of oxygen to the tissues. At sufficiently high concentrations, both chemicals can result in immediate collapse and death.

Narcotics

Narcotics affect the central nervous system causing symptoms that range from mild anesthesia reactions to loss of consciousness and death at high doses. Examples include acetone, methyl ethyl ketone, and chloroform.

Heavy Metals and their Compounds

Heavy metals are relatively harmless in the metallic state, but their fumes, dust, and soluble compounds are well-known toxins. Some are carcinogenic. Others are nephrotoxins, hepatotoxins, or neurotoxins. The most common heavy metals are arsenic, beryllium, cadmium, chromium, lead, mercury, nickel, and silver. Acute toxic effects from exposure to heavy metals result from inhalation and ingestion of dusts or inhalation of fumes. Metal fumes are generally more hazardous than dust because the particles in fumes can enter the bloodstream easier. Bronchitis, chemical pneumonia, and pulmonary edema may result. Beryllium and cadmium are two of the most toxic metals when inhaled. Symptoms include nausea, vomiting, abdominal pain, and diarrhea. Chronic exposure to heavy metals may lead to long-term effects. For

example, chronic exposure to lead may damage the nervous system, brain and kidneys. Exposure to mercury over a long period can permanently damage the liver, kidney, and brain.

Chronic inhalation of cadmium can cause emphysema and kidney damage. Carcinogenic effects have been shown from exposure to chromium, nickel, arsenic, cadmium, and beryllium. Prenatal effects have been observed from exposure to methyl mercury. In addition, some lead compounds are embryotoxic. Some metals and their compounds can be absorbed through the skin. Mercury metal, and tetraethyl lead for example can enter the bloodstream through this route. Nickel, arsenic, chromium, and beryllium cannot penetrate the skin but they can damage the skin or cause allergic-type reactions.

Cyanides

The simple metallic cyanides are highly toxic by ingestion. Cyanides are readily absorbed through the skin, mucous membranes, and by inhalation. Alkali salts are toxic by ingestion. Even small amounts of sodium and potassium cyanide are highly toxic and death may occur within minutes from ingestion. Inhalation of toxic fumes from hydrogen cyanide gas may result in death in a few seconds. Symptoms of poisoning include dizziness, headaches, tightness in the chest, palpitation of the heart, and difficulty in breathing.

Nerve Agents

Nerve agents are the most toxic of the known chemical agents. They are hazards in their liquid and vapor states and can cause death within minutes after exposure. Nerve agents inhibit acetylcholinesterase in tissue, and their effects are caused by the resulting excess acetylcholine. Nerve agents are considered major military threat agents.

Working with Carcinogenic, Highly Toxic, or Acutely Hazardous Chemicals

Employees working with chemical carcinogens, highly toxic, or acutely hazardous chemicals at Trinity University must contact EHS prior to beginning work.

Appendix B
(DEFINITIONS)

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

Area Supervisor is the individual who oversees/supervises area (i.e. lab) or employee(s)

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

Carcinogen (see select carcinogen).

(CHO) Chemical Hygiene Officer means an employee who is designated by the Institution, 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 Institution's organizational structure.

(CHP) Chemical Hygiene Plan means a written program developed and implemented by the Institution which sets forth procedures, equipment, personal protective equipment and work practices that are capable of protecting employees from the health hazards presented by hazardous chemicals used in that particular workplace

Combustible liquid means any liquid having a flashpoint at or above 100°F (37.8°C), but below 200°F (93.3°C) except any mixture having components with flashpoints of 200°F (93.3° C), or higher, the total volume of which makes up 99 percent or more of the total volume of the mixture.

Compressed Gas means:

- A gas or mixture of gases having, in a container, an absolute pressure exceeding 40 psi at 70°F (21.1°C); or
- A gas or mixture of gases having, in a container, an absolute pressure exceeding 104 psi at 130°F (54.4°C) regardless of the pressure at 70°F (21.1°C); or
- A liquid having a vapor pressure exceeding 40 psi at 100°F (37.8°C) as determined by ASTM D-323-72.

Corrosive Chemical means a chemical is defined as corrosive if it causes visible destruction of or irreversible alteration in living tissue by chemical action at the site of contact.

Dose means the amount of chemical that enters the body and also influences the effect. To help quantify the relationship between dose and response and to provide guidelines for use, the

American Conference of Governmental Hygienists (ACGIH) publishes a book of Threshold Limit Values (TLVs) for many common industrial chemicals. These TLVs are exposure levels to which it is felt a healthy working population can be exposed for forty (40) hours a week with no ill effects. OSHA's Permissible Limits (PELs) are based on the TLVs. Chemical fume hoods should be provided in laboratories where work is being done with volatile chemicals having a TLV less than 50 ppm.

(EHS) Environmental Health and Safety is a department of Trinity University.

(EPA) Environmental Protection Agency is an agency of the Federal Government of the United States and was established in order to protect human health and the environment by way of writing and enforcing regulations based on laws passed by Congress.

Explosives are chemicals that cause a sudden, almost instantaneous release of gas, pressure, and heat when subjected to sudden shock, pressure or high temperature.

Exposures (Acute and Chronic) are expressions of toxicity, which can be divided into those having acute and those having chronic effects. Acute exposures involve short-term (usually high) concentrations resulting in illness, irritation, or death. Chronic effects are characterized by symptoms or disease following frequent exposure over a long time period. Symptoms of chronic poisoning are frequently different from those seen in acute poisoning by the same agent. For example, acute poisoning by benzene results in damage to the central nervous system, while chronic exposure affects blood cell production capacity of the bone marrow.

Exposure or exposed means that an employee or student is subjected in the course of employment to a chemical that is a physical or health hazard, and includes potential (e.g. accidental or possible) exposure. "Subjected" in terms of health hazards includes any route of entry (e.g. inhalation, ingestion, skin contact or absorption).

Flammable means a 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 projection exceeding 18 inches at full valve opening, or a
- *Gas, flammable* means a gas that, at ambient temperature and pressure, forms a flammable mixture with air at a concentration of 13 percent by volume or less, 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.
- *Liquid flammable* means any liquid having a flashpoint below 100°F (37.8°C), except any mixture having components with flashpoints of 100°F (37.8°C) or higher, the total of which make up 99 percent or more of the total volume of the mixture.
- *Solid, flammable* means a solid, other than a blasting agent or explosive as defined in §1910.109 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 means the minimum temperature at which a liquid gives off a vapor in sufficient concentration to ignite when tested. Note: Organic peroxides, which undergo auto accelerating thermal decomposition, are excluded from any of the flashpoint determination methods specified above.

Hazmat Employee means a person who in the course of employment directly affects hazardous materials transportation safety.

Highly Toxic Chemical(s) are:

- A chemical that has a lethal dose 50 (LD50) (dose at which 50% of the test animals die) of 50 mg or less per kilogram of body weight when administered orally in albino rats.
- A chemical that has an LD50 of 200 mg or less per kilogram of body weight when administered by continuous contact for 24 hours (or less if death occurs) with the bare skin of albino rabbits.
- A chemical that has a lethal concentration 50 (LC50) (the concentration in air at which 50% of the test animals die) of 200 parts per million (ppm) by volume or less of gas or vapor, or 2 mg per liter or less if mist, fume, or dust, when administered by continuous inhalation for one hour (or less if death occurs) in albino rats.

Irritants mean a chemical that causes a reversible inflammatory effect on living tissue particularly the skin, eyes, nose or respiratory system is an irritant.

Label means any written, printed, or graphic material, displayed on or affixed to containers of hazardous chemicals.

Laboratory Supervisor is the individual who oversees/supervises an area (i.e. lab) or employee(s).

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

Safety Data Sheet (SDS) means written or printed material concerning a hazardous chemical that is prepared in accordance with federal requirements.

Marking means a descriptive name, identification number, instructions, cautions, weight, specification, or UN marks, or combinations thereof, on the outer packaging of hazardous materials.

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

(NFPA) National Fire Protection Association is devoted to eliminating death, injury, property and economic loss due to fire, electrical and related hazards.

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

(OSHA) Occupational Safety Health Administration is a federal organization (part of the Department of Labor) that ensures safe and healthy working conditions for Americans by enforcing standards and providing workplace safety training.

Oxidizer means a chemical other than a blasting agent or explosive as defined in 29 CFR§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.

Physical hazard means 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.

The Table below shows some commonly-used chemicals and their physical hazards:

Physical Hazards	**Examples**
Flammables	Ethanol Acetone Cyclohexane Methanol
Compressed Gases	Nitrogen Carbon Dioxide Oxygen
Organic peroxides	Diethyl Ether Benzoyl Peroxide
Pyrophoric	Barium alloys Phosphorus Titanium Trichloride
Water reactive	Lithium Sodium Magnesium Metal
Combustible liquids	Acetic Acid Acetic Anhydride Isoamyl Alcohol

Explosives	Ammonium Perchlorate Picric Acid
Unstable (reactive)	Methyl Methacrylate

(PPE) Personal Protective Equipment is specialized clothing or equipment worn by an individual for protection against health and safety hazards.

(PI) Principal Investigator is the individual who oversees/supervises an area (i.e. lab) or employee(s).

Pyrophoric materials are ones that ignite spontaneously on contact with air.

Reactive Chemicals or unstable chemicals are materials that will polymerize, decompose (but not explosively), or condense under conditions of temperature, shock or pressure.

Routes of Exposure

Inhalation is by far the most hazardous route of chemical entry. Any chemical that becomes airborne can be inhaled either as a dust or a vapor. For a given chemical, the total quantity absorbed through the respiratory tract depends on its concentration in the air, the duration and frequency of exposure, and the rate of breathing.

The skin is not highly permeable to most chemicals and provides a relatively good barrier to protect from toxins in the environment. However, some chemicals can be absorbed through the skin in sufficient quantities to produce systemic effects. The health of the skin also influences chemical penetration. Skin that is diseased or abraded offers direct access into the body. The absorption of toxic materials through the skin varies under a number of circumstances. Contact with water increases the hydration of the skin and increases its permeability.

The gastrointestinal tract is rarely a route for occupational poisoning. However, accidental ingestions have occurred. Swallowing of particles cleared by the respiratory tract can contribute to the route of poisoning.

(SDS) Safety Data Sheets *(see Safety Data Sheets)*

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

- It is regulated by OSHA as a carcinogen; or
- It is listed under the category, "known to be carcinogens," in the Annual Report on Carcinogens published by the National Toxicology Program (NTP) (latest edition); or
- It is listed under Group 1 ("carcinogenic to humans") by the International Agency for Research on Cancer Monographs (IARC) (latest editions); or
- It is listed in either Group 2A or 2B by IARC or under the category, "reasonably anticipated to be carcinogens" by NTP, and causes statistically significant tumor incidence in experimental animals in accordance with any of the following criteria:
- After inhalation exposure of 6-7 hours per day, 5 days per week, for a significant portion of a lifetime to dosages of less than 10 mg/m^3;
- After repeated skin application of less than 300 (mg/kg of body weight) per week
- After oral dosages of less than 50 mg/kg of body weight per day.

Sensitizers are materials that cause an allergic reaction of the skin or respiratory system.

Toxic Chemicals

- A chemical is considered toxic if it falls into any of the categories below:
- A chemical with an LD50 between 50 mg and 500 mg per kilogram body weight when administered orally to albino rats.
- A chemical with an LD50 between 200 mg and 1000 mg per kilogram body weight when administered by continuous contact with the skin of albino rats for 24 hours.
- A chemical with an LC50 in air between 200 and 2000 ppm by volume, or between 2mg and 20 mg per liter of dust, mist or fume when administered by inhalation for one hour to albino rats.

Target Organ Toxicity: metabolic and excretory processes work to keep the body free of foreign substances. The liver and kidney help protect the body against poisoning and aid in removing poisonous substances. However, some toxic substances are accumulated in these same organs. Hepatotoxins, such as carbon tetrachloride act principally to damage the liver. Nephrotoxins, including halogenated hydrocarbons and uranium, cause damage to the kidneys. As the bloodstream circulates toxic chemicals throughout the body, every organ is in contact with the material. Many poisons show a selective affinity for the cells of a particular organ and produce specific effects on them. Poisons affecting the nervous system are called neurotoxins. An example of a neurotoxin is tetrodotoxin. Those affecting the circulatory system are hemotoxins, such as snake venom. Reproductive toxins such as toluene are agents that interfere with normal reproductive capabilities. Mutagens such as ethidium bromide are substances that cause genetic damage. Chemicals that cause defects of fetal development are called teratogens. Examples of teratogens include lead and ethylene oxide.

(TCEQ) Texas Commission on Environmental Quality is dedicated to the protection of the environment and human health through the responsible licensing of individuals whose occupations may have an environmental impact.

Unstable (reactive) means a chemical which in 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 Chemicals react with water to release a gas that is either flammable or a health hazard. Lithium and sodium are examples of water reactive chemicals.

References

29 CFR 1910.120 *Hazardous Waste Operations and Emergency Response*

29 CFR 1910.1200 *Hazard Communication*

40 CFR 279 *Standards for the Management of Used Oils*

40 CFR 261-265 *Hazardous Waste Standards*

40 CFR 273 *Standards for Universal Waste Management*

49 CFR 171.3 *Hazardous Waste*

49 CFR 172.704 *Hazardous Material Training Requirements*

29 CFR 1910.1450 *Occupational exposure to hazardous chemicals in laboratories*

Contact Information

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For all emergencies, contact TUPD at 210-999-7000