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1.0 Applicability

This program applies to all SMU faculty, staff, students, and service providers engaged in the laboratory use of hazardous chemicals at all facilities owned and/or operated by SMU. Additionally, it applies to all research and teaching laboratories which may carry out small-scale operations using multiple chemicals and procedures.

2.0 Scope

As part of the continuing effort to reduce exposure and risk to the laboratory personnel, the Southern Methodist University Environmental Health and Safety Department (EHS) has implemented this Chemical Hygiene Plan to provide information about hazardous chemicals exposure in the laboratory and appropriate preventive and protective measures. The written program is designed to comply with the requirements of the federal Occupational Safety and Health Administration (OSHA) Occupational Hazardous Chemicals Exposure in Laboratories Standard (29 CFR 1910.1450). This plan conforms to the SMU's policies and EHS Management System standards and guidance documents.

3.0 Definitions

The following terms are defined in order to allow a better understanding of this program:

- **American Conference of Governmental Industrial Hygienist (ACGIH):** An association of industrial hygienists and practitioners of related professions to advance worker protection by providing timely, objective, and scientific information related to the occupational and environmental health professionals.
- **Action level:** A concentration designated in OSHA 29 CFR 1910 (or in the absence of an action level, the PEL) for a specific substance, calculated as an eight-hour time-weighted average, which initiates certain required activities such as exposure monitoring and medical surveillance.
- **American National Standards Institute (ANSI):** A not-for-profit organization dedicated to supporting the U.S. voluntary standards and conformity assessment system and strengthening its impact, both domestically and internationally.
- **Chemical Hygiene Officer (CHO):** An employee designated by the employer to provide technical guidance in the development and implementation of the provisions of the Chemical Hygiene Plan. Employee should have previous experience via training or experience in working with chemicals in the laboratories.
- **Chemical Hygiene Plan (CHP):** A written program developed and implemented by the employer which (1) 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, and (2) meets the requirements of OSHA's Laboratory Safety Standard; 29 CFR 1910.1450(e).
- **Environmentally Health and Safety (EHS):** An office that's dedicated to the safety, health and environmental protection in research safety, community and occupational safety, and environment programs and activities.
- **Environmental Protection Agency (EPA):** A federal governmental agency that provide guidelines on human and environmental protection in the U.S.
- **Hazardous chemical:** Any chemical which is classified as health hazard or simple asphyxiant in accordance with the Hazard Communication Standard (29 CFR 1910.1200).
- **Health hazard:** Any chemical that is classified as posing one of the following hazardous effects: acute toxicity (any route of exposure); skin corrosion or irritation; serious eye damage or eye irritation;

respiratory or skin sensitization; germ cell mutagenicity; carcinogenicity; reproductive toxicity; specific target organ toxicity (single or repeated exposure); aspiration hazard or simple asphyxiant.

- **Laboratory:** A workplace where relatively small quantities of hazardous chemicals are used on a non-productive basis.
- **Lab Manager:** A staff employee responsible for managing laboratory operations.
- **Lab Safety Coordinator:** A safety officer designated, when requested by EHS, for a school, department, or other subdivision by the dean, chairman, or director to serve as liaison to IUEHS when EHS determines that the standard practice of contacting the laboratory directly is not meeting the communication needs due to the number of laboratories, scope of research, or complexity within the department.
- **Lab Supervisor:** A faculty or staff member responsible for supervising laboratory and it's personnel.
- **Laboratory use of hazardous chemicals:** The handling or use of such chemicals in which all of the following conditions are met:
  - Chemical manipulations are carried out on a "laboratory scale;"
  - Multiple chemical procedures or chemicals are used;
  - The procedures involved are not part of a production process, nor in any way simulate a production process; and
  - "Protective laboratory practices and equipment" are available and in common use to minimize the potential for employee for employee exposure to hazardous chemicals.
- **Lab Workers:** An individual employed in a laboratory workplace who may be exposed to hazardous chemicals in the course of his or her assignments. Laboratory Supervisors must ensure that their staff are instructed in the laboratory safety procedures. Examples include teaching assistant, research assistant, visiting professors, volunteers, or faculty member instructing an academic lab. However, it does not include students in an academic laboratory. It is the responsibility of the instructor to ensure that students in academic laboratory classes adhere to the principles of this plan
- **National Fire Protection Association (NFPA):** An international non-profit organization that is dedicated to the promotion of safety standards, education, training, and advocacy on fire and electrical-related hazards.
- **National Institute for Occupational Safety and Health (NIOSH):** A federal agency responsible for conducting research and making recommendations in regards to the prevention of work-related incidents such as injuries and illnesses.
- **Occupational Safety and Health Administration (OSHA):** A federal governmental agency that determines standard and regulations in regards to worker safety and health protection.
- **Oxidizer:** 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
- **Particularly Hazardous Substances (PHS):** Chemicals that are a select carcinogen, a reproductive toxin, or a chemical having a high degree of acute toxicity.
- **Permissible Exposure Limit (PEL):** The regulatory limit or maximum concentration of a substance in the air that personnel can be exposed to without personal protective equipment or engineering controls (such as a fume hood) set forth by OSHA. These chemicals may also have a "skin designation" that prohibits skin contact.
- **Physical hazard**: Any chemical that has been classified as posing one of the following hazardous effects: explosives, flammables (gases, aerosols, liquids, or solids), oxidizers (liquid, solid, or gas), self-reactive, pyrophoric (gas, liquid or solid), self-heating, organic peroxides, chemicals corrosive to metal, gases under pressure, water reactive that emit flammable gases, or combustible dusts.
- **Personal Protective Equipment (PPE**): Specialized clothing or equipment worn for protection against health and safety hazards.
- **Recommended Exposure Limit (REL):** The recommended guideline for upper exposure limits to hazardous substances set forth by NIOSH.

- **Principal Investigator (PI):** The lead scientist that plans and/or conducts the laboratory research and assumes the overall supervisory responsibility for laboratory operations and project completion.
- **Reproductive Toxin:** Chemicals that affect the reproductive capabilities including adverse effects on sexual function and fertility in adult males and females, as well as adverse effects on the development of the offspring including but not limited to those that damage chromosomes (mutagens) or the fetus (teratogens).
- **Safety Data Sheet (SDS)**: A written documentation that provide specific details on the hazards of the hazardous chemical product.
- **Select Carcinogen** - Any substance which meets one of the following criteria: (1) it is regulated by OSHA as a carcinogen; or (2) 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 (3) it is listed under Group 1 ("carcinogenic to humans") by the International Agency for Research on Cancer Monographs (IARC) (latest editions); or (4) it is listed in either Group 2A or 2B by IARC or under the category "reasonably anticipated to be carcinogens" by NTP, and causes statistically significant tumor incidence in experimental animals in accordance with any of the following criteria: (a) after inhalation exposure of 6-7 hours per day, 5 days per week, for a significant portion of a lifetime to dosages of less than 10 mg/m3; (b) after repeated skin application of less than 300 (mg/kg of body weight) per week; or (c) after oral dosages of less than 50 mg/kg of body weight per day.
- **Short-Term Exposure Limit (STEL)**: An allowable average exposure over a short period of time set forth by the ACGIH. It is typically around 15 minutes and should not be exceeded more than four times in a day as long as the time weighted average is not exceeded.
- **Threshold Limit Value (TLV)**: The concentration of chemicals to which a worker can be exposed for 8 hours per day set forth by the ACGIH
- **Standard Operating Procedures (SOP)**: A written document prepared by the laboratory to describe the hazards of a hazardous chemical, as well as guidelines for the selection and purchase, storage and transportation, engineering controls, work practice controls, and appropriate PPE.

4.0 Core Information and Requirements

4.1 Introduction

The hazards of chemicals vary widely and appropriate caution must always be used. Every chemical can be hazardous in certain circumstances. An understanding of the hazards of chemicals and how they enter the body can help those working with chemicals devise procedures to work with them safely. This Chemical Hygiene Plan will discuss specific details regarding physical and health hazards associated with chemicals, toxicity factors, routes of exposures, chemical exposure measures, engineering and administrative controls, PPE, training, requirements, and recordkeeping.

4.2 Physical Hazards

The following terms are frequently used when describing the physical hazards associated with chemicals:

- **Combustible liquid:** Any liquid, or mixture with 1% or more of a liquid, with a flashpoint above 140° F but below 200° F.
- **Compressed gas:** A gas or gas mixture with an absolute pressure exceeding 40 psi at 70°F, or exceeding 104 psi at 130°F, or a liquid having a vapor pressure exceeding 40 psi at 100°F as determined by ASTM D-232-72, a standard of the American Society of Testing and Materials.
- **Explosive:** A chemical that causes a sudden, almost instantaneous release of gas, pressure, and heat when subjected to sudden shock, high temperature or pressure.

- **Flammable:** There are four kinds of flammable materials.
  - Aerosol: A material that can produce a flame or flashback from a valve opening.
  - Gas: Any gas at ambient conditions that will cause a flammable mixture with air in concentrations of 13% or less.
  - Liquid: Any liqui or mixture with 1% or more of a liquid, with a flash point below 141°F.
  - Solid: A material that is liable to cause fire through friction, contact with moisture, spontaneous reaction, or retained heat, or which can be readily ignited and burns with enough persistence or violence to cause a serious health hazard.
- **Organic peroxides:** An organic compound with a bivalent O-O structure, which may be considered a peroxide derivative with one or both of the hydrogen atoms replaced with an organic molecule. They present dangerous fire and explosion risks; many are strong oxidizers.
- **Oxidizer:** A chemical that initiates or supports combustion of other materials, causing fire by itself or by the release of oxygen or other gasses.
- **Pyrophoric:** A material that will ignite spontaneously in air at or below 130°F.
- **Unstable:** Any material which will vigorously decompose, polymerize, condense, or will become self reactive when exposed to conditions of shock, pressure, or temperature.
- **Water-reactive:** A material, which can react with water or steam to produce a gas, which is either toxic or flammable.

4.3 Health Hazards

The following are health hazard classes as defined by the Occupational Safety and Health Administration:

- **Carcinogen:** A material which causes or potentially causes cancer according to the International Research on Cancer, or is listed as such in the National Toxicology Program Annual Report on Carcinogens https://ntp.niehs.nih.gov/whatwestudy/assessments/cancer/roc/index.html#toc1
- **Corrosives:** Chemicals that cause visible destruction of, or irreversible alterations in, living tissue by chemical action at the site of contact.
- **Irritants:** Chemicals which are not corrosive, but which cause reversible inflammatory effects on living tissue at the site of contact.
- **Sensitizer:** A chemical, which will cause an allergic reaction in a substantial number of exposed people.

4.4 Target Organ Effects

TOXINS	TARGET ORGAN
Cutaneous hazards	Damage the skin
Eye hazards	Damage the eye
Hematopoietic toxins	Damage the blood and/or blood forming organs
Hepatotoxic	Damage the liver
Nephrotoxic	Damage the kidneys
Neurotoxins	Damage the nervous system
Pulmonary toxins	Damage the lungs
Reproductive toxins	Affect the fetus

4.5 Factors Affecting Toxicity

All chemicals are hazardous under some conditions. An understanding of the factors that affect toxicity is helpful in devising safe procedures to prevent hazardous exposures. Some of these factors are briefly discussed below:

4.5.1 Dose: Perhaps the single most significant factor of concern is the amount of exposure to the chemical. An exposure to a large amount of the chemical is usually of more concern than exposure to a small amount. For most chemicals, there is a level of exposure below which no adverse effects are likely to be observed.

4.5.2 Toxicity: Chemicals vary widely in how toxic (poisonous) they are. Exposure to small amounts of highly toxic chemicals can be a greater danger than exposure to large amounts of less toxic chemicals.

4.5.3 Duration and frequency: One-time exposures that are of short duration are of less concern than multiple exposures of long duration, all other factors being equal. Thus, when there has been a chemical exposure, an important piece of information concerns duration and frequency.

4.5.4 Synergistic effects: Many situations involve exposure to two or more chemicals at the same time. When this happens, it is possible that the combined exposures are more hazardous than what one might expect from simply adding the two effects together. While information to exposures to a single chemical is often available, good information on the possible toxic effects to chemical mixtures is often not available.

4.5.5 Individual characteristics: Each person is unique. While there are many similarities in response to chemical exposures, responses may vary dramatically among individuals. For examples, males can react differently than females. Special concern is often given for women who are pregnant. Some individuals are allergic or hypersensitive to certain chemicals.

4.5.6 Acute effects: Effects that show up immediately after a chemical exposure. An example of acute effect is chemical burns result from an acid spillage.

4.5.7 Chronic effects: Effects that occurs after a significant amount of time has passed after a chemical exposure and it may be the result of multiple chemical exposures over a period of time. An example of chronic effects include cancer. Cancer from chemical exposures may not appear until 20 or more years after the initial exposure.

4.6 Exposure Routes

There are three major routes of entry for a chemical to enter the body: inhalation; direct contact (to skin and eyes); and ingestion. Injection is a fourth, though much less common, route of entry for chemicals. An understanding of these routes of entries enables one to develop procedures or controls to prevent hazardous exposures to chemicals:

4.6.1 Inhalation hazards: This is one of the most common routes of entry a chemical can enter the body. Chemicals that could be inhaled include: gases, volatile liquid vapors, volatile and non-volatile liquid substance mists and sprays, and solid chemicals in the form of particles, fibers, and dusts.

4.6.2 Direct contact hazards: Many chemicals (e.g. corrosives) can injure the skin directly, while others may cause irritation or an allergic reaction. In addition to causing local toxic effects, many chemicals may be absorbed through the skin and/or eyes in sufficient quantity to cause systemic effects. The main avenues by which chemicals enter the body through the skin are hair follicles, sebaceous glands, sweat glands, and cuts or abrasions of the skin. Direct contact effects and absorption of chemicals through the skin depend on a number of factors,

including: chemical concentration, chemical reactivity, chemical solubility, and skin condition and contact duration.

4.6.3 Ingestion hazards: Chemical ingestion is one of the least common routes of entry. However, persons using chemicals can easily ingest chemicals into the body via contaminated hands if they are not washed prior to eating, drinking, smoking, applying cosmetics, or sticking part of the hand or a writing tool that has become contaminated into the mouth.

4.6.4 Injection hazards: Injection, or subcutaneous exposure to chemicals is not very common but may occur in a variety of ways. The most well known is accidental puncture via syringe. Other ways a subcutaneous exposure may occur is broken glass or through open wounds that are not covered while working with chemicals. Injections can also occur through high-pressure streams of liquids or gases.

4.7 Chemical Exposure Control

Using the information presented in the earlier sections of this chapter and knowing the specific hazards of the chemicals to be used, one can design procedures to minimize hazards. At no time should any laboratory staff be exposed to any chemical above the OSHA Permissible Exposure Limit (PEL) or Short Term Exposure Limit (STEL). OSHA has established these limits as protective of virtually all workers. The National Institute of Occupational Health and Safety (NIOSH) publishes an annual guide with Recommended Exposure Limits (RELs). The American Conference of Industrial Hygienist (ACGIH) publishes a list of Threshold Limit Values (TLVs) that also dictates exposure limits for workers.

OSHA recently released documentation comparing all of the exposure limits after recognizing that many of its values may be outdated compared to the other organizations. Those comparison tables can be found here:

https://www.osha.gov/dsg/annotated-pels/

Control techniques fall into three broad classes in order of preference: engineering controls, administrative controls, and personal protective equipment.

4.7.1 Engineering controls: Devices that eliminate, isolate, or reduce exposure to chemical or physical hazards are considered engineering controls. Conducting work with hazardous chemicals in a fume hood or glove box, using machine guarding for moving parts, and providing secondary containment in the event of spills are examples of engineering controls.

4.7.2 Administrative controls: Whereas engineering controls are controls that work passively once they are established, administrative controls require that workers take active steps. Examples of administrative controls are posting hazard signs on laboratory doors, laboratory safety training, and chemical inventory, minimizing exposure time when working with hazardous chemicals, restricting access to areas where hazardous chemicals are used, working with highly odorous chemicals during non-office hours, and adopting standard operating procedures.

4.7.3 Personal protective equipment: This is the last line of defense against exposure to hazardous chemicals and should be the options last employed. Examples of PPE include items such as gloves, eye protection, suitable clothing, and respirators. Note that selection of appropriate personal protective equipment is not always straightforward. In the case of gloves, there are a wide variety of types depending on the specific application. Although some types

of personal protective equipment may be suitable for a wide range of applications, each operation should be assessed individually.

4.8 Particularly Hazardous Substances (PHS)

Individuals planning to use Particularly Hazardous Substances must have it approved by the Principal Investigator or supervisor and the Chemical Hygiene Officer prior to their initial use of the substance. Responsibility for determining whether a chemical is a Particularly Hazardous Substance rests jointly with the supervisor and the individual planning to use the substance. Particularly hazardous substances are defined to include select carcinogens, reproductive toxins and substances that have a high degree of acute toxicity (such as cyanides and dimethyl mercury).

4.8.1 Select carcinogens:

a. OSHA Carcinogen List

b. Annual Report on Carcinogens published by the National Toxicology Program (NTP), including all of the substances listed as "known to be carcinogens" and some substances listed as "reasonably anticipated to be carcinogens"

c. International Agency for Research on Cancer (IARC), including all of Group 1 "carcinogen to humans" and some in Group 2A or 2B, "reasonably anticipated to be carcinogens"

4.8.2 Reproductive toxins:

a. Mutagens: a chemical that may cause genetic mutation

b. Teratogen: a chemical that may cause embryo malformation

c. Sterility: a chemical that may cause reproduction incapability

4.8.3 High acute toxicity:

a. A chemical with a median lethal dose (LD_{50}) of 50 mg or less per kg of body weight when administered orally to certain test populations.

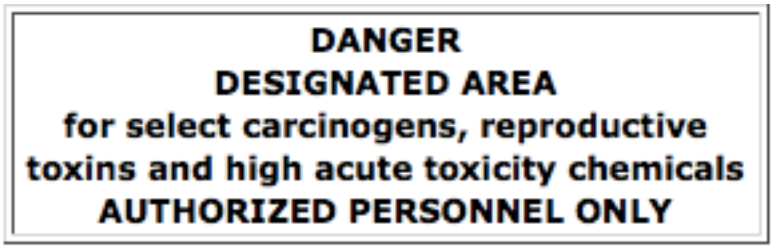
b. A chemical with an LD_{50} of 200 mg or less per kg of body weight when administered by continuous contact for 24 hours (or less if death occurs within 24 hours) to certain test populations.

c. A chemical with a median lethal concentration (LC_{50}) in air of 200 parts per million (ppm) by volume or less of gas or vapor, or 2 mg per liter or less of mist, fume, or dust, when administered to certain test populations by continuous inhalation for one hour, provided such concentration and/or condition are likely to be encountered by humans when the chemical is used in any reasonably foreseeable manner.

A list of the more commonly used particularly hazardous substances is available on the EHS website. This list is not exhaustive and you should consult with the product SDS or contact EHS for assistance in determining whether a substance is classified as particularly hazardous

Before using a particularly hazardous substance, an individual must:

1. Develop a laboratory-customized standard operating procedure and implement it.
2. Post the area where the substance will be used with a designated area sign (shown below).
3. Maintain an up-to-date and accurate inventory of all PHS used in the lab.



The specific standard operating procedure for use of the substance must include the use of containment devices and personal protective equipment, decontamination procedures and procedures for safe removal of contaminated waste.

4.9 Electrical Hazards

a. Laboratory staff should know the basic procedures for removing a person from contact with a live electrical conductor.

b. Laboratory should be designed so that all 110-volt AC outlet receptacles accept a three prong-grounding plug.

c. It is required that Ground Fault Circuit Interrupters (GFCI) be used on outdoor receptacles and indoors near any wet operations.

d. Outlets for ventilation hoods should be located outside of the hood to prevent any possible electrical sparks inside the hood.

e. All electrical cords should be inspected annually, and any cords with cut or frayed coverings shall be destroyed and thrown away.

f. Overload protection should be provided on equipment that is likely to be left on and unattended for long periods of time.

g. Non-sparking induction motors should be used in laboratories where volatile flammable materials may be present.

4.10 Sources of Information

4.10.1 Safety Data Sheets (SDS): SDSs should be the first source of information about the chemical hazards. SDSs will contain the following information, usually in separate sections on the sheet:

a. Section 1. Identification includes product identifier; manufacturer or distributor name, address, phone number; emergency phone number; recommended use; restrictions on use

b. Section 2. Hazard(s) Identification

c. Section 3. Composition/Information on Ingredients

d. Section 4. First-aid Measures

e. Section 5. Fire-fighting Measures

f. Section 6. Accidental Release Measures

g. Section 7. Handling and Storage

h. Section 8. Exposure Controls/Personal Protection lists

i. Section 9. Physical and Chemical Properties

j. Section 10. Stability and Reactivity

k. Section 11. Toxicological Information

l. Section 12. Ecological Information

m. Section 13. Disposal Considerations.

n. Section 14. Transport Information

o. Section 15. Regulatory Information

p. Section 16. Other information, includes the date of preparation or last revision

Manufacturers are required to provide a SDS for each chemical product sold. Also, SDS can be obtain through the internet by looking up the chemical's CAS# or its proper chemical name then followed by "SDS". Government regulations specify that SDSs should be readily available to employees. "Readily available" means that it can be easily accessible whether via digitally, phone, or hard copy. It is recommended that each laboratory obtain hard copies of SDS if employees do not have access to a computer, smartphone, or tablet connected to the internet. Further information and links to common SDS

search engines can be found on SMU's SDS Website.

4.11 Researcher Training

All laboratory staff including students and visitors potentially exposed to hazardous chemicals in the laboratories must attend the EHS-provided Laboratory Safety Training prescribed in the Chemical Hygiene Plan. The Lab Manager or Supervisor is responsible for determining who must complete the required training and for maintaining attendance records for both general and lab-specific training.

It is the responsibility of the department to provide lab-specific (on-the-job) training and to contact EHS to make arrangements for Laboratory Safety Training of new laboratory members prior to any job assignment involving hazardous chemicals in laboratory area.

The EHS-provided laboratory safety training will give a broad overview of various laboratory safety topics. The training will also serve as a forum for researchers to share their health and safety concerns and to obtain answers from EHS professionals. It is a place where researchers can share their ideas and real-life experiences dealing with potentially hazardous situations that can be beneficial for their peers.

An outline of the EHS-provided Laboratory Safety training program is attached as Appendix A. The training includes, as a minimum:

1. The provisions of the OSHA Occupational Exposure to Hazardous Chemicals in Laboratories Standard, including:
   a. permissible exposure limits
   b. monitoring requirements
   c. identifying requirements and best practices for handling and storing hazardous chemicals
   d. training requirements
   e. documentation

2. An overview of physical and chemical hazards, SDS, waste disposal and common methods to prevent and control employee hazardous chemical exposure in the laboratories

4.12 Chemical Procurement/Distribution/Storage

4.12.1 Procurement

a. The decision to procure a chemical shall be a commitment to handle and use the chemical properly from the initial receipt to ultimate disposal.

b. The SDS must be reviewed for all hazardous chemical users.

c. No container should be accepted without an adequate identifying label. The label should include at a minimum the substance name, manufacturer, distributor, appropriate warning, and precautionary measures.

d. All shipments should be dated when received and opened.

e. Update the chemical inventory to reflect the procurement of an existing or new chemical.

4.12.2 Inventory

a. Each department shall update their chemical inventory at a minimum annually.

b. Inventory should include the chemicals' name, quantity, size of the container and storage location.

c. The updated inventory shall be sent to EHS at least once a year for recordkeeping.

d. Annual inventories of chemicals stored in the laboratory shall ensure container integrity, label maintenance, expiration dates, and proper storage and disposal of chemicals**.**

e. Inventory will be review during laboratory survey.

4.12.3 Distribution

a. Chemicals carried by hand should be placed in secondary containment to protect against breakage or spillage. EHS has a limited supply of secondary containment that can be distributed to laboratories.

b. When a cart or other load carrying equipment is used to transport chemicals, the cart should be stable under the load and have sidewalls.

c. Freight elevators should be used whenever possible to avoid possible exposure to persons on passenger elevators.

d. Verify that the material and known information is indicated on the label when a hazardous chemicals is transported.

e. Avoid high pedestrian and high traffic areas during transportation.

4.12.4 Storage

a. All chemical containers must have a legible label firmly secured.

b. Determine the quantity that should be stored in the laboratory by considering the capability of the laboratory workers, the extent of the safety features available, the location of the lab, and the nature of the chemical operations.

c. All containers must be suitable for the types of materials to be stored.

d. All containers shall be dated when receive and open.

e. Every chemical in the lab should be returned to that location after each use and have a definite storage place.

f. Excess chemicals should never return to the original container.

g. The maximum quantity of flammable chemicals that shall be stored outside of a flammable cabinet shall not exceed 10 gallons unless permission is granted by EHS and the University Fire Safety manager.

h. Incompatible chemicals shall be kept segregated.

i. All flammable chemicals must be stored in a flammable material cabinet or refrigerator designed for that type of storage.

j. All gas cylinders must be secured and the protective valve cover in place when the cylinder is not in use. Oxidizing and flammable gases must be stored separately as dictated by regulatory requirements.

k. For more information on chemical storage, see EHS's Chemical Storage Website

4.13 Handling and Usage

4.13.1 Flammable and Combustible Liquids

Flammables liquid means any liquid with a flash point below 100°F (37°C). Combustible liquid means any liquid with a flash point at or above 100°F (37°C) but below 200°F (93.3°C). Examples include alcohols, toluene, diethyl ether, acetone kerosene, ethylene glycol, etc.

a. Eliminate ignition sources such as open flames, smoking materials, hot surfaces, sparks from welding or cutting, operation of electrical equipment, and static electricity. Post conspicuous "No Smoking" or "No Open Flame" signs in areas where flammable materials are used.

b. Laboratories should store combustible and flammable liquids in approved containers and quantities.

c. When transporting approved glass containers of flammable liquids through hallways, stairways, and elevators, use a non-breakable container large enough to retain the contents of the reagent container in case breakage occurs. Approved glass and/or plastic containers used for flammable liquids shall not exceed 1 gallon in capacity.

d. Flammable liquids that require freezing or refrigerator storage shall have no internal sources of ignition (explosion-proof).

e. Flammable liquids should never be heated over an open flame, hot plate, or insulated resistance heaters. Use a heating mantle, steam bath, or hot water bath.

f. Drums used as a dispensing vessel shall be properly grounded and bonded.

g. Any flammable liquid dispensing and receiving containers must be bonded together before pouring to prevent the accumulation of static electrical charge.

h. Flammable liquids should be stored in approved flammable liquid containers and storage cabinets or in a special storage room designed for that purpose.

i. Work with flammable and combustible materials in ventilation hood as much as possible.

4.13.2 Corrosives

Corrosive chemicals cause visible destruction of irreversible alterations in living tissue by chemical action at the site of contact. Such chemicals commonly include strong acids or bases in concentrated form, dehydrating agents, or oxidizing agents.

a. Equipment and containers used for storage and processing of corrosive materials shall be resistant to corrosion.

b. Eye protection and appropriate gloves shall always be used when handling corrosive materials.

c. Corrosive chemicals must be stored below eye level.

d. If exposure to corrosive chemical occurs, wash the affected area with copious amounts of water, immediately remove any contaminated clothing, and seek first aid or medical help.

4.13.3 Highly Toxic and Corrosive Gases

Highly toxic and corrosive gases are gases that are sufficiently toxic and/or corrosive and may require additional procedures for handling and storage. Highly toxic gas is a gas with a median lethal concentration (LC_{50}) in air of 200 ppm or less and classified as GHS Category 1 for Acute Toxicity. Corrosive gases can cause visible destruction of or irreversible alterations in living tissue by chemical action at the point of contact and corrode metals. Effects are depended upon the material solubility in the body fluids. Examples include chlorine, diazomethane, fluorine, ammonia, methylamine, acetylene, ethylene, hydrogen, silane, vinyl fluoride, oxygen, and etc.

a. Storage and transport is depended upon the hazards and physical properties of the chemicals.

b. These gases may not be stored in corridors or public areas of the building.

c. Do not stored near combustible materials, electrical connections, ignition, or heat sources.

d. All work performed with highly toxic and corrosive gases should be complete inside the chemical fume hood.

e. Ventilated gas cabinet is required for storage.

f. Gas monitoring must be in place.

g. Please notified EHS prior to ordering.

h. Coaxial tubing must be used.

4.13.4 Oxidizers

Oxidizer materials reacts vigorously at ambient temperatures when in contact with educing materials, may evolve oxygen at room temperature under slight heating. For example: chlorates, permanganates, nitrates, peroxides, etc.

a. Know the reactivity of the materials involved in an experiment or process.

b. Assure that there are no extraneous materials in the area that could become involved in a reaction.

c. If a reaction can be violent or explosive, use shields or other methods for isolating the materials or the process.

d. Use the minimum amounts necessary for the procedure. Do not keep excessive amounts of the material in the vicinity of the process.

e. Materials that are flammable shall be stored away from organic materials and/or reducers.

4.13.5 Acids and Base

Acids have a pH of less than 7 and they donate protons or receives electrons that are corrosive to eyes, skin, and mucous membrane. There are various types of acids: oxidizing acids, organic and mineral acids. Care should be taked to follow appropriate storage guidelines as not all acids can be stored together (such as nitric and acetic acid) Acid examples include hydrochloric acid, nitric acid, sulfuric acid, acetic acid, and phosphoric acid. Bases have a pH greater than 7 and they donate electrons, accepts protons, or release hydroxide ions that can be highly corrosive to the skins and eyes.

a. When acid is mixed with another reagent, an exothermic reaction may occur.

b. All work with concentrated acids must be done in the fume hood.

c. Latex gloves are not recommended for work with most acids.

d. Do not try to neutralize an acid splash or spill with a strong base.

e. Use sodium carbonate and sodium bicarbonate for acid neutralization.

f. Pour acid/base into the water and never water into the acid/base.

g. Use proper storage containers.

h. Base should be store separately from acids and oxidizers.

i. Do not store hydroxide solutions in metal containers.

j. Use sodium bisulfate and citric acid for base neutralization.

4.13.6 Peroxide-Forming Materials

Peroxide-forming materials react with oxygen to form peroxides, which can explode with impact, heat, or friction such as removing a lid. Examples of peroxide-forming materials include ethyl ether, tetrahydrofuran, isopropyl ether, liquid paraffin (alkenes) and olefins (alkenes). For more information, click HERE.

a. Any container of chemicals that can form peroxides should be handled very carefully and not opened at all if it is of uncertain age, has formed a precipitate, its physical properties differ from those of the pure substance, or if the cap is tightly stuck.

b. Containers of such substance should always be labeled with date received, date opened, and disposal/expiration date.

c. Store away from heat and light.

d. If possible, use polyethylene bottles.

e. Always order inhibited materials when possible.

f. Oxidizers and acids should be stored away from peroxide-forming chemicals.

4.13.7 Pyrophoric Materials

Pyrophoric materials can ignite spontaneously when exposed to air or water and can be extremely dangerous due to ease of an accident. Examples include metal oxide, metal nitride, reducing agents, metal hydrides, alloys of reactive metals, low-valent metal salts, and iron sulfides.

a. Experiments involving these materials should be performed in a glove box under an inert atmosphere.

b. If unable to use a glove box, transfers should be performed with a double-tipped cannula, inert gas.

c. Store away from flammables, heat, oxidizers, and water sources.

d. Stored under an atmosphere of inert gas or under kerosene as appropriate.

e. Limit the amount purchased and do not accumulate unneeded pyrophoric reagents.

f. Minimum PPE should include goggles, flame-resistant lab coats, and gloves.

g. Standard operating procedures and hazard assessment are required.

4.13.8 Light Sensitive Materials

Light sensitive materials degrade in the presence of light forming new compounds that can be hazardous or result in conditions such as pressure build-up inside a container that may be hazardous. It is imperative that these materials are stored in amber bottles in a cool, dry, and dark area.

4.13.9 Water-Reactive Chemicals

Water-reactive materials are chemicals that can react vigorously with moisture. These chemicals may emit flammable gases that can form explosive mixtures with air and ignited by sources of ignition such

as light bulb. Some examples of such materials include sodium, potassium, lithium metals and aluminum alkyls.

a. Stored in a cool, dry place and away from any water source and flammable materials.

b. Avoid working with water-reactive chemicals when working alone.

c. Fume hood is recommended to prevent buildup of combustible gases.

d. Glove boxes should be used when a dry atmosphere is required.

e. Class D fire extinguisher should be available for use.

f. Disposed of all water-reactive chemicals whenever they are no longer in use.

4.14 Disposal

Potentially Hazardous chemicals must be disposed of in accordance with federal and state regulations and procedures established by EHS. Your department may also have procedures that you are required to follow. Contact your supervisor, instructor or EHS before discarding of any potentially hazardous chemical.

4.14.1 Guidelines for Waste Collection and Disposal

a. To determine if the chemical you want to dispose, from your laboratory or work area, is a regulated hazardous waste, contact, and consult EHS.

b. All laboratory staff must be familiar with the location and composition of all wastes produced and/or stored in the laboratory.

c. Waste containers must remain closed except when actually adding waste. Open containers violate state and federal waste regulations.

d. All hazardous waste containers should be appropriately labeled with all of the required information.

e. Laboratory cannot accumulate more than 55 gallons of hazardous waste or 1 quart of acutely toxic waste.

f. For disposal information, contact 8-2464 or email riskmanagement@smu.edu.

g. Hazardous waste can be dropped off bimonthly.

h. If necessary, request waste pickup for disposal at Hazardous Waste Pickup Request Form.

i. Waste chemicals must not be placed or left for removal in the hallways.

j. Disposal of radioactive materials require special procedures. Contact EHS before proceeding.

k. Universal wastes such as batteries and paint are managed by both EHS and Facilities Services. Contact EHS for direction regarding its disposal.

l. Update the chemical inventory to reflect the disposal of the chemicals.

4.14.2 Waste Containers

a. Upon waste drop off, the laboratory may collect the same number of empty containers as full containers are dropped off.

b. If necessary, request empty waste containers from the Hazardous Waste Pickup Request Form.

c. The reuse of chemical containers for waste collection is encouraged provided that the original contents are compatible with the waste being collected.

d. Only use proper chemical containers as waste containers.

e. Waste containers should be free of damage and properly secured.

4.15 Pollution Prevention/Waste Minimization

Waste minimization strategies usually have the dual benefits of improving safety and reducing chemical purchase and disposal costs. It is recommended that each unit evaluate its procedures periodically to consider the possible usage of less hazardous or smaller quantities of chemicals. Waste minimization and pollution prevention may also help with meeting the legal requirements. There are federal, states, and local laws that govern waste disposal. The best way to comply with these laws is to not generate the waste in the first place.

4.15.1 Waste Minimization Strategy

a. Substitute safer chemicals for hazardous chemicals.

b. Limit the amount of hazardous chemical purchased.

c. Do not accumulate any unused or unneeded chemicals in the laboratory.

d. Properly handle any mislabeled or unlabeled chemicals that were left behind by another laboratory.

e. Communicate the importance of waste minimization to school administrators, laboratory staff, and students.

f. If possible, recycle chemicals.

c. Emphasize the importance of environmental responsibility to your laboratory staff and students.

d. Complete laboratory decommissioning procedures prior to vacating any laboratory or space where chemical, biological or radioactive agents are located.

4.16 Personal Protective Equipment

Personal protective equipment and personal hygiene are basic aspects of laboratory safety. Wearing appropriate personal protective equipment and practicing good personal hygiene as described below will minimize exposures to hazardous chemicals during routine use and in the event of an accident.

4.16.1 Attire: Wear a lab coat or apron; cover legs (no shorts or skirts) and feet (no sandals or open-toed shoes), confine loose clothing and long hair. Nylons and/or pantyhose are not recommended because they may melt upon contact with acid. Lab coats shall not be worn outside of the laboratory and should only be laundered by commercial vendors. They should not be taken home to be laundered.

4.16.1 Eye protection: It's state law and campus policy that personnel including students, staff and visitors in laboratories wear safety glasses, goggles, or face shields at all times where eye hazards are a possibility. Goggles are recommended when chemical splashes are possible. Contact lenses may be worn in the laboratory; however, they do not provide any protection of the eyes. Persons who wear contacts and/or prescription glasses must use the same eye protective equipment as persons who do not wear contacts.

4.16.2 Face shields: Full-face shields must be worn when conducting a procedure that may result in a violent reaction. Full-face shields with bottom caps to protect the neck are preferred because they provide the best protection.

4.16.3 Glass tubing: When inserting tubing into stoppers, lubricate tubing and wear leather gloves to protect hands from being cut in the event of the tubing slipping and breaking.

4.16.4 Gloves: Gloves are essential when working with hazardous substances. The proper gloves will prevent skin absorption, infection or burns. Glove materials vary in effectiveness in protecting against chemical hazards.

4.16.5 Personal hygiene: Hands should be washed frequently throughout the day, after glove removal, before leaving the lab, after contact with any hazardous material, and before eating, drinking, smoking, or applying cosmetics.

4.16.6 Respiratory protection: Work in a fume hood or provide adequate ventilation when working with materials that produce hazardous vapors or fumes. If you feel that additional respiratory protection may be warranted, please contact EHS at 8-2430.

4.17 Housekeeping

4.17.1 Checklist

a. Exits, aisles, and safety equipment must NOT be obstructed in any way with equipment, furniture, or other items.

b. Aisles within the laboratory should be 36 inches in clear width.

c. Work areas and floors are not to be used for excessive storage.

d. Doors which area not in use but which area accessible from a corridor or adjacent room should be appropriately labeled if they are blocked on the interior of the room.

e. Hallways are not to be used as storage areas.

f. Hazardous waste must not be stored for prolong period.

g. Make sure that trash is picked up regularly.

h. Sharps should be stored ¾ of the way full inside a hard-walled container for disposal.

i. Full non-hazardous waste container must be sealed, labeled as “trash” before placing it in the hallway for custodial pick up.

j. Storage containers must be clearly labeled and free of damages.

k. All the electrical cables must be organized and well insulated.

l. Inspect laboratory equipment before use.

m. Needles should be directly placed into sharps containers without being recap, bend, break, and clip.

4.18 Surveys and Monitoring

EHS shall conduct regular lab surveys and follow ups to maintain safety and environment friendly work place. These shall take place annually. PI, lab supervisors and lab managers shall conduct routine self-inspections to ensure laboratory compliance. Please referred to the Laboratory Survey Program for specific details in lab surveys and monitoring.

4.19 Hazard Identification and Labeling

a. Labels on all incoming hazardous material containers shall not be removed or defaced.

b. All departments must ensure that all laboratory containers of chemicals are labeled where required. Laboratory containers, including bottles, flasks, sample vials, etc., must be marked, labeled or coded in all cases. The labels should be dated and should identify the generator of the material.

c. Chemicals substances developed in the laboratory shall be assumed to be hazardous in the absence of other information.

d. A review of hazard materials not previously used in the laboratory shall be completed with all lab personnel before actual handling occurs.

e. Areas of the labs that have special or unusual hazards (radiation, x-ray, laser operations, flammable materials, biological hazards, etc.) shall be posted with warning signs.

f. Exemptions for labeling requirements shall be made for chemical transfers from a labeled container into a container that is intended only for the immediate use of the employee who performed the transfer.

4.20 Laboratory Behavior

a. Employees shall behave in a professional manner at all times in the laboratory.

b. Always wear appropriate PPE while working in the laboratory.

c. Know the proper operation and use of the appropriate safety procedures.

d. Avoid practical jokes or other behavior, which may result in a distraction of another worker.

e. Always obtain information on the hazards involved and the proper personal protective equipment required.

f. There should always be more than one person when working on a potentially hazardous activity.

g. All visitors to laboratories must observe all safety rules.

h. Practice laboratory safety awareness and report unsafe conditions when they are discovered.

i. Use your legs, not your back when lifting heavy objects. Make sure the load is close to your body at the start of the lift. Get help when lifting loads that are heavy, bulky or awkward.

4.21 Spill Control

4.21.1 Spill Prevention Guidelines

Before moving a box of chemicals, examine its integrity. If a box is wet, torn, improperly sealed, or in any way defective such that movement from a stable surface world result in contents being broken, scattered, or otherwise displaced, remove contents. Place individual containers in storage or place them in another suitable box.

Boxes of chemical containers should not be stacked where there would be any danger of toppling, breakage, or spillage of contents. Chemical containers should not be left on the floor or in aisles where they could be kicked or knocked over. Always check the compatibility of the chemical with the container used (i.e., do not place acids in metal can) and with the compatibility of other chemicals in adjacent containers. When appropriate, use secondary container for storage.

4.21.2 Spill Evaluation

Assess the severity of the spill and take the appropriate action: Does the material pose a substantial hazard to human health or is there any immediate danger or fire or explosion? If it is a hazardous spill and/or large non-hazardous spill (approximately 1 gallon or more), contact the SMU Environmental Health and Safety Department (EHS) at 8-2430. If you are not able to contact EHS, call 911 from a landline or 214-768-3333 from a mobile phone for SMUPD.

The individual investigator should handle small, low hazard spills. In any event, persons involved in clean-up must wear appropriate personal protective equipment; i.e. safety goggles, gloves, lab coats, and if necessary, respiratory equipment.

Avoid prolonged exposure to all vapors, fumes, and smoke. Remove all ignition sources from the area. Evacuate all necessary personnel from the area.

4.21.3 Spill Response and Clean-up Procedures

In the event of a chemical spill, the individual(s) who caused the spill is responsible for prompt and proper cleanup. It is also their responsibility to have spill control and personal protective equipment appropriate for the chemicals being handled readily available.

4.22 Emergency Procedures

No universal emergency plan will accomplish all emergency situations. Plan in advance for an emergency. The most important component of emergency planning is prevention.

4.22.1 High Hazard Emergencies

If the emergency consists of the following hazards treat the emergency as high hazard. Call the SMU PD at 911 from a landline or 214-768-3333 from a mobile phone.

- Immediately dangerous to life and health.
- Involves a large area.
- Major injury to personnel
- Is a threat to personnel and the public?
- Involves an infectious agent
- Involves a highly toxic, corrosive, or reactive material.
- If the nature of the emergency is unknown.
- If it is uncertain how to handle the emergency.
- If possible, isolate or evacuate the area.

When reporting the emergency give the following information:

- Name of caller and reason for calling.
- Location of victim or emergency.
- Name of victim
- Phone number of caller
- Facts concerning the emergency

Be available to provide emergency response personnel with information regarding the accident and hazards within the area. If possible collect safety data sheets for the chemicals involved.

4.22.2 Lower Hazard Emergencies

If the emergency consists of the following hazards treat the emergency as low hazard:

- A fire hazard does not exist
- Involves low to moderately toxic materials in small amounts
- Involves a readily treatable injury

Notify the immediate supervisor/instructor/manager, SMU PD, and the EHS of all illnesses and injuries related to exposure of hazardous chemicals or hazards. For a small spill, use a compatible absorbent material that will neutralize the spill, if available. Wear appropriate protective clothing when cleanup is involved. The area should be decontaminated with soap and water after clean up. Residue should be placed in an appropriate container for waste disposal. SMU has spill kits placed strategically throughout campus for laboratory spills.

4.22.3 Fire and Fire-Related Emergencies

If you discover a fire or fire-related emergency, activate the building fire alarm system. If fire alarm system is not available or operational, verbally notify persons in the building. Contact the SMU Police department immediately at 214-768-3333.

Use a portable fire extinguisher to extinguish the fire only if your exit is blocked by the fire. Provide the fire/police departments with the details of the problem upon their arrival and any special hazard information if possible.

If fire alarms ring in your building evacuate the building and move at least 200 feet away from the building. Do not re-enter the building until directed to do so.

4.22.4 Injury and Illness

Employees and students must notify their immediate supervisor or instructor of all illnesses and injuries related to exposure to hazardous chemicals.

Provide emergency and medical personnel with the following information:

- Name, location, and nature of the emergency
- Name of chemical involved
- Amount of chemical involved
- Area of body affected
- Symptoms

4.23 Recordkeeping

Department must keep records concerning any laboratory-specific safety records and training regarding Chemical Hygiene Plan. EHS will maintain a database for all individuals that complete General Laboratory Safety training through their office. This training covers various components of this CHP. All records must be kept for a minimum of 3 years within the department. Chemical inventory should be current and updated. SDS and emergency procedures should be easily accessible and reviewed by the laboratory staff. The training records should include employee name, training date, and the content of the training. The records must be made available to regulatory agencies such as OSHA and EHS upon request.

5 Roles and Responsibilities

5.1 Executives and Administrators

- Ensure that responsibilities assigned within this program are carried out within their administrative work units.

- Monitor implementation of this program within their work unit.
- Ensure adequate funding is available to support this program.

5.2 Environmental Health and Safety Department (EHS)

- Responsible for the development and implementation of the Written Chemical Hygiene Plan.
- Designate an individual who is qualified by training or experience to serve as a Chemical Hygiene Officer (CHO).
- Develop and provide general training and assist supervisors with specific training, when necessary.
- Provide attendance records for training provided by EHS.
- Provide advice on health and safety issues related to the Chemical Hygiene Plan.
- Assist in the disposal of hazardous chemical waste.
- Provide and update the chemical hazard warning signs
- Periodically audit the Chemical Hygiene Plan.

5.3 Chemical Hygiene Officer (CHO) – Brandon S. Chance, CCHO (2021-2022)

- Serve on the University's Research Safety Committees to provide technical guidance in the development and implementation the Chemical Hygiene Plan.
- Provide oversight for general training to all individuals working in SMU research laboratories.
- In conjunction with EHS, review the written Chemical Hygiene Plan annually.

5.4 Principal Investigator (PI), Laboratory Manager or Laboratory Supervisor

- Responsible for coordinating and administering the Chemical Hygiene Plan for in their respective areas.
- Serves as the first point of contact for employees on hazardous chemical exposure issues for the area
- Ensure laboratory staff adhere to the Chemical Hygiene Plan requirements
- Ensure appropriate chemical hazard warning signs are posted in the affected area
- Maintain proper documentations in regards to the Chemical Hygiene Plan
- Provide staff the required general and specialized training in regards to the Plan
- Ensure staff are informed of the location and availability of the written Chemical Hygiene Plan
- Determine and provide the required safety protection and wears for staff
- Ensure that personnel working in the area are properly trained and advised of lab rules and procedures.
- Provide laboratory staff/students/visitors with necessary information, upon request
- Complete periodic inspections to ensure adherence to the Chemical Hygiene Plan procedures as described in this document.
- Annually review the written Chemical Hygiene Plan.
- Notify EHS Department of any hazardous chemical issues in the area.

5.5 Laboratory Staff/Students/Visitors

- Adhere to the provisions of the Written Chemical Hygiene Plan.
- Follow appropriate lab rules and procedures.
- Complete general and specific training related to the Chemical Hygiene Plan.
- Ability to locate and identify chemical hazard warning signs and Chemical Hygiene Plan.
- Develop good personal chemical hygiene practices.
- Understand the contents of the Chemical Hygiene Plan
- Use and maintain the required safety protection appropriately.
- Report any hazardous chemical exposure problems in the area to the PI/manager/supervisor

6 Program Evaluation

The EHS will review the effectiveness of the program by:

- Verifying and documenting that all qualified persons have had appropriate training and documentations.
- Inspecting the program application for each area in which Chemical Hygiene Plan is required.
- Reviewing incidents related to applicable operations and Chemical Hygiene Plan failure.
- Documenting and reviewing the periodic inspections and annual program inspections.
- Providing an annual review of the Chemical Hygiene Plan for compliance and opportunities for improvement.
- Revise the written Chemical Hygiene Plan as required.

7 Associated Forms, Documents, and References

7.1 Forms

Appendix A: Laboratory Safety Training

7.2 References

- 29 CFR 1910.1450, the Occupational Exposure to Hazardous Chemicals in Laboratories Standard (OSHA)

APPENDIX A

LABORATORY SAFETY TRAINING

Course Outline - General Training

Description

Hazardous chemicals is a major hazard in many laboratories. This course will teach employees about the content of the Chemical Hygiene Plan and recommendations on hazardous chemical exposure prevention and procedures. Employees will learn how to define physical and chemical hazards, chemical permissible exposure limits, and recognize different types of hazardous chemicals protection. This is a required, in-person course for any individual that works in the laboratories.

Relevant Standards

29 CFR 1910.1450 Occupational Hazardous Chemicals Exposure in Laboratories Standard (OSHA)

Outline

- Introduction and objectives
- An overview of the OSHA Laboratory Standard
- The content and availability of the Chemical Hygiene Plan
- The availability of safety data sheets and how to use them
- An explanation of permissible exposure limits for chemicals
- An overview of methods to recognize hazards, how to evaluate hazards, and common methods to prevent and control exposure,
- The use, function and selection of personal protective equipment
- Common chemical and physical hazards present in the laboratory
- Emergency procedures for fire, injury, chemical exposure, and chemical spill situations
- Chemical waste disposal procedures at SMU

APPENDIX B

Occupational Exposure to Hazardous Chemicals in Laboratories – 29 CFR 1910.1450

Part Number: 1910
Part Title: Occupational Safety and Health Standards
Subpart: Z
Subpart Title: Toxic and Hazardous Substances
Standard Number: 1910.1450
Title: Occupational exposure to hazardous chemicals in laboratories.
Appendix: A; B
GPO Source: e-CFR

Scope and application. (1) This section shall apply to all employers engaged in the laboratory use of hazardous chemicals as defined below.

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

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

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

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

(3) This section shall not apply to:

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

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

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

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

(b) *Definitions*—

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

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

Carcinogen (see *select carcinogen*).

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

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

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

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

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

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

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

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

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

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

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

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

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

(ii) Multiple chemical procedures or chemicals are used;

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

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

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

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

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

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

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

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

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

(ii) It is listed under the category, “known to be carcinogens,” in the Annual Report on Carcinogens published by the National Toxicology Program (NTP) (latest edition); or

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

(iv) It is listed in either Group 2A or 2B by IARC or under the category, “reasonably anticipated to be carcinogens” by NTP, and causes statistically significant tumor incidence in experimental animals in accordance with any of the following criteria:

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

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

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

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

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

(2) *Periodic monitoring.* If the initial monitoring prescribed by paragraph (d)(1) of this section discloses employee exposure over the action level (or in the absence of an action level, the PEL), the employer shall immediately comply with the exposure monitoring provisions of the relevant standard.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

(viii) Provisions for additional employee protection for work with particularly hazardous substances. These include “select carcinogens,” reproductive toxins and substances which have a high degree of acute

toxicity. Specific consideration shall be given to the following provisions which shall be included where appropriate:

(A) Establishment of a designated area;

(B) Use of containment devices such as fume hoods or glove boxes;

(C) Procedures for safe removal of contaminated waste; and

(D) Decontamination procedures.

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

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

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

(3) *Information.* Employees shall be informed of:

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

(ii) The location and availability of the employer's Chemical Hygiene Plan;

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

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

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

(4) *Training.* (i) Employee training shall include:

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

(B) The physical and health hazards of chemicals in the work area; and

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

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

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

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

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

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

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

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

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

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

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

(4) *Physician's written opinion.* (i) For examination or consultation required under this standard, the employer shall obtain a written opinion from the examining physician which shall include the following:

(A) Any recommendation for further medical follow-up;

(B) The results of the medical examination and any associated tests;

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

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

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

(h) *Hazard identification.* (1) With respect to labels and safety data sheets:

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

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

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

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

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

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

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

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

(2) The employer shall assure that such records are kept, transferred, and made available in accordance with 29 CFR 1910.20.

(k) [Reserved]

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