SOUTHERN METHODIST UNIVERSITY

CHEMICAL HYGIENE PLAN

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OFFICE OF RISK MANAGEMENT
ENVIRONMENTAL HEALTH & SAFETY

CHEMICAL HYGIENE PLAN

CONTENTS

1. UNIVERSITY POLICY

1.1 POLICY

Southern Methodist University is committed to the responsibility of providing a safe work environment for its employees, students, visitors and other personnel conducting university business. It is with this commitment that the university developed and is implementing a Chemical Hygiene Plan to manage activities associated with certain recognized hazards.

In May 1990, the Occupational Safety and Health Administration (OSHA) adopted the workplace standard "Occupational Exposure to Hazardous Chemicals in Laboratories" to provide health and safety of employees working in laboratories. Southern Methodist University has responded to this regulation by providing a model plan to be used as a guide for compliance. This guide shall be used for safety and compliance concerning laboratory practices.

When properly developed and followed, this plan can serve as a comprehensive health and safety program for each laboratory. The Southern Methodist University Chemical Hygiene Guide will be reviewed, evaluated and updated at least annually to ensure it is compatible with current institutional practices and regulations and will be made readily available to employees, their representatives, and the Occupational Safety and Health Administration.

1.2 SCOPE

At Southern Methodist University (SMU) the Laboratory standard applies to all employees and students engaged in the "laboratory use" of hazardous chemicals. It applies to all research and teaching laboratories which carry out small-scale operations using multiple chemicals and procedures, where the procedures are neither apart of, nor simulate, a production process.

1.3 RESPONSIBILITIES

Responsibility for chemical hygiene rests at all levels from President to Students of the university.

1.3.1 **President of the University** has the ultimate responsibility for the safety and health of all personnel within the University and must, with other administrators, provide continuing support for the University's environmental health and safety program including the Chemical Hygiene Plan.

1.3.2 **Deans and Department Heads** are responsible for implementing the chemical hygiene plan in their respective operating units or departments.

1.3.3 **Chemical Hygiene Officer (CHO)**
Department of Risk Management and Environmental Health & Safety shall designate an individual who is qualified by training or experience to serve as a chemical hygiene officer (CHO). Designated CHO shall serve on the University's Chemical Hygiene Committee to provide technical guidance in the development and implementation of the Chemical Hygiene Plan.

1.3.4 Chemical Hygiene Committee

The Chemical Hygiene Committee's membership shall consist of designated CHO, representations from departments of the university that are engaged in "laboratory use" of hazardous chemicals and representatives from the University's Environmental Health & Safety (EH&S) Department.

The Committee's responsibilities include:

a) To work with administrators and other employees to develop and implement appropriate chemical hygiene policies and practices,
b) To monitor procurement, use and disposal of chemicals used in laboratory operations and see that appropriate audits are maintained,
c) To maintain current knowledge of regulatory requirements for controlled or regulated substances; and evaluate ways to improve the chemical hygiene program and
d) To assist project directors to develop precautions and adequate facilities.

1.3.5 Laboratory Supervisor or Faculty member assigned to lab space has overall responsibility for the chemical hygiene plan in their respective operations, including the responsibility to:

a) Ensure that all laboratory workers know and follow the chemical hygiene rules, that protective equipment is available and in working order, and that appropriate training has been provided,
b) Provide regular, formal chemical hygiene and housekeeping inspections including routine inspections of emergency equipment,
c) Know the current regulatory requirements for controlled and regulated substances,
d) Determine the required levels of protective apparel and equipment,
e) Ensure that facilities for storage and use for any materials are adequate and
f) Ensure that personnel working in the labs are properly trained and advised of lab rules and procedures.

1.3.5 Project Director and Other Director of Specific Operations have primary responsibility for chemical hygiene procedures for that operation.

1.3.6 Laboratory Worker is responsible for the following,

a) Planning and conducting each operation in accordance with the University's chemical hygiene procedures and specific rules or practices as established by the lab supervisor, and
b) Developing good personal chemical hygiene practices.

2. CHEMICAL HAZARD INFORMATION

2.1 INTRODUCTION

The hazards of chemicals vary widely and appropriate caution must always be used. Every chemical can be hazardous in certain circumstances. For example, even water can be a serious health hazard under certain conditions and when the proper personal protective equipment is not used (e.g. drowning). 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 chapter presents information on the physical and health hazards associated with chemicals, factors affecting toxicity, routes of exposures, and general measures that can be taken to control chemical exposures.

2.2 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.

2.2.1 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.

2.2.2 Explosive: A chemical that causes a sudden, almost instantaneous release of gas, pressure, and heat when subjected to sudden shock, high temperature or pressure.

2.2.3 Flammable: There are four kinds of flammable materials.

a) Aerosol: A material that can produce a flame or flashback from a valve opening.
b) Gas: Any gas at ambient conditions that will cause a flammable mixture with air in concentrations of 13% or less.
c) Liquid: Any liquid, or mixture with 1% or more of a liquid, with a flash point below 141°F.
d) 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.

2.2.4 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.

2.2.5 Oxidizer: A chemical that initiates or supports combustion of other materials, causing fire by itself or by the release of oxygen or other gasses.

2.2.6 Pyrophoric: A material that will ignite spontaneously in air at or below 130°F.

2.2.7 **Unstable:** Any material which will vigorously decompose, polymerize, condense, or will become self reactive when exposed to conditions of shock, pressure, or temperature.

2.2.8 **Water-reactive:** A material, which can react with water or steam to produce a gas, which is either toxic or flammable.

2.3 HEALTH HAZARDS

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

2.3.1 **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 http://ehis.niehs.nih.gov/roc/

2.3.2 **Corrosives:** Chemicals that cause visible destruction of, or irreversible alterations in, living tissue by chemical action at the site of contact.

2.3.3 **Irritants:** Chemicals which are not corrosive, but which cause reversible inflammatory effects on living tissue at the site of contact.

2.3.4 **Mutagen:** A material that damages chromosomes.

2.3.5 **Sensitizer:** A chemical, which will cause an allergic reaction in a substantial number of exposed people.

2.4 TARGET ORGAN EFFECTS

TOXINS	TARGET ORGAN
Cutaneous hazards	Damage the skin
Eye hazards	Damage the eye
Hematopoetic 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
Teratogen	A material that causes birth defects

2.5 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:

2.5.1 **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.

2.5.2 **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.

2.5.3 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.

2.5.4 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.

2.5.5 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.

2.5.6 Acute and chronic effects: Acute effects are those that show up immediately after a chemical exposure occurs. A good example of an acute effect is the spillage of acid on the skin--a chemical burn will occur immediately. Chronic effects are those that occur after a significant amount of time passes and usually are the result of multiple exposures over a period of time. Cancer is a typical example of a chronic effect because cancers caused by chemical exposures often do not show up until 20 or more years after the initial exposure.

2.6 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.

2.6.1 Inhalation hazards: Inhalation of chemicals is the most common route of entry a chemical can take to enter the body. Chemicals that could be inhaled include:

a) Gases
b) The vapors of volatile liquids
c) Mists and sprays of both volatile and nonvolatile liquid substances
d) Solid chemicals in the form of particles, fibers, and dusts

2.6.2 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:

a) Chemical concentration
b) Chemical reactivity
c) The solubility of the chemical in fat and water
d) The condition of the skin
e) The duration of contact

2.6.3 Ingestion hazards: Ingestion of chemicals is a less common route of entry into the body. 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. Accidental injection of chemicals through needles is unlikely. However, if needles are contaminated or contaminated glassware breaks, there is the possibility of injecting chemicals into the body. Injections can also occur through high-pressure streams of liquids or gases.

2.7 CONTROLLING CHEMICAL EXPOSURES

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 campus employee 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.

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

2.7.1 Engineering controls: Options for engineering controls are those that eliminate the hazard through methods such as changing the procedures or substituting less hazardous materials for more hazardous materials. Conducting work with hazardous chemicals in a fume hood or glove box, and providing secondary containment in the event of spills are examples of engineering controls.

2.7.2 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, 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 like those listed in Chapter 3.

2.7.3 Personal protective equipment: Personal protective equipment includes items such as gloves, eye protection, suitable clothing, and respirators. Because such equipment is the last line of defense against exposure to hazardous chemicals, these are the options last employed. 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.

2.8 MITIGATING ELECTRICAL HAZARDS

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

b) Labs 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.

2.9 SOURCES OF INFORMATION

2.8.1. Material Safety Data Sheets (MSDS)

MSDSs should be the first source of information about the chemical hazards. Typically, MSDSs will contain the following information, usually in separate sections on the sheet:
a) Name, address, and phone number of manufacturer
b) Chemical name, synonyms, and Chemical Abstracts (CAS) number
c) Physical properties
d) A listing of hazardous constituents for mixtures
e) Health hazard information
f) First-aid measures
g) Fire fighting measures
h) Handling and storage precautions
i) Exposure controls/personal protection
j) Stability and reactivity

Newer MSDSs will contain the following additional information:
k) Toxicological information
l) Ecological information
m) Disposal considerations
n) Transport information
o) Regulatory information
p) Other information

Manufacturers are required to provide a MSDS for each chemical product sold. The Department of Risk Management and Environmental Health and Safety (RMEH&S) maintains a repository of all the MSDSs received by the campus. If RMEH&S does not have a MSDS for a product you are using, they will obtain one. Government regulations specify that MSDSs be readily available to employees. It is recommended that each unit obtain hard copies of MSDSs for the products most commonly used.

Instructions for electronic access to the RMEH&S repository (for the campus community only) and connections to MSDSs available through the Web can be found on the RMEH&S website at http://www.smu.edu/riskmgmt/hazardous/index.asp. Alternatively, MSDSs may be requested by contacting RMEH&S 8-3224.

Material Safety Data Sheet Dictionary for the acronyms and common terms used on

MSDSs. http://www.umt.edu/research/files/environ/appendic.htm

2.10 EMPLOYEE TRAINING

2.10.1 Purpose of the Training Program

The purpose of hazard communication training is to explain and reinforce the information presented to employees through the written mediums of labels and material safety data sheets, and to apply this information in their workplace. Labels and material safety data sheets will only be successful when employees understand the information presented and are aware of the actions to be taken to avoid or minimize exposure, and thus the occurrence of adverse effects.

Training helps to integrate and classify the many pieces of information that relate to chemical hazard communication. In a typical workplace, a worker may be confronted with posted hazard warnings, signs, tags, incoming labels, workplace labels, material safety data sheets (MSDSs), manuals explaining the company hazard communication program, lists of chemicals, and information furnished by the union. This wide variety of communications will differ in format, content and reading level. These differences can obscure the important hazard communication message. Training can reduce this background "noise" by presenting the necessary information in a structured and logical manner.

Training sessions serve another important purpose - they provide a forum for employees to share their health and safety concerns, and to obtain answers from managers and occupational health and safety professionals. Employees can also share their ideas and job experiences - they often have acquired real expertise in dealing with potentially hazardous situations.

2.10.2 Specific Requirements

a) First, employers should provide employees with *effective* information and training on hazardous chemicals in their work area at the time of their initial assignment, and whenever a new physical or health hazard that employees have not been previously trained about is introduced into their work area. Information and training may be designed to cover categories of hazards (such as flammability or carcinogenicity) or specific chemicals. Chemical-specific information must always be available through labels and material safety data sheets.

b) Second, employees shall be *informed* of the requirements of this section; any *operations in their work area* where hazardous chemicals are present; the *location and availability* of the written hazard communication program, including the required list of hazardous chemicals, and material safety data sheets required by this section.

c) Third, employee training shall include at least: *methods and observations* that may be used to detect the presence or release of a hazardous chemical in the work area (such as monitoring conducted by the employer, continuous monitoring devices, visual appearance or odor of hazardous chemicals when being released, etc.); the *physical and health* hazards of the chemicals in the work area; 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; and the *details of the hazard communication program* developed by the employer, including an explanation of labels and material safety data sheets, and how

employees can obtain and use the appropriate hazard information

3. PROCEDURES AND SAFETY RULES

3.1 CHEMICAL PROCUREMENT / DISTRIBUTION / STORAGE

3.1.1. 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) A material safety data sheet (MSDS) shall be requested for all hazardous chemicals if the MSDS is not already on file. Before handling, using, or storing of materials, an MSDS shall be on file. (The MSDS should be provided by the vendor and included with each substance received.)
c) No container should be accepted without an adequate identifying label. The label should include as a minimum the substance name, manufacturer, distributor, appropriate warning, and precautionary measures.
d) All shipments should be dated when received and opened.

3.1.2. Inventory

a) Each department shall provide a yearly inventory of their laboratories' chemical supplies to the Environmental Health and Safety Department.
b) Annual inventories of chemicals stored in the laboratory shall ensure container integrity, label maintenance, chemical expiration dates, and proper disposal of unneeded chemicals.

3.1.3. Distribution

a) Chemicals carried by hand should be placed in an outside container or an acid-carrying bucket to protect against breakage or spillage.
b) When a cart or other load carrying equipment is used to transport chemicals, the cart should be stable under the load and easily manipulated
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 chemical is transported.

3.1.4. Storage

a) All chemical containers must have a legible label firmly attached
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) The containers shall be dated when received and also when open
e) Every chemical in the lab should be returned to that location after each use and have a definite storage place.
f) The maximum quantity of flammable chemicals that shall be stored in a laboratory shall not exceed 60 gallons total.
g) Incompatible chemicals shall be kept segregated.

- Flammable/combustible liquids
- Flammable solids
- Mineral acids (requires refrigeration)
- Organic acids
- Caustics (shock sensitive, explosive)
- Oxidizers, perchloric acid
- Water reactive oxidizers
- Air reactive
- Heat reactive
- Unstable
- Others
- Gases: toxic, flammable

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

i) All gas cylinders must be secured and the protective valve cover in place when the cylinder is not in use.

3.2 HANDLING AND USAGE

3.2.1 Flammables and Combustibles

a) A flammable liquid means any liquid with a flash point below 100 °F (37 °C). A combustible liquid means any liquid with a flash point at or above 100 ° F (37 °C) but below 200 ° F (93.3 °C).

b) 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.

c) Combustible and flammable liquids, in laboratories, shall be stored in approved containers and quantities.

d) 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 I gallon in capacity.

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

f) 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.

g) Drums used as a dispensing vessel shall be properly grounded and bonded

h) Any flammable liquid dispensing and receiving containers must be bonded

i) Together before pouring to prevent the accumulation of static electrical charge.

j) Store flammable liquids in approved flammable liquid containers and storage cabinets, or in a special storage room designed for that purpose

k) Work in ventilation hoods as much as possible.

3.2.2 Corrosives

a) A corrosive chemical causes 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.

b) Equipment and containers used for storage and processing of corrosive material shall be resistant to corrosion.
c) Eye protection and rubber gloves shall always be used when handling corrosive materials.
d) When mixing concentrated acids with water, always add the acid to water very slowly.
e) Acids and bases shall be stored separately from each other.
f) If exposure to a corrosive chemical occurs, wash the affected area with copious amounts of water, immediately remove any contaminated clothing, and seek first aid or medical help.

3.2.3 Oxidizers

a) A material, which 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.
b) Know the reactivity of the materials involved in a experiment or process Assure that there are no extraneous materials in the area which 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.

3.2.4 Water Reactive Material

a) Materials, which reacts violently with water. Examples include aluminum chloride, phosphorus pentachloride, and all hydrides.
b) Store water reactive compounds according to label directions. Wear proper safety equipment.
c) Use only in a hood.

3.2.5 Pyrophoric Materials

a) Pyrophoric materials ignite in air at or below room temperature in the absence of added heat, shock or friction. Examples include silane, silicon tetrachloride, and white or yellow phosphorous.
b) Pyrophoric materials should be used and stored in an inert environment.

3.2.6 Peroxidizable Material

a) Peroxidizable materials react with oxygen to form peroxides, which can explode with impact, heat, or friction such as removing a lid. Examples of peroxidizables include ethyl ether, tetrahydrofuran, isopropyl ether, liquid paraffin (alkenes) and olefins (alkenes).
b) 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.
c) Store away from heat and light. Polyethylene bottles are the best containers.

3.2.7 Light Sensitive Materials

a) 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.

3.3 DISPOSAL

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

3.3.1 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 RMEH&S, or the EPA.
b) All lab personnel must be familiar with the location and composition of all wastes produced and/or stored in the lab.
c) Waste containers must remain closed except when actually adding waste. Open containers violate state and federal waste regulations.
d) For disposal information, call 8-3228 or email: zurawski@mail.smu.edu
e) Request waste pickup for disposal purpose at http://www.smu.edu/riskmgmt/hazardous/disposal-form.asp.
f) Waste chemicals must not be placed or left for removal in hallways.
g) Disposal of radioactive materials require special procedures. Contact RMEH&S before proceeding.

3.4 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.

3.4.1 Introduction

Waste minimization and pollution prevention also helps ensure that the University meets the legal requirements. There are federal, state, 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.

3.4.2 Waste Minimization Strategy

a) Substitute safer chemicals for hazardous chemicals.
b) Deal with a large inventory of mislabeled or unlabeled chemicals that were left by another teacher.
c) Communicate the importance of waste minimization to school administrators.
d) Recycle chemicals.
e) Teach students environmental responsibility as you teach them to perform experiments.

3.5 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.

3.5.1 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.

3.5.2 Eye protection: It is 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 must use the same eye protective equipment as persons who do not wear contacts.

3.5.3 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.

3.5.4 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.

3.5.5 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.

3.5.6 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.

3.5.7 Respiratory protection: Work in a fume hood or provide adequate ventilation when working with materials that produce hazardous vapors or fumes.

3.6 HOUSEKEEPING

3.6.1 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 are not in use but which are 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) All the electrical cables must be organized and well insulated.

3.7 INSPECTIONS AND MONITORING

RMEH&S shall conduct regular lab inspections and follow ups to maintain safety and environment friendly work place. Lab supervisors and faculty members must conduct routine lab inspections to make

sure that common housekeeping is observed.

3.8 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.

3.9 LABORATORY BEHAVIOR

a) Employees shall behave in a professional manner at all times in the laboratory,
b) Know the proper operation and use of the appropriate safety procedures,
c) A void practical jokes or other behavior, which may result in a distraction of another worker
d) Always obtain information on the hazards involved and the proper personal protective equipment required,
e) There should always be more than one person when working on a potentially hazardous activity,
f) Only well-controlled and understood reactions shall be permitted to proceed without on site supervisors. Lights should remain on and all necessary precautions should be established to contain any hazardous substances in the event of a utility malfunction to the unattended operation,
g) All visitors to laboratories must observe all safety rules,
h) Practice laboratory safety awareness and report unsafe conditions when they are discovered and
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. SPILL CONTROL

4.1 SPILL PREVENTION GUIDELINES

Before moving a box of chemicals, examine its integrity. If a box is wet, tom, improperly sealed, or in any way defective such that movement from a stable surface would 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.

4.2 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 5 gallons or more), contact the SMU Environmental Health and Safety Department (EH&S) at 768-3228. If you are not able to contact RMEH&S, call 911.

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 unnecessary personnel from the area

4.3 TECHNIQUES FOR SMALL SPILL CLEAN UP

4.3.1 Liquids

Liquids should be covered with a spill mix, vermiculite or equivalent absorbent to contain and absorb the material. A 1:1:1 mixture by weight of soda ash (Na2CO3), clay cat litter (bentonite) and sand is very effective in rapidly absorbing liquids, in neutralizing acids, in controlling fumes, and in moderating the hazard due to reactive materials.

The liquid spill is covered with the mix and, after the liquid has been absorbed, the solid is collected into a heavy-walled plastic bag. The bag is secured and labeled as material for disposal.

If the liquid is an acid, or a compound readily hydrolyzed to an acid such as an acid chloride or anhydride, the spill mixture should be collected and slowly added to a pail of cold water, and after any reaction has ceased) allow the mixture to stand in a hood for 24 hours), the solution

should be further neutralized with Na2CO3 or CaCO3 and decanted into a drain with a large volume (several gallons) of water. The solid residue, after it dries can be treated as normal refuse.

Liquid oxidizing agents, except chromic acid solution, plus spill mix should be slowly added to a pail of cold water, then reduced by adding 10% NaHSO3 solution. The neutralized solution is decanted into the drain with a large volume of water and the dried solid residue treated as normal refuse. Thoroughly wash the area of the original spill with detergent solution.

4.3.2 Solid Caustic Alkalis

Solid dry material should be collected and then dissolved in a beaker, carefully neutralized with an acid and then flushed into the sink drain with large amounts of water. Flush contaminated areas with water and neutralize with dilute acid, preferably acetic acid.

4.3.3 Solid Acids

Solid dry material may be collected; the Environmental Health and Safety Department should be called to remove this material. Flush contaminated areas with water and neutralize with sodium bicarbonate.

4.3.4 Mercury

For small mercury spills, collect all droplets and pools by means of a suction pump and aspirator bottle with a long capillary tube. Alternatively, add a very small amount of dry ice acetone mixture to the mercury. Within seconds the mercury is frozen solid and may be swept up and placed in a suitable container.

For large mercury spills call the Environmental Health and Safety Department at 768-3228 or SMU Public Safety at 911

5. 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.

5.1 HIGH HAZARD EMERGENCIES

If the emergency consists of the following hazards treat the emergency as high hazards. Call the University Police at 911.

- 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 material safety data sheets for the chemicals involved.

5.2 LOW 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, DPS and the Environmental Health & Safety Department of all illnesses and injuries related to exposure of hazardous chemicals or hazards. For a small spill, use an 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 collection.

5.3 FIRE AND FIRE-RELATED EMERGENCIES

If you discover a fire or fire related emergency such as a hazardous material spill, flammable liquid spill, hazardous gas leak, smoke, or odor of burning activate the building fire alarm system. If fire alarm system is not available or operational, verbally notify persons in the building.

Use a portable fire extinguisher to extinguish the fire only if the fire is small, only at the source AND not spreading quickly. Provide the fire/police departments with the details of the problem upon their arrival. Special hazard information you may know is essential.

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.

5.4 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

APPENDIX A

Regulations (Standards - 29 CFR)

Occupational Exposure to Hazardous Chemicals in Laboratories - 1910.1450

Subpart: Z

This document and related links could be found at
http://www.osha-slc.gov/pls/oshaweb/owadisp.show_document?p_table=STANDARDS&p_id=10106

1910.1450(a): **Scope and Application**

1910.1450(a)(1)
This section shall apply to all employers engaged in the laboratory use of hazardous chemicals as defined below.

1910.1450(a)(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:

1910.1450(a)(2)(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.

1910.1450(a)(2)(ii)
Prohibition of eye and skin contact where specified by any OSHA health standard shall be observed.

1910.1450(a)(2)(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.

1910.1450(a)(3)
This section shall not apply to:

1910.1450(a)(3)(i)
Uses of hazardous chemicals that 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.

1910.1450(a)(3)(ii)
Laboratory uses of hazardous chemicals that provide no potential for employee exposure. Examples of such conditions might include:

1910.1450(a)(3)(ii)(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

1910.1450(a)(3)(ii)(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.

1910.1450(b): **Definitions**

1910.1450(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.

1910.1450(d): **Employee Exposure Determination**

1910.1450(d)(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).

1910.1450(d)(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.

1910.1450(d)(3)
Termination of monitoring: Monitoring may be terminated in accordance with the relevant standard.

1910.1450(d)(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.

1910.1450(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).

1910.1450(e)(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 that is:

1910.1450(e)(1)(i)
Capable of protecting employees from health hazards associated with hazardous chemicals in that laboratory and

1910.1450(e)(1)(ii)
Capable of keeping exposures below the limits specified in paragraph (c) of this section;

1910.1450(e)(2)
The Chemical Hygiene Plan shall be readily available to employees, employee representatives and, upon request, to the Assistant Secretary.

1910.1450(e)(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;

1910.1450(e)(3)(i)
Standard operating procedures relevant to safety and health considerations to be followed when laboratory work involves the use of hazardous chemicals;

1910.1450(e)(3)(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;

1910.1450(e)(3)(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;

1910.1450(e)(3)(iv)
Provisions for employee information and training as prescribed in paragraph (f) of this section;

1910.1450(e)(3)(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;

1910.1450(e)(3)(vi)
Provisions for medical consultation and medical examinations in accordance with paragraph (g) of this section;

1910.1450(e)(3)(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

1910.1450(e)(3)(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:

1910.1450(e)(3)(viii)(A)
Establishment of a designated area;

1910.1450(e)(3)(viii)(B)
Use of containment devices such as fume hoods or glove boxes;

1910.1450(e)(3)(viii)(C)
Procedures for safe removal of contaminated waste; and

1910.1450(e)(3)(viii)(D)
Decontamination procedures.

1910.1450(e)(4)
The employer shall review and evaluate the effectiveness of the Chemical Hygiene Plan at least annually and update it as necessary.

1910.1450(f): **Employee Information and Training**

1910.1450(f)(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.

1910.1450(f)(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.

1910.1450(f)(3)
Information. Employees shall be informed of:

1910.1450(f)(3)(i)
The contents of this standard and its appendices, which shall be made available to employees;

1910.1450(f)(3)(ii)
The location and availability of the employer's Chemical Hygiene Plan;

1910.1450(f)(3)(iii)
The permissible exposure limits for OSHA regulated substances or recommended exposure limits for other hazardous chemicals where there is no applicable OSHA standard;

1910.1450(f)(3)(iv)
Signs and symptoms associated with exposures to hazardous chemicals used in the laboratory; and

1910.1450(f)(3)(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, Material Safety Data Sheets received from the chemical supplier.

1910.1450(f)(4)
Training.

1910.1450(f)(4)(i)
Employee training shall include:

1910.1450(f)(4)(i)(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.);

1910.1450(f)(4)(i)(B)
The physical and health hazards of chemicals in the work area; and

1910.1450(f)(4)(i)(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.

1910.1450(f)(4)(ii)
The employee shall be trained on the applicable details of the employer's written Chemical Hygiene Plan.

1910.1450(g): **Medical Consultation and Medical Examinations**

1910.1450(g)(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:

1910.1450(g)(1)(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.

1910.1450(g)(1)(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.

1910.1450(g)(1)(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.

1910.1450(g)(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.

1910.1450(g)(3)
Information provided to the physician. The employer shall provide the following information to the physician:

1910.1450(g)(3)(i)
The identity of the hazardous chemical(s) to which the employee may have been exposed;

1910.1450(g)(3)(ii)

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

1910.1450(g)(3)(iii)
A description of the signs and symptoms of exposure that the employee is experiencing, if any.

1910.1450(g)(4)
Physician's written opinion.

1910.1450(g)(4)(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:

1910.1450(g)(4)(i)(A)
Any recommendation for further medical follow-up;

1910.1450(g)(4)(i)(B)
The results of the medical examination and any associated tests;

1910.1450(g)(4)(i)(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 workplace; and

1910.1450(g)(4)(i)(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.

1910.1450(g)(4)(ii)
The written opinion shall not reveal specific findings of diagnoses unrelated to occupational exposure.

1910.1450(h): **Hazard identification**

1910.1450(h)(1)
With respect to labels and material safety data sheets:

1910.1450(h)(1)(i)
Employers shall ensure that labels on incoming containers of hazardous chemicals are not removed or defaced.

1910.1450(h)(1)(ii)
Employers shall maintain any material safety data sheets that are received with incoming shipments of hazardous chemicals, and ensure that they are readily accessible to laboratory employees.

1910.1450(h)(2)
The following provisions shall apply to chemical substances developed in the laboratory:

1910.1450(h)(2)(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.

1910.1450(h)(2)(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.

1910.1450(h)(2)(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 material safety data sheets and labeling.

1910.1450(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.

1910.1450(j): **Record keeping**

1910.1450(j)(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.

1910.1450(j)(2)
The employer shall assure that such records are kept, transferred, and made available in accordance with 29 CFR 1910.1020.

1910.1450(k): **Dates**

1910.1450(k)(1)
Effective date: This section shall become effective May 1, 1990.

1910.1450(k)(2)
Start-up dates.

1910.1450(k)(2)(i)
Employers shall have developed and implemented a written Chemical Hygiene Plan no later than January 31, 1991.

1910.1450(k)(2)(ii)
Paragraph (a)(2) of this section shall not take effect until the employer has developed and implemented a written Chemical Hygiene Plan.

1910.1450(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.

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