



SAM HOUSTON STATE UNIVERSITY

A Member of the Texas State University System

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Chemical Hygiene Plan

For the

Analytical Laboratory

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1.0 Introduction

The University encourages and supports all programs which promote safety, good health, and well being of University faculty, staff, students, participants in University sponsored programs, and visitors. It is the policy of the Sam Houston State University Analytical Laboratory to provide safe and healthful conditions and to reduce injuries and illnesses to the lowest possible level. No task is so important and no service so urgent that it cannot be done safely. In keeping with this commitment, this Chemical Hygiene Plan was developed as part of the Laboratory Safety Program.

The Chemical Hygiene Plan (CHP) is designed to protect laboratory personnel from potential hazards associated with the use of chemicals. Compliance is mandatory for all employees working in campus laboratories due to requirements of the Occupational Safety and Health Administration (OSHA) standard on "Hazardous Chemicals in Laboratories". While these regulations pertain specifically to employees, provisions of the CHP may apply to students and visitors depending on their activities.

A variety of hazardous chemicals are used in small quantities in research and teaching laboratories creating a unique environment with a number of risks. These chemicals may cause injury or damage because they are toxic, flammable, corrosive, or reactive with water and other materials. How these substances are handled will determine the degree of risk.

The objective of this CHP is to provide uniform requirements for safe use of potentially hazardous substances in the laboratory. Work with select carcinogens, reproductive toxins, highly acute substances and operations posing a special hazard (for example, heating perchloric acid, working with pyrophorics, conducting electrophoresis, distillations, extractions, etc.) are addressed in the method specific Standard Operating Procedure (SOP).

Maintaining a safe and healthy environment in the laboratory is ultimately the responsibility of the Supervisor or Principal Investigator. However, each individual is expected to conduct all operations and procedures involving chemicals in a safe and prudent manner.

2.0 Definitions

Action Level- A concentration designated in 29 CFR part 1910 for a specific substance, calculated as an 8 hour time weighted average (TWA), which initiates certain required activities.

Chemical Hygiene Officer- An employee who is qualified by training or experience, to provide technical guidance in the development and implementation of the provisions of the CHP.

Chemical Hygiene Plan- A written program developed and implemented which sets forth procedures, equipment, personal protective equipment and work practices that are capable of protecting personnel from the health hazards presented by hazardous chemicals used in the laboratory. This plan shall be reviewed and updated annually.

Designated Area- An area used for work with selected carcinogens, reproductive toxins or substances that have a high degree of acute toxicity. Laboratory fume hoods are the designated areas.

Hazardous Chemical- A chemical for which there is statistically significant evidence, based on at least one study conducted in accordance with established scientific principles, which acute or chronic health effects may occur in exposed employees. The term “health hazard” includes chemicals which are carcinogens, toxic or highly toxic agents, reproductive toxins, hepatotoxins, nephrotoxins, neurotoxins, irritants, corrosives, sensitizers, agents which act on the hemotopoietic systems and agents which damage the lungs, skin, eyes or mucous membranes. These include chemicals with a health, flammability or reactivity rating of 2, 3 or 4 as designated by NFPA 49.

Highly Acute Toxin- Any substance for which:

1. the median oral LD50 is less than or equal to 50 mg/kg when administered orally to albino rats, or
2. the median inhalation lethal concentration, LC50, value is less than or equal to 200 ppm by volume of gas or vapor, or 2 mg/liter or less of dust, mist, or fume when administered continuously for one hour or less to albino rats, or
3. the median LD50 is less than or equal to 200 mg/kg when administered by continuous contact for 24 hours or less with the bare skin of albino rabbits.

Laboratory-A facility where the use of hazardous chemicals occurs.

Laboratory Scale-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 Use of Hazardous Chemicals-Handling or use of such chemicals in which all of the following conditions are met:

1. Chemical manipulations are carried out on a laboratory scale
2. Multiple chemical procedures or chemicals are used

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

Laboratory personnel-An individual employed in a laboratory workplace that may be exposed to hazardous chemicals in the course of performing assignments.

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

Select Carcinogen-Any substance that meets one of the following criteria:

1. It is regulated by OSHA as a carcinogen
2. It is listed under the category, known to be carcinogens, in the Annual Report on Carcinogens published by the National Toxicology Program (NTP)
3. It is listed under Group 1 (carcinogenic to humans) by the International Agency for Research on Cancer Monographs (IARC)
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
 - c. After oral dosages of less than 50 mg/kg of body weight per day

3.0 Roles and Responsibilities

Laboratory Director- The Director has ultimate responsibility for the CHP and shall provide endorsement and support for implementation.

The Director is also responsible for chemical hygiene in the laboratory and must assure that:

1. Laboratory personnel know and follow the rules of chemical hygiene
2. Protective equipment is available and in working order
3. Appropriate training has been provided
4. Facilities and training for use of any material being ordered are adequate
5. Inspections of emergency equipment, chemical hygiene and housekeeping are conducted.

Laboratory personnel- Each worker is responsible for:

1. planning and conducting all activities in accordance with chemical hygiene practices and procedures
2. using equipment only for its designed purpose
3. Being familiar with emergency procedures, including knowledge of the location and use of emergency equipment for the laboratory as well as how to obtain additional help in an emergency
4. developing good personal chemical hygiene habits
5. being alert to unsafe conditions and actions and calling attention to them so corrections can be made as soon as possible

Chemical Hygiene Officer/Safety Officer- The Chemical Hygiene Officer/Safety Officer shall:

1. Assist the Lab Director with the development and implementation of chemical hygiene policies and practices in the laboratory
2. Monitor the use and disposal of chemicals used in the analytical laboratory
3. Maintain appropriate audits
4. Help the Laboratory Director develop precautions and adequate facilities
5. Know the current legal requirements concerning regulated substances
6. Seek ways to improve the overall chemical hygiene plan

4.0 Employee Information and Training

The Lab Director shall ensure that information and training are 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. Refresher information and training shall be conducted at least annually and documented

4.1. Information

All laboratory personnel shall be informed of

1. Requirements of the OSHA Standard, "Occupational Exposure to Hazardous Chemicals in Laboratories",
2. The contents and availability of this Chemical Hygiene Plan
3. Permissible Exposure Limits (PELs) for OSHA regulated substances or recommended exposure limits where there is no applicable OSHA standard
4. Signs and symptoms associated with exposures to hazardous chemicals used in their laboratory
5. The location of reference materials on the hazards, safe handling, storage and disposal of hazardous chemicals found in the laboratory including, but not limited to, Material Safety Data Sheets (MSDS).

Within 24 hours after an occurrence of an employee accident that directly or indirectly involves chemical exposure, fatality, asphyxiation, hospitalization or injury three reports must be filed. The Accident Report, located on-line, the University's "Employer's First Report of Injury or Illness", located in the Safety file, and the "Supervisor's Investigation of Employee's Accident/Incident" reports, located on-line, are completed and given to the Safety Officer within 24 hours of an accident.

4.2. Training

Employee training shall include:

1. The physical and health hazards associated with chemicals stored and used in their work area
2. The contents of this Chemical Hygiene Plan
3. Methods and observations that may be used to detect the presence or release of a hazardous chemical; e.g., exposure monitoring conducted by the Safety Officer, visual appearance or odor of hazardous chemicals when being released, etc

The Analytical Laboratory provides education and training for personnel who use or handle hazardous chemicals. This education includes information on the following:

1. understanding and interpreting labels and MSDS
2. safe handling, location and acute and chronic effects of hazardous chemicals present in the work area
3. properly using personal protective equipment and first aid treatment
4. general safety instructions on the handling, cleaning and disposing of hazardous chemicals

This training is provided as part of a new employee orientation, specialized certification classes (HAZWOPER, first aid and CPR), weekly lab meetings and individual section (inorganic, organic, wet chemistry) training. A record of training is kept in the personnel file.

All employees have an Employee Safety Information form on file. Training is accomplished individually and as a group. The form is kept in the individual's personnel file along with other documented safety training and certifications. This folder provides the laboratory with all required documentation for staff training. Copies of all safety training and certification can be sent to the SHSU Safety Office if requested.

The Analytical Laboratory posts copies of the Texas Hazard Communication Act summary on the bulletin boards (THCA Chapter 502.017). Copies of the summary and complete law are available to all personnel in the Safety File. This summary contains the toll free number to file complaints with the Texas Department of Health

Employees are informed of chemical hazards to which they are potentially exposed. A copy of the chemical inventory and MSDS are available in the lab at all times. Training and personal protective equipment are provided appropriate to the hazards. Employees are encouraged to inform each other and supervisors of hazards and proper protective measures to be taken.

In addition to the requirement of THCA Chapter 502, employees receive information and training in the following areas:

1. hazard communications
2. first aid / CPR certification
3. fire safety and prevention
4. lab safety,
5. general safety
6. waste disposal.

The basic training information is contained in the chemical hygiene plan. Each employee is supplied with an individual copy of the CHP. A lab copy and other safety references are available in the lab.

The OSHA Permissible Exposure Limits (PELs) (29 CFR 1910 Table Z-1-A) are available in the Safety File in the form of a Right-to-Know Pocket Guide for Laboratory Employees: Be Aware of What Can Hurt You

5.0 Prior Approval Circumstances

Employees must obtain prior approval to proceed with a laboratory task from the Lab Director or his/her designee when:

1. Radioactive materials will be used
2. Recombinant DNA or biological material of Biosafety Level 3 or greater will be used,
3. It is likely that exposure limit concentrations could be exceeded or that other harm is likely,
4. There is failure of any equipment used in the process, especially of safeguards such as chemical fume hoods.
5. Members of the laboratory staff become ill, suspect that they or others have been exposed, or otherwise suspect a failure of any safeguards.

6.0 Standard Operating Procedures

6.1. General Rules

Employees shall act in a professional manner at all times

For chemicals they are working with, all employees should know:

1. the chemical's hazards, as determined from a MSDS and other appropriate references
2. appropriate safeguards for using that chemical, including personal protective equipment
3. how to properly store the chemical when it is not in use
4. proper chemical waste disposal procedures
5. proper personal hygiene practices
6. appropriate procedures for emergencies, including first aid, evacuation routes, and spill cleanup procedures.

Practical Jokes or other behavior that may confuse, startle or distract other workers is not tolerated.

Employees should avoid working alone. Arrangements should be made between individuals working in the lab outside of regular working hours to be in the lab together while working. Experiments known to be hazardous should not be undertaken by an employee who is alone in the laboratory.

Employees should inform the Lab Director if they are pregnant or nursing, because hazardous material exposure by the mother can result in fetal and infant exposure. Information given of this type will be held confidential and appropriate precautions will be made.

Employees are alert for unsafe conditions, practices and operations and report them promptly to the Lab Director or Safety Officer.

Employees are not allowed to perform laboratory work under the influence of any illicit substance(s) or medications that impair motor skills or sensory perception.

Visitors, those persons not employed by the Texas Research Institute of Environmental Studies or SHSU, to the laboratory are to be escorted by an employee and are the responsibility of that employee. All safety regulations must be observed.

Only well understood procedures are permitted to run unattended. If a procedure is left unattended, appropriate measures must be taken to ensure safety of others on the premises, such as using signs on doors or leaving lights on.

Employees shall be aware of the location and proper operation of laboratory safety equipment (i.e. fire extinguishers, fire alarms, eye wash stations, safety showers, first aid kits).

6.2. Avoidance of routine exposure

Skin contact with chemicals should be avoided

Avoid inhalation of chemicals. Do not "sniff" to test chemicals

Never pipette by mouth. Use a vacuum or a pipette bulb.

Apparatus capable of discharging toxic chemicals must be vented into a chemical fume hood.

6.3. Personal Hygiene

Eating, drinking, gum chewing and cosmetic application are not permitted in unauthorized laboratory areas.

Smoking is not allowed in the building.

Food shall not be eaten in places where chemicals are being used or stored.

Laboratory refrigerators, freezers and ice chests shall not be used for food storage. Lab ovens and microwave are not used for food or drink.

No glassware or utensils used for laboratory analyses shall be used for storage, handling or consumption of food or beverages.

Hands should be washed before using the restrooms, before eating or smoking and after handling potentially infectious materials. Areas of exposed skin should be washed frequently if there is a potential for contact with chemicals.

Confine long hair and loose clothing. Wear shoes at all times in the laboratory. The wearing of open-toed shoes or sandals is not allowed in the laboratory.

Exposed skin or face is not touched when handling biological material.

Any spills or accumulations of chemicals on work surfaces shall be removed as soon as possible using techniques that minimize residual surface contamination.

Wash promptly whenever a chemical has contacted your skin. Flush for at least 15 minutes prior to seeking medical attention.

Wash well with soap and water before leaving the laboratory. Avoid the use of solvents for washing skin. Solvents remove the natural protective oils from skin and can cause irritation and inflammation. In some cases, washing with solvent may facilitate absorption of toxic chemicals

6.4. Housekeeping

Housekeeping is directly related to safety and must be given importance of equal value to other procedures. Lack of good housekeeping reduces work efficiency and may result in accidents

All work areas, especially laboratory benchtops, should be kept clear of clutter. This will help prevent spillage, breakage, personal injuries and unnecessary contact with chemicals. All aisles, corridors, and doorways shall be kept clear of chemicals, equipment, supplies, boxes, and debris.

Contaminated or unclean glassware is placed on the lab cart in the dish-room for cleaning.

The laboratory must have a puncture resistant (e.g., cardboard) container specifically designated for glassware disposal.

Spills are to be cleaned up immediately from work areas and floors.

Floors must be kept dry at all times.

Access to exits, emergency equipment, utility controls, showers, eyewashes and fire extinguishers shall never be blocked.

All contaminated work surfaces are decontaminated after completion of procedures and immediately or, as soon as feasible after any spill of potentially infectious materials. If surfaces may have become contaminated since the last cleaning, they are cleaned at the end of the work shift. Cleaning is done by wiping with a disinfectant such as isopropyl alcohol or a 10 % bleach mixture in water.

Chemical containers should be regularly monitored for proper labeling and container integrity. Labels which are fading, falling off, or deteriorating must be promptly replaced. If abbreviations are used, they should be kept to a minimum and clearly identify the contents of the container as well as hazards associated with use; i.e., HgCl₂/poison, HCl/corrosive, MeOH/flammable, H₂O₂/corrosive-oxidizer, Nonhazardous buffer, etc. Improperly labeled or unlabeled chemicals make hazard identification and disposal difficult, and may create a hazard.

All chemicals should be placed in their proper storage areas at the end of each workday. Chemicals shall not be stored on desks, laboratory benchtops, floors, fume

hoods or in aisles. At the end of each workday, the contents of all unlabeled containers are to be considered waste and disposed of appropriately.

Collection containers for wastes must be clearly labeled including hazard identification.

Food and drink for human consumption shall not be kept in the same refrigerator used to store chemicals and laboratory samples. Eating and office areas must be clearly separated from laboratory and chemical storage areas.

Empty containers shall be treated in the following manner:

1. For water soluble solvents: triple rinse, deface the label, relabel as "Empty" and dispose with normal trash.
2. For non-water soluble solvents: triple rinse using a solvent capable of removing the chemical. ALL rinsate must be collected in a hazardous waste disposal container. Deface the label, relabel as "Empty" and dispose with normal trash.

6.5. Protective Clothing and Equipment

Carefully inspect all protective equipment prior to use. Do not use defective equipment.

Eye protection (safety glasses, chemical-resistant goggles, or face shield) shall be worn at all times in laboratories where chemicals are being used. This includes visitors. Ordinary prescription glasses are not considered effective eye protection since they lack necessary shielding. Chemical-resistant goggles should be worn over the glasses or prescription safety glasses be provided to employees required to wear corrective lenses.

The wearing of contact lenses in the laboratory is very controversial. Consult with an Optometrist prior to wear in the laboratory. Safety glasses or chemical-resistant goggles shall be worn over contacts at all times.

When working with corrosive, toxic, allergenic, or sensitizing chemicals, rough or sharp-edged objects, very hot or very cold materials, gloves made of material known to be resistant to permeation by the substance shall be worn. No one glove can protect against all hazards. Cloth gloves, while not appropriate for use around liquids, can protect against light abrasive materials and moderate temperature changes. Synthetic or rubber gloves protect against corrosives, solvents, and poisons. Leather gloves, often used for tasks like welding, protect against sparks, heat, and rough abrasives. Consult the manufacturer's performance chart or contact the Chemical Hygiene Officer to determine the proper choice of glove material.

Low-heeled shoes with fully covered uppers shall be worn at all times in the laboratory. Shoes or sandals with open toes shall not be worn.

Long pants and long sleeves should be worn when working with or around chemicals.

Long hair should be held in place behind the head.

Loose clothing, especially loose trouser legs and sleeves, should not be worn in the laboratory.

A full-body-length rubber, plastic, or neoprene apron appropriate for the material being handled should be worn if there is risk of splash or spill.

A proper respirator must be worn whenever exposure by inhalation is likely to exceed the action level or Personnel Exposure Limit (PEL) and a fume hood is not accessible. Employees must be medically qualified, trained, and fit-tested prior to using a respirator. Consult the Lab Director or Safety Officer before doing any such work.

Noise levels in the laboratory do not exceed the OSHA limit of 90 dB over an 8 hour day (29 CFR 1911.95). Ear plugs are available in the laboratory for the convenience of employees

7.0 Chemical Procurement, Distribution and Storage

7.1. Procurement

All chemicals in the laboratory must have approval of the Lab Director prior to purchase. Prior to purchasing approval the following must be considered:

1. Proper storage and handling procedures
2. Proper disposal procedures
3. Adequate facilities are available to safely handle the material
4. Properly trained personnel to handle the material

Before a substance is received, information on proper handling, storage and disposal should be given to all personnel involved. All original Material Safety Data Sheets (MSDS) are maintained on file available in the laboratory as well as electronic copies maintained in the Chemical Management System (CMS) software.

No container should be accepted without an adequate identifying label. The label should include as a minimum the substance name, appropriate hazard warnings and specific target organ effects.

7.2. Chemical Inventory

All chemicals shall be included in the chemical inventory. A Workplace Chemical List of each chemical stored in the laboratory giving the quantities, sizes, manufacturers, location and Chemical Abstract Service (CAS) numbers is compiled and submitted annually to the SHSU Safety Coordinator (THCA Chapter 502.005).

Chemical inventory is maintained in computerized chemical inventory software, in which include the following fields:

1. Name
2. CAS Number
3. Manufacturer
4. Classification, if applicable
5. Structural formula
6. Physical description
7. Storage compatibility
8. NFPA hazard identification information
9. Required Personal Protective Equipment
10. Warnings
11. Location
12. Size
13. Lot numbers
14. Expiration date, if applicable
15. Quantity
16. Received date

7.3. Chemical Storage

Both the storage and working amounts of hazardous chemicals shall be kept to a minimum.

Chemicals received at the laboratory are initially placed in the chemical receiving zone. This zone is located near the side door out of the main traffic flow and clearly visible. Upon receiving a shipment, the packing carton is inspected for damage and any outside labels and warning information is read and heeded. The contents are checked with the packing slip and entered into the software. The chemical is stored according to its storage class.

The lab storage classes, determined by compatibilities, are defined as follows:

1. Health – Blue
2. Flammability – Red
3. Corrosivity – White
4. Reactive – Yellow
5. General – Green

If storage class can not be determined from the label, the MSDS, NFPA charts, U.S. Department of Transportation Emergency Response Guide Book, NIOSH Pocket Guide to Chemical Hazards, industry toxic and chemical charts, and the manufacturer are consulted. The Chemical Storage room is inspected quarterly to determine that the storage classes are correct.

Storage facilities meet OSHA requirements (29 CFR 1911.106(d) (4)) of six complete air changes per hour. The Chemical Storage room has vented cabinets for flammable storage. Large containers are stored on a low shelf. Chemical containers are never placed directly on the floor, even temporarily. Reaction products to be disposed of as waste are stored in appropriate containers on spill trays with proper hazard labeling. All labels are readable from the shelves. The date of receipt and the date of initial opening of every chemical container are indicated on its label. Storage facilities are inspected quarterly for integrity of shelving and cabinets.

Chemicals and reagents shall be kept in closed containers when not in use. Chemical aliquots not used during analyses are never returned to the stock container.

7.3.1. **Flammable Materials**

Precautions for safe handling of flammable materials include the following:

1. Storage of flammable substances shall be limited to quantities specified in SHSU Waste Management Program.
2. Flammable substances shall be handled only in areas free of ignition sources.

3. Flammable substances should never be heated by using an open flame. Preferred heat sources include steam baths, water baths, oil baths, heating mantles, and hot air baths.
4. Class I liquids shall not be transferred from one vessel to another in any exit way.
5. Transfer of flammable liquids from 5 gallon containers (or less) to smaller containers shall be conducted in a laboratory fume hood or an approved flammable liquid storage room

7.3.2. Corrosive Chemicals

A reactive chemical is one that:

1. Fits the UOSH definition of "unstable" in 1910.1450(b):
"Unstable (reactive) means a chemical which in the pure state, or as produced or transported, will vigorously polymerize, decompose, condense, or will become self-reactive under conditions of shocks, pressure, or temperature
2. Is ranked by the National Fire Protection Association (NFPA) as 3 or 4 for reactivity,
3. Is identified by the Department of Transportation (DOT) as:
 - a. An oxidizer,
 - b. An organic peroxide, or
 - c. A class A, B, or C explosive,
4. Violently reacts with exposure to water or air.

Handle reactive chemicals with all proper safety precautions. This includes designating a separate storage area, monitoring periodically for degradation, and using appropriate personal protection.

7.3.3. Acids and Bases

Materials are classified as corrosive if they:

1. are capable of rapidly eroding building materials or metals, or
2. burn, irritate or destructively attack organic tissues such as skin, eyes, lungs and stomach.

Examples of commonly used chemicals that have corrosive properties are:

| | | |
|--------------|-------------|-----------|
| glacial | | |
| acetic acid | | |
| hydrofluoric | nitric acid | sodium |
| acid | bromine | hydroxide |
| hydrochloric | potassium | fluorine |
| acid | hydroxide | sulfuric |
| acetic | chlorine | acid |
| anhydride | | |

Safe handling procedures will vary with each operation and the type and concentration of the corrosive chemical.

The following general guidelines should be followed for procedures involving acids and bases:

1. Never pour water into acid. Slowly add the acid to the water and stir.
2. Open bottles or carboys slowly and carefully, wearing protective equipment to guard hands, face, and body.
3. OSHA requires suitable facilities, such as a safety shower and eyewash, to be located within the work area. The American National Standards Institute (ANSI) recommends that the safety shower and eyewash be within 100 feet of the work area for quick drenching or flushing of the eyes and body. *Eyewash stations and Showers should be flushed on a monthly basis by laboratory personnel.* Eyewash stations and showers are tested quarterly by SAFETY OFFICE personnel.
4. Procedures requiring the use of concentrated acids and bases must be conducted in a fume hood.
5. Never mix acid wastes with other materials such as solvents, metal-contaminated solutions, etc. Noncontaminated acid wastes can be easily disposed by neutralization.
6. When disposable containers are completely emptied of their contents, flush them thoroughly with water before throwing them away.
7. Never dispose of acids or bases in the sanitary sewer system (i.e., down the drain) until neutralized (pH 6.0-8.0). Neutralization may be conducted in the laboratory when included as part of an experiment, and should be conducted in a fume hood. The solution should then be poured slowly down the drain with copious amounts of water; i.e., leave the water running for approximately 5 minutes.
8. Contact the Safety Officer at x41921 for assistance with disposal of large quantities (more than 1 gallon or 1/2 pound) of acids and bases.
9. Each laboratory should have access to a spill kit that includes acid and base neutralizer. Never use combustible organic materials (sawdust, excelsior, wood scraps and shavings, paper, rags, or burlap bags) to absorb or cleanup spillage.

7.4. Gas Cylinder Storage

7.4.1. High Pressure Cylinders

Use of compressed gases in the laboratory requires anticipating chemical, physical, and health hazards. Cylinders that are knocked over or dropped can be very dangerous. If a valve is knocked off, the cylinder can become a lethal projectile. Accidental releases may result in an oxygen depleted atmosphere or

adverse health effects. In short, improper handling and use can cause structural damage, severe injury, and possibly death

Some of the gases used in the laboratory are supplied in high pressure cylinders. These cylinders are high energy sources and should be treated as potential explosives. All cylinders are labeled as full, in-use or empty while in the lab. Labels are kept in the lab and placed on the cylinders upon receipt from the manufacturer.

Restrain cylinders of all sizes, empty or full, individually by straps, chains, or a suitable stand to prevent them from falling.

When moving large cylinders, strap them to properly designed, wheeled carts to ensure stability.

When storing or moving cylinders, have the protective caps securely in place to protect the valve stems

Do not place cylinders near heat, sparks, or flames or where they might become part of an electrical circuit.

Cylinders should not be accepted unless the cylinder contents are clearly labeled. Color code only should not be accepted, since it does not constitute adequate labeling.

Never lubricate, modify, force, or tamper with cylinder valves.

Use toxic, flammable, or reactive gases in fume hoods only. In an enclosed system, a flammable gas may be used with caution.

Never direct high-pressure gases at a person. Do not use compressed gas or compressed air to blow away dust or dirt; the resultant flying particles are dangerous.

Be aware that rapid release of a compressed gas will cause an unsecured gas hose to whip dangerously and also may build up a static charge that could ignite a combustible gas.

Do not extinguish a flame involving a highly combustible gas until the source of gas has been shut off; otherwise, it can reignite causing an explosion.

Close the main cylinder valves tightly when not in use

Promptly remove the regulators from empty cylinders and replace the protective caps at once. Mark all empty cylinders.

Never bleed cylinders completely empty. Leave a slight pressure to keep contaminants out.

Use the appropriate regulator on each gas cylinder.

Always wear impact resistant glasses or goggles when handling and using compressed gases.

7.4.2. **Dewar Cylinder**

Cryogenic liquids are defined as liquids with temperatures lower than -74.3°C . Liquid Argon, an inert gas which is not flammable, toxic or odorous, may be used in the laboratory. The liquid is kept in a Dewar cylinder. Cryogenic liquids create a highly visible and dense fog when exposed to the atmosphere. These liquids may displace breathable air and can cause asphyxiation. They also can cause frostbite and burns on exposed skin and eye tissue. When dealing with cryogenic liquids use the following guidelines:

1. Acquire knowledge of cryogenic procedures, equipment operation and safety procedures.
2. Keep equipment and systems extremely clean.
3. Avoid skin and eye contact.
4. Do not inhale vapors.
5. Purge lines slowly when discharging.
6. Rubber and plastic may become very brittle in extreme cold. Handle these items carefully.
7. Store cryogenic liquids in Dewar flasks and cylinders.

Do not store Dewar cylinders in hallways, doorways or public reception areas.

8.0 Hazard Identification

Labels on existing chemical containers are not removed or defaced (THCA Chapter 502.007). Labels are required to contain the hazardous chemical identity, appropriate hazard warning, and the name and address of the manufacturer. If labels are not complete the omissions must be corrected. Personnel receiving chemicals for the laboratory ensure that each container of chemicals is entered into the inventory software and labeled with the date of receipt, date opened, expiration date and analyst initials.

Chemicals moved from their original containers are labeled with the chemical identity and appropriate hazard warnings. Hazard sticker labels are in the safety drawer and posters explaining labeling are located outside each lab entrance and in the main lab

Hazardous waste is disposed of following SHSU guidelines. All waste items in a given container are identified, documented on the SHSU Hazardous Waste Disposal Tag and Hazard Waste Pick up Inventory List. The SHSU Safety Office is contacted by the person who completed the tag(s) and list to arrange a pickup. Blank tags and lists are located in the front desk drawer.

The laboratory has an MSDS on file for each chemical in its possession. If manufacturers MSDS is not included in the shipment, the MSDS is requested from the company if not available from the Internet. The original MSDS is filed in the MSDS binder in the laboratory located on the bookshelf. A copy of any MSDS is available upon request either as a paper or electronic copy.

9.0 Control Measures

9.1. Ventilation

Laboratory ventilation is normally designed to provide a minimum of eight air changes per hour. This flow is not necessarily sufficient to prevent accumulation of chemical vapors. The Analytical Laboratory was designed and engineered for a 100% fresh air replacement every 5 minutes. Laboratory work shall be conducted in a fume hood or similar device when:

1. Procedures call for work with toxic substances which are volatile; i.e., evaporate at normal temperature and pressure, or
2. There is a possibility the action level or PEL will be exceeded.

The protection provided by laboratory fume hoods is dependent upon two important factors:

1. proper use of the hood
2. maintenance of adequate airflow through the hood.

The way the hood is used will determine the degree of protection it will provide. Each employee is responsible for implementing the following work practices when using a hood.

1. Continually monitor air being drawn into the hood. This can be done by attaching a light-weight strip of paper to the bottom of the sash.
2. Operate the hood at a sash position that will provide splash protection for the user; e.g. 10-12 inch opening for hoods with vertical sliding (up and down) sashes and the sashes closed as much as possible for continuous air flow hoods with horizontal sliding (left and right) sashes. This helps to ensure optimum protection when conducting operations in the hood.
3. Avoid using the hood for storage of bottles and equipment, especially along the back wall. Any apparatus that must be housed within the hood should fit completely inside the hood. Elevate the apparatus on blocks (at least 2 inches off the benchtop) to allow air to flow freely around and beneath.
4. Manipulations within the hood should be performed at least 6 inches inside the face of the hood or as far towards the back of the hood as possible. This minimizes the possibility of contaminants escaping from the hood.
5. Things which cause air turbulence across the face of the hood such as fans, window air conditioning units, or excessive movement should be avoided.
6. Exhaust hoods do not provide adequate protection for all operations involving toxic materials. A higher level of containment should be used for procedures where minor contamination can be serious. If you are in doubt about the level of containment needed for your operation, ask the Lab Director, or contact the Safety Officer.

Work where flammable gas, toxic vapors, or noxious odors are given off is performed in the fume hoods. Chemicals and equipment storage (not for immediate or continual use) are not allowed in the fume hoods. Apparatus used in the hoods is

placed 5-10 cm from the front edge to maximize the effectiveness of the hood. Hood sashes are closed when active work is not going on and during work sashes are kept at the lowest appropriate location for maximum effectiveness.

The Analytical Laboratory has two fume hoods located in the main lab, one fume hood in the glassware storage room and two in the small lab. The fume hoods are set to 130 cfm (cubic feet per minute) and are equipped with monitors which are checked daily. Any hood ventilation problems or failure are promptly reported to the Lab Director, SHSU Physical Plant and the SHSU Safety Office.

The Safety Office will conduct annual surveys of fume hoods to ensure adequate airflow is maintained through the hood face. Face velocities should be between 80 and 120 feet per minute (fpm). Hoods that do not meet these minimum standards are considered "inadequate" and should not be used for protection from toxic or volatile materials. Contact the Safety Officer at x41921 if the hood is not working properly.

9.2. Safety Showers

The laboratory has one safety shower in the main lab and a shower in each of the restrooms. The showers are located no more than 10 seconds in time and not greater than 100 feet in distance from any potential hazard. The shower areas are readily accessible, kept clear of obstructions, and clearly labeled. The pull which activates the safety shower has a large triangle. The valve opens readily and remains open until intentionally closed. Water flow provides the recommended 30 gallons per minute. The shower is checked monthly for flow and operation. Employees are instructed in shower location and operation (duration for at least 15 minutes to cleanse a chemical contact).

9.3. Eye Wash Stations

Eyewashes are located at each sink in the laboratory with the exception of the washroom and restrooms. These locations are within recommended National Safety Council guidelines of 25 feet or 15 seconds from potentially harmful activity. The eyewashes provide at least 0.4 gallons per minute, at a relatively low pressure (25 psi or less) and provide a flow of aerated potable water. Employees are instructed in eyewash location and operation (duration for at least 15 minutes to cleanse a chemical contact). Eyewash stations are tested, following National Safety Council recommendations, every week for a minimum of three minutes, and a record is kept of these tests. The three minute flush of plumbed installations is preformed weekly to reduce the threat of eye infections. Eyewash locations are clearly labeled. Plastic portable eyewash bottles are part of field equipment.

9.4. Electrical Hazards

The Analytical Laboratory meets the NFPA Standard 70, the National Electrical Code. All electrical outlets and circuit breakers are plainly labeled on the outlet and in the Mechanical room. All electrical outlets have a grounding connection requiring

a three-pronged plug. If equipment does not have a three pronged plug, is missing a prong, or has a loose or bent prong, the plug and cord are replaced by the SHSU Physical Plant.

Frayed or worn wiring is reported in monthly inspections and eliminated. Electrical cords are kept away from areas where they pose a tripping or fire hazard. Extension cords are used only when necessary and only on a temporary basis. New outlets are requested if present outlets are not sufficient.

9.5. Chemical Spills

9.5.1. Spill Cleanup Procedure

When a spill occurs follow the procedure as outlined in this section

Immediately alert other nearby workers of the accident and the nature of the spill. In the event of the release of a highly toxic gas or volatile material, the laboratory is evacuated and personnel are posted at entrances to prevent other workers from inadvertently entering the contaminated area. If the incident requires, the alarms are sounded and the entire facility.

If an individual is injured or contaminated with a hazardous material, tending the victim takes priority over spill containment. Call for medical help as soon as possible. The MSDS is copied and transported with the victim. A note indicating the exact chemical names is supplied to emergency personnel.

9.5.1.1.Spills on skin

For spills covering small areas of skin, the following steps are taken:

1. Flush skin with water no less than 15 minutes
2. If there is no visible burn, wash with warm water and soap, removing any jewelry to facilitate cleaning of any residual materials
3. Check the MSDS to see if any delayed effects should be expected
4. Do not use creams, lotions, or salves.

9.5.1.2.Spills on clothes

Follow these steps when spills have occurred on clothing:

1. Do not attempt to wipe clothes
2. All contaminated clothing, jewelry, and shoes are removed immediately while in the safety shower in the main lab. Seconds count. Do not waste time because of modesty
3. Take care not to spread the chemical on the skin, or especially, in the eyes

4. Use caution when removing pullover shirts or sweaters to prevent contamination of the eyes; it may be better to cut the garments off
5. Immediately flood the affected body area with warm water for at least 15 minutes. Resume if pain returns
6. Get medical attention as soon as possible
7. Clothes must be discarded or laundered before reuse, (do not wash with other clothing).

9.5.1.3. Splashes in the eyes

For splashes into the eye, the following steps are taken:

1. Immediately flush with eyewashes for 15 minutes
2. Hold the victim's eyelids away from the eyeball, and instruct the victim to move the eye up and down and sideways to wash thoroughly behind the eyelids
3. Follow first aid by prompt treatment by a member of a medical staff or an ophthalmologist who is acquainted with chemical injuries.

9.5.2. Spill Containment

The Analytical Laboratory has two chemical spill kits and one mercury spill kit to confine and limit a spill. Spill containment takes place if there is no risk of injury or contamination.

Spill kits are located in the Chemical Storage room and the main lab. Personnel are trained in kit use and know the location of the kits. Warning cones are also located in the lab and are used to mark off danger zones.

9.5.3. Spill Cleanup

If the employee has determined that cleanup can be safely done without emergency assistance, the following steps are taken:

1. Wear appropriate protective clothing and equipment
2. Have another person stand by during the cleanup
3. Clean up the spill and collect all wastes for proper disposal
4. Ventilate the area, as necessary, before it is reoccupied
5. Decontaminate reusable cleanup supplies such as scoops, shoes, etc
6. Restock the spill kit and return it to its storage location

Unnecessary risks are not taken. Call the SHSU Safety Office (X1921) when a spill involves the following:

1. large volume of spilled material
2. very hazardous material
3. very hazardous conditions
4. strong odor

5. personnel injury or exposure

9.6. Common Spill Cleanup

9.6.1. Materials having low flammability, low volatility or low toxicity

This category of substances includes inorganic acids (sulfuric and nitric acid) and caustic bases (sodium and potassium hydroxide). For cleanup, appropriate protective apparel, including gloves, goggles, and (if necessary) shoe covering are worn. Spilled chemicals are neutralized with materials such as sodium bisulfate (for alkalis) and sodium carbonate or bicarbonate (for acids), absorbed on vermiculite, scooped up and disposed of as non-hazardous or hazardous waste appropriately.

9.6.2. Flammable solvents

Fast action is crucial when flammable solvent of relatively low toxicity is spilled. This category includes petroleum ether, pentane, diethyl ether, dimethoxyethane, and tetrahydrofuran. Other workers in the laboratory are alerted, all flames extinguished, and any spark-producing equipment turned off. The spilled solvent is soaked up with spill pillows as quickly as possible and disposed of in properly sealed containers by the SHSU Safety Office. Non-sparking tools are used in the cleanup.

9.6.3. Highly toxic substances

The cleanup of highly toxic substances is not attempted alone. Laboratory personnel are notified and evacuated if necessary. The SHSU Safety Office is notified and is responsible for the cleanup.

9.7. Waste Disposal

9.7.1. General Disposal Plan

The disposal plan for the Analytical Laboratory is as follows:

1. Chemicals are purchased in the smallest reasonable quantity.
2. Procedures that require minimal chemical and / or less hazardous chemicals are used in lab protocols
3. Chemicals that can be, are recycled and reused
4. The employee generating the waste is initially responsible for disposal in an appropriate container with correct labeling including contents and hazards. (Proper containers are available in the lab
5. Hazardous waste is tagged indicating contents and amount
6. The employee informs the Lab Director of the waste and proper storage and labeling is inspected
7. MSDS are consulted as to special disposal requirements
8. Copies of waste records are kept on file

9.7.2. Hazardous Waste

Hazardous waste is defined by Analytical Laboratory as any material that cannot be poured down the sink, put in the regular trash or put in the biohazard/broken glass/pipette or sharps disposal containers. Hazardous waste is disposed of following SHSU guidelines. All waste items in a given container are identified, and the SHSU Hazardous Waste Disposal Tags and Hazard Waste Pick up Inventory List are completely filled out. The SHSU Safety Office is contacted by the person who completed the tag(s) and list to arrange a pickup. Blank tags and lists are located in the front desk drawer. Waste is stored in the drums in the disposal area until pick up.

9.7.3. Sharps Disposal Procedures

The laboratory defines sharps as any equipment or material that has the potential for cutting or puncturing personnel. Examples: pipettes (glass and plastic), needles, broken glass, scalpel blades, razor blades, etc.

9.7.3.1. Broken Glass

Broken glass is disposed of in a labeled broken glass container. A heavy cardboard box with red biohazard plastic lining is provided by the SHSU Safety Office. When full, the sack is closed the SHSU Safety Office is contacted. Boxes are not overfilled.

9.7.3.2. Needles and Scalpel Blades

Needles and blades are placed in red plastic boxes (Sharps Containers). Needles are not recapped before disposal. If the needles and scalpels have been used in animal applications, the box is autoclaved prior to disposal.

9.7.3.3. Pipettes

Pipettes, plastic tips and glass, are disposed of with the broken glass.

9.8. Fire Prevention and Safety

9.8.1. General

The laboratory's fire safety / prevention policy is designed to ensure that all reasonable steps are taken to preserve life and property from exposure to fire hazards. The requirements listed here identify the basic elements of the fire prevention program. The Analytical Laboratory consults with SHSU Safety Office and local emergency personnel to ensure optimal prevention and preparation for fire.

9.8.2. Emergency Phone Numbers

Emergency phone numbers are posted on all phones and inspected monthly for accuracy and readability. Employees have access to telephones at all times. Off-hours phone numbers of personnel are posted by each entrance to the laboratory.

| | |
|----------------------|------------------|
| FIRE | 9-911 |
| AMBULANCE | 9-911 |
| POLICE | 9-911 |
| SHSU POLICE | X41794 |
| SHSU SAFETY OFFICE | X41921 |
| POISON CONTROL | 8-1-409-756-1420 |
| TOXIC CHEMICAL SPILL | 9-1-800-424-8802 |

9.8.3. Detection Systems

The laboratory is equipped with smoke and heat detectors which are connected with the fire alarms. Fire alarms are activated automatically by the detectors or manually. Each person in the laboratory is required to know the locations of all the manual alarms and their operation.

9.8.4. Laboratory Inspections

A quarterly inspection is conducted to identify and correct recognizable fire hazards using the Laboratory Inspection Checklist. Exit doors, exit signs, passageways, emergency lighting, and means of emergency exit are inspected monthly to ensure their proper working condition and unobstructed access. Padlocking of any exit door is prohibited.

9.8.5. Drills and Training

Fire drills are carried out bi-annually. Employees are trained in evacuation procedures and emergency response.

9.8.6. Fire Extinguishers/Fire Blankets

Ten pound CO₂ type fire extinguishers are hung from the wall in the hallway outside the lab doors (2) and are placed at the end of each bench (4) in the laboratory. Fire extinguishers are inspected annually by the SHSU Safety Office following NFPA 72. Carbon dioxide is satisfactory for most small fires. All employees are trained in the use of these fire extinguishers.

Two fire blankets are available in the laboratory and are hung at the end of the benches near a fire extinguisher. Employees are trained in the location and use of the fire blankets.

9.9. Emergency Response

In preparation for emergencies, the lab safety officer consults with the SHSU Safety Office, SHSU Police and the local emergency personnel to improve plans for the handling of emergencies in the laboratory.

First Aid Kits are available in the laboratory, and portable kits are taken into the field.

Emergency phone numbers are posted on all telephones and are inspected monthly for accuracy and readability. Employees have access to telephones at all times. Off-hours phone numbers of personnel are posted by each of the entrances to the laboratory.

First Aid and CPR certification is provided annually for personnel

Emergency evacuation procedures and maps are posted throughout the building. Training on emergency procedures occurs during the CHP training sessions.

Evacuation drills are conducted annually.

Response Procedure

1. Remain calm
2. Sound alarm and alert others
3. Call for help and give all pertinent information
4. Limit emergency by appropriate action
5. Give first aid and other life protection
6. Follow evacuation procedures when necessary
7. Assist emergency professionals
8. Complete accident written reports

10.0 Exposure Monitoring

Exposure monitoring shall be performed when there is reason to believe that exposures are in excess of the action-level or the PEL. Materials which require monitoring under these conditions are listed in OSHA Regulations. If an employee would like to have an exposure assessment conducted, the Safety Officer should be contacted. Exposure assessments and monitoring may be conducted by the Safety Officer or designee. Documentation of exposure monitoring shall be kept and maintained as part of each employee's personnel record.

11.0 Medical Consultations and Examinations

Employees shall be provided an opportunity to receive medical attention, including any related follow-up examinations, at the University's expense, under the following circumstances:

1. An individual develops signs or symptoms associated with exposure to hazardous chemicals in the laboratory
2. Exposure monitoring reveals an exposure level routinely above the action level or PEL for a UOSH regulated substance for which there are exposure monitoring and medical surveillance requirements
3. An accident such as a spill, leak, equipment failure, or explosion results in possible over-exposure to hazardous chemicals

The Lab Director is responsible for establishing and maintaining an accurate record of any medical consultations and examinations provided to an employee.

All employees working with hazardous chemicals and potentially infectious materials are required to have appropriate medical clearance for laboratory work. Appropriate inoculations are required for anticipated exposures to pathogens.

12.0 Select Carcinogens, Reproductive Toxins and Highly Acute Toxins

The procedures described in this section are mandatory when performing laboratory work with greater than 10 mg or 100 mL of any carcinogen, reproductive toxin, or substance that has a high degree of acute toxicity.

Access to designated areas shall be restricted. Only trained employees will be allowed to work with chemicals in the designated area. All such persons will:

1. Use the smallest amount of chemical that is consistent with the requirement of the work to be done
2. Always use these chemicals in a hood with adequate air flow (face velocity between 80 and 120 feet per minute) or other containment device for procedures which may result in the generation of aerosols or vapors containing the substance
3. Use high-efficiency particulate air (HEPA) filters or high-efficiency scrubber systems to protect vacuum lines and pumps.
4. Decontaminate designated areas before normal work is resumed there. This includes contaminated equipment.
5. Remove any protective apparel, place it in an appropriately labeled container, and thoroughly wash hands, forearms, face, and neck on leaving a designated area.
6. Prepare wastes for disposal in accordance with Chemical Waste Disposal Guidelines
7. Do not wear jewelry when working in designated areas since decontamination of jewelry may be difficult or impossible.