Chemical Hygiene Plan

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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 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 University laboratories. General standard operating procedures are outlined, including work with select carcinogens, reproductive toxins, and highly acute substances. Specific standard operating procedures for operations posing a special hazard (for example, heating perchloric acid, working with pyrophorics, conducting electrophoresis, distillations, extractions, etc.) must be developed for your laboratory.

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.

I. ROLES AND RESPONSIBILITIES

A. Principal Investigator (PI)
(PI:_____ Lab Supervisor: _____)
The PI has responsibility for implementation of the Chemical Hygiene Plan (CHP) in his/her laboratory. The PI shall:

1. ensure that workers are trained and follow the CHP outlined in this document;
2. ensure that the necessary protective and emergency equipment is available, in working order, and that appropriate training has been provided;
3. ensure that periodic laboratory inspections are performed;
4. know current legal requirements concerning regulated substances;
5. review and evaluate the effectiveness of the laboratory specific Standard Operating Procedures (SOP) at least annually and update as necessary.

B. Laboratory Employees
Laboratory employees are responsible for:

1. planning and conducting each operation in accordance with practices and procedures established in this CHP;
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. knowing the types of protective equipment available and using the proper type for each procedure;
5. being alert to unsafe conditions and actions and calling attention to them so corrections can be made as soon as possible.

C. Chemical Hygiene Officer (CHO) is an employee who is qualified by training or experience to provide technical guidance in the development and implementation of the provisions of the CHP. The Chemical Hygiene Officer shall:

1. assist PI's and other laboratory employees with development and implementation of appropriate chemical hygiene procedures and practices, including providing consultation and information;
2. keep abreast of legal requirements concerning regulated substances and communicate any changes to PI's and laboratory employees.

3. seek ways to improve the overall chemical hygiene program.

II. EMPLOYEE INFORMATION AND TRAINING

PI's 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.

A. 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's).

B. 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 CHO, visual appearance or odor of hazardous chemicals when being released, etc.

III. PRIOR APPROVAL CIRCUMSTANCES

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

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

IV. STANDARD OPERATING PROCEDURES

A. General Rules

1. For chemicals they are working with, all employees should know:
   a. the chemical's hazards, as determined from a MSDS and other appropriate references;

b. appropriate safeguards for using that chemical, including personal protective equipment;
c. how to properly store the chemical when it is not in use;
d. Hazardous Waste Management procedures;
e. proper personal hygiene practices;
f. appropriate procedures for emergencies, including first aid, evacuation routes, and spill cleanup procedures.

2. Employees should avoid working alone. Arrangements should be made between individuals working in separate laboratories outside of regular working hours to crosscheck each other periodically. Experiments known to be hazardous should not be undertaken by an employee who is alone in the laboratory.

B. Personal Hygiene

1. Wash promptly whenever a chemical has contacted your skin. Flush for at least 15 minutes prior to seeking medical attention.
2. Avoid inhalation of chemicals. Do not "sniff" to test chemicals.
3. Do not use mouth suction to pipette anything. Pipetting aids must be used at all times.
4. Do not bring food (including gum and candy), beverages, tobacco, or cosmetic products into chemical storage or use areas. Eating, drinking, and applying cosmetics is allowed in designated areas only. Smoking is prohibited in all University facilities.
5. 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.

C. 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. Laboratory personnel must adhere to the following:

1. Access to emergency equipment, showers, eyewashes, fire extinguishers, exits and circuit breakers shall never be blocked or obstructed.
2. 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., $HgCl_2$/poison, HCl/corrosive, MeOH/flammable, H_2O_2/corrosive-oxidizer, Nonhazardous buffer, etc. Improperly labeled or unlabeled chemicals make hazard identification and disposal difficult, and may create a hazard.
3. 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.
4. Each laboratory must have a puncture resistant (e.g., cardboard) container specifically designated for glassware disposal.
5. At the end of each workday, the contents of all unlabeled containers are to be considered waste and disposed of appropriately.
6. Collection containers for wastes must be clearly labeled including hazard identification.
7. All work areas, especially laboratory benchtops, should be kept clear of clutter.
8. All aisles, corridors, stairs, and stairwells shall be kept clear of chemicals, equipment, supplies, boxes, and debris.

9. 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.
10. Empty containers shall be treated in the following manner:
    a. For water soluble solvents: triple rinse, deface the label, relabel as "Empty" and dispose with Biohazardous waste
    b. 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 Biohazardous waste.

D. Protective Clothing and Equipment
1. Carefully inspect all protective equipment prior to use. Do not use defective equipment.
2. 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.
3. 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.
4. 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.
5. 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.
6. Long pants and long sleeves should be worn when working with or around chemicals.
7. Long hair should be held in place behind the head.
8. Loose clothing, especially loose trouser legs and sleeves, should not be worn in the laboratory.
9. 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.
10. 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. Consult your PI and/or the CHO before doing any such work.

E. Chemical Storage
1. Store chemicals by hazard class, i.e. flammable, corrosive, reactive, toxic and general (non-hazardous). Maintain adequate separation of incompatible chemicals.
2. Store flammable solvents and strong acids or bases separately and in appropriate cabinets.
3. Secure compressed gas cylinders (strap, chain or cylinder stand).

4. All stored chemicals must be in appropriate containers, tightly sealed, properly labeled, and in good condition.
5. Flammable materials must not be stored in refrigerated equipment, unless the refrigerator is specifically designed for that purpose.

F. Flammable Materials

Precautions for safe handling of flammable materials include the following:

1. Storage of flammable substances shall be limited to the minimal quantities needed.
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 (see Table 1) shall not be transferred from one vessel to another in an 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.

G. Reactive Chemicals

A reactive chemical is one that:

1. Fits the OSHA 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.

H. Corrosive Chemicals

1. Materials are classified as corrosive if they:
   a. are capable of rapidly eroding building materials or metals, or
   b. 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	nitric acid	sodium hydroxide
hydrofluoric acid	bromine	fluorine
hydrochloric acid	potassium hydroxide	sulfuric acid
acetic anhydride	chlorine	

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

2. The following general guidelines should be followed for procedures involving acids and bases:
   a. Never pour water into acid. Slowly add the acid to the water and stir.
   b. Open bottles or carboys slowly and carefully, wearing protective equipment to guard hands, face, and body.
   c. 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 annually by Physical Plant personnel.
   d. Procedures requiring the use of concentrated acids and bases must be conducted in a fume hood.
   e. Never mix acid wastes with other materials such as solvents, metal-contaminated solutions, etc. 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 a written experiment protocol, 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.
   f. Contact SAFETY OFFICE at 4-1921 for assistance with disposal of large quantities (more than 1 gallon or 1/2 pound) of acids and bases.
   g. Each laboratory should have access to a spill kit that includes acid and base neutralizer; follow Spill Response Procedures Never use combustible organic materials (sawdust, excelsior, wood scraps and shavings, paper, rags, or burlap bags) to absorb or cleanup spillage.
3. Compressed Gas 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.

The following guidelines will help ensure safe handling, use, and storage of compressed gas cylinders.

RECEIVING AND STORAGE

1. Be sure to arrange a return agreement with suppliers prior to purchase since disposal of compressed gas cylinders is difficult and very expensive.
2. 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.
3. Do not accept cylinders which are damaged or do not have a valve protection cap.

4. All gas cylinders in use shall be secured in an upright position in racks, holders, or clamping devices. When cylinders are grouped together, they should be individually secured and conspicuously labeled on the neck area.
5. Oxygen cylinders shall never be placed near highly combustible materials, especially oil and grease, or near stocks of carbide and acetylene or other fuel gas cylinders, nor near any other substance likely to cause or accelerate a fire. Systems and components used for other gases and purposes must never be used for oxygen or interconnected with oxygen.
6. Cylinders should have current hydrostatic test date (normally less than 5 years old for steel and 3 years old for aluminum) engraved on the cylinder. Cylinders should be returned to the supplier for servicing prior to the expiration date.
7. Do not place cylinders near heat, sparks, or flames or where they might become part of an electrical circuit.
8. Do not store cylinders in exit corridors or hallways.

HANDLING AND USE

9. Only Compressed Gas Association fittings and components are permitted for use with gas cylinders. Only use regulators approved for the type of gas in the cylinder. Do not use adapters to interchange regulators.
10. Open cylinder valves slowly and away from the direction of people (including yourself). Never force a gas cylinder valve. If the valve cannot be opened by the wheel or small wrench provided, the cylinder should be returned.
11. No attempt shall be made to transfer gases from one cylinder to another, to refill cylinders, or to mix gases in a cylinder in the laboratory.
12. All cylinders are to be considered full unless properly identified as empty by the user. Empty cylinders must be returned to the supplier and not accumulated.
13. Compressed gases must not be used to clean your skin or clothing.
14. Never heat cylinders to raise internal pressure.
15. Do not use copper (>65%) connectors or tubing with acetylene. Acetylene can form explosive compounds with copper, silver, and mercury.
16. Always leave at least 30 psi minimum pressure in all "empty" cylinders. Do not leave an empty cylinder attached to a pressurized system.

I. CONTROL MEASURES

i. Ventilation

1. 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. Laboratory work shall be conducted in a fume hood, glove box, or similar device when:
    a. Procedures call for work with toxic substances which are volatile; i.e., evaporate at normal temperature and pressure, or
    b. There is a possibility the action level or PEL will be exceeded.
2. The protection provided by laboratory fume hoods is dependent upon two important factors:
    a. proper use of the hood, and
    b. maintenance of adequate airflow through the hood.

3. 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.
    a. 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.
    b. 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. Sashes must be kept closed when the fume hood is unattended.
    c. 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.
    d. 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.
    e. Things which cause air turbulence across the face of the hood such as fans, window air conditioning units, or excessive movement should be avoided.
    f. 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 your PI, Lab Supervisor, or contact the CHO.
4. Physical Plant personnel 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 Work Control at 4-1926 if you suspect the hood is not working properly.

ii. SPILL CLEAN-UP PROCEDURES

1. Attend to anyone who may have been contaminated.
2. Notify occupants in the immediate area about the spill.
3. Evacuate all nonessential personnel from the spill area.
4. If the spilled material is flammable, turn off all ignition and heat sources; this includes magnetic stirrers.
5. Avoid breathing vapors of the spilled material. Call University Police at 4-1000.
6. Ensure that the fume hood(s) is on. Open windows where possible to increase exhaust ventilation.
7. Secure cleanup supplies. Ensure protective apparel is resistant to the spill material.
8. Confine or contain the spill to a small area.

j. 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 Office should be contacted. Exposure assessments. Documentation of exposure monitoring shall be kept and maintained as part of each employee's personnel record.

k. 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:

An individual develops signs or symptoms associated with exposure to hazardous chemicals in the laboratory.

Exposure monitoring reveals an exposure level routinely above the action level or PEL for a OSHA regulated substance for which there are exposure monitoring and medical surveillance requirements.

An accident such as a spill, leak, equipment failure, or explosion results in possible over-exposure to hazardous chemicals.

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

L. SELECT CARCINOGENS, REPRODUCTIVE TOXINS, 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.

. Definitions

. Select carcinogens: any substance defined as such by OSHA.

a. Reproductive toxin: chemicals which affect reproductive capabilities including chromosomal damage (mutations) and effects on fetuses (teratogenesis).

b. Highly Acute Toxin is any substance for which:

a. the median oral LD50 is less than or equal to 50 mg/kg when administered orally to albino rats, or

b. 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

c. 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.

c. Designated area: a hood, glove box, portion of a laboratory, or an entire laboratory room, designated as the only area where work shall be conducted with quantities of select carcinogens, reproductive toxins, or highly acute toxins in excess of the limits specified above.

A. Designated Area

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:

. Use the smallest amount of chemical that is consistent with the requirement of the work to be done.

a. 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.

b. Use high-efficiency particulate air (HEPA) filters or high-efficiency scrubber systems to protect vacuum lines and pumps.

c. Decontaminate designated areas before normal work is resumed there. This includes contaminated equipment.

d. Remove any protective apparel, place it in an appropriately labeled container, thoroughly wash hands, forearms, face, and neck on leaving a designated area.

e. Prepare wastes for disposal in accordance Hazardous Waste Management procedures

f. Do not wear jewelry when working in designated areas since decontamination of jewelry may be difficult or impossible.