CHEMICAL HYGIENE PLAN

COLLEGE OF SCIENCE AND ENGINEERING
UNIVERSITY OF SOUTHERN INDIANA

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DISCLAIMER

THIS PLAN IS DESIGNED FOR USE IN ANY GENERAL LABORATORY SETTING THAT IS ENCLOSED IN THE UNIVERSITY.

THE GUIDELINES IN THE PLAN ARE MEANT TO BE THE GENERAL REQUIREMENTS TO ENSURE LABORATORY

PLAN REVIEW FORM (TO BE COMPLETED BY INSTRUCTORS OR RESEARCH SUPERVISOR)

LOCATION OF LAB_____

THIS CHEMICAL HYGIENE PLAN WAS REVIEWED AND CONTENTS ACCEPTED FOR THIS LOCATION

NAME OF PERSON POSITION DATE

PLAN TRAINING FORM

TEACHING LAB-SIGN BY ALL LABORATORY INSTRUCTORS

RESEARCH LAB-SIGN BY ALL RESEARCH STUDENTS

THE FOLLOWING HAVE REVIEWED THE CHEMICAL HYGIENE PLAN IN ACCORDANCE TO TRAINING REQUIREMENTS (REFER TO PART VI-EMPLOYEE INFORMATION AND TRAINING)

LOCATION

NAME TITLE DATE

PART I. INTRODUCTION

I. INTRODUCTION

PURPOSE OF THE CHEMICAL HYGIENE PLAN

OSHA (Occupational Safety and Health Administration) has established a standard (29 CFR 1910.1450), which establishes rules designed to protect employees from health hazards associated with hazardous chemicals in the laboratory.

A part of this requirement is the development of a chemical hygiene plan, which shall be readily available to all employees who work in such hazardous environments. This plan contains work practices, procedures, and policies which when followed will provide a safe environment.

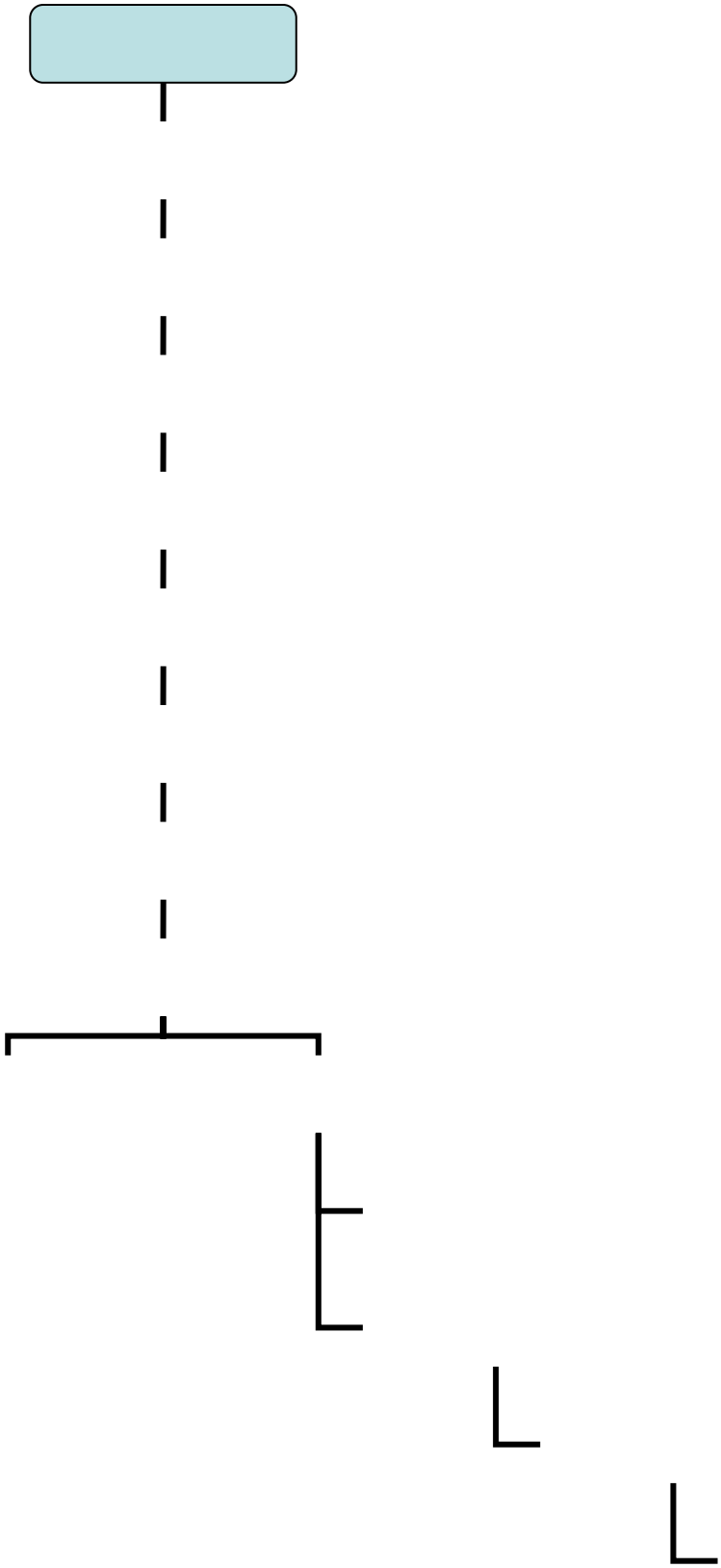
This plan must be presented to all employees and provide to OSHA during inspections.

29 CFR 1910.1450 may be found in Appendix 1

PART II DEFINITIONS AND RESPONSIBILITIES OF EMPLOYEES

Wear and properly maintain the personal protective equipment necessary to perform each task to which he/she is assigned.
Use engineering controls and safety equipment properly and according to laboratory requirements.
Follow good industrial and chemical hygiene practices.
Participate in all required training programs.
Read, understand, and sign off on health and safety SOP's and other program documents.
Report to the supervisor or the HSO/CHO all facts pertaining to accidents that result in injury or exposure to hazardous substances and any action or condition that may result in an accident (AKA-near miss).
Assist with the medical consultation/examination process by providing required information to the examining physician.

SOURCE Stricoff and Walters, Handbook of Laboratory Health and Safety 2nd ed.,



PART III. STANDARD OPERATING PROCEDURES

III STANDARD OPERATING PROCEDURES

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THE CHEMICAL HYGIENE PLAN COVERS THE FOLLOWING FACILITIES:

ALL LABORATORIES ENCLOSED WITHIN THE FOLLOWING DEPARTMENTS

BIOLOGY

CHEMISTRY

PHYSICS

GEOLOGY

ENGINEERING

SECTION A-GENERAL GUIDELINES FOR WORKING IN A LABORATORY

1. PERSONAL PROTECTIVE EQUIPMENT
   Protect yourself from potential injury by choosing appropriate personal protective equipment for the task. The following list will detail personal protective equipment available in the laboratory.

   a. EYE PROTECTION
      1.) Safety glasses

      At a minimum, safety glasses meeting ANSI standard Z87.1 (APPENDIX II) must be worn AT ALL TIMES while you are in a lab area where eye hazards are a possibility.

      Prescription eye glasses and contact lenses
      Prescription eyeglasses are NOT ACCEPTABLE as a form of eye protection. While they may meet FDA accepted guidelines for eye protection, they do not provide the side shield protection required in the laboratory. Safety glasses or goggles must be worn over eyeglasses.
      Contact lenses are allowed in the laboratory however be aware that some organic solvents will react with the lens and can cause serious eye damage. Safety glasses or splash goggles must be worn with contact lenses since contact lenses are not an adequate form of eye protection. It is also recommended that you let your co-workers know that you are wearing contact lenses so that proper safety measures can be taken in case of emergency.

      2.) Chemical Splash Goggles

      These are designed for additional eye protection especially when working with hazardous liquids (example, corrosives) or anything where a splashing hazard is present. These goggles should be splash proof goggles and not industrial or garden goggles where materials can spill into them.

      3.) Complete Face Shield or Blast Shield

      These are designed for highly hazardous or explosive materials. The ideal shield will be one that covers the face down to the neck. You must wear either safety glasses or chemical goggles in addition to the face shield. It is also advisable that any procedure that involves the use of a face shield be carried out with the use of an additional barrier or contained environment.

      4.) Safety Glasses for Optical Light Hazards
      When working with optical light hazards, use eye protection that has wavelength protection corresponding with the light. An example is the use of plastic safety glasses when working with UV light. The plastic will provide moderate UV protection since the plastic cuts off light at longer wavelengths.

b. SKIN PROTECTION

1.) Appropriate Clothing and Attire
When chemicals or hazardous materials are being used, proper attire in the laboratory provides some protection to the body and may prove to be the difference from keeping a minor injury from becoming a major one. No loose clothing is to be worn because it can come into contact with instrumentation or chemicals. Long hair must be tied back for the same reason.

Shoes must be made of leather or equivalent material and should cover the feet completely. Sandals or flip-flops are not allowed. Shoes that are made of canvas are not recommended because the chemical can transfer through the fabric and stay trapped to the skin.

2). Gloves

a.) Chemical Hazards
Always wear protective gloves when working with chemical hazards. A chemical resistance chart is given in Appendix III. In general, nitrile gloves provide the best all around protective. Latex gloves will provide minimal coverage and are not recommended for chemical handling. Make sure when wearing gloves not to contaminate water/utility/door handles or other surfaces likely to be touched by bare hands. Be sure to inspect the gloves for punctures or tears before wearing them. Wash or decontaminate the gloves before removing them.

Please note that the best source for determining what glove to wear is to consult the manufacturers chart as far as what materials their products are meant to handle.

If you have any questions, consult with your lab supervisor.

b.) Broken Glassware/Glassware under strain
Always wear leather gloves when working with either broken glassware and or glassware that are under strain. Be advised that leather gloves do not provide protection from chemicals.

c.) Temperature Extremes
Use an appropriate insulated glove when working with temperature extremes. As with leather gloves, these gloves do not provide protection from chemicals.

2. INGESTION/INHALATION HAZARDS

a. Smoking, Food, and Drink Policy

Smoking, eating, and drinking are forbidden in the laboratory. Airborne powders/sprays/vapors, as well as residues on surfaces, can contaminate food and drink.

Application of cosmetics is forbidden in areas where hazardous chemicals are used and shall be done only in well-defined designated non-chemical areas.

If food is to be used as part of an experiment it must be labeled for such purposes when stored. Under no circumstance is this food to be consumed by anyone.

If an experiment is designed that involves consumption of food, it is the job of the experimenter, instructor, and lab supervisor to develop appropriate protocols for handling of this material.

b. Pipetting Regulations
Never pipette by mouth. Always use a pipette bulb or other means as appropriate.

c. If any situation occurs in which you have to smell a chemical, waft the sample with your hand rather than directly smelling the substance.

d. Personal Hygiene

Hands should be washed frequently throughout the day, especially after working with chemicals. If wearing gloves, do not leave the room or interact with anything that may come in contact with someone and possibly subject the person to exposure.

7. Unattended Experiments
   Do not leave experiment unattended without pr

to prevent injury when working with compressed cylinders included: Cylinders should be firmly secured at all times with a belt or chain. An appropriate hand cart with a strap should be used for moving cylinders

Moving and storing cylinders

a. Cylinders must be capped during movement
b. Cylinders should be kept away from sources of heat or ignition.
c. Cylinders should be stored with their protected caps on and the cylinder secured (strapped or chained down) to reduce the chance of the cylinder being knocked over. Storage of large quantities of cylinders must be done in an approved gas cylinder storage area.

Any questions concerning the use of gas cylinders should be directed to the equipment technician.

5. Dewar Flasks

   All Dewar Flasks must be handled carefully. They represent an implosion/explosion hazard with the potential of abruptly releasing glass shrapnel and the contents of the container.

6. Electrical Equipment

   Access to electrical shut-offs (plugs, switches, and electrical panels) must be maintained free from obstructions to allow immediate access in case of emergency. All receptacle outlets in laboratory spaces shall be the polarized grounding type.

   a.) Repairs

   Safe procedures to use in repairing electrical equipment are: 1.) Turn off the equipment but leave it plugged in for a few seconds so that the internal capacitor have time to discharge to ground potential. 2) Unplug. 3) If unsure for any reason on repairs, contact equipment technician for repair. 4) Do not replace blown fuses with fuses of higher ratings. 5) If you are working on any apparatus that is or was capable of producing high currents or high voltages, assume that the voltage is still resident within the device when probing for problems. Never have more than one hand in the apparatus, keeping the other hand in your pocket. 6) Do not use a standard voltmeter with standard leads to measure high voltages because the voltmeter could explode.

   b.) Extension Cords

   All electrical extension cords used shall be visible and inspected on a periodic basis for damage and or defects. Cords may not run through doors, walls or partitions, under rugs or above dropped ceilings. They may not be wrapped around fixtures, tied in knots, or draped over pipes, lights, and ventilation ductwork. Cords may not run down aisles or corridors where it could reasonably be expected they would be damaged or create a tripping hazard8219 0 Tm( )TjETEMC /P 9 Tm( )TjETEMC /P 9 ors whp1itionsca6(exte

Frayed cords must be replaced.

Extension cords must be of appropriate length. Excessive lengths or inadequate conductor sizing causes resistive heating, creating a fire hazard.

Power strips should not be plugged into another power strip.

7. Vacuum systems

Evacuated glassware poses a significant implosion hazard, potentially releasing glass shrapnel and the contents of the container.

a.) Desiccators

Caution must be given when evacuating desiccators. Inspect for defects/cracks. Implosion protection should be provided without impairing visual inspection. This is often accompanied by wrapping tape in a grid pattern that leaves the contents visible while guarding against flying glass should the vessel implode.

b.) Flasks

Never evacuate ordinary flasks with flat surfaces. Always use a round bottom flask or flask designed for use with a vacuum.

c.) Rotovaps

The body of a rotary evaporator needs to be implosion protected. A one-liter flask is the largest that can be used with most rotary evaporators.

d.) Water Aspirators

Glassware evacuated using water aspirators poses a significant implosion hazard. Aspirators are a good vacuum source relative to atmospheric pressure and care should be taken when evacuating glassware with water aspirators.

8. Flooding

Flooding from laboratory sinks and service connectors has caused major damage to research equipment, furniture, and project records on both the flooded floor and floors below. In addition to physical damage, the standing water creates significant electrical shock and slip hazards. The following measures can be taken to minimize the chance of flooding.

a.) Sink and Hood Gutter Drains

Maintain sink drains open. Make sure there are no objects or debris in the sinks or hood gutters that could restrict flow down the drain.

b.) Water Regulators

If available, use a water line with a regulator on it for all unattended water use. Water regulators in the lab reduce the chance of flooding because they maintain a steady flow of water regardless of changes in water pressure in the building. To insure regulators will work properly:

1). Make sure valves in line with the regulator are fully open
2). Flush out debris from the regulator by momentarily increasing flow through them.

c.) Tubing

Replace tubing before it becomes too decomposed or brittle

d.) Bench top vessels

When filling bench top vessels, such as water baths from the sink, consider placing the receiving container into a sink-drained secondary container or tray.

9. Laboratory Chemical Hoods (Fume Hoods) (consult part V of this plan for hood inspection parameters)

a.) Usage

Laboratory chemical hoods should be used when chemicals being used have high sufficient volatility to be hazardous or offensive if vented to the laboratory atmosphere. These chemicals include but are not limited to volatile organics, corrosives, highly exothermic when mixed, and solutions that give off hazardous vapor when prepared (ex, sodium hydroxide added to water). Highly toxic chemicals should only be used under a hood. Highly toxic chemicals are those with a PEL (Permissible exposure limits) of 50 ppm or

can be placed on legs or blocks (min. of 2 inches high) to allow the proper flow of air under and around the equipment.

3) Hoods are not intended for storage

Avoid using hood for storage. If storage is necessary, locate material so as to minimize air flow disturbances. Use of blocks to elevate equipment above the lower baffle air intake can improve the hood's airflow.

4) Tampering with Hood Not Permitted.

Do not modify hood in any way that adversely affects the hood's performance. If hood modifications are needed, consult laboratory supervisor. Proper hood airflow must be verified following any modification.

5) Hood not Intended for Waste

Do not intentionally utilize a hood for waste disposal. Waste may be temporarily collected in a fume hood. Consult lab supervisor or chemical hygiene officer with questions.

6) Hood Malfunctions

If for any reason a hood is not operating properly contact lab supervisor immediately. Clearly label the hood as out of order and problem associated with hood.

7) Keep Hood Closed

Keep the hood sash closed when you are not actively working in the hood area.

d. Hood Performance

Laboratory fume hoods should be designed to attain a face velocity of 100 ft/min. They should be capable of maintaining a minimum average face velocity of 80 ft/min with a sash open to approximately 18 inches. Typically a range of 80-120 ft/min is acceptable for most uses.

1) Air Flow

Always verify airflow PRIOR to starting experiments or commencing work. Check air flow visually to assure the hood is functioning adequately. Air flow may be checked visually including:

Simple tell-tale device such as a Kim wipe, tinsel, or a ribbon attached to the sash.
Installed hood monitors
Anemometer may be borrowed from Chemistry Laboratory Supervisor.

2) Turbulence

Avoid opening and closing the hood sash rapidly as well as swift arm and body movements in front of or inside the hood. These actions may increase turbulence and reduce the effectiveness of hood containment.

3) Cross Drafts

Check room condition in front of the hood prior to use. Any cross drafts present may seriously degrade the performance of the hood. Minimize cross drafts from open windows or people passing by.

4) Alarms

Do not disable alarms. Know what they mean, act on what they indicate, and report the discrepancy for corrective maintenance.

5) Exhaust fan

The hoods exhaust fans should remain on. Also remember that the hood doors should always be kept closed when you are not actively working in the hood area.

10. Glassware

a. Glass Containers

Glass containers are easily broken, resulting in a significant threat to life and property depending upon the contents, quantity, and location. To minimize the chance of breaking glass bottles, store them properly and well protected if on the floor. Transport them safely using a bottle carrier when transporting glass containers in the halls, stairwells, and elevators. If a bottle carrier is not available, use a cart to transport. Place the bottle in a plastic container and then set the container on the cart. Minimize the size of your working containers. Use proper protective gloves that do not hamper dexterity.

b. Glass Tubing and Thermometers

When cutting, inserting, or removing glass tubes or thermometers into/from corks, rubber stoppers or hoses, always use protective gloves or wraps. Lubricate glass with glycerin or soap. Moisten TYGON tubing with acetone. All glass tubing should be fire polished at both ends. When pushing glass tubing through a cork or stopper, l0.0024 Tw 0 -4J0.0002 Tc -0.004omainte

11. Heating Cautions

    a. Closed Systems

    Never heat a closed system! Always use a boiling chip when heating any liquid, even water. When heating a test tube, never point it at yourself or at anyone else.

    b. Flammable Solvents

    When possible, use a hot plate or heating mantle when heating flammable solvents. Avoid using a Bunsen burner around flammable solvents. If using a Bunsen burner, first be sure that none of your neighbors are using flammable solvents. Light the match first, then turn on the gas supply by using the gas valve on the counter and then using the regulator on the burner while holding the match close to the top of the burner. Long hair must be kept tied back and do not wear garments with floppy sleeves or loose wrist cuffs when using a burner. When finished, turn off the regulator valve of the burner and then turn off the gas valve on the counter. Do not blow the flame out. If the flame should happen to go out, immediately shut off the gas valve on the counter.

12. Heating Mantles

    Heating mantles are ok for heating flammable solvents. They are not suitable for heating highly flammable solvents or reactions where you wish to control the temperature carefully because they form hot spots that can result in intense localized heating and or fire. A stirred fluid bath with temperature control would be better in these situations. Regardless of either means, use an appropriate size mantle or bath for the reaction vessel. Also avoid overheating.

13. High Voltage and/or High Current Equipment

    Equipment that produces high current or high voltage is a special problem in many analytical labs.

    a. Warning Signs

    As a general warning of the dangers, equipment using high currents or high voltages must be clearly marked.

    b. Precautions

    Grounding- Use a 3-prong plug for proper grounding unless other grounding provisions are made and checked. OSHA REQUIREMENT

    Safe Territory- Avoid becoming grounded by stay

14. Lasers

    a. Knowledge of Hazards

    Know the hazards associated with the particular laser(s) with which you are working.

    b. Warning Signs

    It is important to have warning signs for optical light hazards at all the entrance doorways. Not all potentially dangerous light can be seen by the human eye.

    c. Light Paths

    Mark paths of intensive laser light. Before adding or removing optical components anticipate and examine projected light paths.

    d. Eye/Skin Protection

    Always wear specially designed protective gl

working with these compounds, let people in the area know so they do not suspect a gas leak has occurred.

8. Noxious Gases

The internal pressure in laboratories is generally less than the outside pressure. Since the drainage system is vented to the atmosphere on the roof, it is easy for odors and noxious gases to be swept back into the lab through open sink drains. Two things can be done to avoid this:

a. Keep all sink traps filled with water by running water (a gallon or so) down the drain at least monthly.
b. Do NOT utilize the sinks for waste disposal.

c. Housekeeping

Utilize good housekeeping techniques such as:

-Keep aisles clear
-Clean up all spills
-Clean up all glassware
-Wipe down counters and all areas you worked in

Sharps containers should be used for the disposal of all sharps (needles, syringes, pipettes if applicable, etc). Disposal of broken sharps containers should be arranged through the Biology Lab Supervisor.

5) Glass Disposal

a) Glass should never be disposed in normal trash receptacles. They should be discarded in labeled broken glassware boxes. If possible, triple rinse the glassware before discarding the glassware in these boxes.

b) When full, seal off box and arrange with supervisor for box pick-up and replacement.

c) Do not overfill these boxes in any circumstance.

14. Chemical Handling

Encourage the use of poly-coated bottles or use bottle carriers for transporting chemicals that are in regular glass containers. Close caps securely and avoid storing chemical containers in hard to reach areas. Pour chemicals carefully, and never add water to concentrated acid. Metal containers and non-conductive containers (e.g., glass or plastic) holding more than five gallons must be grounded when transferring flammable liquids.

SECTION D-GUIDELINES FOR EMERGENCY PROCEDURES

No matter what approaches one may take to minimize laboratory hazards, emergency situations will occur. Although few staff members, students and visitors are capable in dealing with these situations to completion, all must understand the basics of:

Assessing and emergency situation
Communicating this to an appropriate level

Professional help obtained by contacting security at 7777 from campus phones or 464-1845 from cell or other phones is the best means of combating serious emergencies. Until their arrival, isolate the hazard as much as possible to keep people away. If first aid is required, locate someone with the required skills who is willing to help-be it you, lab supervisor, faculty member, student, another university employee, etc. First aid may be provided by anyone willing to assist who is knowledgeable in handling the matter at hand. Good Samaritan Laws cover those who are trained in first aid and certified in CPR.

Note that not all laboratory staff members are trained in first aid practices though training is available through Red Cross. Providing first aid where needed is NOT a condition of employment and first aid can only be administered by an individual on a volunteer basis.

GUIDELINES FOR EMERGENCY PROCEDURES

1. Alert other people immediately! Do this first!

2. Report all accidents. This should also include any near misses.

3. Get medical attention immediately, if necessary. In emergencies, call 7777.
Note: During this process the emergency operator will contact the appropriate response team and send them to your aid. Do not hang up until directed to do so.

When waiting for help send someone to meet the emergency response team and send someone to notify lab personnel.

4. In the event of an injury, the following conditions are required PRIOR TO administering first aid:

a. Others have been notified
b. Personal safety of care giver is not in jeopardy.
c. Care giver is knowledgeable concerning the treatment needed and associated hazards.
d. Victim agrees to treatment IF he/she is still conscious

5. Serious Wounds

A doctor should only attend to serious wounds. Temporarily cover wounds with clean cloth only.

6. Small Burns

Treat with cool water only. Do not use oils, powders, etc.

7. Inhalation of Noxious Gases

Quickly remove the victim from the lab into fresh air and call the doctor.

8. Ingestion of Poisonous Chemicals

Seek medical help immediately. Inducing vomiting may result in a more severe injury, as with some acids and bases. Induce vomiting if directed by medical personnel or if known to be beneficial.

a. Secure the area
b. Seek advice concerning the cleanup
c. Disinfect the area with bleach after the cleanup
d. Use gloves during all stages of the cleanup

12 Mercury Spills and Cleanup

A small spill of mercury, where the amount is small and the spill is relatively contained, can be managed by using a mercury cleanup kit that can be obtained from SC 2226 if one is not

4. Spill Kits

As needed, spill kits are available in laboratories and in the distribution center. Please be familiar to their location and use. Consult chemical hygiene officer or laboratory supervisors for instructions on how to use this equipment.

5. Fire Blankets

Fire Blankets should be provided in areas in which safety showers are not available or in laboratories that utilize water sensitive materials in which the shower would aggravate the problem. As with any fire, if possible, first alert others to the fire, evacuate anyone in the area and contact security at 7777 or 464-1845. Fire blankets can be used on Class A (Combustibles), Class B (Flammable liquids), Class C (Electrical) and some Class D (burning metals) fires. Ensure that you have a safe exit – an escape route in case you are unable to extinguish the fire. The fire should NOT be between you and the exit. Open the fire blanket and hold it in front of you to shield your body (especially the face and hands) from the fire. Cover the burning material completely, ensuring there are no gaps for oxygen to reach the fire. Leave the blanket in place until the fire department arrives. IMPORTANT: If using the fire blanket on a person, remove the blanket immediately after the flames are extinguished; get them to a safety shower immediately until first responders arrive.

6. Gas Mains

Each lab that utilizes natural gas is equipped with a shut off device either located inside the lab or just by the lab door. Please familiarize yourself with the location of these devices. Always leave the mains in an off position when not in use.

PART IV-CONTROLLING CHEMICAL EXPOSURES

Administrative controls to reduce skin/eye contact include:

Enforcement of policies pertaining to skin and eye protection
Discarding or repair of cracked or broken glassware

C. Ingestion Hazards

Ingestion of chemicals is the least common route of entry into the body. However a laboratory worker can easily ingest chemicals into the body via contaminated hands if they are not washed prior to eating, smoking, or sticking part of the hand or a writing tool that has been in contaminated hands into the mouth. Some controls for preventing this route of exposure include engineering controls, such as isolating the hazardous substance so minimal contact is required (e.g., use glove box), personal protective equipment such as the wearing of gloves, and separate areas where eating, drinking and the application of cosmetics is permitted.

PART V-LABORATORY CHEMICAL HOODS (FUME HOODS) AND OTHER ENGINEERING CONTROLS

V. Laboratory chemical hood (fume hoods) and Other Engineering Controls

“A requirement that laboratory chemical hood (fume hood)s and other protective equipment are functioning properly and specific measures that shall be taken to ensure proper and adequate performance of such equipment.” 29CFR 1910.1450(e)(3)(iii)

All laboratory fume hoods should comply with this standard at all times. This includes proper maintenance and ensur

MONITORING RECORD FOR LABORATORY FUME HOODS

HOOD IDENTIFICATION NUMBER **DATE**

LOCATION **RE-TEST DATE**

TYPE AND FEATURES

HOOD MANUFACTURER

BYPASS?
YES NO

AUXILLARY AIR?
YES NO

FLOW CONTROLLED (VARIABLE AIR VOLUME)
YES NO

CONNECTION TO OTHER HOODS
YES NO

ADJUSTABLE SASHES

YES NO IF YES VERITCAL HORIZONTAL

DAMPER(S)

YES NO

FAN SWITCH

YES NO

BOTTOM AIR FOIL

YES NO

OTHER FEATURES, DESIGN CHARACTERISTICS

SPECIAL USE CONDITIONS (E.G., RADIONUCLIDES, PERCHLORIC ACID)

AUTOMATIC MEASURING DEVICES

HOOD STATIC PR

HOOD FACE VELOCITY MONITOR

YES NO

OTHER ALARMS, GAUGES?

YES NO

CAPTURE TEST

INTERFERENCE FROM DOORS, WINDOWS, WALKWAYS, SUPPLY AIR DIFFUSERS?

YES NO

IF YES, CONDUCT SMOKE TEST

RESULTS:

FACE VELOCITY MEASUREMENTS

LEFT TOP	**CENTER TOP**	**RIGHT TOP**
LEFT MIDDLE	**CENTER MIDDLE**	**RIGHT MIDDLE**
LEFT SURFACE	**CENTER SURFACE**	**RIGHT SURFACE**

TOTAL ALL MEASUREMENTS \ TOTAL SAMPLES =
AVERAGE FACE VELOCITY

SASH HEIGHT

HOOD AREA SASH OPEN

HOOD VLOW RATE

COMMENTS

TESTED BY

FORMS MUST BE RETURNED TO CHO FOR RECORDKEEPING. A COPY OF THE MOST RECENT TEST FORM SHOULD BE KEPT IN THE CHP FOR THAT ROOM

PART VI-EMPLOYEE INFORMATION AND TRAINING

VI. Employee Information and Training

"Provisions for employee information and training as prescribed in paragraph (f) of this section." 29 CFR 1910.1450(e)(3)(iv)

All individuals who work in laboratories who may be exposed to hazardous chemicals must be apprised of the hazards of chemicals present in their work area. THIS INFORMATION AND TRAINING AS OUTLINED BELOW MUST BE PROVIDED BEFORE INITIAL ASSIGNMENT AND BEFORE NEW EXPOSURE SITUATIONS. Equipment necessary for the safe handling of hazardous substances must also be provided.

Upon request by departments or other administrative units or under their direction, Risk management or environmental health and safety will provide from time to time training presentations on general lab safety practices. However, training specific to a particular lab will be the responsibility of the employee's supervisor. The supervisor shall determine the frequency of refresher information and training.

A. Information

Laboratory workers shall be informed of the location and availability of the following

29 CFR Part 1910.1450 "Occupational Exposures to Hazardous Chemicals in Laboratories"
This Chemical Hygiene Plan
Reference materials on chemical safety as well as MSDS forms
Access to Permissible Exposure Limits (PEL) for OSHA regulated substances, or if there is no applicable OSHA standard, the recommended exposure limits or threshold limit value (TLV) may be provided.
Signs and symptoms associated with exposure to the hazardous chemicals found in lab

B. Training

Laboratory worker training shall include:

Detection methods and observations that may be used to detect the presence or release of a hazardous chemical. Examples of detection methods include visual appearance, odor, and an understanding of chemical monitoring devices.
Physical and health hazards of the chemicals "1,2,3 approach".

1-Read label of bottle before pulling from shelf
2-Reread label when moving towards work area
3-Check label once more before starting work

The work practices, personal protective equipment, and emergency procedures to be used to ensure that the employee may protect himself/herself from overexposure to hazardous chemicals
The manufacturer's MSDS will generally contain much of the above information needed to comply with the information and training requirements of the OSHA lab standard. Hence, employees should peruse and understand the relevant MSDS and/or other comparable literature on the hazardous chemicals which are used or stored in the laboratory. Additional training for specific lab hazards must be provided by the employee's supervisor.
The OSHA Lab Standard, the chemical hygiene plan, a library of MSDS and other health and safety references are maintained in SC 2226 for chemistry and in SC1264 for Biology.
Health and Safety training information are available to students, faculty, or staff upon request.

Copies of MSDS may be obtained from the chemical supplier. Though security maintains a library of MSDS, individual departments and laboratories are strongly encouraged to maintain their own files of MSDS and reference materials.

PART VII-PRIOR APPROVAL

PART VIII MEDICAL CONSULTATION

VIII. Medical Consultation

“Provisions for medical consultation and medical examinations in accordance with paragraph (g) of this section.” 29CFR1910.1450(e)(3)(vi)

An opportunity to receive medical consultation shall be provided under the following circumstances: if an employee develops any symptoms thought to arise from chemical overexposure; after an event such as a major spill, leak, or explosion which may have resulted in an overexposure; or an overexposure is identified as the result of an evaluation by the Chemical Hygiene Officer. Any medical examination required by this Plan shall be provided without cost to the employee, without loss of pay and at a reasonable time and place.

Students, Faculty, and staff are to notify security immediately (7777) or 464-1845 for any incident involving the need for medical attention in the event of an emergency.

Accident reports are to be kept by security.

PART IX. CHEMICAL HYGIENE OFFICER

IX. Chemical Hygiene Officer

“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.” 29 CFR1910.1450(e)(3)(vii)
Academic units are encouraged to have their own Chemical Hygiene Officers to help implement this plan in their units. Please consult the list of names to locate identities of Chemical Hygiene officer and respective safety committees.

LIST OF PERSONEL AND RESPONSIBILITIES

TITLE	NAME	EXT
ENVIRONMENTAL HEALTH MANAGER	BRYAN MORRISON	5393
CHEMICAL HYGIENE OFFICER	CHRISTOPHER HOGUE	7022
RADIATION SAFETY OFFICER	KENT SCHELLER	1903
BIOLOGICAL SAFETY OFFICER	ALEKSANDRA NORTON	1259
INSTRUMENT TECHNICIAN	VINCE FRAZIER	1839
LABORATORY SAFETY COMMITTEE		
CHAIRPERSON	SHELLY BLUNT	1268
MEMBER-CHAIR CHEMISTRY DEPT	JEFF SEYLER	1923
MEMBER-CHAIR BIOLOGY DEPT	HENRI MAURICE	5231
MEMBER-PHYSICS DEPT	KENT SCHELLER	1903
MEMBER-CHEMISTRY	CHRISTOPHER HOGUE	7022
MEMBER-BIOLOGY	ALEKSANDRA NORTON	1259

APPENDIX I

29 CFR 1910.1450

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 an9.48 0 0 r0u.ih.26 673.2C /P 19ud1 T5alt9el (or out -1it us chemica8/TT2 1 Tf

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

Oxidizer means a chemical other than a blasting agent or explosive as defined in § 1910.109(a), that initiates or promotes combustion in other materials, thereby causing fire either of itself or through the release of oxygen or other gases.

Physical hazard means a chemical for which there is scientifically valid evidence tat it is a combustible liquid, a compressed gas, explosive, flammable, an organic peroxide, an oxidizer pyrophoric, unstable (reactive) or water-reactive.

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

Reproductive toxins means chemicals which affect the reproductive chemicals which affect the reproductive capabilities including chromosomal damage (mutations) and effects on fetuses (teratogenesis).

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

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

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

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

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

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

(B) After repeated skin applica(isnsof less t)-6(han 300 (mg/kgsof body)-6(w)8(eig)-6(ht) per w)8(eek;)-6(or)]TJ0 Tc 0 Tw T

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 which 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)

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)

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)

Recordkeeping.

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.

APPENDIX II

ANSI Z87.1

ANSI Z87.1-2003

ANSI Z87.1-2003
The new standard is a voluntary standard and there is no requirement that manufacturer or end user comply with it unless it is mandated by the United States Department of Labor – OSHA. However, in the past, most manufacturers have chosen to comply with revisions to the Z87.1 Standard. Currently, OSHA requires (29 CFR 1910.133) that eye protectors comply with the 1989 version of the Z87.1 Standard, and eye protection devices now in use may continue to be used.

*****All of the protective eyewear we sell already complies with the performance requirements of the new standard. The new marking requirements will be phased in over time by each manufacturer.*****

1. Two Levels of Protection:
Basic and High
LENSES: The new standard designates that lenses will be divided into two protection levels, Basic Impact and High Impact as dictated by test criteria. Basic Impact lenses must pass the “drop ball” test, a 1" diameter steel ball is dropped on the lens from 50 inches. High Impact lenses must pass “high velocity” testing where 1/4" steel balls are “shot” at different velocities.

Spectacles: 150 ft./sec.
Goggles: 250 ft./sec.
Faceshields: 300 ft./sec.

FRAMES: Now, all eyewear/goggle frames, faceshields or crowns must comply with the High Impact requirement. (This revision helps eliminate the use of “test lenses”, and assures all protectors are tested as complete - lenses in frame - devices). After making an eye hazard assessment, employers (safety personnel) should decide on appropriate eyewear to be worn, although High Impact would always be recommended. All of our spectacles are High Impact protectors.

2. Now, Products Must Indicate
Impact Protection Level.
To identify a device’s level of impact protection, the following marking requirements apply to all new production spectacles, goggles and faceshields. Basic Impact spectacle lenses will have the manufacturer’s mark, i.e. an AOSafety product will have “AOS” and a Pyramex product will have a "P" etc. Goggles and faceshields will have AOS and Z87 (AOS Z87). High Impact spectacle lenses will also have a plus + sign, (AOS+) or "P+" etc. All goggle lenses and faceshield windows are to be marked with the manufacturer's mark, Z87, and a + sign (AOSZ87+).

*Note: Lenses/windows **may have** additional markings. Shaded lens may have markings denoting a shade number such as 3.0, 5.0 etc. Special purpose lenses may be marked with “S”. A variable tint lens may have a “V” marking.*

3. Sideshield Coverage Area Increased
Sideshield coverage, as part of the lens, part of the spectacle, or as an individual component, has been increased rearward by 10-millimeters via a revised impact test procedure. While side protection in the form of wraparound lens, integral or attached component sideshield devices is not mandated in this standard, it is highly recommended. Further, OSHA does require lateral protection on eye protection devices wherever a flying particle hazard may exist, and flying particle hazards are virtually always present in any occupational environment. All

need.

Note: Glass lenses still fall into the Basic Impact lens category. The “minimum lens thickness” of 3 millimeters remains in effect for this category.

APPENDIX III GLOVE SELECTION CHART

NOTE: THIS CHART IS MEANT AS AN GENERAL REFERENCE FOR GLOVE SELECTION FOR THE FOLLOWING CHEMICALS. IT IS RECOMMENDED THAT YOU CONSULT THE GLOVE DESIGNER FOR CONFIRMATION OF PROPER GLOVE SELECTION.

Dioctyl phthalate	G	P	F	VG
Diaxane	VG	G	G	G
Epoxy resins, dry	VG	VG	VG	VG
*Ethyl acetate	G	F	G	F
Ethyl alcohol	VG	VG	VG	VG
*Ethyl ether	VG	G	VG	G
*Ethylene dichloride	F	P	F	P
Ethylene glycol	VG	VG	VG	VG
Formaldehyde	VG	VG	VG	VG
Formic acid	VG	VG	VG	VG
Freon 11	G	P	F	G
Freon 12	G	P	F	G
Freon 21	G	P	F	G
Freon 22	G	P	F	G
*Furfural	G	G	G	G
Gasoline, leaded	G	P	F	VG
Gasoline, unleaded	G	P	F	VG
Glycerin	VG	VG	VG	VG
Hexane	F	P	P	G
Hydrazine (65%)	F	G	G	G
Hydrochloric acid	VG	G	G	G
Hydrofluoric acid (48%)	VG	G	G	G
Hydrogen peroxide (30%)	G	G	G	G
Hydroquinone	G	G	G	F
Isooctane	F	P	P	VG
Kerosene	VG	F	F	VG
Ketones	G	VG	VG	P

Perchloric acid (60%)	VG	F	G	G
Perchloroethylene	F	P	P	G
Petroleum distillates (naphtha)	G	P	P	VG
Phenol	VG	F	G	F
Phosphoric acid	VG	G	VG	VG
Potassium hydroxide	VG	VG	VG	VG
Propyl acetate	G	F	G	F
Propyl alcohol	VG	VG	VG	VG
Propyl alcohol (iso)	VG	VG	VG	VG
Sodium hydroxide	VG	VG	VG	VG
Styrene	P	P	P	F
Styrene (100%)	P	P	P	F
Sulfuric acid	G	G	G	G
Tannic acid (65%)	VG	VG	VG	VG
Tetrahydrofuran	P	F	F	F
*Toluene	F	P	P	F
Toluene diisocyanate	F	G	G	F

APPENDIX IV- REFERENCE MANUALS AVAILABLE

APPENDIX V

EVALUATION OF HAZARDS AND RISK ASSESSMENT

RISK ASSESSMENT WORKSHEET WITH HAZARDOUS MATERIALS

INSTRUCTIONS: PLEASE FILL OUT A BRIEF REPORT WITH THE FOLLOWING INFORMATION. PLEASE INFORM YOUR STUDENTS ABOUT THE INFORMATION ON THIS WORKSHEET AS PART OF THEIR TRAINING.

LAB

INSTRUCTOR IN CHARGE

SYNOPSIS OF EXPERIMENT

REAGENTS TO BE USED

EQUIPMENT TO BE USED (HOT PLATES, BUNSEN BURNERS, DISTILATION APPARATUS, ETC)

HAZARDS PRESENT

1. **CHEMICAL**
2. **PHYSICAL**
3. **BIOLOGICAL**
4. **MECHANICAL**
5. **RADIATION**
6. **HI/LOW PRESSURE**
7. **ELECTRICAL**
8. **STRESS**
9. **NOISE**

PERSONAL PROTECTIVE EQUIPMENT AVAILABLE

EMERGENCY EQUIPMENT AVAILABLE/PROTOCOL

ATTACH MSDS FOR CHEMICALS TO THIS WORKSHEET

SUBMIT COPY OF WORKSHEET TO SUPERVISOR AND KEEP COPY WITH CHP

FILLING OUT THE WORKSHEET

THE WORKSHEET SHOULD BE FILLED OUT AS A SEPARATE DOCUMENT USING THE TEMPLATE ON PAGE 77.

THE DOCUMENT NEEDS TO START WITH THE FOLLOWING INFORMATION:

DATE OF ASSESSMENT
ROOM NUMBER
INSTRUCTOR IN CHARGE
SYNOPSIS OF PROCESS THIS ASSESSMENT IS FOR
(NOTE: IF YOU ARE PERFORMING MORE THAN ONE PROCESS, UNLESS MATERIALS ARE SIMILAR, YOU WILL HAVE TO FILL OUT MORE THAN ONE DOCUMENT)

THE ASSESSMENT PROCEDURE

1. MATERIALS YOU ARE WORKING WITH

BEGIN A LIST OF EVERYTHING YOU ARE WORKING WITH THAT COULD POSE A HAZARD. THIS WILL PRIMARILY FOCUS ON CHEMICALS AND EQUIPMENT (NOT NECESSARILY INCLUDING BEAKERS, SPATULAS, ETC,) YOU ARE PLANNING ON USING.

2. DETERMINE THE HAZARDS YOU ARE WORKING WITH

IN GENERAL, NINE TYPES OF HAZARDS CAN BE PRESENT WITH ANY TASK:

> **CHEMICAL: ARE THEY TOXIC, FLAMMABLE, CORROSIVE, REACTIVE? HOW CAN THEY BE DISPOSED OF? (SEE APPENDIX VI FOR MORE INFORMATION)**
>
> **PHYSICAL: ARE THERE ANY TASKS INVOLVING AN EXCESSIVE USE OF PHYSICAL LABOR?**
>
> **BIOLOGICAL: TOXIC SIDE EFFECTS? REACTIVITY? EXPOSURE? DISPOSAL?**
>
> **MECHANICAL: THE EQUIPMENT I AM WORKING WITH? IS THERE A SHOCK HAZARD? BURN HAZARD? CAN I HURT MYSELF WITH THIS?**
>
> **RADIATION: ARE WE WORKING WITH RADIOACTIVE MATERIALS? HOW DO WE DISPOSE? HOW DO WE STORE?**
>
> **HI/LOW PRESSURE: ARE YOU WORKING WITH ANYTHING IN HIGH OR LOW PRESSURE ENVIRONMENTS? IS THERE A RISK OF IMPLOSION?**
>
> **ELECTRICAL: SHOCK HAZARDS PRESENT. IF WE NEED ELECTRICITY, WILL A BACK UP GENERATOR BE NEEDED?**
>
> **STRESS: ARE THERE ANY STRESSORS THAT PERTAIN TO THE USER OR THE REACTION THAT COULD CAUSE HARM?**
>
> **NOISE: HOW LOUD IS THE LAB OR REACTION? SHOULD WE WEAR EAR PLUGS?**

MAKE A LIST OF POTENTIAL HAZARDS THAT THE TASK INVOLVES. HAVE YOUR LAB STAFF WORK WITH YOU ON PREPARING THIS LIST.

NOTE ON CHEMICAL ASSESSMENT: IT IS HELPFUL TO OBTAIN A COPY OF THE MSDS FOR EACH CHEMICAL YOU ARE USING AND KEEP IT AVAILABLE IN THE LAB AS WELL AS THIS ASSESSMENT.

3. DETERMINE WHAT PERSONAL PROTECTIVE EQUIPMENT AND SAFETY EQUIPMENT IS AVAILABLE IN THE LAB.

YOU NEED TO DETERMINE IF THE EQUIPMENT IN THE LAB IS SUFFICIENT FOR WHAT YOU ARE WORKING WITH. IF YOU DO NOT HAVE THE PROPER SAFETY EQUIPMENT, YOU EITHER NEED TO CHANGE YOUR PROTOCOL OR ORDER THE NECESSARY EQUIPMENT AFTER OBTAINING PERMISSION FROM THE LAB SUPERVISOR OR CHEMICAL HYGIENE OFFICER.

4. A PLAN FOR HANDLING THE HAZARDS

IF PROTOCOLS ARE ALREADY LISTED IN THE CHP FOR THE HAZARDS PRESENT AND IS DEEMED SUFFICIENT YOU ARE SET TO GO. SIMPLY REFER TO THE SECTIONS IN THE CHP WHICH ADDRESSES THESE HAZARDS IN THE ASSESSMENT WORKSHEET.

IF A HAZARD IS PRESENT THAT IS NOT HANDLED IN THE CHP THAN A PROTOCOL MUST BE DEVELOPED AND ATTACHED TO THE WORKSHEET. YOU SHOULD HAVE LAB SUPERVISOR APPROVAL FOR THE PROTOCOL AS A BACKUP.

5. PERIODIC REVIEW

APPENDIX VI. CHEMICAL HAZARDS: TYPES AND INFORMATION

PURPOSE:

THIS SECTION DETAILS HOW TO DETERMINE WHAT TYPES OF HAZARDS ARE PRESENT WITH CHEMICALS AND HOW TO OBTAIN ADDITIONAL INFORMATION BESIDES THE DETAILS GIVEN IN THIS CHEMICAL HYGIENE PLAN.

PLEASE NOTE THAT THIS SECTION PROVIDES A BASIS OF DETERMINING HAZARDS WITH CHEMICALS, IT IS NOT MEANT TO SERVE AS THE ONLY SOURCE OF HAZARD DETERMINATION.

5. Reproductive and Developmental Toxins

Reproductive toxins are substances that have adverse effects on various aspects of reproduction, including fertility, gestation, lactation, and general reproductive performance. It is important to protect both the male and female (especially in the case of a pregnant female) from these hazards when present.

of higher toxicity, a TLV/STEL value may be given which is the concentration a person can be exposed to in 15 minutes without adverse side effects.

In the absence of a TLV value, a PEL value may be given which in principle covers the same concept of a TLV.

For general purposes a substance with a PEL or TLV value of less than 50 ppm should be handled in a fume hood.

Monitoring of these chemicals should be determined periodically using specialized equipment or trained personel. Be aware that the PEL or TLV may be lower than the Detectable odor threshold meaning that you may be overexposed even before you can smell the chemical.

E. FLAMMABLE HAZARDS

1. Flammable substances, those that readily catch fire and burn in the air, may be solid, liquid or gaseous. Proper use of substances that can cause fire requires knowledge of their tendencies to vaporize, ignite, or burn under the variety of conditions of use in the laboratory.

For a fire to occur, three conditions must exist simultaneously: an oxidizing atmosphere; a concentration of flammable gas or vapor that is within the flammability limits of the substance; and a source of ignition. Prevention of the coexistance of flammable vapors and ignition sources is the optimal way to deal with the hazard.

2. Flash points

The flash point is the lowest temperature at which a liquid has a sufficient vapor pressure to form an ignitable mixture with air near the surface of the liquid.

3. Ignition temperature

The ignition temperature of a substance, whether solid, liquid, or gas is the minimum temperature required to initiate or cause self-sustained combustion independent of the heat source. The lower the ignition temperature, the greater the potential for a fire by typical laboratory equipment.

4. Limits of flammability

Each flammable gas and liquid(as a vapor) has two fairly definite limits of flammability defining the range of concentrations in mixtures with air that will propegate a flame and cause an explosion. The lower flammability limit is the minimal concentration while the maximum concentration is referred to as the upper flammability limit. Concentrations lower than the lower limit and higher than the upper limit will not ignite.

F. Reactive Hazards

1. Water Hazards

Water reactive materials are those that react violently with water. Common water reactives are alkali metals, many organometallic compounds, and some hydrides. Some anhydrous metal halides, oxides, and nonmetal oxides and halides react exothermically with water and the reaction can be violent.

2. Pyrophoric materials

For pyrophoric materials, oxidation of the compound by oxygen or moisture in air proceeds so rapidly that ignition occurs. Many reducing agents, such as metal hydrides, alloys of reactive metals, low-valent metal salts, and iron sulfides are also pyrophoric.

3. Incompatible Chemicals

Accidental contact of incompatible chemicals could result in an explosion, or the formation of toxic substances or both. Tables VI-3 and VI-4 list the classes of incompatible chemicals and care should be taken in the segregation and storage of these materials.

G. Explosive Hazards

1. An explosive is any chemical compound or mechanical mixture that when exposed to heat, impact, friction, detonation, or other suitable initiation, undergoes rapid chemical change, evolving large volumes of highly heated gases that exert pressure on the surrounding medium. Shock sensitive compounds include acetylides, azides, nitrogen triiodide, organic nitrates, nitro compounds, perchlorate salts, many organic peroxides, and compounds containing diazo, halamine, nitroso, and ozonide functional groups.

2. Peroxides

Organic peroxides are the most hazardous substances handled in the laboratory. They are generally low-power explosives that are sensitive to shock, sparks, or other accidental ignition. Also potentially hazardous are compounds that undergo autooxidation to form organic hydroperoxides and/or peroxides when exposed to the oxygen in air. These chemicals should not be stored for a long period of time and testing for peroxide formation may be necessary before using the materials in a reaction.

3. Dusts

Some dusts (flour, coal, magnesium, zinc, carbon powder, sulfur) can combust in the air in a powerful explosion. Care must be taken that these materials should be used with adequate ventilation and should not be exposed to ignition sources.

Source: Prudent Practices in the Laboratory, 4th edition.