

GUIDELINES FOR SAFE LABORATORY PRACTICES

in the

Department of Chemistry

Xavier University

EMERGENCY TELEPHONE NUMBERS

**Xavier Emergency (Police & Fire): 745-1000
Environmental, Health & Safety (EHS): 745-1000**

Have a Chemical Spill?

**Call: 8:30 A.M.-5:00 P.M. Weekdays, 745-3352
All Other Times, Police 745-1000**

***Physical Facility Emergencies (Hoods, Floods, Electrical, etc.)
Physical Plant : 745-3151***

***Routine Issues:
Chemistry Department Chair (Daniel McLoughlin): 745-3352***

1. Introduction

The wide variety of chemicals and research equipment that may present risk to researchers and staff alike requires proper training, awareness, and vigilance. This document's principal focus is upon chemical safety. However, there is something here for everyone! There is an old saying that familiarity breeds contempt. This adage is true if one adopts a cavalier attitude toward one's local work environment. On the other hand, it is important that all researchers be informed about potential dangers outside of their own laboratory. Accidents may arise when you visit a laboratory that is out of your area of expertise. Moreover, there is the outside chance that you may find yourself called upon to aid a fellow researcher in need of medical assistance. Would you be adequately prepared?

This document is modeled upon the Yale University Office of Environmental Health and Safety to address issues that have immediate relevance to the Department of Chemistry. These guidelines are intended to focus attention on the aspects of laboratory safety that are the common concern of all who work in the Chemistry Department. If a particular operation or procedure is not mentioned in this document, one may not assume that the procedure or operation is safe. Its absence may simply reflect the impossibility of anticipating all conceivable and specialized laboratory situations.

- Before a chemistry department employee or student begins initial work in a laboratory, he/she is to be apprised of potential hazards associated with the particular laboratory in which he/she will work.

If you have questions about safe laboratory practices, see a chemistry department faculty member.

2. Cardinal Rules of Laboratory Safety

- Never work in the laboratory alone. Make sure someone is within shouting distance.
- Always wear eye protection in the laboratory. For routine work, prescription glasses with tempered lenses or plastic glasses (available in the stockroom) are acceptable. For work under conditions of special hazard (explosion, corrosive chemicals), use a face shield. EYE PROTECTION ALSO IS REQUIRED FOR ALL VISITORS IN THE LABORATORY. For the purpose of this guideline, the "laboratory" is defined as the bench area or a supporting non-isolated instrumentation room
- When working with chemicals, wear gloves that are appropriate for the material being handled. Use of especially hazardous reagents (bromine, chlorosulfonic acid, etc.) may

require a rubber apron also. Protective garments are not equally effective for every hazardous chemical.

- Keep a clean laboratory. Clutter offers the opportunity for accidents.
- Eating, drinking, and smoking are forbidden in the laboratory. Food and drink containers located in the laboratory are a presumption (OSHA) of these activities having been carried out in the laboratory. Smoking is forbidden in all buildings of the university.
- Follow the prescribed procedures in your textbooks for disposal of chemical waste and for the storage of chemicals. Do what you can to reduce the chemical waste generated in the course of your research.
- Never pipette by mouth.
- Keep aisles and corridors clear. Do not store chemicals on the floor, even temporarily. Access to emergency equipment (fire extinguishers, showers, etc.) should be unobstructed.
- Know what you are doing in the laboratory. If you do not know how to go about an operation, ask someone who does.
- Become familiar with the location of fire extinguishers, spill kits, and safety blankets in your area. Familiarize yourself with their use. Spill kits are available in the stockroom.
- Do not carry chemicals in glass bottles through the hallways without using a rubber bucket or cart. The stockroom has safety carriers for sale. Large flasks (e.g., Erlenmeyer) should be moved from room to room or to and from autoclaves on carts.
- When you check out at the end of your studies in the Chemistry Department, make sure your bench and desk are clean and that all waste chemicals are properly removed. **BE SURE THAT THE CONTENTS OF ALL CONTAINERS ARE PROPERLY IDENTIFIED.** Disposal of unknown materials costs are at least an order of magnitude greater than for normal disposal.
- Write (in indelible pen) the date on new chemicals that are brought into the laboratory. This procedure is particularly important for peroxide-forming compounds (e.g., diethyl ether and tetrahydrofuran (THF)).

The following sections are intended to give more details on some specific procedures. It must be re-emphasized, however, that no set of rules can substitute for common sense and a good professional attitude toward laboratory safety.

3. Obtaining Material Safety Data Sheets (MSDS)

MATERIAL SAFETY DATA SHEETS

This describes how to set up a Netscape bookmark that takes you to the Sigma-Aldrich Chemical Home Page, a source of nearly every MSDS you will ever need. Follow the steps below.

1. Go to Netscape Navigator type in the "aldrich.com"

(At this point create a bookmark for this page. Click on "Bookmarks" on the toolbar on the top of the page, and then click on "Add Bookmark." This creates a bookmark for the Sigma-Aldrich Home page. You can find this bookmark in the bookmark list.

2. Change the name of the bookmark as follows:
 1. click on "bookmarks"
 2. click on "edit bookmark"
 3. click on the displayed bookmark "Sigma-Aldrich Home"
 4. click on "Edit"
 5. type "MSDS" in front of "Sigma-Aldrich Home"
 6. click on "OK"

Your bookmark will now have the name "MSDS Sigma-Aldrich Home"

To get an MSDS

Click on your bookmark "MSDS Sigma-Aldrich Home"

2. from the Sigma-Aldrich Home Page click on the arrow where it says "Please make a selection."
3. click on "Find an MSDS or CofA"
4. type in your search request on the "Enter Search Text"
5. click on "Go"

Note: first time users are required to register. Registration is free.

Search Hints

For the fastest, most specific search in Sigma-Aldrich, search for the CAS number.

Search under Primary Name (rather than Name/Synonym) to get a better hit list.

Search under Name/Synonym only if you fail to find your MSDS with a Primary Name search.

Put quotations around the name to avoid problems. For example, "2,4-dichlorophenol," not 2,4-dichlorophenol. A search in Sigma-Aldrich for 2,4-dichlorophenol returns 27,958 hits, nearly all of them irrelevant. A search for "2,4-dichlorophenol" returns 8 hits, 7 of which are good. (You can also search by CAS number or product number.)

THE NEXT TIME YOU NEED TO GET AN MSDS

Open Netscape, Open Bookmarks, Click on MSDS Sigma-Aldrich Home, Follow the search instructions as above.

4. Laboratory Accidents

4.1 Chemical Spills

4.1.1. General Information

Try to anticipate the types of spills that can occur in your laboratory and obtain the necessary equipment (spill kits, personal protective equipment, and disinfection materials if biological materials are present in the laboratory) to respond to a spill prior to it happening. You should only clean up minor spills of chemicals with whose clean up procedure you are familiar. An MSDS contains special spill clean up information and they should be consulted.

If the spill is too large, highly toxic or a reactive chemical, call for assistance immediately. The Stockroom is equipped to handle most spills that can occur in the department. If there is the slightest doubt regarding how to proceed, call for assistance. In the case of highly toxic spills, evacuate the room, and do not allow anyone to enter until assistance arrives.

**Department Chairperson, 745-3351 (8:30 A.M.-5:00 P.M., Weekdays)
University Police 745-1000 (All Other Times)**

The following compounds are considered very hazardous. You should not clean them up if you are uncertain how to do so.

Aromatic amines	Hydrazine
Bromine	Hexamethylphosphoramide (HMPA)
Carbon disulfide	Organic Halides
Cyanides	Nitriles
Sodium Metal, Mercury Metal	Nitro compounds

If biological materials and microorganisms known not to cause disease in healthy humans, are spilled, you should be prepared to clean them up.

4.1.2. Minor Chemical Spills

If you are cleaning up a small spill yourself, alert people in the immediate area of the spill and make sure that you are aware of the hazards associated with the material spilled. Have adequate ventilation (fume hoods on) and proper protective equipment (minimum: gloves, goggles, and lab coat). Neutralize and absorb inorganic acids and bases appropriately. For other chemicals, use a spill kit that you can obtain from the stockroom, dry sand, diatomaceous earth or paper towels. Consider all residual chemicals and cleanup materials (absorbent, gloves, etc.) a hazardous waste. Place the materials in sealed containers (plastic bags) and store them in a chemical fume hood.

4.1.3 Major Chemical Spills

Attend to injured or contaminated personnel and remove them from exposure. Alert people in the laboratory to evacuate. If the spilled material is flammable, turn off ignition and heat sources. Place a plastic bag, if available, over the spill to minimize evaporation. Call the Chemistry Department Office (745-3352). Close doors to the affected area. Have a person with knowledge of the incident available when the emergency team arrives. At night or on weekends, call the University Police at 745-1000.

4.1.4 Spills of Specific Materials

In case of a MERCURY spill use a vacuum line with an in-line trap attached to a glass pipette to pick up droplets. *Do not use a vacuum cleaner.* Cover small droplets in inaccessible areas with powdered sulfur. Call the stockroom manager who will place the residue in a labeled container for disposal.

To cleanup ALKALI METAL spills, smother with anhydrous sodium carbonate, calcium carbonate, powdered graphite, or sand, and call for the stockroom for assistance (745-2063).

4.2. **Personal Contamination and Injury**

4.2.1. Responsibility

Should a laboratory accident occur, it is the responsibility of uninjured laboratory occupants nearby to initiate first aid treatment to the victim if trained or qualified to do so, and to arrange for notification of medical personnel. For all but the most minor injuries, the victim should be transported by the Xavier Police (745-1000). **BE SURE THAT YOU TELL THE UNIVERSITY POLICE YOUR PRECISE LOCATION.** Victims who cannot readily walk should be transported by ambulance. Until medical help comes, **DO NOT LEAVE THE VICTIM UNATTENDED.**

4.2.2. Essential Procedures in the Case of an Accident

- If an individual is contaminated or exposed to a hazardous material in the laboratory, do what is necessary to protect his/her life and health as well as your own. Determine the nature of the hazardous material. The MSDS will contain special first aid information.
- Do not move an injured person unless he/she is in further danger from inhalation or further skin exposure. Keep the victim warm and recumbent.
- Provide mouth-to-mouth resuscitation at first suspicion of difficulty in breathing.
- If the person is in contact with a live electrical circuit, **DO NOT TOUCH HIM/HER**. Disconnect the power first by turning off circuit breakers or by dislocating the live wire with a non-conducting object.
- In the case of severe bleeding, place a pad or cloth on the cut and apply firm pressure to control the bleeding.
- Get medical attention and assistance immediately by dialing 745-1000

4.2.3. Burning Clothing and Thermal Burns

If clothes are on fire, immediately deluge the victim with water under a safety shower and wrap him/her in a blanket to extinguish the fire completely. Remove the clothing contaminated with chemicals but do not remove clothing that has burned onto the skin. Immerse the burned area in very cold or ice water until pain not only is relieved but also does not return when the burned area is removed from the water. If the burn cannot be immersed, apply ice cold compresses.

When there are extensive burns, beware of shock. Keep patient quiet (with sufficient blankets to keep him/her warm, not hot). Be careful not to contaminate the burned area. Cover the burned area with sterile gauze or a sheet. **DO NOT** apply ointments, lotions or cleanser to the burned area. Contact Xavier Police (dial: 1000) and request immediate medical attention. Do not use a fire extinguisher in the face area of a person whose clothing is burning; he/she may suffocate.

4.2.4. Chemical Spills on the Body

Remove the victim from contact with the chemical as promptly as possible. If clothing has been contaminated, immediately remove all contaminated clothing while the victim is under a shower. (Do not overlook shoes!)

Affected areas of the skin should be thoroughly flushed with water (at least 15 minutes) by shower or by hose as required. Do not apply neutralizing or buffering agents. During flushing, goggles should be left on the victim until his head and face have been washed.

Contact the Xavier Police (dial: 1000) to transfer the victim. If you have information on appropriate treatments (chemical antidotes, etc.), relay this information. Only persons trained and qualified to administer antidotes should attempt to intervene, but your advice may be helpful and welcome.

4.2.5. Cuts

If blood is spurting, place a pad directly on the wound and apply firm pressure, wrap the injured in a fire blanket to avoid shock, and obtain immediate medical attention. Never use a tourniquet. In the case of a less severe but still major cut, the Xavier Police should be contacted for transfer of the victim to Xavier Health Services. Only in the case of trivial cuts should the wound simply be washed and a bandage applied. Report all injuries to your laboratory supervisor.

The most frequent cause of cuts in the laboratory is the mishandling of glassware. Insertion of glass tubing into rubber or cork stoppers should be carried out only after applying a lubricating agent (glycerol) and wrapping the glass in a towel. It is important to hold the glass tubing as close to the stopper as possible to avoid excessive strain on the tubing. Care should be exercised while inserting pipettes into rubber pro-pipettes because the top of the pipette may break under pressure. A towel should be used when breaking a glass rod.

4.2.6. Electrical Shock

Do not touch the victim. Disconnect the power first by turning off circuit breakers or by moving either the live wire or the victim with a nonconducting object (i.e., wood, plastic, glass, rubber). Ensure that asphyxiation does not occur and contact medical personnel (through Xavier Police). If asphyxiation is suspected, begin mouth-to-mouth resuscitation immediately.

4.2.7. Eye Injuries

Loose, unattached foreign matter in the eye can often be safely removed with a wet piece of clean cotton on an applicator. However, if the particle is on the cornea or is embedded in the eye, DO NOT touch it. Contact a Xavier Police (1000) for transport to a physician or ophthalmologist.

Splashes of chemicals in the eye or exposure of the eye to corrosive vapors require immediate treatment. Remove contact lenses if necessary and flush the eye thoroughly with water from an eye-wash fountain. Eyelids should be forcibly held apart so that the entire surface of the eye may be washed. Flushing should be continued for at least fifteen minutes. Afterwards, Contact a Xavier Police (1000) for transport to a physician or ophthalmologist and inform the police of the chemical which caused the injury. Never apply a neutralizing solution as first aid.

4.2.8. Fainting

An individual who feels faint should be made to lie down or to sit quietly with their head lowered below the level of their knees until the period of faintness passes. If loss of consciousness occurs, place the victim in a reclining position, loosen any tight clothing, maintain an open airway and treat any injury that may have been sustained in the fall. Bathe the face with cool water but do not give any liquid by mouth until consciousness returns. Contact the Xavier Police (1000) who will transfer the student to Xavier Health Services for observation.

4.2.9. Ingestion of Chemicals

Contact the Xavier Police (1000) who will transfer the individual to the Xavier Health Services. Indicate the chemical swallowed. Cover the injured person to prevent shock. Provide the ambulance crew and physician with the chemical name and other relevant information. If possible, send the container, MSDS, or label with the victim.

4.2.10. Inhalation of Chemicals

Remove the victim from the contaminated atmosphere and move into the fresh air as quickly as possible. Keep the victim warm and recumbent. At the first sign of breathing difficulty, begin CPR protocols if you are CPR certified. Ensure that the Xavier Police (1000) have been contacted. If possible, identify the substance to which the victim was exposed. (DO NOT ENTER THE AREA IF YOU EXPECT THAT A LIFE THREATENING CONDITION STILL EXISTS - OXYGEN DEPLETION, EXPLOSIVE VAPORS OR HIGHLY TOXIC GASES. SPECIAL EQUIPMENT WILL HAVE TO BE WORN BY THE RESCUE PARTY. CALL XAVIER POLICE 1000 AND EVACUATE PEOPLE FROM THE AREA.)

4.2.11. Special Precautions for Bromine and Alkali Metals

Contact with bromine, hydrogen fluoride, or hydrofluoric acid will lead to excruciatingly painful burns. Thus, an apron, gloves, and a face shield should always be worn when handling these chemicals and procedures should be carried out in the hood. In the case of bromine burns, immediately flush the area with cold water, contact Xavier Police (1000), and transfer the victim. Do not use any other chemicals to neutralize bromine burns on the skin. If clothing is contaminated, it must be removed.

Alkali metals (e.g., lithium, sodium, and potassium) are also extremely caustic to all tissue. Any particles of metal that fall onto the skin should be rapidly removed with a cloth, paper towel or tweezers followed by flushing of the skin with water. If any metal on the skin ignites on contact with water, immediately deluge it with cold water.

4.3 Accidents Involving Biological Materials

If a spill of viable biological materials occurs you should decontaminate the area. Use protective clothing and equipment which should at least include safety glasses, rubber utility gloves, and a lab coat. Decontamination can be accomplished by using a number of disinfectants, which include bleach (1:4 dilution), 70% ethyl alcohol, Lysol, and other commercially available products.

Actions to take during a spill of viable biological materials:

- Stop work and notify others in the immediate area that a spill has occurred.
- Contain the spill to prevent spread to uncontaminated areas by placing absorbent material (paper towels) around and over the spill area.
- Pour disinfectant into the spill to double the size (if possible) of the spill.
- Soak up the spill material with absorbent materials and discard the absorbent material into a red, biohazard bag.
- After removing the spill materials, decontaminate the area again with the disinfectant.
- Wash reusable (rubber utility) gloves with the disinfectant used to decontaminate the spill.
- Discard disposable gloves.
- Wash hands thoroughly with soap and water afterward.

In the event of personal contamination:

- Remove contaminated personal protective equipment.
- For needle sticks and other puncture wounds:
 - Wash the injured area with disinfectant or antiseptic soak and warm water for 15 minutes.
 - For needle sticks, squeeze around injury to encourage the flow of blood out of the wound.
- For splashes to the face (mucous membranes of eyes, nose, and mouth). Use eyewash for 15 minutes to flush exposed area. Eyelids should be forcibly held apart so that the entire surface of the eye may be washed.
- Notify your advisor.
- Call or have someone call the University Police (745-1000) to alert them of the incident.

4.4 Fire and Fire Related Emergencies

If you discover a fire or fire-related emergency such as abnormal heating of material, a flammable gas leak, a flammable liquid spill, smoke, or odor of burning, immediately follow these procedures:

- Notify the University Police by dialing 1000

- Activate the building alarm (fire pull station). If not available or operational, verbally notify people in the building.
- Isolate the area by closing windows and doors; evacuate the building.
- Shut down equipment in the immediate area, if possible.
- Use a portable fire extinguisher to:
 - assist oneself to evacuate
 - assist another to evacuate
 - control a small fire, if possible

Provide the fire/police teams with the details of the problem upon their arrival. Special hazard information you might know is essential for the safety of the emergency response team.

If the fire alarms are ringing in the Logan Hall Stockroom:

- Evacuate the building and stay out until notified to return.
- Move upwind from the building; stay clear of streets, driveways, sidewalks, and other access ways to the building.
- If you are an instructor, try to account for your students, keep them together and report any missing persons to the emergency personnel at the scene.

5. Operational Guidelines

5.1. Location and Use of Emergency Equipment

It is the responsibility of anyone working in a chemical laboratory to make sure that he/she is familiar with the location and use of emergency equipment. This information can be gained from orientation sessions, members of the safety committee, or qualified personnel.

Spill kits and first-aid kits are available in the Logan Hall Stockroom.

When fire extinguishers are used to any extent, contact the Physical Plant (3151) for a replacement.

Safety Procedures for Transportation, Storage, Dispensing, and Disposal of Chemicals, Solvents, and Gases

SOLVENTS IN GLASS CONTAINERS, ACIDS, AND OTHER CHEMICALS WHICH PRESENT A POTENTIAL SAFETY HAZARD SHOULD BE TRANSPORTED THROUGH

THE HALLWAYS OF LOGAN HALL ON LIPPED CARTS OR IN SAFETY CARRIERS, WHICH ARE AVAILABLE IN THE STOCKROOM. Stockroom personnel will dispense such materials only in safety carriers.

5.2. Hood Operation

The satisfactory operation of each hood in most instances depends as much upon the work habits of an individual as the physical operation of the hood. Listed below are several issues with which you should be familiar to assure an efficient hood operation.

5.2.1. Adequate Air Flow

The Physical Plant inspects hoods once a year. If the tag on your hood is dated over a year ago, call for an inspection. If you have doubts about the performance of your hood, contact the Physical Plant (3151).

5.2.2. Storage of Chemicals in Hoods

The proper functioning of the laboratory fume hood is dependent upon unobstructed flow through the hood cabinet. Minimize the amount of chemicals stored in the hood. Periodic housekeeping is recommended to remove unnecessary chemicals from hoods. If chemicals require storage in a hood, a communal hood is recommended.

5.2.3. Proper Work Habits

Chemical activities taking place within the hood should be conducted at least 6 inches inside the face of the hood. The hood user should remain outside the hood at all times.

It is also extremely important, that you report as quickly as possible all instances that indicate the improper functioning of your hood system.

5.3. Solvents

5.3.1. Solvent Dispensing

Flammable and combustible solvents in pint, quart, and gallon containers may be obtained from the stockroom and transported to laboratories in safety carriers or on a lipped cart. Gallon containers of flammable solvents (class I-II) must be stored in safety cabinets. Solvents in 5-gallon DOT (Department of Transportation) cans and 55-gallon drums may NOT be dispensed in laboratories. Such operations must be conducted with proper grounding in the solvent storage

area in the chemistry stockroom. Transfers should be made into 1, 2-1/2, or 5 gallon safety cans (1 and 2-1/2 gallon sized are available in the stockroom).

5.3.2. Solvent Stills

The stills that are used to dry organic solvents can be a source of explosion and fire. Stills should be kept full so that the solvent level is above the heating mantle. Allowing solvent levels to get low or the still to go dry, can cause excessive heating and explosions. This danger is particularly high for lithium aluminum hydride (LiAlH_4 , LAH), which decomposes at $125\text{ }^\circ\text{C}$, a temperature readily reached by a heating mantle in a still with a low volume or by a high boiling solvent (diglyme). AVOID LiAlH_4 .

Calcium hydride can be used to dry pyridine, toluene, and CH_2Cl_2 . Sodium or potassium benzophenone ketyl are common drying agents for ether and tetrahydrofuran. The problem with CaH_2 and the metal ketyls is the danger of cleaning the stills. Stills should be cleaned on a regular basis to avoid the accumulation of reactive drying agents. The dropwise, cautious addition of isopropyl alcohol to the still pot is recommended. This procedure is best conducted at reflux to assure that the decomposition takes place under optimum conditions. Room temperature decomposition is acceptable but often the decomposition is too slow. There is a tendency to add too much alcohol too fast, which may lead to an uncontrollable reaction. Still pot decomposition should be conducted using safety glasses, a lab coat, and a shield in a hood.

5.3.3. Waste Solvents and Chemicals

The disposal of waste chemicals is to be accomplished in the following manner to comply with the Federal Resource Conservation and Recovery Act (1976). Waste is collected on an as-needed basis by calling contacting the Logan Hall Chemistry Stockroom when materials are ready for pick-up. The packaging of waste solvents should comply with the following guidelines:

- Material should be placed into appropriate storage containers with secure tops and labeled.
- Waste solvents may be placed in the type of container in which they were purchased (glass, plastic or metal). Metal cans should not be used for aqueous solutions and corrosive agents (alkali, acid, etc.)
- Keep a log sheet of the materials placed into a waste container. The log sheet can be used to complete the required waste tag. All containers must be labelled with the Hazardous Waste tag.
- Aqueous wastes which contain heavy metal salts (Cr, Pb, etc.) or are contaminated with organic solvents are to be placed in glass or plastic containers and labeled appropriately for collection.

- Flammables (benzene, ether, ethyl acetate, acetone, hydrocarbons, and other non-halogenated combustible liquids - solvents from a rotary evaporator) are to be placed in glass, plastic or metal containers and labeled for collection.
- Halocarbons (methylene chloride, chloroform, carbon tetrachloride, contaminated flammables (e.g., from cleaning flasks with acetone)), solids, still pots, etc. are to be placed in glass, plastic or metal containers, and labeled for collection.

Uncontaminated acids and bases may be neutralized (except chromic acid, hydrofluoric acid and ammonium hydroxide) to pH 5.5 - 9.5 and flushed down the drain with copious quantities of water.

5.4. Chemical Storage

5.4.1. Solvent Storage

- a) *Definition of solvents by flashpoints.* Classes IA-II are characterized as flammable; Class III is called combustible.

<u>Class</u>	<u>Flashpoints</u>	<u>Boiling Point</u>
IA	below 73°F (23°C)	below 100°F (38°C)
IB	below 73°F (23°C)	100°F (38°C) or above
IC	73°-99°F (23°-37°C)	100°F (38°C) or above
II	100°-139°F (38°-59°C)	100°F (38°C) or above
IIIA	140°-199°F (60°-93°C)	100°F (38°C) or above
IIIB	above 200°F (93°C)	100°F (38°C) or above

- b) *Some examples:*

IA: ether, petroleum ether, pentane
IB: acetone, acetonitrile, methanol, propanol, ethanol, benzene, carbon disulfide, cyclohexane, dioxane, ethyl acetate, heptane hexane, pyridine, toluene
II: acetic acid, amyl acetate, formaldehyde, dimethylformamide
IIIA: aniline, benzaldehyde, bromobenzene, cyclohexanol, formic acid, nitrobenzene, octanol
IIIB: acetophenone, castor oil, dibutyl phthalate, ethylene glycol, glycerine, dimethyl sulfoxide

- c) *Maximum allowed container size:*

Class

Container	IA	IB	IC	II	III
	-----Flammable-----				
Combustible glass or plastic	1 pt	1 qt	1 gal	1 gal	1 gal
metal (other than drum)	1 gal	5 gal	5 gal	5 gal	5 gal
safety can (spring to and flame resistor)	2 gal	5 gal	5 gal	5 gal	5 gal

d) Maximum permissible limits in an individual laboratory: (OSHA)

- (1) Not more than 10 gallons of flammable liquids may be stored outside of an approved storage cabinet in laboratories except in safety cans. The collective volume of waste disposal cans is included in the 10 gallon limit. This OSHA regulation means that it is permissible to have up to 10 gallons of flammable liquids in the usual containers found in laboratories, namely glass and metal cans. Larger amounts must be accommodated in three ways: (a) use safety cans; (b) place the excess over 10 gallons in another room; (c) use an approved flammable storage cabinet.
- (2) Not more than 25 gallons of Class I and Class II liquids combined and not more than a total of 60 gallons of combustible liquids (Class III) shall be stored outside of a storage room or storage cabinet. This limit applies to storage in safety cans and other containers in a single laboratory. The 25 gallons is the 10 gallons in (1) plus 15 gallons in safety cans. The excess must be stored in flammable storage cabinet.

5.4.2. General Procedures For Chemical Storage

- Do not store unsegregated chemicals in alphabetical order. Do not store incompatible chemicals close to one another
- Separate hazardous chemicals in storage as follows:
 Solids: oxidizers/flammable solids/water reactives/all others
 Liquids: acids/bases/oxidizers/flammable & combustible/perchloric acid
 Gases: toxic/oxidizers & inert/flammable
- Containers on shelves should not extend over the edge of the shelf.
- Large bottles and bottles containing corrosives and solvents should not be stored on shelves above eye level.

- Minimize the storage of chemicals on benchtops and in hoods.
- Use a tray or basin under concentrated acids and bases.
- Large glass objects (e.g., chromatography columns) should not be stored on the sink peg board.
- A good place to store volatile hazardous chemicals is in a vented cabinet or in a vented area under a hood. Chemicals of different hazard classes can be segregated by placing them in trays.
- Volatile or unstable materials may be stored in a spark-proof refrigerator only in properly sealed containers. Never store flammable solvents (ether, benzene) in the refrigerator in open containers (beakers). **Food or drink should never be stored in a laboratory refrigerator or freezer.**
- Label all refrigerated samples with the contents, owner's name, and date of preparation. Commercially obtained samples should be dated.
- Refrigerators used to store organic materials must be "spark-proof". Commercially available units meeting this requirement are available. Note that attempts to modify standard household-type refrigerators by mounting the controls on the exterior of the cabinet will not suffice, since the compressor motor, which operates intermittently, usually cannot be kept from contact with flammable heavier-than-air vapors.
- Be careful with older bottles of materials that may form peroxides (diethyl ether, tetrahydrofuran, dioxane). Opened containers of these materials should be discarded within one year of opening. All such containers should be dated upon receipt and upon opening.
- AN UNFORGIVABLE SIN: Leaving a large unlabeled bottle of "something" behind when you depart.

5.5. Working With Chemicals Having Specific Hazards

Some chemicals have special hazardous properties that require special laboratory procedures and precautions. These chemicals fall into several classes and can be categorized as:

- Flammable Solvents
- Highly Reactive Chemicals & High Energy Oxidizers
- Compressed Gases
- Corrosive Chemicals
- Chemicals of High, Acute, & Chronic Toxicity

5.6. Special Procedures For Regulated Chemicals & Particularly Hazardous Chemicals

This section establishes supplemental work procedures to control the handling of substances that are known to exhibit unusual, acute, or long-term chronic health hazards (carcinogens, reproductive toxins, and highly, acutely toxic pressurized gases). This set of procedures applies to chemical carcinogens listed and regulated by the Department of Labor, Occupational Safety and Health Administration (OSHA), and to human carcinogens listed by the International Agency for Research on Cancer (IARC) and the National Toxicology Program (NTP). Please note that a key component of these procedures is the controlled distribution of these substances. In some instances special authorization is required before purchasing and using these substances.

The pressurized hazardous gases identified below have been classified as particularly hazardous and *require prior approval for purchasing of new materials, or handling and storage of existing material.*

Pressurized Gases Requiring Chemical Safety Committee Review & Approval

Compound	Exempt Quantity
Arsine and gaseous derivatives Chloropicrin in gas mixtures Cyanogen chloride Cyanogen Diborane Germane Hexaethyltetraphosphate	None None None None None None None
Hydrogen cyanide Hydrogen selenide Nitric oxide Nitrogen dioxide Nitrogen Tetroxide Phosgene Phosphine	None None None None None None None

The substances listed in the table below (titled "Regulated Chemicals & Chemicals with High Chronic Toxicity Requiring Special Procedures") when stored or handled in quantities exceeding the exempt quantities must be stored and handled according to the special procedures outlined below.

**Regulated Chemicals & Chemicals With High Chronic Toxicity
Requiring Special Procedures**

Compound	Exempt Quantity (See Note 1 Below)	OSHA Regulated Substance
N-Acetoxy-2-acetylaminofluorene	2	
2-Acetylaminofluorene	2	Y
Acrylonitrile	1	Y
Aflatoxins	2	
o-Aminoazotoluene	2	
4-Aminodiphenyl	3	Y
2-Aminofluorene	2	
Asbestos	1	Y
Arsenic and arsenic compounds	2	Y
Azathiopurine	2	
Benz[a]anthracene	2	
Benzene	1	Y
Benzydine	3	Y
Benzo[a]pyrene	2	
Bromoethyl methanesulfonate	2	
1,4-Butanediol dimethanesulfonate (myleran)	2	
Carbon tetrachloride	1	
Chlorambucil	2	
Chloroform	1	
N,N-bis(2-chloroethyl)-2-naphthylamine	2	
bis-Chloromethyl ether	3	Y
1-(2-Chloroethyl)-3-(4-methylcyclohexyl)-1-nitrosourea	2	
Cycasin	2	
Cyclophosphamide	2	
Diazomethane	2	
Dibenz[a,h]anthracene	2	
1,2-Dibromo-3-chloropropane	1	Y
3,3'-Dichlorobenzidine (& its salts)	3	Y

Diepoxybutane	2	
4-Dimethylaminoazobenzene	2	Y
7,12-Dimethylbenz[a]anthracene	2	
3,3'-Dimethylbenzidine	2	
1,1-Dimethylethylenimine	1	
1,1-Dimethylhydrazine	2	
1,2-Dimethylhydrazine	2	
1,4-Dinitrosopiperazine	2	
p-Dioxane	1	
Ethylene dibromide	1	
Ethyleneimine	2	Y
Ethyl methanesulfonate	2	
Ethylene oxide	1	Y
Ethionine	1	
Ethylenimine	2	
2-Ethoxyethanol	2	
2-Ethoxyethylacetate	2	
Formaldehyde	1	Y
Formamide	1	
Hexavalent chromium and chromium compounds	1	
Hydrazine	2	
N-Hydroxy-2-acetylaminofluorene	2	
Lead and lead compounds	1	Y
2-Methoxyethanol	2	
2-Methoxyethylacetate	2	
3'-Methyl-4-aminoazobenzene	1	
Methyl chloromethyl ether	3	
3-Methylcholanthrene	2	
4,4'-Methylene bis(2-chloroaniline)	2	
Methylhydrazine	2	
Alkyl mercury compounds	3	
Methyl methanesulfonate	2	
1-Methyl-3-nitro-1-nitrosoguanidine	2	
alpha-Naphthylamine	2	Y
beta-Naphthylamine	3	Y
4-Nitrobiphenyl	3	Y
N-[4-(5-nitro-2-furyl)-2-thiazoyl]-formamide	2	
4-Nitroquinoline-1-oxide	2	
N-Nitrosodiethylamine	2	
N-Nitrosodimethylamine	2	Y
N-Nitrosodi-n-butylamine	2	

N-Nitrosodi-n-propylamine	2	
N-Nitroso-N-ethylurea	2	
N-Nitroso-N-ethylurethane	2	
N-Nitroso-N-methylurea	2	
N-Nitroso-N-methylurethane	2	
N-Nitrosopiperidine	2	
Polychlorinated biphenyls	2	
Procarbazine	2	
1,3-Propane sulfone	2	
beta-Propiolactone	2	Y
Propylenimine	1	
Thorium dioxide	2	
m-Toluediamine	2	
Uracil mustard	2	
Urethane	1	
Vinyl chloride	2	Y

Note 1 - The exempt quantities are defined as:

Exempt Quantities

<u>Number</u>	<u>For Laboratory Storage</u>	<u>For Laboratory Use</u>
1	< 1 liter or 1000 grams	< 50 milliliters or 50 grams
2	< 0.1 liter or 100 grams	< 5 milliliters or 5 grams
3	none	none

Special Handling Procedures

Use these chemicals only in a chemical fume hood or other appropriate containment device (glove box).

Volatile chemicals should be stored in a vented storage area in an unbreakable, primary or secondary container or placed in a chemically resistant tray (to contain spills). Nonvolatile chemicals should be stored in cabinets. *Do not store these chemicals on open shelves or counters.* Access to all of these chemicals should be restricted.

Volatile chemicals should be transported between laboratories in durable rubber containers.

All procedures with these chemicals should be performed in designated areas. Other employees working in the area should be informed of the particular hazards associated with these substances and the appropriate precautions that are necessary for preventing exposures. All designated areas should be posted with a sign which reads:

WARNING
DESIGNATED AREA FOR HANDLING THE FOLLOWING
SUBSTANCES WITH HIGH, ACUTE, OR CHRONIC TOXICITY:

[list of substances - identify acute or chronic hazard]
[Example: Benzene - carcinogen]

AUTHORIZED PERSONNEL ONLY

Vacuum pumps used in procedures should be protected from contamination with scrubbers or filters. The pump exhaust should be equipped with an oil mist filter and the pump exhaust discharged to a fume hood or other dedicated exhaust line.

Analytical instruments or other laboratory equipment generating vapors and/or aerosols during their operation should be exhausted locally or vented in a chemical fume hood.

Skin surfaces that might be exposed to these substances during routine operations or foreseeable accidents should be covered with appropriate protective clothing. Gloves should be worn whenever transferring or handling these substances. When wearing washable garments (such as a laboratory coat), evaluate the potential for exposing non-laboratory personnel (and placing them at risk) during the laundering process. Wear disposable garments if others may be placed at risk during the laundering process. Consider using full body protection (disposable coveralls) if the potential for extensive personal contamination exists.

All protective equipment should be removed when leaving the designated area and decontaminated (washed) or, if disposable, placed in a plastic bag and secured.

Work surfaces on which these substances will be handled should be covered with an easily decontaminated surface (such as stainless steel) or protected from contamination with plastic trays or plastic backed paper. Materials that will be discarded should be placed in plastic bags and secured.

Chemical wastes from procedures using these substances should be placed in containers, tagged and discarded through the University's hazardous chemical waste program. The wastes should be stored in the designated area (defined above) until picked up. If it is possible to safely chemically decontaminate all toxic substances to nontoxic materials during or at the end of the procedure this should be done.

Normal laboratory work should not be conducted in a designated area until it has been decontaminated or determined to be acceptable by the principal investigator, laboratory supervisor or OEHS.

Lab personnel of childbearing age should be informed of any known reproductive toxins used in the laboratory

5.7 Use of Rotary Evaporators

All rotary evaporators employing aspirators must be cooled with circulating ice water to prevent solvents from entering the water and waste systems. Under no circumstances are organic substances or the volatile toxic materials to be flushed down drains.

All aspirators are to be used only on faucets containing backflow preventers. These devices prohibit contamination of the city water supply.

5.8. Broken Glass

Broken glass must not be discarded in the wastebaskets or trash cans; neither the housekeeping staff nor the trash facilities are equipped to handle it. Serious accidents have occurred due to broken glassware being placed in ordinary waste paper receptacles. Dispose of glassware in specially marked containers provided for this purpose.

6. Safety Check List

Although the OEHS conducts periodic safety inspections of the laboratory facilities, you are strongly encouraged to perform regular-self assessments of your laboratory. The following list and check-off form are a good place to start:

- 1) Compressed gases securely strapped
- 2) Safety shower and eyewash inspection up-to-date
- 3) Eyewash stations flushed
- 4) Unobstructed access to safety showers and eyewash stations
- 5) Unused cup sinks stoppered or filled with mineral oil/glycerol
- 6) Proper use of wire or hose clamps on all water and gas connections
- 7) Fume hood inspection up-to-date
- 8) Sufficient fume hood air velocity
- 9) Electrical wires properly grounded and connected; no frayed wires
- 10) No wires on the floor
- 11) Belt guards on all vacuum pumps
- 12) Flammable solvents stored in appropriate storage cabinets
- 13) All chemicals properly labeled
- 14) All chemical waste containers capped and properly labeled
- 15) No food stored in chemical refrigerators
- 16) Unobstructed access to all fire extinguishers
- 17) Up-to-date fire extinguisher fire extinguisher weight and inspection tag
- 18) Up-to-date emergency phone numbers posted on all laboratory doors
- 19) Proper hazard warnings (Laser, etc.) posted on all laboratory doors
- 20) Copy of Chemistry Safety Manual available in laboratory.
- 21) Occupants wearing safety equipment in labs: glasses, gloves, lab coat, etc.

8. Laboratory Door Emergency Sticker

The sticker below must be posted on the door of every laboratory. It should be updated once a year or more frequently as needed.

In Case of Emergency, contact:

Date _____

Room: _____

PI: _____ (office)

_____ (home phone)

Room Occupants: (Phone only)

_____	_____
_____	_____
_____	_____
_____	_____
_____	_____

Xavier Emergency-- Fire and Police 1000
Chemistry Department Office 3351
Physical Plant 3151