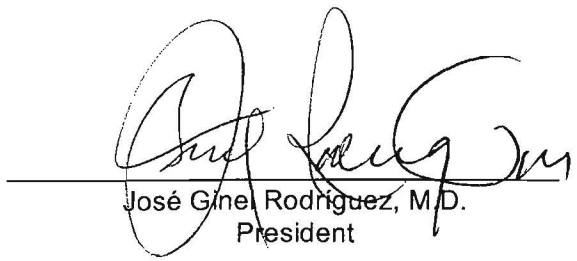
Universidad Central del Caribe
Chemical Safety Manual



José Ginel Rodriguez, M.D.
President

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Chemical Hygiene Plan

The Occupational Safety and Health Administration (OSHA), part of the Department of Labor, administers a variety of regulations. These regulatory requirements are published in and referred to as the Code of Federal Regulations (CFR). The Code of Federal Regulations is a codification of the general and permanent rules published in the Federal Register by the Executive departments and agencies of the Federal Government. The Code is divided into 50 titles, which represent broad areas subject to Federal regulation. Each title is divided into chapters with each chapter further subdivided into parts, subparts and sections. Part 1910 of Title 29 (cited as "29 CFR 1910"), section 1450 of subpart Z, "Occupational Exposures to Hazardous Chemicals in Laboratories", referred to as the "Laboratory Standard", specifically addresses mandated regulatory requirements. Many educational institutions, colleges, universities, industry, and other organizations that use hazardous chemicals in their laboratories are now required by the Laboratory Standard to develop Chemical Hygiene Plans.

The development of a detailed written chemical hygiene plan is necessary to establish continuity, to train personnel, and to help ensure that all employees recognize and comply with workplace safety. It is extremely difficult to effectively communicate and enforce requirements without a detailed written chemical hygiene plan.

An effective chemical hygiene plan necessitates that mechanisms be in place and functioning to ensure that safety policies and procedures are being adhered to, personnel are meeting their safety responsibilities, and an effective form of monitoring and documentation is in place for confirmation purposes.

A. Introduction

The Universidad Central del Caribe is required by the Federal OSHA Standards, Title 29 of the Code of Federal Regulations (CFR) parts 1910 and 1926 (hereafter cited as 29 CFR 1910 and 29 CFR 1926)29 CFR 1910 section 1450 of subpart Z (Occupational Exposures to Hazardous Chemicals in Laboratories) to develop a chemical hygiene plan for certain laboratories. The Laboratory Standard (29 CFR 1910.1450) does not apply to all laboratories, but where it applies, it supersedes the Hazard Communication Standard 29 CFR 1910.1200. It is therefore the intent of this Laboratory Chemical Safety Policy to define the guidelines for the implementation of the Laboratory Standard.

B. Scope and Definitions

The UCC Laboratory Safety Chemical Policy applies only to certain laboratories. Many laboratories use hazardous chemicals. OSHA defines a hazardous chemical as a substance for which there is statistically significant evidence, based on at least one scientific study, showing that acute or chronic harm may result from exposure to that chemical. This broad definition clearly applies to almost all of the chemicals typically used in laboratories.

The purpose of the UCC Laboratory Safety Chemical Policy is to protect laboratory employees, while they are working in a laboratory, from harm due to potential exposure of hazardous chemicals. In addition to employees who ordinarily spend their full time working in a laboratory space, for the purposes of this policy "laboratory employee" also includes office, custodial, maintenance, and repair personnel, and others who, as part of their duties, regularly spend a significant amount of their time within a laboratory environment. The appropriate University administrative units shall determine what constitutes a "significant amount" of working time. This definition is subject to review at the time of an OSHA visit.

The UCC Laboratory Chemical Safety Policy does not apply to all places where hazardous chemicals are used. Only laboratories meeting the following four criteria are subject to the UCC Laboratory Chemical Safety Policy:

1. Chemical manipulations are carried out on a laboratory scale. That is, the work with chemicals is in containers of a size that could be easily and safely manipulated by one person.

2. Multiple chemical procedures or chemicals are used.

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

4. The procedures involved are not part of a production process whose function is to produce commercial quantities of materials, nor do the procedures in any way simulate a production process.

This fourth criterion would normally exclude quality control laboratories in industrial operations because they "are usually adjuncts of production operations which typically perform repetitive procedures for the purpose of monitoring a product or a process" [FR 55, 3312 (January 31, 1990)]. This criterion also would normally exclude pilot plant operations, which are typically

closely connected with production processes. However, if pilot plant operations are an integral part of a research function for the purpose of evaluating a particular effect (for example, "the operations do not proceed to production but remain part of the research activity"), then that pilot plant operation may be covered under the UCC Laboratory Chemical Safety Policy.

Some laboratories may also be required to meet the requirements of substance-specific federal standards in addition to the Laboratory Standard. One set of such standards is contained in OSHA's 29 CFR 1910.1000 - 1999.

Action level - A concentration for a specific substance, calculated as an eight (8) hour time-weighted average, which initiates certain required activities such as exposure monitoring and medical surveillance. Typically it is one-half that of the Permissible Exposure Limit (PEL) for that substance.

Acute - Severe, often dangerous conditions in which relatively rapid changes occur.

Carcinogen - Any substance that causes the development of cancerous growths in living tissue, either those that are known to induce cancer in man or animals or experimental carcinogens that have been found to cause cancer in animals under experimental conditions.

Designated Area - An area that may be used for work with "select carcinogens, reproductive toxins, or substances which have a high degree of acute toxicity." A designated area may be the entire laboratory, an area of a laboratory, or a device such as a laboratory hood. A designated area shall be placarded to reflect the designated hazard.

Employee - An individual employed in a laboratory work place who may be exposed to hazardous materials in the course of his or her assignments.

Health Hazard - A substance for which there is statistically significant evidence based on at least one study conducted in accordance with established scientific principles that acute or chronic health effects may occur in exposed employees. This term includes carcinogens, toxic agents, reproductive toxins, irritants, corrosives, sensitizers, hepatotoxins, nephrotoxins, neurotoxins, agents which act on the hematopoietic systems, and agents which damage the lungs, skin, eyes, or mucous membranes.

MSDS - Material Safety Data Sheet.

(PEL) Permissible Exposure Limit - An exposure limit that is published and enforced by OSHA as a legal standard. PEL may be either a time-weighted-average (TWA) exposure limit (8 hour), a 15-minute short term exposure limit (STEL), or a ceiling (C). The PELs are found in Tables Z-1, Z-2, or Z-3 of 29 CFR 1910.100. This level of exposure is deemed to be the maximum safe concentration and is generally the same value as the threshold limit value (TLV).

(PPE) Personal Protective Equipment - Any devices or clothing worn by the worker to protect against hazards in the environment. Examples are respirators, gloves, and chemical splash goggles.

Respirator - A device that is designed to protect the wearer from inhaling harmful contaminants.

(STEL) Short Term Exposure Limit - Represented as STEL or TLV-STEL, this is the maximum concentration to which workers can be exposed for a short period of time (15 minutes) for only four times throughout the day with at least one hour between exposures.

(TLV) Threshold Limit Value - Airborne concentrations of substances devised by the ACGIH that represents conditions under which it is believed that nearly all workers may be exposed day after day with no adverse effect. TLVs are advisory exposure guidelines, not legal standards, which are based on evidence from industrial experience, animal studies, or human studies when they exist. There are three different types of TLVs: Time Weighted Average (TLV-TWA), Short Term Exposure Limit (TLV-STEL) and Ceiling (TLV-C). (See also PEL.)

Time Weighted Average - (TLV-TWA, Threshold Limit Value-Time Weighted Average) The time weighted average airborne chemical concentration for a normal eight hour work day and a 40 hour work week to which nearly all workers may be repeatedly exposed, day after day, without adverse effect.

Toxic - Substances such as carcinogens, irritants, or poisonous gases, liquids, and solids which are irritating to or affect the health of humans.

C. University Responsibilities

The Universidad Central del Caribe has certain obligations. Among these the University must:

1. Keep records of employee exposures to hazardous chemicals:

    a. Records should include measurements made to monitor exposures, if any, as well as any medical consultations and examinations, including written opinions.

    b. These records shall be kept by the department in which the exposure occurred.

    c. Maintain these records as mandated in 29 CFR 1910.20, Access to Employee Exposure and Medical Records.

2. Provide University employees with:

    a. Training and information regarding chemical and physical hazards.

    b. Identification of other hazards (see Subparts D through T of 29 CFR).

    c. Access to medical consultation and examinations.

3. For incoming hazardous chemicals:

a. Require that the incoming hazardous chemicals have adequate labels. Do not allow the removal or defacement of these labels.

b. Require that the MSDSs for incoming hazardous chemicals be on hand prior to receipt of hazardous chemicals whenever possible. Require that MSDSs be acquired for all hazardous chemicals on hand whenever possible.

c. Keep all material safety data sheets (MSDS) that the University receives.

d. Make MSDSs accessible to employees.

e. Maintain an accurate inventory of all chemicals in University laboratories.

4. When hazardous chemicals are generated in University laboratories:

a. If the hazardous properties are known, train University employees.

b. If the hazardous properties are not known, treat the chemical as though it is hazardous and provide protection as described in the Chemical Hygiene Plan.

c. If the chemicals are produced for use elsewhere, follow 29 CFR 1910.1200 and the various Environmental Protection Agency (EPA) and Department of Transportation (DOT) regulations that apply to that chemical.

5. If there is reason to believe that the action level, or PEL if there is no action level, has been exceeded for any chemical for which a substance-specific standard has been established, the University must measure the concentration of that chemical in the air. If the level measured is greater that the PEL or action level, then:

a. Notify all affected laboratory employees of the results of the measurement, and

b. Comply with the OSHA exposure-monitoring provisions for that chemical, as stated in 29 CFR 1910.1000 through 1910.1199.

6. If respirators are necessary to keep exposures below the PEL or action level, follow the requirements of the Respiratory Protection Standard, 29 CFR 1910.134.

7. If select carcinogens, reproductive toxins, or acute toxins that are very highly toxic are used in the laboratory, identify and post one or more areas as "designated area(s)."

8. Require a Chemical Safety Officer (CSO) be appointed to insure that the Chemical Hygiene Plan (CHP) is followed adequately.

D. Individual Responsibilities

Responsibility for chemical hygiene rests at all levels including the:

1. **University President**, who has ultimate responsibility for chemical hygiene within the Universidad Central del Caribe and must, with other administrators, provide continuing support for University chemical hygiene.

2. **Supervisor of a College, Department or other administrative unit**, who is responsible for chemical hygiene in that unit.

3. **Chemical Safety Officer**, who have overall responsibility for chemical hygiene in all departmental laboratories including responsibility to:

a. Work with administrators and other employees to develop and implement appropriate chemical hygiene policies and practices;

b. Help project directors develop precautions and adequate facilities;

c. Ensure that workers know and follow the chemical hygiene rules and document that appropriate training has been provided;

d. Determine the required levels of protective apparel and equipment and insure that this equipment is available and in working order;

e. Monitor procurement, use, and disposal of chemicals in the lab;

f. Maintain an accurate Departmental Chemical Inventory List.

g. Provide regular, formal chemical hygiene and housekeeping inspections including routine inspections of emergency equipment;

h. Know the current legal requirements concerning regulated substances; and

i. Seek ways to improve the chemical hygiene program.

4. **Project director or director of other specific operation**, who has primary responsibility for chemical hygiene procedures for that operation, and is responsible for:

a. Maintaining an accurate Laboratory Chemical Inventory List.

b. Ensuring that workers know and follow the chemical hygiene rules,

c. Ensuring that protective equipment is available and in working odor,

d. Ensuring that all containers in the work area are properly labeled,

e. Ensuring that MSDS's are maintained for each hazardous substance in the laboratory and ensuring that they are readily accessible to laboratory employees,

f. Ensuring that appropriate training has been provided to all employees,

g. Providing regular, formal chemical hygiene and housekeeping inspections including routine inspections of emergency equipment,

h. Knowing the current legal requirements concerning regulated substances,

i. Determining the required levels of protective apparel and equipment, and

j. Ensuring that facilities for use of any material being ordered are adequate.

5. **Laboratory worker**, who is responsible for:

a. Planning and conducting each operation in accordance with safe procedures; and

b. Developing and maintaining good personal chemical hygiene habits.

E. The Content of the Chemical Hygiene Plan

The chemical hygiene plan shall include each of the following elements and shall also indicate the specific measures to be taken to ensure that University employees are protected.

1. Standard operating procedures relevant to all laboratory operations, to be followed by laboratory employees.

2. Statements of the criteria that will be used to determine and implement control measures to reduce employee exposure to hazardous chemicals. These measures include engineering controls, use of personal protective equipment, and personal hygiene practices. Criteria to reduce exposure to extremely hazardous chemicals used in the laboratory shall be specifically included.

3. A requirement that fume hoods and other protective equipment shall function properly and descriptions of the methods to be taken to make sure that such equipment is functioning properly.

4. Provisions for employee training and information.

5. Circumstances under which a laboratory practice requires prior approval from a supervisor before implementation.

6. Provisions for medical consultation and examination.

7. Designation of personnel responsible for implementation of the chemical hygiene plan.

8. Provisions for additional protection for employees when working with particularly hazardous substances, including:

a. Select carcinogens.

b. Reproductive toxins.

c. Substances with a high degree of acute toxicity.

9. Specific mention of the following provisions, including when appropriate:

a. Establishment of a designated area.

b. Use of containment devices such as fume hoods or glove boxes.

c. Procedures for safe removal and disposal of contaminated and hazardous waste; and

d. Decontamination procedures.

F. Exposure Assessments, Medical Consultations, and Examinations

1. Suspected Exposures to Toxic Substances

There may be times when employees or supervisors suspect that an employee has been exposed to a hazardous chemical to a degree and in a manner that might have caused harm to the victim. If the circumstances suggest a reasonable suspicion of exposure, the victim is entitled to a medical consultation and, if so determined in the consultation, also to a medical examination. All medical examinations and consultations shall be provided without cost to the employee, without loss of pay, and at a reasonable time and place.

a. Criteria for Reasonable Suspicion of Exposure

(1) It is the policy of the Universidad Central del Caribe to promptly investigate all employee-reported incidents in which there is even a remote possibility of employee overexposure to a toxic substance.

(2) Events or circumstances that might reasonably constitute overexposure include:

(a) A hazardous chemical leaked or was spilled or was otherwise rapidly released in an uncontrolled manner.

(b) A laboratory employee had direct skin or eye contact with a hazardous chemical.

(c) A laboratory employee manifests symptoms, such as headache, rash, nausea, coughing, tearing, irritation or redness of eyes, irritation of nose or throat, dizziness, loss of motor dexterity or judgment, etc., and some or all of the symptoms disappear when the person is

taken away from the exposure area and breathes fresh air, and the symptoms reappear soon after the employee returns to work with the same hazardous chemicals.

(d) Two or more persons in the same laboratory work area have similar complaints.

b. Exposures

All exposure complaints and their disposition, no matter what the ultimate disposition may be, are to be documented by Human Resources Department. A copy of this document shall be sent to the Chemical Safety Officer. If no further assessment of the event is deemed necessary, the reason for that decision shall be included in the document submitted.

2. Medical Consultation and Examination

If employees feel that they have been exposed to hazardous chemicals, employees are required to contact the Human Resources Department who will assist them in arranging for a medical consult; the consulting physician will determine if further medical consultations and examinations are warranted.

The details of medical consultations and examinations are determined by the physician.

The purpose of a medical consultation is to determine whether a medical examination is warranted. When it is suspected or known that an employee was overexposed to a hazardous chemical or chemicals, the employee should obtain medical consultation from or under the direct supervision of a licensed physician.

When warranted, employees also should receive a medical examination from or under the direct supervision of a licensed physician who is experienced in treating victims of chemical overexposure. The medical professional should also be knowledgeable about which tests or procedures are appropriate to determine if there has been an overexposure; these diagnostic techniques are called "differential diagnoses."

These provisions apply to medical consultations and examinations:

a. All employees who work with hazardous chemicals must be provided an opportunity to receive medical consultation and examination when:

(1) The employee develops signs or symptoms associated with a hazardous chemical to which the employee may have been exposed in the laboratory.

(2) Monitoring, routine or otherwise, suggests that there could have been an exposure above the action level, or OSHA PEL if there is no action level, for a chemical for which an OSHA substance-specific standard has been established.

(3) There is a spill, leak, or other uncontrolled release of a hazardous chemical.

b. Provide the physician with:

(1) The identity of the hazardous chemical or chemicals to which the employee may have been exposed (Formal Exposure Assessment if available).

(2) The exposure conditions.

(3) The signs and symptoms of exposure the victim is experiencing, if any.

c. Ordinarily, physicians will furnish to the Office of Human Resources at UCC in written form with:

(1) Recommendations for follow-up, if determined to be pertinent.

(2) A record of the results of the consultation and, if applicable, of the examination and any tests that were conducted.

(3) Conclusions concerning any other medical condition noted that could put the employee at increased risk.

(4) A statement that the employee has been informed both of the results of the consultation or examination and of any medical condition that may require further examination or treatment.

d. These written statements and records should not reveal specific findings that are not related to an occupational exposure.

e. Documentation
All memos, notes, and reports related to a complaint of actual or possible exposure to hazardous chemicals are to be maintained as part of the record.

f. Notification
Employees shall be notified of the results of any medical consultation or examination with regard to any medical condition that exists or might exist as a result of overexposure to a hazardous chemical.

G. Records and Recordkeeping

1. Employee Exposure and Medical Records

OSHA regulation 29 CFR 1910.20, Access to Employee Exposure and Medical Records, addresses the storage and access to employee exposure and medical records pertaining to toxic substances or harmful physical agents.

The following is a summary of this regulation:

a. The medical record for each employee is to be preserved and maintained for at least the duration of employment plus thirty years.

b. Each employee exposure record shall be preserved and maintained for at least thirty years.

c. Each analysis using employee exposure or medical records shall be preserved and maintained for at least thirty years.

d. MSDSs and other descriptions of substances do not have to be retained as long as some record of the identity (chemical name if known) of the substance or agent, where it was used, and when it was used is retained for 30 years.

e. If an employee or their designated representative, requests a copy of the employee's health record, the University is to provide a copy within 15 days of the request, or provide facilities to make copies at no cost, or loan the records to employee or designated representative so that copies can be made.

CHEMICAL SAFETY

Working with potentially hazardous chemicals is an everyday occurrence in a laboratory setting. Hazardous situations can occur if employees are not educated in general chemical safety, toxicological information, and procedures for handling and storage for the chemicals they are using. This section of the laboratory manual addresses these educational components and spells out specific protocols to minimize hazardous chemical exposures.

A. Modes of Entry

There are four major modes of entry to chemicals: inhalation, skin absorption, injection, and ingestion. Inhalation and skin absorption are the predominant occupational exposures you may expect to encounter in the laboratory and will be discussed in some detail. Accidental injection of chemicals can be eliminated by good laboratory safety practices. Accidental ingestion of chemicals can be eliminated by a combination of good laboratory and hygienic practices such as washing hands and prohibiting foods, drinks, cosmetics, and tobacco products in the laboratory workplace. All potential exposures, i.e., inhalation, skin absorption, injection, and ingestion, are discussed in the Material Safety Data Sheets available for each chemical or product.

The hundreds of chemicals which employees are routinely exposed to during the course of their work in the laboratory can be divided into three main types: volatile solvents, corrosives, and toxic solids. The particular hazards associated with exposure to these materials, and ways to avoid them, are discussed in detail below.

B. Basic Chemical Classifications

1. Volatile Solvents

Organic solvents are perhaps the most ubiquitous chemicals found in the laboratory setting. The potential chronic health effects of some of these materials warrant special attention as one is likely to be exposed to more solvents than any other type of chemical. For safety purposes, these chemicals are generally subdivided into two categories: chlorinated and non-chlorinated. This is done mainly because the chlorinated solvents are, in general, not flammable while non-chlorinated solvents are often flammable. It should be kept in mind, however, that the chlorinated solvents do decompose when burned. This results in high concentrations of toxic vapors, such as phosgene and hydrogen chloride.

Keeping in mind the difference in flammability between these two classes of solvents, we can discuss the health effects common to both classes. The primary route of exposure to these materials is through inhalation. In general, high concentrations of the vapor, when inhaled, produce drowsiness, dizziness and headaches. This can occur quite quickly, since chemical vapors are rapidly absorbed. Most of the solvents will also act as upper respiratory and/or eye irritants.

One physical property common to most solvents is odor. Unfortunately, the odor of a solvent offers little in the way of determining whether or not the environment is immediately hazardous. Solvent odor thresholds vary widely and acclimation or odor fatigue is often rapid. Odor is also not generally indicative of the degree of hazard that the material presents. Butyl mercaptan has

such an extremely disagreeable odor that one cannot tolerate a concentration necessary to be injurious. Chloroform, however, has a sweet odor to many people and tolerance levels can far exceed safe levels.

Chronic effects of solvent exposure vary widely. Of most concern is the potential for lung, liver, and kidney damage posed by some solvents. This, in general, applies to solvents that are not water soluble. Examples of these solvents would be benzene, toluene, xylene, chloroform, carbon tetrachloride, and trichloroethylene. Instances of chronic disease caused by occupational exposure to these solvents have been documented. However, it must be kept in mind that everyone reacts differently and individual susceptibilities are quite variable.

Skin absorption is an additional mode of entry for which an exposure to a solvent may occur. Most commonly, solvents act to de-fat the skin. This will cause drying and cracking of the skin, and may lead to chronic dermatitis with prolonged and repeated exposure. Some solvents can also act as corrosives. Most amines and phenols act in this manner.

In addition, many of the solvents (dimethyl sulfoxide and dimethyl formamide, for example) will penetrate the skin and be absorbed into the body. In this case, the effects of exposure will be analogous to inhalation exposure. Carbon disulfide, n-butyl alcohol, and phenol are common solvents that can penetrate intact skin. For those solvents, there will be a notation of skin exposure noted on the Material Safety Data Sheet. Most skin contact with solvents can be avoided by wearing gloves suitable for that chemical. It is important that the glove be resistant to the material being handled. Using the wrong glove can give a false sense of security and overexposure via the skin may result. If a solvent penetrates the glove, a prolonged contact will result due to slowed evaporation rates. Rubber and neoprene gloves can be classed as good general purpose gloves, but a chemical resistance chart and the MSDS should always be consulted.

Direct liquid contact by solvents in the eyes can be very serious. The victim could easily panic. Get them to the eye wash immediately and flush the eyes for at least 15 to 30 minutes. Medical assistance should also be summoned.

In summary, volatile solvents can pose inhalation, skin, and ingestion hazards. Some of the solvents may also be flammable, which could cause fire and/or explosion hazards. Whenever possible, use volatile solvents in a properly operating fume hood to eliminate inhalation hazards, use correct skin and eye protection and use good laboratory and hygienic technique to eliminate any possible ingestion of volatile solvents.

2. Acid and Bases

Common to all acids and bases is their corrosive action on human tissues. Minor exposures are generally reversible, although often painful for a short period of time. The reversibility of the effects of acid or base exposure will depend on three factors: the duration of exposure, concentration of the material, and the first aid methods used.

Exposure can occur through skin absorption or inhalation. With inhalation exposure, remove the victim from the area (try to keep the victim from breathing too deeply, as this may exacerbate the

effects) and summon medical help.

Skin contact is the most common route of exposure. Here the concentration and type of acid are the most important factors. In concentrated forms, all types of corrosives may cause severe penetrating burns. Dilute solutions do not have the same warning properties as concentrated forms, so guard against exposure. One should be particularly careful with hydrofluoric acid.

Neoprene gloves provide the best protection from skin exposure to both acids and bases, but in all cases, follow the recommendations in the MSDS. When using or dispensing concentrated acids or bases, a lab coat or apron and a full face shield is required.

If there is skin or eye contact with acids or bases, make sure to flush the area with water for 15 to 30 minutes and summon medical assistance.

3. Toxic Solids

Many of the chemicals used in the laboratory that are solid and toxic are used in solution, so skin absorption can be of a concern. This is particularly true when a substance is dissolved in a solvent that can penetrate the skin. Also, an oxidizing material dissolved in water can act directly on the skin causing irritation where the solid alone would be relatively less irritating. It is therefore important that proper personal protective equipment be worn. In the solid form, the greatest risk of exposure is through inhalation. This risk can be lessened by wearing the appropriate respirator and/or working in a fume hood.

C. Incompatible Chemicals

Certain hazardous chemicals cannot be mixed or stored safely with other chemicals due to potentially severe or extremely toxic reactions taking place. For example, keep oxidizing agents separated from reducing agents, initiators separated from
monomers, and acids separated from alkalis, etc.

The chemical label and Material Safety Data Sheet will contain information on incompatibilities.

D. Chemical Stability

Stability refers to the susceptibility of the chemical to decomposition. Ethers, liquid paraffins, and olefins can form peroxides on exposure to air and light. Since these chemicals are packaged in an air atmosphere, peroxides can form even though the containers have remained sealed. Some inorganic chemicals also are unstable.

Unless an inhibitor was added by the manufacturer, closed containers of ethers shall be discarded after one year. Appropriate use of peroxide inhibitors is suggested.

E. Shock-Sensitive Chemicals

Shock-sensitive refers to the sensitivity of the chemical to decompose rapidly or explode when struck, vibrated, or otherwise agitated.

The label and Material Safety Data Sheet will indicate if a chemical is shock-sensitive.

Shock-sensitive chemicals should be procured as needed to minimize storage problems. Shock-sensitive materials should be considered individually and disposed of as soon as practical.

Many chemicals become increasingly shock-sensitive with age. The date received and date opened shall be clearly marked on all containers of shock-sensitive chemicals.

Inhibitors are not to be added to shock-sensitive materials unless specific instructions from the manufacturer are provided.

Some common potentially explosive chemicals are:

1. Nitrated Compounds

Nitrated organics and inorganics constitute the largest class of compounds that are explosive when dehydrated.

Purchase nitrated compounds in small quantities. Do not break the seal on the cap until the chemical is needed.

When you purchase a nitrated compound, weigh the container and note the weight on the bottle. Prior to subsequent use, weigh the container again. If the container weighs less, add an appropriate solvent to replace the weight lost. After the reagent is opened and an aliquot is taken, again note the weight of the container. Visually inspect the container for problems prior to each use and wipe down the bottleneck, cap, and threads with a wet cloth before resealing.

Table 2-9 Nitrated Compounds

Diphenyl hydrazine	3-Nitrotoluene	Trinitrophenol (Picric acid)
Nitrocellulose	Trinitrobenzene	Trinitrotoluene

Picric acid is a nitrated compound usually purchased as a solid wet with 10% water. Extreme heat, blasting cap, or electric charge can detonate picric acid. It becomes highly unstable if allowed to dehydrate. When wet, picric acid is an orange colored, compact crystalline solid with the consistency of lumpy sand. When dry, picric acid is a crystalline solid with visible air pockets below the surface.

Picric acid will readily form explosive metal picrates. These metal picrates are extremely shock sensitive and will detonate with the slightest movement or vibration. Do not allow picric acid to contact metal that is readily oxidized or be stored in a container with a metal cap. Lead, iron and copper metals are particularly dangerous, due to metallic picrate formation.

2. Organic Peroxide-Forming Solvents

Organic peroxide-forming solvents become shock sensitive when allowed to oxidize and form appreciable quantities of explosive peroxides. Most of these solvents are also flammable. Most peroxide forming solvents are colorless, mobile liquids. Oxidation can occur when the solvent is exposed to atmospheric oxygen. This reaction is catalyzed by light as well as by temperature and pressure changes.

Below is a list of good laboratory practices.

(a) Highly Concentrated Peroxides - Over a period of time, peroxide concentrations can increase to hazardous levels. Solvents with high concentrations of peroxides will appear viscous or contain needle-like crystals.

(b) Explosive Capability - Peroxides formed in organic solvents have caused some laboratory accidents, including unexpected explosions during distillation and use. Such formulations are considered low powered explosives in that they will detonate in moderate concentrations by modest shock, friction, or when heated.

(c) Required Procedures - Purchase peroxide forming solvents in small quantities that contain an inhibitor, such as butylated hydroxytoluene (BHT), which will delay the formation of peroxides until the inhibitor is used up. Label the container with the date received and opened. Do not break the seal on the container until the solvent is needed. Once opened, store solvent in an airtight amber glass bottle or metal container, with an inert gas, such as nitrogen, in the headspace.

The biggest dangers of organic peroxides in these solutions are opening the container and distilling. Do **NOT** open or move the container if you see crystals on or around the container cap.

(d) Testing Peroxides - It is a good laboratory practice to use test strips to test the solvent for peroxides prior to each use. After each use, wipe down the bottleneck, cap and threads with a cloth before resealing. Reduce formed peroxides and add an inhibitor as necessary to keep the concentration of peroxides below 10 ppm. Extreme caution should be exercised if concentrations of peroxides exceed 30 ppm.

(e) Distillation and Evaporation Precautions - Always test for peroxides before distillation or evaporation because these procedures will increase the concentration of any peroxides present. Do not distill or evaporate solvents containing any amount of peroxides. Use a water bath over a hermetically sealed electrical mantle to safely heat the solvent. Use any distilled solvent immediately, or add an inhibitor.

(f) Use of Inhibitors – Inhibitors slow the formation of peroxides in the future. They do not reduce or remove peroxides. Organic peroxides should be reduced safely.

(g) Monitoring Expiration Date - Use the solvent before the manufacturer's expiration date.

3. Azides

Organic and inorganic azides, R-N3, can explode when heated or exposed to ground glass joints. Some azides are shock sensitive. Metal azides are relatively insensitive to shock, but may explode when heated. Sink disposal of azides can be extremely hazardous because they can form metal azides that are shock sensitive, like iron azide. Azides present a hazard around ground glass joints because they can be shock sensitive.

4. Fulminates
Fulminates are compounds that contain a carbon-nitrogen-oxygen group. Metal fulminates such as mercury, silver, gold are highly explosive. Explosions are typically initiated by heat. Silver fulminates can form in undiscarded Tollen's reagent.

F. Material Safety Data Sheets
The Material Safety Data Sheet (MSDS) is a format for describing what chemical or product you are working with, potential chemical hazards, and ways of minimizing these hazards. These sheets shall be on hand in the laboratory for people who use these chemicals. Information that is contained in the Material Safety Data Sheets is also required by law to be conveyed to employees on a chemical-by-chemical basis.

MSDSs are generally written for chemicals that are used in the industrial setting and it will become apparent that some of the information provided on the MSDS may not be applicable to laboratory usage. The use of chemicals in a laboratory is generally in a more controlled environment than in the industrial setting and much smaller quantities of the chemical are being used at any one time. Nevertheless, a great deal of information on hazards associated with laboratory chemicals can be obtained by reading the MSDS.

G. Procurement of Chemicals
The achievement of safe handling, use, and disposal of hazardous substances begins with the persons who requisition such substances and those who approve their purchase orders. These persons must be aware of the potential hazards of the substances being ordered, know whether or not adequate facilities and trained personnel are available to handle such substances, and should ensure that a safe disposal route exists.

Before a new substance is received, information concerning its proper handling methods, including proper disposal procedures, should be given to all those who will be working with it. It is the responsibility of the laboratory supervisor to ensure that the facilities are adequate and that those who will handle any material have received proper training and education to do so safely.

For most substances, Material Safety Data Sheets, which give physical property data and toxicological information, can be obtained by request to the vendor. However, the quality and depth of information on these sheets varies widely.

The US Department of Transportation (DOT) requires that shippers furnish and attach DOT prescribed labels on all shipment of hazardous substances. These labels indicate the nature of the hazard(s) of the substance(s) shipped and thus provide some indication to receiving personnel of the type of hazard received.

No container or cylinder should be accepted that does not have an identifying label. For chemicals, it is desirable that this label correspond to ANSI Z129.1, which requires, at a minimum, the following components:

1. Identification of contents of container;

2. Signal word and summary description of any hazard(s);

3. Precautionary information - what to do to minimize hazard or prevent an accident from happening;

4. First aid in case of exposure;

5. Spill and cleanup procedures; and

6. If appropriate, special instructions to physicians.

Every effort should be made to ensure that this label remains on the container and legible.

Drug Enforcement Administration (DEA) controlled substances such as tranquilizers and controlled materials needed to make certain drugs must be ordered through the Pharmacology Department. Authorization to buy these substances requires prior registration using a *Controlled Substance Registration Form* signed by your department chair. Controlled substances must be kept in locked cabinets that have limited access. An accurate inventory is required to be kept for all controlled substances and that expired or no longer needed substances be returned to them for destruction.

H. Spill Prevention

A hazardous chemical spill means that an uncontrolled release of a hazardous chemical has occurred. The release may involve a gas, liquid, or solid, and usually requires some action be taken to control the point of release or the spread of the chemical. A chemical is hazardous if it possesses a physical or health threat to humans, the environment, or property.

More specifically, a substance is considered hazardous when:

a. It is flammable, explosive, or reactive;

b. It generates harmful vapor or dust;

c. It is a carcinogen;

d. It is a corrosive and attacks skin, clothing, equipment, or facilities;

e. It is poisonous by ingestion, inhalation or absorption.

Spills involving hazardous materials will require different tactics depending on the magnitude of

the spill, the material's toxicity, reactivity, and flammability, routes of entry of the material into the body, and the promptness with which the spill can be safely managed.

Many spills can be prevented or controlled by careful planning, use of trays, and absorbent paper.

Proper techniques for transporting hazardous chemicals and proper storage techniques may help prevent spills.

I. Handling and Transportation of Chemicals

Many laboratory accidents occur through the simple operation of carrying chemicals from one place to another or transferring them from one container to another. The chemicals used in a laboratory are often corrosive, toxic, or flammable and any accident involving these has the potential for personal injury. Therefore, it is good practice to assume that **all** chemicals are potentially hazardous.

1. When large bottles of acids, solvents, or other liquids are transported within the laboratory without a cart, only one bottle should be carried at a time. The bottle should be carried with both hands, one on the neck of the bottle and the other underneath. Avoid the temptation to hook a finger through the glass ring on top of the bottle, allowing it to dangle while being transported. Never carry or attempt to pick up a bottle by the cap.

2. When transporting bottles within the laboratory, a wheeled cart may be used. Carts should be stable under load and have wheels large enough to negotiate uneven surfaces (such as expansion joints and floor drain depressions) without tipping or stopping suddenly. Do not place the bottles near the edge of the cart, nor should they be touching each other or other glassware during transport. Be cautious rolling the cart over door sills or other possible obstructions. Incompatible chemicals should not be transported on the same cart.

3. Freight-only elevators should be used, if possible, when transporting chemicals, to avoid exposure to persons on passenger elevators.

4. Special padded or rubber bottle carriers, pails, or carts should be used to prevent breakage by accidental striking against walls or floor, and to contain the material if breakage does occur.

5. Large quantities of concentrated mineral acids, e.g., sulfuric, nitric and hydrochloric acids, shall be kept in storage rooms, in cabinets for corrosive substances, or chemical transfer rooms. Bottles of concentrated acids must be carried from the aforementioned areas in an approved acid bottle carrier.

6. Organic solvents shall also be stored in specialized flammable storage areas. These solvents shall be carried from storage areas in special rubber carriers. Organic solvents can present fire hazards as well as inhalation hazards.

7. When moving compressed gas cylinders, they must:

a. Have metal outlet cap/plug installed,

b. Have the valve cap installed if the cylinder has one, and

c. Be secured in a cart or container designed to prevent the cylinder from falling over while being moved.

J. Chemical Storage

The principle concerns in achieving proper storage are to maximize employee safety with regard to chemical compatibility, spill control, fire/explosion control, to provide security, identification, and provide a "user-friendly" system with respect to point-of-use.

1. Every chemical in the laboratory should have a definite storage place and should be returned to that location after each use.

2. Storage must conform to compatibility restrictions as described in the MSDSs. Typically, solvents, acids, bases, reactives, oxidizers, and toxins will be stored separately. Separation basically refers to physical separation of containers and isolation of potential spills and releases with the goal of preventing chemical reactions. Ideally, separate cabinets or isolated areas within a central storage area should be utilized for segregated storage of incompatibles.

3. Adequate containment for spills and accidental releases shall be provided.

4. Hazardous chemicals should never be stored on the floor. Containers should be kept on low shelves or in cabinets. The shelves should have a lip on the forward edge to prevent bottles from slipping off. Chemicals tend to "creep" toward and over the edge of a shelf. Shelving units should be securely fastened to the wall or floors. Shelves should not be overloaded.

5. Utilize a compatible/suitable container for experiments, stored chemicals and collected wastes. In instances of corrosive wastes or halogenated solvents, the use of metal containers is often unsuitable, even if the solvents were originally shipped in metal containers. In these instances, plastic carboys (high density polyethylene) or lined metal containers may be more suitable. See the Material Safety Data Sheet for specific information.

6. There shall be constant vigilance for any sign of chemical leakage. Containers storing chemical waste must be inspected weekly for any sign of chemical leakage. Containers of all types should be free of rust and deformation.

7. Caps and covers for containers shall be securely in place whenever the container is not in immediate use.

8. Storage shall be physically secure.

9. NFPA labeling shall appear on cabinets and room doors at approximately waist level or lower

to allow adequate visualization in dense smoke conditions.

10. All containers used for storage (even short term) shall be labeled in accordance with Hazard Communication regulations and NFPA and University fire codes. At a minimum, all containers must be labeled with regard to content and general hazard. A container that is too small for labels; installed into a process but routinely opened; or would become unusable for its intended purpose if labeled must still be identified unless the container will not be used beyond the end of the day. Use any labeling method that enables employees and visitors from other agencies such as the fire department to identify the chemicals and their hazards. Examples include a sign identifying the materials and their hazards and color or numeric codes or room diagrams identifying locations of the chemicals and hazards.

11. Flammable liquids in quantities greater than one liter should be kept in metal safety cans designed for such storage. The cans should be used only as recommended by the manufacturer, including the following safety practices:

a. Never disable the spring-loaded closure.

b. Always keep flame-arrestor screen in place; replace punctured or damaged cabinets. The shelves should have a lip on the forward edge to prevent bottles from slipping off. Chemicals tend to "creep" toward and over the edge of a shelf. Shelving units should be securely fastened to the wall or floors. Shelves should not be overloaded.

12. Flammable liquids shall not be stored in your laboratory unit in amounts greater than the specified limits for flammable liquid storage.

13. Metal drums used for storage and dispensing of flammable chemicals shall be properly grounded. Ground cables shall be available and utilized in any lab using metal storage containers for flammable liquid storage.

14. Chemicals should be stored as close as feasible to the point of use in order to maximize efficiency and minimize transport distance. Chemical storage should be limited only to areas in which the particular chemical is used. Storage locations must be identified on an emergency floor plan posted in each work area and should be equipped with a fire extinguisher, spill kit, eye wash, first aid kit, and telephone or other communication system to allow for adequate emergency notification.

15. Small quantities of chemicals can be held at individual workstations if this quantity is to be promptly used in a test and does not compromise acceptable ambient organic vapor levels or procedures for spill control and fire safety. These containers must be properly labeled.

16. Only limited quantities of chemicals and solvents should be stored in the laboratory. Large drums or multiple bottles of chemicals should be stored in a centralized chemical storage area.

17. Out-of-date chemicals shall be disposed of on a periodic basis to reduce overall hazard potential and minimize inventory tracking and updating.

CHEMICAL WASTE

Hazardous chemical waste must be managed properly. Laboratory workers must be able to determine whether their chemical wastes are hazardous. For hazardous waste, they must know the hazards of the waste, label the waste accordingly, and understand and abide by accumulation rules, which include labeling, storage and handling requirements. Due to the small size of our University, laboratory waste will remain properly stored in the laboratory until the company Safety/Kleen comes to retrieve it (every two years). They must prevent the accumulation of "legacy chemicals" and "inherently waste-like chemicals" by cleaning out their chemical inventory on a regular basis. Laboratory workers must know the rules for disposal of chemicals and contaminated items to trash and sanitary sewer.

Hazardous Waste

Chemicals that are corrosive, flammable, toxic, reactive, and/or "persistent in the environment" are by legal definition "hazardous". Some additional chemicals are managed as hazardous waste because they are carcinogenic/mutagenic or are not allowed in the trash because they generate dusts or other hazards.

In order to determine whether or not your chemical is hazardous, use your knowledge, the chemical's original label and/or the chemical's Material Data Safety Sheet (MSDS) to determine if the waste is corrosive, flammable, toxic, reactive, "persistent in the environment" and/or mutagenic or carcinogenic.

1. Flammable/Ignitable

A chemical is flammable if it is one of the following:

a. A liquid having a flash point less than 140 °F (*e.g.*, ethanol, xylene, diethyl ether). The flash point is defined as the lowest temperature at which a chemical can form an ignitable mixture with air (by evaporating in the space above an open beaker, for example.) MSDSs include information about flash points.

b. A solid or gas capable, under standard temperature and pressure, of causing fire through friction, absorption of moisture or spontaneous chemical changes and, when ignited, burns so vigorously and persistently that it creates a hazard.

c. A solid, liquid, or gas that evolves oxygen either at room temperature or under slight heating (*e.g.*, peroxides, chlorates, perchlorates, nitrates, and permanganates.)

2. Corrosive

A chemical is corrosive if it is one of the following:

a. An aqueous solution having a pH of less than or equal to 2 or greater than or equal to 12.5.

b. A solid that, when mixed with an equal part of water, will form a solution with a pH as described above.

3. Reactive
A chemical is reactive if it is one of the following:

a. Normally unstable compound that readily undergoes violent change without detonating (*e.g.,* acrylonitrile, butyl hydroperoxide).

b. When mixed with water, the chemical reacts violently, forms potentially explosive mixtures, or generates toxic gases in sufficient quantities to present a danger to human health (*e.g.*, sodium metal, chloropropionyl chloride).

c. The compound contains cyanides or sulfides that when exposed to pH conditions between 2.0 and 12.5 could generate toxic gases in sufficient quantities to present a danger to human health (*e.g.*, sodium sulfide, arsenic sulfide).

4. Toxic
Toxicity is based upon the LC50 (concentration of substance required to kill 50% of the tested population) for fish or the LD50 (dose amount of substance required to kill 50% of the tested population) for rats. Five categories of toxicity are established: X, A, B, C, and D. The X category (Tox-X) is the most toxic; the smallest dose or lowest concentration is lethal to 50% of the population. If data is available for more than one toxicity test, the data showing the severest toxicity should be used.

Chemical Waste Toxicity Categories

Toxic Category	Fish **LC50 (ppm)***	Oral (rat) **LD50 (mg/Kg)**	Inhalation (rat) **LC50 (mg/L)**	Dermal (rabbit) **LD50 (mg/Kg)**
X	< 0.01	< 0.5	< 0.02	< 2
A	0.01 - < 0.1	0.5 - < 5	0.02 - < 0.2	2 - < 20
B	0.1 - < 1.0	5 - < 50	0.2 - < 2	20 - < 200
C	1.0 - < 10.0	50 - < 500	2 - < 20	200 - < 2,000
D	10.0 - 100.0	500 - 5,000	20 - 200	2,000 - 20,000

* LC50 must be for an exposure period greater than 24 hours

Chemical waste that qualifies for any of these categories is hazardous waste. Chemical waste that qualifies for toxic categories X, A, or B is "extremely hazardous waste" and is subject to additional requirements, such as a maximum waste accumulation volume of one quart. Chemical waste with toxicity below the D category is not regulated as hazardous waste, but may still be managed as hazardous waste if it is carcinogenic/mutagenic.

5. Persistent
Persistent chemicals are those that do not biodegrade quickly in the environment

6. Carcinogenic
UCC strongly encourages you to manage chemical waste that is carcinogenic or mutagenic as if it were hazardous waste, even if it is not toxic (according to the definition above, which accounts for acute and immediate toxicity.)

Hazardous Waste Accumulation Rules
Follow the below rules for hazardous chemical waste accumulation.

1. Appropriate Containers
Accumulate waste in an appropriate container compatible with the waste. You may reuse containers, even containers that were used for other chemicals, as long as they have been rinsed well and the original labels have been defaced. However, containers that were designed for solid chemicals should not be used for liquids. Also, use only containers that show no sign of damage or deterioration.

You must use containers with screw top closures. The lids to waste containers should be removed only when waste is being added to the container. Use spring-loaded funnels for adding waste frequently to waste containers.

Finally, do not fill the containers completely. Each container must have at least a one inch of headspace above the waste when it is collected.

2. Location
Waste must be under the control of the individual(s) generating the waste. The waste should be in a physically safe area (*e.g.*, not on a windowsill.) Do not accumulate large amounts of waste in the fume hood. Use flammable liquid storage cabinets for flammable waste over ten gallons in volume. Store the waste away from emergency equipment such as safety showers and emergency access panels. Do not block exits. Do not store the waste near or in sinks. Finally, if the waste is stored in an area that drains to a floor drain, the waste must be in secondary containment.

3. Segregation
Segregate regulated chemical waste by chemical compatibility. Use secondary containment (tubs or buckets) for segregation of wastes accumulated in the same area.

4. Accumulation Volume Limits
Accumulate no more than 204 liters (54 gallons) of chemical waste per waste stream or 0.9 liters (1 quart) of acutely hazardous waste or extremely hazardous waste per waste stream. Also, any one type of flammable chemical waste cannot exceed the limits specified by the Puerto Rico Fire Department. For class IA flammables, the total volume of allowed flammables, including chemicals that are not waste, is limited to 60 gallons per control area in a sprinklered building and 30 gallons in a nonsprinklered building. Leave some headspace (at least one inch) in each container to allow for temperature and corresponding vapor pressure changes.

5. Large Containers (Drums)
If you are accumulating wastes in containers greater than five gallons in volume, you must also ensure that:

a. Drums used to accumulate regulated wastes are in good condition and are approved by Department of Transportation (DOT) for highway mode transportation. Note: if the drums were shipped to you in the first place, they are very likely DOT-approved.

b. Drums containing liquids should have ten centimeters (four inches) of air space between the surface of the liquid and the lid.

c. Collection is requested before the drum is full, especially in the case of 55-gallon drums.

6. Waste-like Chemicals

Waste-like chemicals include expired chemicals, chemicals in deteriorating containers and chemicals that are or appear to be unusable. State inspectors may issue fines or infractions for the presence of inherently waste-like chemicals in your laboratory. These chemicals must be disposed of as hazardous waste in a timely manner. You can also avoid inherently waste-like chemicals in the first place by not keeping chemicals past their expiration date and by conducting cleanouts of unwanted chemicals when you do your annual chemical inventory update.

Legacy chemicals are those that are left behind by laboratory staff when they leave the university or move laboratories.

Hazardous Waste Collection

Federal and state laws strictly regulate hazardous waste disposal. Each container of waste must be tracked from the point of collection by the appropriate collection company or agent to its final disposal facility location, a certificate of disposal/destruction for that container must be sent back to UCC. UCC will periodically hire a collection company to remove the hazardous waste in a way that complies with Federal and state laws.

CHEMICAL SPILLS

All chemical spills shall be reported in writing to the Chemical Safety Officer, regardless of size. The report shall include the date, time, location, chemical(s) and their volume, and names of all persons involved, including any visitors who were exposed and personnel involved in the clean up.

A. Emergency Spills

A chemical spill is classified as an Emergency Spill whenever it:

1. Causes personal injury or chemical exposure that requires medical attention;
2. Causes a fire hazard or uncontrollable volatility;
3. Requires a need for breathing apparatus of the supplied air or self-contained type to handle the material involved;
4. Involves or contaminates a public area;
5. Causes airborne contamination that requires local or building evacuation;
6. Causes a spill that cannot be controlled or isolated by laboratory personnel;
7. Causes damage to university property that will require repairs;
8. Involves any quantity of metallic mercury;
9. Cannot be properly handled due to lack of local trained personnel and/or equipment to perform a safe, effective cleanup;
10. Requires prolonged or overnight cleanup;
11. Involves an unknown substance; or
12. Enters the land or water.

Although the following tactics are prioritized in terms of usual preferred action sequences, each spill incident is unique and involves persons with varying levels of spill expertise and experience. Thus, for any individual incident, isolation of the spill and/or securing the area might best occur prior to or simultaneously with contacting the Deanship of Administration and emergency response personnel.

1. Contact the Deanship of Administration for assistance. Notify the location of the spill and, if known, the chemical spilled.
2. Don't panic! Always send for help first, if possible.
3. If the spill presents an immediate danger, leave the spill site and warn others, control entry to the spill site, and wait for emergency response.
4. Remove contaminated clothing. Flush skin/eyes with water at least 15 minutes to 30; use soap for intermediate and final cleaning of skin areas.
5. Protect yourself, then remove injured person(s) to fresh air, if safe to do so.
6. Notify nearby persons and evacuate as necessary. Prevent entry, as necessary, by posting a guard in a safe area and/or shutting doors.
7. If flammable vapors are involved, do not operate electrical switches unless to turn off motorized equipment. Try to turn off or remove heat sources, where safe to do so.
8. If the substance involved is an unknown, then emergency spill response procedures are limited to self-protection, notification of Campus Security for response, isolation of the chemical, and evacuating and securing the area involved.
9. Do not touch the spill without protective clothing.
10. Where the spill does not present immediate personal danger, try to control the spread or volume of the spill. This could mean shutting a door, moving nearby equipment to prevent further contamination, repositioning an overturned container or one that has a hole in the bottom or side, creating a dike by putting an absorbent around a spill or opening the sashes on the fume hoods to facilitate removal of vapors.
11. Never assume gases or vapors do not exist or are harmless because of lack of smell.
12. Increase ventilation by opening closed fume hood sashes to the 12 inch or full open position. Exterior doors may be opened to ventilate non-toxic vapors.
13. Use absorbents to collect substances. Reduce vapor concentrations by covering the surface of a liquid spill with absorbent. Control enlargement of the spill area by diking with absorbent.

B. Minor Spills

Minor spills are those spills that do not fit the requirements for Emergency Spills.
The following general procedures should be used for all minor spills:

1. Attend to any persons who may have been contaminated. If these persons require medical attention this is an Emergency Spill (See above).
2. Notify persons in the immediate area about the spill.
3. Evacuate all nonessential personnel from the spill area.
4. If the spilled material is flammable, turn off ignition and heat sources.
5. Avoid breathing vapors of the spilled material. If respiratory protection is necessary this is an Emergency Spill.
6. Leave on or establish exhaust ventilation if it is safe to do so.
7. Secure supplies to effect cleanup.
8. Don appropriate personnel protective equipment.
9. Spilled Liquids
    a. Confine or contain the spill to a small area. Do not let it spread.
    b. For small quantities of inorganic acids or bases, use a neutralizing agent or an absorbent mixture (e.g., soda ash or diatomaceous earth). For small quantities of other materials, absorb the spill with a nonreactive material (such as vermiculite, clay, dry sand, or towels).
    c. For larger amounts of inorganic acids and bases, flush with large amounts of water

(providing the water will not cause additional damage). Flooding is not recommended in storerooms where violent spattering may cause additional hazards or in areas where water-reactive chemicals may be present.

d. Mop up the spill, wringing out the mop in a sink or a pail equipped with rollers.
e. Carefully pick up and clean any cartons or bottles that have been splashed or immersed.
f. If needed, vacuum the area with a HEPA filtered vacuum cleaner approved and designed for the material involved.
g. If the spilled material is extremely volatile, let it evaporate and be exhausted by the laboratory hood (provided that the hood is authorized for use with the spilled chemical).

10. Spilled Solids
    a. Generally, sweep spilled solids of low toxicity into a dust pan and place them into a container suitable for that chemical. Additional precautions such as the use of a vacuum cleaner equipped with a HEPA filter may be necessary when cleaning up spills of more highly toxic solids.
    b. Dispose of residues according to safe disposal procedures. Remembering that personal protective equipment, brooms, dust pans, and other items may require special disposal procedures.
11. Report the chemical spill in writing as required above.

C. Mercury Handling and Spill Clean Up

1. Health Effects

The ACGIH has established a TLV of 0.05 mg/m3, based on an 8-hour day and 40-hour week. The TLV for mercury also carries a "skin" notation, which indicates that metallic mercury can be absorbed into the body as well as through inhalation and ingestion into the skin. Mercury vapors are odorless, colorless, and tasteless. A quantity as small as 1 milliliter can evaporate over time, as raise levels in excess of allowable limits. Mercury poisoning from exposure by chronic inhalation can cause emotional disturbances, unsteadiness, inflammation of the mouth and gums, general fatigue, memory loss, and headaches. In most cases of exposure by chronic inhalation, the symptoms of poisoning gradually disappear when the source of exposure is removed. Improvement, however, may be slow and complete recovery may take years.

2. Storage and Handling

Because of the health effects of mercury, the extremely difficult and time-consuming procedures required to properly clean spills, every effort should be taken to prevent accidents involving mercury. Always store mercury in unbreakable containers and stored in a well-ventilated area. When breakage of instruments or apparatus containing mercury is a possibility, the equipment should be placed in an enameled or plastic tray or pan that can be cleaned easily and is large enough to contain the mercury. Transfers of mercury from one container to another should be carried out in a hood, over a tray or pan to confine any spills. If at all possible, the use of mercury thermometers should be avoided. If a mercury thermometer is required, many are now available with a Teflon® coating that will prevent shattering. Always wash hands after handling mercury to prevent skin absorption or irritation.

3. Air Monitoring

Any mercury spill has the potential to generate airborne concentrations in excess of regulated levels. Contact the Deanship of Administration for air monitoring of the spill area before cleanup to determine the airborne concentration.

Large spills or spills with elevated vapor levels may dictate cleanup by a qualified contractor.

4. Protective Clothing

For small spills, a laboratory coat, safety glasses, and gloves should be used. Gloves made of the following have been rated as excellent for protection against elemental mercury:

Chlorinated polyethylene (CPE)
Polyurethane
Viton
Butyl Rubber
Polyvinyl Chloride (PVC)
Nitrile Rubber, (also known by several brand names)
Neoprene

If mercury has been spilled on the floor, the workers involved in cleanup and decontamination should wear plastic shoe covers. EHS should be called immediately if a spill is extensive enough to require workers to kneel or sit where mercury has been spilled since Tyvek® or similar impermeable clothing will be required.

5. Spill Kits

Special spill kits are available from a variety of sources. If a spill kit is purchased, follow the manufacturer's directions. Alternatively, a kit can be assembled with the following components:

a. protective gloves,
b. mercury suction pump or disposable pipettes to recover small droplets,
c. elemental zinc powder (or commercial amalgam material),
d. dilute sulfuric acid (5-10%) in spray bottle,
e. sponge or tool to work amalgam,
f. plastic trash bag,
g. plastic container (for amalgam), and
h. plastic sealed vial for recovered mercury.

6. Clean Up Procedures

a. Wearing protective clothing, pools and droplets of metallic mercury can be pushed together and then collected by a suction pump.
b. After the gross contamination has been removed, sprinkler the entire area with zinc powder. Spray the zinc with the dilute sulfuric acid.
c. Using the sponge, work the zinc powder/sulfuric acid into a paste consistency while scrubbing the contaminated surface and cracks or crevices.
d. To minimize contamination of housekeeping items, stiff paper may be used to assist in cleaning up the amalgam.
e. After the paste has dried, it can be swept up and placed into the plastic container for disposal.
f. Rags, shoe covers, sponges, and anything used for the cleanup should be placed in the trash bag to be disposed of as contaminated material.