Chemical and Hazardous Materials Safety

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INTRODUCTION

The purpose of the Chemical Safety Section is to provide information useful in the recognition, evaluation, and control of workplace hazards and environmental factors existing within and/or associated with the laboratories of the University.

Almost everyone works with or around chemicals and chemical products every day. Chemical safety is inherently linked to other safety issues including engineering controls, laboratory procedures, personal protective equipment, electrical safety, fire safety, and hazardous waste disposal. Many chemicals have properties that make them hazardous: they can represent physical hazards (fire, explosion) and/or health hazards (toxicity, chemical burns, and dangerous fumes). However, there are many ways to work with chemicals which can both reduce the probability of an accident and minimize the consequences should an accident occur.

Risk minimization depends on safe practices, appropriate engineering controls for chemical containment, the proper use of personal protective equipment, the use of the minimum quantity of material necessary, and/or substitution of less hazardous chemicals. Before beginning an operation, one should ask "What would happen if . . .?" The answer to this question requires an understanding of the hazards associated with the chemicals, equipment and procedures involved. The hazardous properties of the material and its intended use will dictate the precautions to be taken.

It is important to distinguish the difference between *hazard* and *risk*. The two terms are sometimes used as synonyms. In fact, the term ―hazard‖ is a much more complex concept because it includes conditions of use. The hazard presented by a chemical has two components: (1) its inherent capacity to do harm by virtue of its toxicity, flammability, explosiveness, corrosiveness, etc.; and (2) the ease with which the chemical can come into contact with a person or other object of concern. The two components together determine ―risk‖ – the likelihood or probability that a harmful consequence will occur. Thus, an extremely toxic chemical such as strychnine cannot cause poisoning if it is in a sealed container and does not contact the handler. In contrast, a chemical that is not highly toxic can be lethal if a large amount is ingested.
It should be noted that not all chemicals are considered *hazardous*. Examples of nonhazardous chemicals include pH neutral buffers, sugars, starches, agar, and naturally occurring amino acids. This chapter will focus on hazardous chemicals.

This section is not intended to be an exhaustive reference, but rather, a guide to assist investigators, laboratory managers, and other technically qualified individuals. Further advice concerning the hazards associated with specific substances may be obtained from The Office of Environmental Health and Safety or from your supervisor.

Each program shall provide a supplement to this Chemical Safety Section which addresses specific hazards in its program area. A copy of this supplement should be provided to the Office of Environmental Health and Safety, which will provide it to the local fire department and other emergency responders as appropriate.

The University Radiation Safety Section should be consulted for specific safety information concerning radioactive materials and/or radiation producing devices.

CHEMICAL SAFETY GUIDELINES

Always follow these guidelines when working with chemicals:

a. Assume that any unfamiliar chemical is hazardous and treat it as such.

b. Know all the hazards of the chemicals with which you work. For example, perchloric acid is a corrosive, an oxidizer, and a reactive. Benzene is an irritant that is also flammable, toxic, and carcinogenic.

c. Never underestimate the potential hazard of any chemical or combination of chemicals. Consider any mixture or reaction product to be at least as hazardous as – if not *more* hazardous than – its most hazardous component.

d. Never use any substance that is not properly labeled. It may not be what you think it is!

e. Date all chemicals when they are received and again when they are opened.

f. Follow all chemical safety instructions, such as those listed in Material Safety Data Sheets or on chemical container labels, precisely.

g. Minimize your exposure to any chemical, regardless of its hazard rating, and avoid repeated exposure.

h. Use personal protective equipment (PPE), as appropriate for that chemical.

i. Use the buddy system when working with hazardous chemicals. Don't work in the laboratory alone.

MATERIAL SAFETY DATA SHEETS

Before using any chemical, read the appropriate Material Safety Data Sheet (MSDS). An MSDS is a document that details information about chemicals and along with the container label is a good source of information for chemical safety. It provides the following information:

a. Identity of the chemical

b. The manufacturer's name and address

c. Hazardous ingredients

d. Exposure limits

i. Permissible Exposure Limit (PEL) or Recommended Exposure Limit (REL) – This is the amount of a chemical that a person can be exposed to, averaged over an eight hour period, before it causes him/her harm.
ii. Short Term Exposure Limit (STEL) – This is the amount of a chemical that a person can be exposed to, averaged over a 15 minute period, before it causes him/her harm.
iii. Immediately Dangerous to Life and Health (IDLH) – This is the amount of chemical that immediately puts a person a risk of serious injury or death.

If this level is reach or exceeded, the area should be evacuated immediately!

e. Physical characteristics, such as:

i. Boiling point
ii. Vapor pressure

f. Chemical hazards, including the following:

i. Flammability
ii. Explosiveness
iii. Reactivity

g. Health hazards, including chemicals that are:

1) Toxins (both acute and long-term)
2) Carcinogens
3) Reproductive Toxins
4) Teratogens
5) Mutagens
6) Neurotoxins
ii. Irritants
6) Routes of Entry
7) Emergency and first-aid procedures
8) Proper leak, spill, and disposal techniques
9) Proper storage and handling procedures

l. Other special provisions

Each person working with chemicals should have access to the MSDS for all chemicals they use. "Access" may be:

-A current hard copy kept in a work area file or binder.
-An electronic copy.

TYPES OF CHEMICAL HAZARDS

CORROSIVES

Corrosive chemicals destroy or damage living tissue by direct contact. Some acids, bases, dehydrating agents, oxidizing agents, and organics are corrosives. Examples of the different types of corrosive chemicals are listed below:

Acidic corrosives:
- -Inorganic Acids
  - -Hydrochloric acid
  - -Nitric Acid
  - -Sulfuric acid
- -Organic Acids
  - -Acetic Acid
  - -Propionic acid

Alkaline, or basic, corrosives:
- -Sodium hydroxide
- -Potassium hydroxide

Corrosive dehydrating agents:
- -Phosphorous pentoxide
- -Calcium oxide

Corrosive oxidizing agents:
- -Halogen gases
- -Hydrogen peroxide (concentrated)
- -Perchloric acid

Organic corrosive:
- -Butylamine

<u>HEALTH CONSEQUENCES</u>

Extreme caution should be taken when handling corrosive chemicals, or severe injury may result.

A. Concentrated acids can cause painful and sometimes severe burns.

B. Inorganic hydroxides can cause serious damage to skin tissues because a protective protein layer does not form. Even a dilute solution such as sodium or potassium hydroxide can attack skin by reacting with the fat tissues and forming a soapy, slick film.

C. At first, skin contact with phenol may not be painful, but the exposed area may turn white due to the severe burn. Systemic poisoning may also result from dermal exposure.

D. Skin contact with low concentrations of hydrofluoric acid (HF) may not cause pain immediately but can still cause tissue damage if not treated properly. Higher concentrations of HF (50% or greater) can cause immediate, painful damage to tissues.

SAFE HANDLING FOR CORROSIVES

To ensure safe handling of corrosives, the following special handling procedures should be used:

A. Always store corrosives properly. Segregate acids from bases and inorganics from organics. Refer to the Chemical Storage section of this chapter for more information.

B. Always wear a laboratory coat, gloves and chemical splash goggles when working with corrosives. Wear other personal protective equipment, as appropriate.

C. To dilute acids, carefully add the acid to the water, not the water to the acid. This will minimize any reaction.

D. Corrosives, especially inorganic bases (e.g., sodium hydroxide), may be very slippery; handle these chemicals with care and clean any spills, leaks, splashes, or dribbles immediately.

E. Work in a chemical fume hood when handling fuming acids or volatile irritants (e.g., ammonium hydroxide).

F. A continuous flow eye wash station should be in every work area where corrosives are present. An emergency shower should also be within 55 feet of the area.

ACID HANDLING SAFETY

I. PURPOSE

The importance of using acids in the laboratories throughout the University should not overshadow the inherent hazards and the possible damaging effects of acids for personnel working with acids. Therefore, this procedure will indicate some of the most predominant hazards and the procedures that should be followed to avoid physical impairment.

II. HAZARDS

The hazards of acid are many. Some of the common hazards are:

A. Acids, in liquid and vapor states, are highly toxic and irritating to the eyes, skin, and respiratory tract.

B. Contact of acid with skin causes very painful and medically serious burns.

C. Liquid contact with the eyes can cause immediate blindness.

D. Some acids offer a fire and explosion hazard.

III. PROCEDURES

A. Store strong acids separately and away from volatile organic chemicals. Do not store more than chest high. Close fitting, shatterproof containers shall be available for transporting glass containers of acids.

B. Wear a face shield, acid resistant chemical gloves, and aprons when working with acids. Emergency flood showers and/or eye wash fountains must be available.

C. Dilute acids by stirring the concentrated acid slowly into the water.

-DO NOT POUR WATER INTO ACID.

D. When using acids, make available suitable neutralizing agents for use in the event of spills. Acids should be neutralized with weak bases, such as sodium carbonate or bicarbonate. Spill kits are available in the chemical storeroom.

E. Before packaged acid containers or carboys are handled, inspect them for damage. Empty acid containers should be rinsed and disposed of properly (See Waste Disposal Safety Manual).

F. To transfer acid safely from a carboy, move the liquid by suction from a vacuum pump or aspirator or start a siphon with a rubber bulb or ejector. Compressed air even from a hand pump should not be used. Wear protective equipment face shields, gloves, aprons, etc., during all transfer operations. Never leave the transfer operation unattended. In case of malfunction of transfer equipment, prepare an emergency shutdown procedure.

G. Transport all liter or greater size bottles of acids or bases in a rubber bucket or an acid resistant, shatterproof carrier.

H. In the event of personal contact with acids, pending medical treatment, wash off the chemical by flooding the burned area with copious amounts of water as quickly as possible. This is the only method for limiting the severity of the burn, and the loss of even a few seconds can be vital. Seek professional medical assistance immediately.

Use perchloric acid only in a perchloric acid rated hood. (Refer to the Incompatible Chemicals Table in the Waste Disposal Safety Manual, Appendix 1 for further information.)

Hydrofluoric Acid – Emergency Procedures

First Aid must be started within seconds in the event of contact of any form!

<u>Skin Exposure</u>

a) Immediately flood the body area with cold water throughly cleaning the area, then apply calcium gluconate. If no calcium gluconate is immediately available, continue rinsing the affected area until emergency medical responders arrive, using copious amounts of water. Remove contaminated clothing and footwear while rinsing.

b) Call or have a co-worker call for medical assistance (2222 from UTD phone, 911 from a cell phone). Be sure to indicate that you were exposed to hydrofluoric acid.

c) Gently rub calcium gluconate ointment onto the affected area. Continue applying until emergency medical responders arrive.

d) Inform responders and all others that the exposure involved hydrogen fluoride/hydrofluoric acid.

Eye or Inhalation Exposures to HF

a) Flush eyes with plenty of cool tap water for about 15 minutes.

b) Move inhalation exposure victim to clean air

c) Call or have a co-worker call for medical assistance (2222 from UTD phone, 911 from a cell phone).

d) Await emergency medical responders, informing them and all others that the exposure involved hydrogen fluoride/ hydrofluoric acid.

Hydrogen fluoride and hydrofluoric acid cause severe, deeply penetrating burns to the skin, eyes, and lungs. Although concentrated forms of these compounds are readily perceived by a burning sensation, more dilute forms are often imperceptible for many hours. This potential time delay between exposure recognition and treatment can lead to insidious and difficult to treat burns.

If you work with hydrogen fluoride or hydrofluoric acid, make certain you and your coworkers familiarize yourselves with these first aid procedures, and keep an updated supply of 2.5% calcium gluconate ointment in the work area.

FLAMMABLE LIQUID SAFETY

I. PURPOSE

The fire, explosion, and health hazards of handling, storing, and using flammable liquids generally can be eliminated or minimized by strict observance of safety procedures. This safety guide provides basic information applicable to most areas that use flammable or combustible liquids in their daily operations.

A flammable chemical is any solid, liquid, vapor, or gas that ignites easily and burns rapidly in air. Consult the appropriate MSDS before beginning work with flammables.

Flammable chemicals are classified according to flashpoint, boiling point, fire point, and auto-ignition temperature.

1) Flash Point (FP) is the lowest temperature at which a flammable liquid's vapor burns when ignited.

2) Boiling Point (BP) is the temperature at which the vapor pressure of a liquid is equal to the atmospheric pressure under which the liquid vaporizes. Flammable liquids with low BPs generally present special fire hazards.

3) Fire Point is the temperature at which the flammable liquid will burn.

4) Auto-ignition Temperature is the lowest temperature at which a substance will ignite without an ignition source.

Conditions for a Fire

Improper use of flammable liquids can cause a fire. The following conditions must exist for a fire to occur:

-Flammable material (i.e., fuel) must be present in sufficient concentration to support a fire.
-Oxygen or an oxidizer must be present.
-An ignition source (i.e., heat, spark, etc.) must be present.

When working with flammables, always take care to minimize vapors which act as fuel.

A. Fire and Explosion Hazards

Many flammable liquids are volatile by nature, and it is their vapors combined with air, not the liquid, that ignite and burn. Increased temperature of a flammable liquid generally causes an increase in the rate at which vapors are evolved. Ordinarily, flammable liquid vapors are heavier than air and will settle to the lower levels, not easily diffusing with air unless there is sufficient movement of air. Explosions occur when the lower explosive limit (L.E.L.) is reached and a source of ignition is present. (L.E.L. is the minimum concentration of a flammable liquid vapor in air below which propagation of flame does not occur on contact with a source of ignition.)

B. Health Hazards

Some flammable liquids are primary skin irritants that destroy tissue; others are skin sensitizers. An inhalation hazard exists in all cases, varying in degree in accordance with the concentration and toxicity of the vapor. Some atmospheres containing flammable vapors in

concentrations below their lower explosive limit may still be harmful to health because of the vapor's toxic properties.

A. Minimizing Hazards

Methods of minimizing the hazards associated with flammable liquids and their vapors include:

1. Process modifications that substantially reduce the areas of exposed liquids

2. Substitution of a nonflammable or less flammable material for a low flash liquid

3. Local exhaust removal of the vapors.

B. Basic Principles for Safe Handling

1. Limit the quantities at any one location to those actually necessary.

2. Eliminate other possible ignition sources wherever flammable liquids are stored or used.

3. Avoid sparks from static charges generated by pouring; connect dispensing and receiving containers (if metal) by a suitable electrical conductor.

4. Use flammable chemicals in appropriately equipped areas only.

5. Prevent accumulation of vapors by careful handling and by providing adequate ventilation.

6. Use only approved containers, e.g., safety cans or metal drums, for all transportation and handling.

7. Label every storage container used for flammable liquids with the name of the material and the words: "Danger Flammable Keep away from heat, sparks, and open flames Keep closed when not in use."

8. Use ground straps when transferring flammable chemicals between metal containers to avoid generating static sparks.

C. Storage Inside Buildings

1. Egress

Flammable or combustible liquids shall not be stored so as to limit use of exits, stairways, or areas normally used for the safe egress of people.

2. Containers

   Flammable or combustible liquids should be stored in the container provided by the manufacturer. These liquids, in pure or combined forms, should be transferred to approved containers only and should be labeled to indicate the hazards.

3. Container Storage

   Approved containers for flammable and combustible liquids should be stored in an explosion proof cabinet or explosion proof refrigerator, unless all traces of such chemicals have been removed from the container.

LIQUID SOLVENTS

Organic solvents are often the most hazardous chemicals in the work place. Solvents such as ether, alcohols, and toluene, for example, are highly volatile and flammable. Perchlorinated solvents, such as carbon tetrachloride (CCl4), are non-flammable. But most hydrogen-containing chlorinated solvents, such as chloroform, are flammable. When exposed to heat or flame, chlorinated solvents may produce carbon monoxide, chlorine, phosgene, or other highly toxic gases.

Always use volatile and flammable solvents in an area with good ventilation or preferably in a fume hood. Never use ether or other highly flammable solvents in a room with open flames or other ignition sources present, including non-intrinsically safe fixtures.

Solvent Exposure Hazards

Health hazards associated with solvents include exposure by the following routes:

-Inhalation of a solvent may cause bronchial irritation, dizziness, central nervous system depression, nausea, headache, coma, or death. Prolonged exposure to excessive concentrations of solvent vapors may cause liver or kidney damage. The consumption of alcoholic beverages can enhance these effects.

-Skin contact with solvents may lead to defatting, drying, and skin irritation.

-Ingestion of a solvent may cause severe toxicological effects. Seek medical attention immediately.

The odor threshold for the following chemicals exceeds acceptable exposure limits. Therefore, if you can smell it, you may be overexposed — *increase ventilation immediately!* Examples of such solvents are:

-Chloroform
-Benzene

-Carbon tetrachloride
-Methylene chloride

NOTE: *Do not depend on your sense of smell alone to know when hazardous vapors are present. The odor of some chemicals is so strong that they can be detected at levels far below hazardous concentrations (e.g., xylene).*

Some solvents (e.g., benzene) are known or suspected carcinogens.

Reducing Solvent Exposure

To decrease the effects of solvent exposure, substitute hazardous solvents with less toxic or hazardous solvents whenever possible. For example, use hexane instead of diethyl ether, benzene or a chlorinated solvent.

TOXINS AND IRRITANTS

The toxicity of a chemical refers to its ability to damage an organ system (kidneys, liver), disrupt a biochemical process (e.g., the blood-forming process) or disrupt cell function at some site remote from the site of contact. Any substance, even water, can be harmful to living things under the right conditions.

The **biological effects** – whether beneficial, indifferent or toxic – of all chemicals are dependent on a number of factors, including:

-Dose (the amount of chemical to which one is exposed)
-Duration of exposure (both length of time and frequency)
-Route of entry:
    -Ingestion
    -Absorption through the skin
    -Inhalation
    -Injection

NOTE: *Inhalation and dermal absorption are the most common methods of chemical exposure in the workplace.*

-Individual response and history
-One's exposure to other chemicals
-Mixing the toxin with other chemicals

The most important factor in toxicity is the dose-time relationship. In general, the more toxin to which an individual is exposed, and the longer they are exposed to it, the stronger their physiological response will be. However, an individual's response can also depend on several other factors, including:

-Health

-Gender
-Genetic predisposition
-An individual's exposure to other chemicals
-Previous sensitization

NOTE: *When a person becomes sensitized to a chemical, each subsequent exposure may often produce a stronger response than the previous exposure.*

-Chemical mixtures

NOTE: *Combining a toxic chemical with another chemical can increase the toxic effect of either or both chemicals.*

IMPORTANT: *Minimize exposure to any toxic chemical.*

General Safe Handling Guidelines

a. Read the appropriate MSDS.

b. Be familiar with the chemical's exposure limits.

c. Use a chemical fume hood.

d. *Always* wear appropriate PPE.

e. *Never* eat, drink, or use tobacco products around toxins or store them near any hazardous chemicals.

f. Avoid touching your face or other exposed skin with contaminated gloves or other contaminated materials.

g. Store toxic gases in a gas exhaust cabinet.

Acute Toxins vs. Chronic Toxins

The dose-time relationship forms the basis for distinguishing between acute toxicity and chronic toxicity.

The **acute toxicity** of a chemical is its ability to inflict bodily damage from a single exposure. A sudden, high-level exposure to an acute toxin can result in an emergency situation, such as a severe injury or even death. Examples of acute toxins include the following:

-Hydrogen cyanide
-Hydrogen sulfide
-Nitrogen dioxide

-Ricin
-Organophosphate pesticides
-Arsenic

IMPORTANT: *Do not work alone when handling acute toxins. Use a fume hood to ensure proper ventilation, or wear appropriate respiratory protection if a fume hood is not available.*

Chronic toxicity refers to a chemical's ability to inflict systemic damage as a result of repeated exposures, over a prolonged time period, to relatively low levels of the chemical. Such prolonged exposure may cause severe injury. Examples of chronic toxins include the following:

-Mercury
-Lead
-Formaldehyde

Some chemicals are extremely toxic and are known primarily as acute toxins. Some are known primarily as chronic toxins. Others can cause either acute or chronic effects.

The toxic effects of chemicals can range from mild and reversible (e.g. a headache from a single episode of inhaling the vapors of petroleum naphtha that disappears when the victim gets fresh air) to serious and irreversible (liver or kidney damage from excessive exposures to chlorinated solvents). The toxic effects from chemical exposure depend on the severity of the exposures. Greater exposure and repeated exposure generally lead to more severe effects.

Types of Toxins

Carcinogens are materials that can cause cancer in humans or animals. Several agencies including OSHA (Occupational Safety & Health Administration), NIOSH (National Institute for Occupational Safety and Health), and IARC (International Agency for Research on Cancer) are responsible for identifying carcinogens. There are very few chemicals known to cause cancer in humans, but there are many suspected carcinogens and many substances with properties similar to known carcinogens.

Examples of known carcinogens include the following:

-Asbestos
-Benzene
-Tobacco smoke
-Hexavalent Chromium
-Aflatoxins
-Carbon tetrachloride

Zero exposure should be the goal when working with known or suspected carcinogens. Workers who are routinely exposed to carcinogens should undergo periodic medical examinations.

Reproductive toxins are chemicals that can adversely affect a person's ability to reproduce.

Teratogens are chemicals that adversely affect a developing embryo or fetus. Heavy metals, some aromatic solvents (benzene, toluene, xylenes, etc.), and some therapeutic drugs are among the chemicals that are capable of causing these effects. In addition, the adverse effects produced by ionizing radiation, consuming alcohol, using nicotine and using illicit drugs are recognized.

While some factors are known to affect human reproduction, knowledge in this field (especially related to the male) is not as broadly developed as other areas of toxicology. In addition, the developing embryo is most vulnerable during the time before the mother knows she is pregnant. Therefore, it is prudent for all persons with reproductive potential to minimize chemical exposure.

Sensitizers may cause little or no reaction upon first exposure. Repeated exposures may result in severe allergic reactions.

Examples of sensitizers include the following:

-Isocyanates
-Nickel salts
-Beryllium compounds
-Formaldehyde
-Diazomethane
-Latex

NOTE: *Some people who often use latex-containing products may develop sensitivity to the latex. A sensitized individual's reaction to latex exposure can eventually include anaphylactic shock, which can result in death. To minimize exposure to latex, use non-latex containing gloves, such as nitrile gloves.*

Irritants cause reversible inflammation or irritation to the eyes, respiratory tract, skin, and mucous membranes. Irritants cause inflammation through long-term exposure or high concentration exposure. For the purpose of this section, irritants do not include corrosives.

Examples of irritants include the following:

-Ammonia
-Formaldehyde
-Halogens
-Sulfur dioxide
-Poison ivy
-Dust
-Pollen

-Mold

Mutagens can alter DNA structure. Some mutagens are also carcinogens. Examples of mutagens are:

-Ethidium bromide
-Nitrous acid
-Radiation

Neurotoxins are chemicals that affect the nervous system. Examples of neurotoxins include:

-Methanol
-Many snake and insect venoms
-Botulinum toxin

REACTIVES AND EXPLOSIVES

Reactive chemicals may be sensitive to either friction or shock, or they may react in the presence of air, water, light, heat, or other chemicals. Some reactive chemicals are inherently unstable and may quickly decompose on their own, releasing energy in the process. Others form toxic gases when reacting. **Explosive chemicals** decompose or burn very rapidly when subjected to shock or ignition. Reactive and explosive chemicals produce large amounts of heat and gas when triggered, and thus are extremely dangerous.

Follow these guidelines when handling and storing reactive and explosive chemicals:

a. Read the appropriate MSDS and other pertinent fact sheets on the chemical. Be familiar with chemical specific handling and storage requirements.

b. Follow Standard Operating Procedures and to have a Plan of Action established for how to handle emergency situations.

c. Isolate the chemical from whatever causes a reaction.

    i. Store reactives separate from other chemicals.
    ii. Store reactives in a cool/dry area.
    iii. Keep reactive chemicals out of sunlight and away from heat sources.

d. Know where emergency equipment is located and how to use it.

CHEMICAL LABORATORY SAFETY GUIDELINES

The following guidelines provide an overview of the areas to be considered during the planning and conduct of laboratory activities involving chemical usage. These guidelines are divided into nine categories.

Please contact the Office of Environmental Health and Safety (ext. 4111) if you have any questions or require further information.

I. PERSONNEL

A. The principal investigator and all laboratory personnel must review the University safety policies and understand their responsibilities.

B. Laboratory personnel must attend appropriate training courses (i.e., Radiation Safety Short Course, fire safety seminars, chemical and biological safety seminars, Texas Hazard Communication Act training).

C. Laboratory personnel must receive specific training from principal investigators/laboratory supervisors regarding hazardous materials and procedures.

II. GENERAL LABORATORY PRACTICES

A. Mouth pipetting is prohibited.

B. Required/appropriate caution and warning signs must be posted and removed when necessary.

C. Personnel working with extremely hazardous materials are prohibited from working alone in the laboratory. They should wash their hands frequently and before leaving the laboratory.

D. Personnel are required to confine long hair, loose clothing, ties, jewelry, etc., when working in the laboratory.

E. The wearing of contact lenses is prohibited (see Appendix 3).

F. Glassware must be checked for cracks, sharp edges, and defects and discarded in approved marked receptacles (see Waste Disposal Manual, VII, C for further instruction on "sharps").

G. The use of laboratory glassware, ice, chemical or other laboratory materials for human use/consumption is prohibited.

H. Doors must be locked when the laboratory is unoccupied for extended periods of time (e.g., lunch break, end of the work day, weekend, etc.).

I. Storage of food and drink in laboratory refrigerators is prohibited.

J. Eating and drinking are prohibited in the laboratory.

III. WORKING ENVIRONMENT

A. HOUSEKEEPING

1. Working surfaces must be kept clean and orderly.

2. Absorbent padding used on work surfaces must be changed regularly.

3. Floors must be kept clean and clear of obstructions, slip and trip hazards.

4. Adequate lighting must be provided for each task.

B. VENTILATION

1. Local ventilation (i.e., dilution or exhaust) must be provided where necessary.

2. Laboratory personnel must review the University guidelines for Chemical Fume Hood Use (see Appendix 7).

3. Fume hoods should be used primarily for handling and not for storage of hazardous materials.

4. Work within fume hoods should be conducted at least ~6 inches inside the front face of the hood.

5. Materials that must be stored in fume hoods should be stored in secure and supported shelves.

6. Fume hood air flows are to be measured at least semiannually by the Safety Department.

7. Laboratory personnel should be aware of and respect notices posted on fume hoods concerning maintenance and repair activities.

8. Unobstructed space should be available within and in front of the fume hood to allow sufficient air flow into the hood and access by all personnel.

9. Portable non-exhausting fume hoods are not to be used to control fugitive emissions on a permanent basis.

IV. CHEMICAL STORAGE GUIDELINES

Proper chemical storage is as important to safety as proper chemical handling. Often, seemingly logical storage ideas, such as placing chemicals in alphabetical order, may cause incompatible chemicals to be stored together.

GENERAL STORAGE GUIDELINES
Follow these guidelines for safe chemical storage:

A. Read chemical labels and the MSDS for specific storage instructions.

B. Store chemicals in a well-ventilated area; however, *do not* store chemicals in a fume hood.

C. Date all chemicals when they are received and again when they are opened.

D. Maintain an inventory of all chemicals in storage. A copy of the inventory should be maintained at a location outside of the laboratory.

E. Return chemical containers to their proper storage location after use.

F. Store glass chemical containers so that they are unlikely to be broken. Glass containers should never be stored directly on the floor.

G. Store all hazardous liquid chemicals below eye level of the shortest person working in the laboratory.

H. Never store hazardous chemicals in a public area or corridor. Hazardous chemicals must be kept in a secured area.

In addition to the guidelines above, there are storage requirements for separating hazardous chemicals. Follow these guidelines to ensure that hazardous chemicals are stored safely:

A. Group chemicals according to their hazard category (i.e., corrosives, flammables, toxins, etc.), not alphabetically, and separated by some sort of physical barrier. An alphabetical storage system may place incompatible chemicals next to each other.

B. Separate acids from bases and inorganic acids or bases from organic acids or bases. Store these chemicals near floor level.

C. Isolate perchloric acid from all other chemicals and from organic materials. Do not store perchloric acid on a wooden shelf or spill paper.

D. Separate highly toxic chemicals and carcinogens from all other chemicals. This storage location should have a warning label and should be locked.

E. Time-sensitive chemicals, such as those that form peroxides, should not be kept longer than twelve months from purchase or six months after opening. If stratification of liquids, precipitate formation, and/or change in color or texture is noted, contact EHS immediately.

F. Picric acid *must* be stored under a layer of liquid, as picric crystals are highly explosive. If picric acid dries out (forming yellow crystals), do not touch the container! Contact EHS immediately!

G. If flammables need to be chilled, store them in a laboratory-safe refrigerator, not in a standard (household style) refrigerator.

H. Chemicals may be stored in the cabinets underneath a chemical fume hood provided the cabinetry is designed for that use.

   i. Cabinetry designed for flammable storage vents into the fume hood exhaust duct.
   ii. Cabinetry designed for corrosives storage vents directly into the fume hood. Flammable chemicals should *never* be stored in this type of cabinets!
   iii. Some cabinetry is only designed for general storage or with a drying rack. These cabinets are not meant to be used for hazardous chemical storage.

I. Flammables should be stored in a well ventilated area and large quantities in a flammable storage cabinet. Contact EHS for more information on allowable storage of flammable liquids per NFPA Code.

The UTD EH&S department fully supports the philosophy of the Manufacturing Chemists Association which states:

"Chemicals in any form can be safely stored, handled, or used if the physical, chemical, and hazardous properties are fully understood and the necessary precautions including the use of proper safeguards and personal protective equipment, are observed."

A common problem in many school laboratories and warehoused buildings is how and where hazardous chemicals are stored. The solutions to the proper storage of hazardous laboratory chemicals are really quite simple.

A. Store minimum quantities. The less you have—the smaller your risk.

B. Separate and isolate the most serious hazards to be in compliance with compatibility regulations:

Environmental Protection Agency, EPA 264.177

> *(c) A storage container holding a hazardous waste that is incompatible with any waste or other materials stored nearby in other containers, piles, open tanks, or surface impoundments must be separated from the other materials or protected from them by means of a dike, berm, wall, or other device.*

Separate and Isolate Your Most Serious Hazards

An effective way to minimize a chemical accident or "event" is to isolate your chemical hazards. Chemical compatibility can be critical. The two types of chemical incompatibilities with which to be most concerned are corrosives (acids and bases) and flammable liquids. The improper storage of corrosives and flammable liquids is an "event" waiting to happen.

The **most effective** way to isolate your flammable and corrosive hazards is to store them properly in approved safety storage cabinets. Chemical safety storage cabinets isolate corrosives and flammable liquids from other incompatible chemicals, provide a higher level of security against theft and vandalism, and will contain and control the hazards should an "event" occur.

Common sense and good laboratory procedure should tell us to isolate corrosive and flammable liquids in approved safety storage cabinets. Federal and state laws, insurance companies, and other regulating agencies also dictate how hazardous chemicals must be stored.

The EH&S staff has thoroughly reviewed all chemical storage regulations and guidelines, and these regulations have been condensed into this brief policy. References have been provided should you wish to review the regulations in more detail. Regulations on chemical storage have been obtained from the Environmental Protection Agency (EPA), The Uniform Fire Code (UFC), The National Fire Protection Association (NFPA), and the Occupational Health and Safety Administration (OSHA). The following is a listing of the regulations you **must** follow if you wish to store corrosive and/or flammable liquids.

1) Secondary Containment

Secondary containment simply means that when a chemical spill develops, the spill will be contained and controlled in a secondary area; (i.e., specially designed safety storage cabinet) which will reduce the risk of chemical exposure, fire, explosion, etc. Several regulatory agencies have stated that "secondary containment" **must** be provided and that spill control procedures be adopted for hazardous chemicals.

OSHA 1910.1450

> *(b) Stockrooms/storerooms ... Chemicals which are highly toxic ... should be in unbreakable secondary containers.*

OSHA 1910.1450

> *"A spill control policy should be developed and should include consideration of prevention, containment, cleanup and reporting."*

OSHA 1910.106(d)(3)(ii)

"Fire resistance." Storage cabinets shall be designed and constructed to limit the internal temperature to not more than 325 deg. F. when subjected to a 10-minute fire test using the standard time-temperature curve as set forth in Standard Methods of Fire Tests of Building Construction and Materials, NFPA 251-1969, which is incorporated by reference as specified in Sec. 1910.6. All joints and seams shall remain tight and the door shall remain securely closed

during the fire test. Cabinets shall be labeled in conspicuous lettering, "Flammable - Keep Fire Away."

EPA 264.175

"(a) Container storage area must have a containment system that is designed and operated in accordance with paragraph (b)."

"(b) A containment system must be designed and operated as follows: (1) a base must underlie the containers which is free of cracks or gaps and is sufficiently impervious to contain leaks, spills ...

(c) The containment system must have sufficient capacity to contain 10% of the volume of containers or the volume of the largest container whichever is greater."

Secondary containment must be provided for all corrosives and flammable liquids. Safety corrosive and flammable storage cabinets are ideal for the prevention of accidents and spills, and are required to meet the requirements described above for secondary containment.

2) Segregated Chemical Storage

Corrosives and flammables should never be stored together. The knowledge of chemical reactions tell us that regulations on segregated chemical storage are quite specific.

Uniform Fire Code. UFC 80.301 (n)

"Storage of incompatible hazardous materials shall be separated. Separation shall be accomplished by ... Storing hazardous materials in storage cabinets ... Materials which are incompatible shall not be stored within the same cabinet."

National Fire Protection Association Comments following section 4-3.1

"Finally, it must be remembered that these cabinets are designed and constructed for flammable and combustible liquid storage only ... incompatible materials, whether liquid or solid, should not be stored in these cabinets."

Environmental Protection Agency, EPA 264.177

(a) Incompatible wastes, or incompatible wastes and materials (see appendix V for examples), must not be placed in the same container, unless §264.17(b) is complied with.

3) Corrosives (Acids and Bases)

Corrosive chemicals are usually strong acids and/or bases. Inhalation of vapors or mists can cause severe bronchial irritation. Corrosive chemicals will severely damage the skin and eyes.

OSHA regulation 1910.1450, "Occupational Exposure to Hazardous Chemicals in Laboratories," takes many of its recommendations from the book *Prudent Practices for Handling Hazardous Chemicals in Laboratories*. The following excerpts are taken from this book:

***Prudent Practices for Handling Hazardous Chemicals in Laboratories*, Page 38**

"Bottles of corrosive liquids should be stored in acid containers ... To ensure that mutually reactive chemicals cannot accidentally contact one another, such substances should be stored in corrosion-resistant secondary containers."

4) Fire

While the proper storage of corrosives is important, much concern has been placed on how flammable liquids should be stored and the best way to reduce the risk of fire. The National Fire Protection Association defines flammable and combustible liquids as follows:

National Fire Protection Association. NFPA #30

"Flammable liquid
Class I Flash point below 100 °F (37.8 °C)

Combustible liquid
Class II Flash point above 100 °F (37.8 °C) and below 140 °F (60 °C)
Class III Flash point above 140 °F (60 °C)"

The flash point is the temperature at which a liquid or volatile solid gives off a vapor sufficient to form an ignitable mixture with the air. Chemical solvents like ethyl alcohol, methyl alcohol, acetone, and isopropyl alcohol are commonly used and are all considered Class I flammable liquids.

Both the Uniform Fire Code and the National Fire Protection Association have regulations specifying when flammable liquids should be stored in an approved flammables safety storage cabinet.

Uniform Fire Code. UFC 79.202A(2)

"In group A occupancies used as classrooms or laboratories ... flammable and combustible liquids are allowed to be stored in amounts necessary for use in demonstration ... or laboratory work ... When quantities exceed 10 gallons, storage shall be in cabinets in accordance with section 79.202 (C)."

National Fire Protection Association. NFPA #30 Section 45.4.2
"Not more than 10 gallons of Class I or Class II liquids combined shall be stored ... outside a safety storage cabinet."

If you store in excess of 10 gallons of flammable/combustible liquids, according to one of the

required agencies, then you are required to store them in an approved flammables safety storage cabinet. All flammables cabinets need to meet or exceed NFPA and OSHA specifications for the storage of flammable/combustible liquids; as fire prevention is required.
In conclusion, hazardous chemicals should be stored in locked safety storage cabinets within a central chemical storage area. The issue isn't whether you can afford proper hazardous chemical storage, but that it is a requirement to remain in compliance at all times.

A. GENERAL

1. An inventory is to be maintained of all hazardous chemical, biological, and radioactive materials in the laboratory.

2. All primary and secondary containers of hazardous materials must be properly labeled.

3. Cabinets and shelves shall be secured and supported.

4. Hazardous materials, especially liquids, are not to be stored at or above 5 feet.

5. Large or heavy containers shall be confined to lower shelves.

6. Protective edges are to be provided on laboratory bench island shelves.

7. Catch trays shall be used for containment of hazardous liquids when necessary.

8. Carrier buckets or carts with side rails should be used to transport chemicals.

9. Containers of hazardous liquids (e.g., over 5 gallons) are not to be kept in the laboratory.

10. Proper physical separation of incompatibles must be maintained (i.e., segregation of acids from bases and flammables from oxidizers).

11. Chemical storage areas must be adequately ventilated.

12. Perchloric acid or concentrated nitric acid is not to be stored near organics (i.e., wood, organic solvents).

13. The University policy concerning the handling and storage of Peroxide Forming Chemicals in Appendix 4 should be followed.

14. Face shields and/or suitable barriers are provided for work with highly reactive or explosive materials.

HYGIENE AND CHEMICAL SAFETY

Good personal hygiene will help minimize exposure to hazardous chemicals. When working with chemicals, follow these guidelines:

A. Wash hands frequently and before leaving the laboratory. Also, wash hands before eating, drinking, smoking or applying makeup.

B. Wear appropriate personal protective equipment (PPE). Always wear protective gloves when handling any hazardous chemicals.

C. Remove PPE before leaving the laboratory and before washing hands.

D. Remove contaminated clothing immediately. Do not use the clothing again until it has been properly decontaminated.

E. Follow any special precautions for the chemicals in use.

F. Do not eat, drink, smoke or apply makeup around chemicals.

G. Tie back long hair when working in a laboratory or around hazardous chemicals.

H. Do not keep food, beverages, or food and beverage containers anywhere near chemicals or in laboratories where chemicals are in use.

I. Do not use laboratory equipment, including laboratory refrigerators/freezers, to store or serve food or drinks.

J. Do not wash food and beverage utensils in a laboratory sink.

K. Do not sniff or taste chemicals.

l. Do not touch door knobs, telephones, computer keyboards, etc. with contaminated gloves.

V. FIRE SAFETY

A. GENERAL

1. An explanation of the University fire emergency procedures is to be posted in the laboratory and must be reviewed by all laboratory personnel.

2. Fire extinguishers must be available in the laboratory.

3. Personnel must be trained in the use of portable fire extinguishers.

B. FLAMMABLES AND COMBUSTIBLES

1. University guidelines are to be followed regarding possession limits for flammable and combustible materials located outside of approved storage cabinets. (See Appendix 6.)

2. Flammable liquids that must be refrigerated should be stored only in laboratory safe or explosion proof refrigerators and/or cold rooms.

3. Volatile liquids are to be stored away from sources of heat or electrical spark and sunlight.

4. Flammable or combustible materials may only be heated using appropriate laboratory appliances.

5. Open flame devices are not to be utilized in areas where flammable or combustible liquids or gases are in use.

VI. COMPRESSED GASES/CRYOGENS

A. COMPRESSED GASES (See Compressed Gas Cylinder Safety Manual)

1. The contents of all gas cylinders must be legibly identified.

2. Fuel gases and oxygen cylinders must be stored separated.

3. All gas cylinders should be secured against falling by the use of appropriate clamps and/or brackets.

4. Cylinders, when not in use, must always be shut off at the main valve stem and not through the use of regulators.

5. Appropriate regulators are to be used to control gas flow from cylinders.

6. Valve protection caps should be in place when cylinders are not in use and also during transport.

7. Empty and full gas cylinders should be stored in separate storage areas.

B. CRYOGENS

1. Cryogens (liquified gases or dry ice) are to be used only in well ventilated areas.

2. Cryogenic fluids should be used and transported in appropriate containers.

3. Personnel should not accompany an asphyxiant in an elevator.

4. Tygon tubing must not be used for conveying cryogens.

VII. EQUIPMENT

A. Indicator lights on all equipment must be in working order.

B. Operation manuals for all laboratory equipment must be provided if available.

C. Protective guards are to be provided for machinery moving parts.

D. Hoses and tubing must be free of cracks and abrasions.

E. Electrical cords must be free of breaks, exposed wires, or poor insulation.

F. Electrical equipment should not be operated in areas containing explosive vapors.

G. Refrigerators are to be clearly labeled as either laboratory safe, explosion proof, or nonexplosion proof.

H. All electrical outlets and equipment must be grounded. Ground fault interrupters should be installed in all outlets within 6 feet of a water source.

I. Overloading of circuits is prohibited.

J. Electrical panels are to be identified and to be accessible.

VIII. WASTE DISPOSAL

A. All laboratory personnel should be familiar with the UTD waste disposal procedures for chemicals (Waste Disposal Manual).

B. All waste containers must be properly segregated and clearly marked regarding contents, hazards, and other pertinent information.

C. Waste materials are not allowed to accumulate excessively in the laboratory and in no case longer than 180 days. The date accumulation began should be marked on the container.

D. Needles and broken glassware are to be segregated in appropriately labeled containers away from other waste (see section Waste Disposal Manual, VII, C).

E. Chemicals are prohibited from being disposed of through the sanitary sewer system.

F. Liquid and solid organic waste must be segregated.

G. Inorganic liquid waste should be segregated from other waste.

H. Chlorinated solvent waste should be segregated from nonchlorinated solvent waste.

I. Chemicals that have become hazardous or unstable because of age are to be disposed of properly (see Waste Disposal Manual).

IX. PERSONAL PROTECTION AND EMERGENCY EQUIPMENT

A. Personal protective equipment is to be made available for all laboratory personnel including appropriate eye and face protection, hand protection, foot protection, body protection and respiratory protection.

B. Laboratory personnel are required to wear body, hand, and eye and face protection for all laboratory procedures involving hazardous materials.

C. Water tap eye wash stations are to be made available in working order.

D. Squeeze bottle type eye wash stations are prohibited in the laboratory.

E. Safety showers and eye wash stations are to be accessible to all laboratory personnel.

F. Spill control kits or suitable absorbents must be in each lab.

G. The UTD emergency phone number label and sign should be posted in the laboratory.

H. A first aid kit is to be available in each lab.

I. At least one member of the laboratory must have completed first aid training.

**See section on Personal Protective Equipment for more detail.

Appendix 1

HAZARDOUS MATERIALS DEFINITION

A “hazardous material” is defined as any material or substance which by its inherent properties or if improperly handled can be damaging to health or the environment.*

Such materials cover a broad range of types which may be classified as follows:

1. Poisons or toxic agents including drugs, chemicals, and natural or synthetic products that are in any way harmful, ranging from those that cause death to skin irritants and allergens, and also including genotoxic substances causing cancer, mutations, and/or birth defects.

2. Biological materials including all laboratory specimens or materials consisting of, containing, or contaminated with blood, plasma, serum, urine, feces, or other human or animal tissues or fluids, as well as inoculated media, cultures, and other potentially infectious materials such as bacteria, fungi, viruses, parasites, spores, etc., that must be either sterilized by autoclaving before disposal or must be incinerated.

3. Corrosive chemicals, such as sodium hydroxide or sulfuric acid, that burn or otherwise damage the skin and mucous membranes on external contact or through inhalation.

4. Flammable materials including (a) organic solvents, (b) finely divided metals or powders (e.g., magnesium or sodium), and (c) chemicals that either evolve or absorb oxygen during storage, thus constituting a fire risk in contact with organic materials.

5. Explosives and strong oxidizing agents such as peroxides and nitrates.

6. Materials in which dangerous heat buildup occurs on storage, either by oxidation or microbiological action (e.g., organic waste materials).

*This definition was referenced from the Condensed Chemical Dictionary, 10th Edition. This classification is intended to be advisory and not exhaustive in format. For further classification or consultation, contact the Office of Environmental Health and Safety. See also the term "hazardous substance" found in CERCLA at 42 U.S.C. §9601 (14).

Appendix 2

LABORATORY SAFETY INSPECTION REPORT
INSPECTED BY:
DATE: TIME: BLDG & ROOM NO:
LAB NAME: BY:

CHEMICAL STORAGE

1. Are all containers of chemicals properly labeled?
2. Are liquid chemicals and materials stored at or below eye level?
3. Are protective lips or edges provided on lab bench island shelves?
4. Are five gallon containers of chemicals not kept in the lab?
5. Are chemical storage areas adequately ventilated?
6. Are perchloric acid or concentrated nitric acid stored away from organics (wood, organic solvents)?
7. Are there no more than 10 gallons of flammable liquids stored on shelving and no more than 50 gallons in storage cabinets in the lab?
8. Is there a flammable liquids storage cabinet in lab?
9. Is there a sign on sink ("Do Not Dispose of Chemicals in This Sink?)?

ELECTRICAL

10. Does the lab have adequate lighting?
11. Are electrical cords free of breaks, exposed wires, or insulation?
12. Are all electrical outlets and equipment grounded?
13. Are eating and drinking prohibited in the lab?
14. Is there food or drink in lab refrigerators?
15. Is the Laboratory Safety Poster displayed?
16. Are the following items available for use in the lab?
    - -Lab coats
    - -Eye protection
    - -Respirators
17. Are fire extinguishers available in the lab?
18. Have personnel been trained in the use of portable fire extinguishers?
19. Is a fire blanket readily accessible to lab personnel?
20. Are eyewash stations available and accessible?
21. Are eyewashes and showers positioned so they can be used simultaneously?
22. Are a safety shower and eyewash accessible to all laboratory personnel?
23. Is the University emergency phone number sign and label posted in the laboratory?
24. Does the University Emergency Poster have responsible person's name, office, and home telephone number on it?
25. Is a first aid kit readily available, accessible, and properly stocked?

FUME HOODS

26. Are fume hoods used primarily for handling and not storage of materials?
27. Is work within fume hoods conducted at least six inches inside the front face of the hood?

GAS CYLINDERS

28. Are the contents of all gas cylinders legibly identified?
29. Are all gas cylinders secured against falling by the use of appropriate clamps and/or brackets?
30. Are cylinders always shut off at the main valve stem and not through the use of regulators?
31. Are valve protection caps on cylinders in place when not in use and during transport?
32. Are empty and full gas cylinders stored in separate storage areas?

WASTE MATERIALS

33. Are all waste containers properly segregated and clearly marked regarding contents, hazards, and other pertinent information?
34. Is there no more than one container of each type of hazardous waste stored in the lab?
35. Are spill control kits available and accessible for emergencies?
36. In case of a spill, are the following items available?
    -Respirators
    -Protective clothing
37. Does this lab use hypodermic needles or scalpels?
38. If yes, is there a labeled sharps disposal container?

MISCELLANEOUS

39. Are desks not being used as lab work benches?
40. Is a notice posted about handling chemical waste?

RADIATION LABORATORY SAFETY REPORT

1. Is laboratory identified by radiation sign at all hallway entrances?
2. Is film badge report posted in lab?
3. Are lab benches and hoods identified where radiation is used?
4. How many personnel are in lab during inspections?
5. How many personnel are wearing film badges?
7. Is storage of food and drink in lab refrigerators prohibited and enforced?
8. Are beta boxes in hall refrigerator locked?
9. Is a waste container for radioactive waste marked by using orange plastic bags?

Appendix 3

EYE AND FACE PROTECTION POLICY

Protective eye and face equipment shall be worn where there is a reasonable possibility of injury that could be prevented by such equipment. Suitable eye protectors shall be provided and worn where machines or operations present the hazard of flying objects, glare, liquids, injurious radiation, or a combination of these factors.

The type of eye or face protection required depends on the hazard. For most situations, safety glasses are adequate. Where there is danger of splashing chemicals, glasses with side shields or special goggles are necessary. For more hazardous operations, a face shield or a combination face shield and safety goggles or glasses should be used.

Contact lenses do not provide eye protection. The capillary space between the contact lenses and the cornea may trap material present on the surface of the eye. Chemicals trapped in this space cannot readily be washed off the surface of the cornea. If the material causes pain in the eye or the contact lens is displaced, muscle spasms will make it very difficult to remove the lens.

Therefore, contact lenses must not be worn by persons exposed to hazardous chemicals. Emergency eye wash facilities should be available in areas where corrosive or caustic materials are handled.

Assistance for supervisory personnel and employees in identifying "EyeHazard Areas" is available from the Office of Environmental Health and Safety.

Appendix 4

PEROXIDE FORMING CHEMICAL POLICY

List A: Peroxide Hazard Upon Storage (Discard 3 months after initial opening)

-Isopropyl ether
-Potassium metal
-Sodium amide
-90% hydrogen peroxide

List B: Peroxide Hazard on Concentration (Discard or Test 6 months after initial opening)

-Ethyl ether
-Tetrahydrofuran
-Dioxane
-Methylisobutyl
-ketone
-Ethylene glycol dimethyl ether (diglyme)
-Dicyclopentadiene
-Cumene
-Cyclohexene
-Anisole
-Phenetole & derivatives
-Decahydronaphthalene (Decalin)
-Furan
-Methylcyclopentane

List C: Hazard due to peroxide initiation of polymerization (Discard or test 12 months after initial opening)

-Styrene
-Chloroprene
-Butadiene
-Vinyl acetate
-Acrylic acid
-Acrylonitrile
-Methyl methacrylate

Appendix 5

TRANSPORT/SHIPPING POLICY

Effective immediately, transport or shipment of any substance listed as a "hazardous material" by the U.S. Department of Transportation (DOT) from any operating unit of The University of Texas at Dallas must be packaged and transported in strict accordance with concurrent U.S. DOT regulations and other pertinent international, Federal, State and local rules, regulations and/or guidelines as appropriate. Hazardous materials affected by this policy will include:

-All regulated radioactive materials and/or devices

-All substances listed as "hazardous materials" or "hazardous substances" by the Texas Hazard Communication Act (THCA), the Federal or State Solid Waste Disposal Act, Department of Transportation (DOT), International Air Transporters Association (IATA), and other applicable regulations.

-All compressed gases as defined by the Compressed Gas Association.

-Under no circumstances may any of the subject materials be removed from University buildings or grounds without the specific approval of the Office of Environmental Health and Safety.

-Each package to be transported and/or shipped from the University will be inspected for safety by a designated representative of the Radiation Safety Office (for radioactive materials and/or devices) or the Office of Environmental Health and Safety (for all other hazardous materials), and for compliance with transportation regulations by a designated representative of the Shipping and Receiving Department.

-Contents of all packages covered by this policy will be clearly characterized. The hazardous material will be identified using Chemical Abstracts Service (CAS) number or equivalent recognizable nomenclature; quantities of each substance will be separately listed using either English or metric units.

-All costs for inspection and transport or shipping will be assessed to the originating department or operating unit.

-All required documentation for each package will be completed to the extent possible by the originating department. Inspection and transport/shipping records will be maintained by the Office of Environmental Health and Safety and the Shipping and Receiving Department for an interval dictated by U.S. DOT and/or other pertinent regulations.

For more detail on the packaging and shipping of hazardous materials refer to the section on “Hazardous Materials and Waste Shipping.”

Appendix 6

FLAMMABLE AND COMBUSTIBLE MATERIALS

A. DEFINITIONS

1. "Combustible Liquid" — a liquid having a flash point at or above 100 F (37.8 C). Liquids shall be subdivided as follows:

    a. *Class II* liquids shall include those having flash points at or above 100 F (37.8 C) and below 140 F (60 C),
    b. *Class IIIA* liquids shall include those having flash points at or above 140 F (60 C) and below 200 F (93.4 C),
    c. *Class IIIB* liquids shall include those having flash points at or above 200 F (93.4 C).

2. "Flammable Liquid" — a liquid having a flash point below 100 F (37.8 C) and having a vapor pressure not exceeding 40 pounds per square inch (absolute) at 100 F (37.8 C) and shall be known as a Class I liquid. Class I liquids shall be subdivided as follows:

    a. *Class IA* shall include those liquids having flash points below 73 F (22.8 C) and having a boiling point below 100 F (37.8 C),
    b. *Class IB* shall include those liquids having flash points below 73 F (22.8 C) and having a boiling point at or above 100 F (37.8 C),
    c. *Class IC* shall include those liquids having flash points at or above 73 F (22.8 C) and below 100 F (37.8 C).

3. "Safety can" — a UL or FM approved container, of not more than five gallons capacity, having a spring-loaded lid and spout cover and so designed that it will safely relieve internal pressure when subjected to fire exposure.

4. "Flammable Storage Cabinet" — a cabinet designed and constructed to limit internal temperature to no more than 325 F when subjected to a 10 minute fire test. Cabinets shall be labeled in conspicuous lettering, FLAMMABLE KEEP AWAY.

5. "Reactive Material" — a material that is readily capable of detonation or of explosive decomposition or explosive reaction at normal or elevated temperatures/pressures.

B. QUANTITIES OF CHEMICALS IN LABORATORY

1. The quantities of chemicals within each laboratory area shall not exceed the following maximum quantities per 100 square feet (excludes quantities in storage cabinets):

    Flammable Liquids
    Class I, IA, IB, IC 5 gallons (19 liters)
    Class II, IIIA, IIIB 8 gallons (30 liters)
    Reactive Materials 2 ounces (50 grams)

2. Quantity of Flammable and Combustible Liquids in Storage Cabinets:

a. No more than 50 gallons of flammable or combustible liquids may be stored in storage cabinets.
b. No more than three storage cabinets may be in one lab area.

3. Containers for Flammable and Combustible Liquids:

a. Approved containers, other than safety containers, shall not exceed a capacity of one (1) gallon.
b. Glass containers shall not exceed a capacity of thirty two (32) ounces. Exception: *Class IA* and *IB* flammable liquids may be stored in glass containers of not more than one (1) gallon capacity if the required liquid purity would be affected by storage in metal containers or if liquid would cause excessive corrosion of metal containers.

4. Refrigerators:

a. Flammable and combustible liquids shall not be stored in refrigerators not designed and approved for such storage.
b. Each refrigerator shall be prominently labeled to indicate whether it is or is not suitable for storage of flammable liquids.

Appendix 7

GUIDELINES FOR CHEMICAL FUME HOOD USE

1. Observe posted notices regarding annual hood inspection. Contact the Office of Environmental Health and Safety (4111) if fume hood face velocities have not been evaluated within the last 12 months.

2. Observe notices posted by Physical Plant Utility Operations specifying schedules for shut down of fume hood exhaust fans for routine maintenance and repairs.

3. Ensure working condition of exhaust fan prior to hood use.

4. Remove all items from the hood which are not necessary for the immediate operation of experiment.

5. All equipment necessary for the performance of experiments should be located at least six inches inside the front face of the hood.

6. All work that will release noxious vapors, fumes or aerosols should be performed at least six inches inside the front face of the hood.

7. Limit the quantity of chemicals and/or number of activities conducted within the hood that have potential for creating an explosion or fire situation.

8. The hood sash should be placed at the proper working height for procedures involving the handling of hazardous materials within the hood area.

9. Fume hoods must not be used for the handling and/or storage of hazardous materials during scheduled periods of hood maintenance and/or repair.

Appendix 8

CHEMICAL INCIDENT EMERGENCY PROCEDURES

1. Remove all personnel (patients, students, employees) from the immediate danger area.

2. In the event of a chemical emergency involving a victim exposed to contamination, follow the procedure as listed below:

   -Immediately decontaminate the victim with running water for at least 15 minutes,
   -While the victim is under running water, remove contaminated clothing,
   -Following the 15minute decontamination, take the victim and any involved rescuers for medical attention. Bring the following information (when available) to the medical facility:

      -Identity or other description of the chemical
      -The label, if it can be removed from the container,
      -The Material Safety Data Sheet (MSDS) for the chemical.

3. Avoid breathing vapors or dust from spilled material.

4. If spilled material is flammable, turn off all ignition and heat sources, if possible.

5. Leave any chemically contaminated materials (i.e., lab coats, gloves, etc.) in the laboratory or area of spill.

6. If spill occurs in a laboratory, close and lock the door and post a "DO NOT ENTER" sign on the door,

7. If spill occurs, notify the University Police (911) (if not an emergency, call 2222)

8. Notify the Office of Environmental Health and Safety (4111) of the spill — the following information is necessary:

   -Name or other description of chemical spilled,
   -Location of spill (building, floor, room number)
   -Determination regarding whether chemical is radioactive
   -Quantity of chemical spilled
   -Any injuries resulting from the spill

If spill occurs at a time other than during normal working hours (8:00 a.m. to 5:00 p.m., Monday through Friday), notify the University Police Department (911). If not an emergency, call 2222. Provide the University Police Department with information in item 8. The University Police Department will notify Safety Office personnel.