NORTHERN ILLINOIS UNIVERSITY

CHEMICAL HYGIENE PLAN

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NORTHERN ILLINOIS UNIVERSITY

POLICY STATEMENT

NORTHERN ILLINOIS UNIVERSITY (NIU) SHALL MAKE EVERY REASONABLE EFFORT TO PROVIDE A WORK AND ACADEMIC ENVIRONMENT THAT IS FREE FROM SIGNIFICANT HEALTH AND SAFETY HAZARDS FOR THE UNIVERSITY COMMUNITY. NIU WILL ALSO TAKE STEPS TO ENSURE THAT PROPER WORK PRACTICES, PROCEDURES AND POLICIES HEREIN ARE ADHERED TO FOR THE MINIMIZATION OF EMPLOYEE EXPOSURE TO CHEMICAL AND BIOLOGICAL AGENTS. NIU BELIEVES THAT THE HEALTH AND WELLNESS OF ITS EMPLOYEES AND STUDENTS IS THE UNIVERSITY'S MOST VALUABLE ASSET.

NIU HAS ESTABLISHED AN INSTITUTIONAL BIOSAFETY COMMITTEE, A CHEMISTRY SAFETY AND SECURITY COMMITTEE (WITHIN THE DEPARTMENT OF CHEMISTRY), AND A RADIATION SAFETY COMMITTEE, AS WELL AS A DEPARTMENT OF ENVIRONMENTAL HEALTH AND SAFETY IN ORDER TO ACHIEVE THESE GOALS.

ACKNOWLEDGEMENT

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Preface

The purpose of this manual is to acquaint students and employees with Northern Illinois University's (NIU) safety and health policies and to inform employees of their rights and obligations under federal and state regulations. Because the health and well being of its students and employees is the University's most valuable resource, the University believes it is prudent to minimize all chemical exposures. It is the University's intention to improve the protection of the health and safety of students, employees and the public by providing access to information regarding the safe handling of chemicals, biological agents, and radioactive materials.

SECTION I
INTRODUCTION

Northern Illinois University continually strives to provide a learning, teaching, and research environment free from recognized hazards. Pursuant to Occupational Safety and Health Administration Regulations (29 CFR 1910.1450) the University establishes this Chemical Hygiene Plan (CHP) to protect employees and students from potential health hazards associated with the handling, use, and storage of hazardous chemicals in laboratories.

Scope

This Chemical Hygiene Plan applies to all laboratories at NIU, except those which may develop or have developed their own plans, provided they are at least as stringent with respect to health and safety.

The safe storage, use and disposal of chemicals in the laboratory requires policies for the protection of students, employees, and the environment. Chemicals, which include reagent grade materials through trade name products and wastes, have been the focus of increased regulatory action by federal, state and local governments. The purpose of this Chemical Hygiene Plan is to provide the chemical user with basic safety information regarding the use of chemicals. This Chemical Hygiene Plan forms the foundation of the safe use of chemicals in the laboratory.

The manual is not intended as an encyclopedia of chemicals and their hazards; it will not contain listings of hundreds of chemicals that employees may encounter while working in research and development. Although numerous chemicals may be mentioned, for the most part they will serve as illustrations for broad categories of hazards, except in the case of chemical incompatibility charts or listings.

Biological Safety

The safe use and development of biological organisms requires control measures similar to those found in chemical safety. However, biological agents may have the added dimension of self-replication. Contact the Institutional Biosafety Committee (Dr. Michael Hudspeth Chair, 753-3201) or the Department of Environmental Health and Safety (Michele Crase, 753-9251) for proper work practices involving biological agents.

Radiation Safety

The safe use of radioactive materials requires control measures similar to those found in chemical safety. However, the use of radioactive materials has additional requirements. Contact the Department of Environmental Heath and Safety (Dave Scharenberg, Radiation Safety Officer, 753-1093) for safe work practices involving radioactive materials.

CHEMICAL SAFETY

Responsibilities

A. The NIU Department of Environmental Health and Safety (EH&S) is responsible for recommending to the Office of the Vice President for Business and Operations the minimum requirements of the CHP that all laboratories must follow. EH&S and the Department of Chemistry will review the CHP on an annual basis.

B. Deans and/or department chairpersons are responsible for establishing and maintaining compliance with the CHP. To this end, deans and department chairs may wish to designate safety officers within the Schools or departments. A designated Chemical Hygiene Officer (CHO) should be familiar with all the chemical activities of the department.

C. A Principal Investigator (PI) [Laboratory Supervisor] has the overall responsibility for compliance with the CHP in his or her laboratory. This responsibility may not be shifted to inexperienced or untrained personnel. These responsibilities include:

1. Laboratory workers and others entering the laboratory must know and follow chemical hygiene rules.

2. Personal protective equipment must be available, in working order, and used (where appropriate).

3. Appropriate training (as detailed in Section II) must be provided to all occupants of the laboratory.

4. Appropriate safety training records and Material Safety Data Sheets (MSDS) must be kept on file.

5. Appropriate labelling of chemical containers must be provided and maintained (see Section IV).

D. Individual laboratory workers are responsible for:

1. Planning and conducting each operation in accordance with the standard operating procedures (SOP) outlined in this CHP.

2. Developing good personal hygiene habits.

E. The Department of Environmental Health and Safety (EH&S) is responsible for working with faculty, staff, students, and others to develop and implement appropriate chemical hygiene practices and procedures. To accomplish this:

1. The Director of EH&S or his designee shall be the University Chemical Hygiene Officer.

2. EH&S will establish procedures to:

    - monitor the procurement, use, and disposal of chemicals used in laboratories.

    - assure, on a periodic basis, that appropriate laboratory chemical hygiene and housekeeping inspections are conducted and that records are maintained.

    - help Principal Investigators develop precautions and adequate facilities.

    - know the current legal requirements for regulated substances, and serve as a University-wide resource for such.

F. Wherever hazardous chemicals are used on a laboratory scale, a written Chemical Hygiene Plan must be available and implemented. "Laboratory Scale" is defined by OSHA as: "work with substances in which the containers used for reactions, transfers, and other handling of substances are designed to be easily and safely manipulated by one person. Laboratory Scale excludes those workplaces whose function is to produce commercial quantities of materials."

This manual serves as the reference document for all Chemical Hygiene Plans developed at NIU.

The Chemical Hygiene Plan (CHP) must be:

1. Available in the laboratory where chemicals are being used.

2. Consistent with existing University safety policies.

G. According to federal regulations and standards, the Chemical Hygiene Plan (CHP) must include, at a minimum:

1. Standard operating procedures (SOP's) for each activity that uses hazardous materials. The SOP's may be generic in nature, that is, similar operations using chemicals of the same general class may be covered by one SOP.

2. Criteria used to determine the risk associated with chemicals and the procedures used. For example, Material Safety Data Sheets (MSDSs) may be used for this determination. **NOTE:** To avoid underestimating risks, it must be assumed that a mixture is more toxic than its most toxic component and that all unknown substances are toxic.

3. Criteria used to determine and implement control measures to reduce laboratory workers' exposure to hazardous chemicals including engineering controls, the use of personal protective equipment, and hygiene practices. Particular attention must be given to the selection of control measures for chemicals known or suspected of being carcinogens, reproductive hazards, or acutely toxic.

4. Provisions for laboratory worker training which must be commensurate with the severity of the hazard to which the laboratory worker is exposed. Specialized training may be required for laboratory workers using carcinogens, reproductive hazards, or acutely toxic chemicals.

SECTION II
HOW TO PREPARE A CHEMICAL HYGIENE PLAN

This document provides the background information required to establish safe working practices for chemical use and handling. The responsibility for implementation and enforcement of safe work practices is the responsibility of the Principal Investigator of each laboratory. This document functions as both a training tool and a reference source.

Standard Operating Procedures

The Department of Environmental Health and Safety, in consultation with the Department of Chemistry, has specified *Standard Operating Procedures* (SOP) for 12 classes of chemical hazards commonly found in University laboratories. These SOP's define the minimum use and handling procedures permitted at the University.

Adherence to the SOPs by all laboratories is mandatory. It is the responsibility of the Principal Investigator of each laboratory to review the SOPs and assure that the protective equipment and procedures outlined are in place in the laboratory.

Training Requirements

Principal Investigators should assure that all laboratory workers are provided with information and training to ensure that they are apprised of the hazards of chemicals present in their work area.

Training provided by the Principal Investigator should be as specific to the activities conducted in the laboratory as possible. It should include:

1. The contents of the OSHA standard 29 CFR 1910.1450 (the OSHA Laboratory Safety Standard) and it's appendices which shall be made available to employees (available from Environmental Health and Safety).

2. The location and availability of the Chemical Hygiene Plan.

3. Significant physical and chemical hazards, as well as signs and symptoms associated with overexposures to hazardous materials used in the laboratory.

4. The location and availability of known reference material on the hazards, safe handling, storage and disposal of hazardous chemicals found in the laboratory. This must include Material Safety Data Sheets (MSDSs) as well as other pertinent reference sources.

5. The existence of *Standard Operating Procedures* and their applicability to the laboratory.

6. Proper labeling requirements.

7. The existence and location of all designated areas in the laboratory (see Section VI - "Designated Areas").

SECTION III
HAZARDOUS CHEMICALS

General

"Hazardous Substance" means a substance for which there is statistically significant evidence (based on at least one study conducted according to established scientific principles), that acute or chronic health effects may occur in overexposed persons, or it is flammable, combustible, explosive, corrosive, or reactive.

In most cases, the label will indicate if the chemical is hazardous. Look for key words like "caution", "hazardous", "toxic", "danger", "corrosive", "irritant", or "carcinogen". Old containers of hazardous chemicals (pre-1985) may not contain hazard warnings.

If you are not sure whether a chemical you are using is hazardous, review the Material Safety Data Sheet (MSDS) or contact your supervisor, instructor, or the Department of Environmental Health and Safety.

Types of Hazards

Irritants are materials that cause inflammation of the body surface with which they come in contact. The inflammation results from concentrations far below those needed to cause corrosion. Common irritants include substances such as:

- ammonia*
- alkaline dusts and mists
- epoxy resins
- hydrogen chloride*
- hydrogen fluoride*
- halogens*
- ozone
- nitrogen dioxide*
- phosphorus chloride

Some *irritants* can also cause changes in the mechanics of respiration and lung function. These include:

- sulfur dioxide*
- formaldehyde*
- formic acid*
- sulfuric acid*
- acrolein*
- halogens*

Long term exposure to respiratory irritants can result in increased mucous secretions and chronic bronchitis.

* These materials also have other hazardous properties.

A *primary irritant* exerts no systemic toxic action, either because the products formed on the tissue of the respiratory tract are non-toxic or because the irritant action is more severe than any systemic toxic action.

A *secondary irritant's* effect on mucous membranes is overshadowed by a systemic

effect resulting from absorption. Examples include:

- hydrogen sulfide
- aromatic hydrocarbons

Overexposure to a secondary irritant can result in pulmonary edema, hemorrhage and tissue necrosis.

Simple Asphyxiants deprive the tissue of oxygen by displacement of oxygen. Examples include:

- nitrogen
- carbon dioxide
- helium

Chemical asphyxiants render the body incapable of maintaining an adequate oxygen supply. They are active at very low concentrations. Examples include:

- carbon monoxide
- cyanides

Primary *anesthetics* have a depressant effect upon the central nervous system, particularly the brain. Examples include:

- halogenated hydrocarbons
- alcohols

Chronic overexposure to *hepatotoxic* agents can cause damage to the liver. Examples include:

- carbon tetrachloride
- tetrachloroethane
- methylene chloride
- xylene

Nephrotoxic agents can damage the kidneys. Examples include:

- halogenated hydrocarbons
- uranium compounds

Neurotoxic agents can damage the nervous system. The nervous system is especially sensitive to organometallic compounds and certain sulfide compounds. These include:

- trialkyl tin compounds
- tetraethyl lead

- methyl mercury
- carbon disulfide
- organic phosphorus insecticides
- manganese

Some toxic agents act on the blood or hematopoietic system. The blood cells can be directly affected or the bone marrow can be damaged. These include:

- nitrites
- aniline
- toluidine
- nitrobenzene
- benzene

There are toxic agents that can produce damage to the pulmonary tissue (lungs) but not by immediate irritant action. *Fibrotic* changes can be caused by chronic overexposure to free silica and asbestos. Other dusts can cause a restrictive disease call pneumoconiosis.

A *carcinogen* commonly describes any agent that can initiate or speed the development of malignant or potentially malignant tumors, malignant neoplastic proliferation of cells, or cells that possess such material. A listing of carcinogenic materials can be found in Appendix C. Carcinogens commonly used in significant quantities include formaldehyde, benzene, ethylene oxide, and chloroform.

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

- It is regulated by OSHA as a carcinogen

- It is listed under the category, "known to be carcinogens" in the National Toxicology Program (NTP), "Annual Report of Carcinogens" (latest edition)

- It is listed under Group 1, "carcinogenic to humans" by the International Agency for Research on Cancer (IARC)

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

    a. After inhalation exposure of 6-7 hours per day, 5 days per week, for a significant portion of a lifetime, to doses of less than 10 mg/m^3

    b. After repeated skin application of 300 mg/kg of body weight per week

    c. After oral doses of less than 50 mg/kg of body weight per day

Reproductive hazard applies to chemicals that can affect the reproductive capabilities, including chromosomal damage (mutagens) and effects on the fetus (teratogens). A list of chemicals which can pose reproductive hazards can be found in Appendix D of this document.

A *mutagen* affects the chromosome chains of exposed cells. The effect is hereditary and becomes part of the genetic pool passed on to future generations.

A *teratogen* (embryotoxic or fetotoxic agent) is an agent that interferes with normal embryonic development without damage to the mother or lethal effect on the fetus. Effects are not hereditary.

A *sensitizer* causes a majority of the exposed population to develop an allergic reaction in normal tissue after repeated exposures to the chemical.

The reaction may be as mild as a skin rash (contact dermatitis) or as severe as anaphylactic shock.

Acutely toxic chemicals are substances falling into the following categories:

- A chemical that has a median lethal dose (LD_{50}) of 50 milligrams or less per kilogram of body weight, when administered to albino rats weighing 200g to 300g each.

- A chemical that has a median lethal dose (LD_{50}) of 2000 milligrams or less per kilogram of body weight, when administered by continuous contact for 24 hours, (or less if death occurs within 24 hours), to the bare skin of albino rabbits weighing 200g to 300g each.

- A chemical that has a median lethal concentration (LC_{50}) in air of 200 parts per million by volume, or less, of gas, or vapor, or 2 milligrams per liter or less, of mist, fume, or dust, when administered by continuous inhalation for one hour, (or less if death occurs within one hour), to albino rats weighing 200g to 300g each.

A list of acutely toxic chemicals can be found in Appendix B of this document.

SECTION IV
LABELS

A label is any written, printed, or graphic material displayed on, or affixed to, containers of chemicals.

Labels or other forms of hazard warnings, such as tags or placards, provide immediate

warning of potential danger. They are used to warn of a variety of potential physical hazards, or health hazards.

The Occupational Safety and Health Administration's Hazard Communication Standard established minimum labelling requirements for most chemical containers in the workplace. All chemical containers at the university shall be labelled according to these OSHA requirements. At a minimum, the container shall be labelled with:

- the contents of the container and common name of the chemical (chemical formulas and structural formulas are not acceptable).
- name and address of the manufacturer
- primary physical and health hazards (e.g., "eye irritant")

Existing labels on new containers of chemicals or containers in storage shall not be removed or defaced.

Employees and students shall not work with any chemical from an unlabelled container. However portable containers intended for the immediate and exclusive use, by the employee or student performing the transfer, do not need to be labelled, if all the product is used up by the end of the work shift. This labelling requirement also does not apply to students assigned unknown chemicals for analysis. However, hazard information should be provided with all unlabelled chemicals in student laboratories.

Carefully read all the information on the label. If you do not understand something, contact your supervisor or instructor for an explanation or request the MSDS.

SECTION V
HANDLING OF CHEMICALS

General

Know the physical and health hazards associated with the chemicals you are using. Carefully read the chemical's label and material safety data sheet (MSDS) before using a chemical for the first time. Also review the appropriate *Standard Operating Procedure.* These documents will provide any special handling information. After the potential hazards associated with the chemicals and the experimental processes are evaluated you can modify work procedures so that laboratory hazards are minimized or eliminated.

Keep the following guidelines in mind when handling chemicals:

- Do not work alone in the laboratory. If you do need to work alone notify

someone.
- Use required personal protective equipment. Eye protection is always appropriate.
- Label all containers with chemical content.
- Keep your hands and face clean. Wash thoroughly with soap and water after handling any chemical and whenever you leave the lab.
- Avoid direct contact with any chemical. Always wear a laboratory coat.
- Keep chemicals off your hands, face and clothing, including shoes.
- Never smell, intentionally inhale or taste a chemical.
- Smoking, drinking, eating and the application of cosmetics is forbidden in areas where hazardous chemicals are used or stored.
- Always use chemicals with adequate ventilation or in a chemical fume hood. Refer to the MSDS and the *Standard Operating Procedure* to determine what type of ventilation is needed.
- Use hazardous chemicals only as directed and for their intended purpose.
- Inspect equipment or apparatus for damage before adding a hazardous chemical. Do not use damaged equipment.
- Never use mouth suction to fill a pipette. Use a pipette bulb or other pipette filling device.
- Electrically ground containers using approved methods before transferring or dispensing a flammable liquid from a large container.

For specific information regarding chemical handling, contact your supervisor, instructor or EH&S.

Laboratory Fume Hoods

Local exhaust ventilation is one of the best engineering methods available to reduce the health risk associated with the use of hazardous chemicals in the laboratory. Laboratory fume hoods[1] are the most common local exhaust ventilation devices found in the laboratory. Fume hoods are used to prevent hazardous, offensive, or flammable gases and vapors from mixing with the general room air. A hood, especially with the sash down, acts as a physical barrier between the laboratory workers and chemical reactions. The hood can also contain accidental spills of chemicals.

Check the MSDS, appropriate *Standard Operating Procedure*, or chemical label for special ventilation requirements, such as:

- "Use with adequate ventilation"

[1] Note that laboratory fume hoods and biosafety cabinets, although similar in appearance, are extremely different devices. Biosafety cabinets are used for protection against exposure to biological materials and should not be used with chemicals unless properly vented. If you are uncertain about the type of hood in your laboratory check with the Principal Investigator.

- "Use in a fume hood"
- "Avoid inhalation of vapors"
- "Provide local exhaust ventilation"

Ventilation recommendations must be adapted to the work site and the specific process.

To be effective, laboratory fume hoods must be installed and used correctly. The National Research Council in Prudent Practices for Handling Hazardous Chemicals in Laboratories: (1981) recommends that the following factors be remembered in the daily use of hoods:

1. Hoods should be considered as backup safety devices that can contain and exhaust toxic, offensive, or flammable materials, when the design of an experiment fails. Hoods should not be used as a means for disposing of chemicals. Thus, apparatus used in hoods should be fitted with condensers, traps, or scrubbers to contain and collect waste solvents or toxic vapors or dusts.

2. Hoods should be evaluated before use to ensure adequate face velocities (typically 60-100 fpm) and the absence of excessive turbulence. Further, some continuous monitoring device for adequate hood performance should be present and should be checked before each hood is used. If inadequate hood performance is suspected, it should be established that the hood is performing adequately before it is used. To report inoperable hoods, contact EH&S.

3. Hoods should be kept closed (vertical sashes down and horizontal sashes closed), except when adjustments of apparatus within the hoods are being made. Sliding sashes should not be removed from horizontal sliding-sash hoods. Keeping the face opening of the hood small improves the overall performance of the hood.

4. The airflow pattern, and thus the performance of a hood, depends on such factors as placement of equipment in the hood, room drafts from open doors or windows, persons walking by, or even the presence of the user in front of the hood. For example, the placement of equipment in the hood can have a dramatic effect on its performance. Moving an apparatus 5-10 cm back from the front edge into the hood can reduce the vapor concentration at the user's face by 90%.

5. Hoods are not intended for storage of chemicals. Materials stored in them should be kept to a minimum. Stored chemicals should not block vents or alter airflow patterns. Whenever practical, chemicals should be moved from hoods into cabinets for storage.

6. Solid objects and materials (such as paper) should not be permitted to enter the exhaust ducts of hoods as they can lodge in the ducts or fans and adversely

affect their operation.

7. An emergency plan should always be prepared for the event of ventilation failure (power failure, for example) or other unexpected occurrence such as fire or explosion in the hood.

8. Persistent problems with fume hoods should be reported to EH&S.

Engineering and administrative controls to reduce or eliminate exposures to hazardous chemicals include:

- **substitution** of a less hazardous substance
- **substitution** of less hazardous equipment or process (e.g., safety cans for glass bottles)
- **isolation** of the operator or the process
- **local and general ventilation** (use of fume hoods)
- **hazard education**
- **job rotation**

PERSONAL PROTECTIVE EQUIPMENT (PPE)

The MSDS will list the personal protective equipment recommended for use with the chemical. The MSDS addresses "worst case" conditions. Therefore, not all of the equipment shown may be needed for a specific job. For example, respirators should be considered only when engineering and administrative controls (such as fume hoods) cannot be used or made adequate, or while such controls are being instituted.

The employer must provide appropriate personal protective equipment to employees.

Eye Protection

Eye and face protection must be worn whenever its use will reduce or eliminate injury. It is recommended that eye protection **ALWAYS** be worn in the laboratory.

The need for adequate eye protection is fundamental to the use of chemicals, including housekeeping materials such as wax strippers, detergent and toilet bowl cleaners, and operations such as grinding, drilling, sawing with power tools. Eye protection, and at times face protection, is required wherever the potential for eye injury exists. Areas where eye protection must be worn are laboratories, glass cleaning and glassblowing shops, and machine shops. Eye protection is required for all personnel and visitors in these areas. No personnel may enter laboratories where chemicals are being handled or automated processes are in operation without eye protection.

Ordinary (street) prescription glasses do not provide adequate protection. (Contrary to

popular opinion these glasses cannot pass the rigorous test for industrial safety glasses.) Adequate safety glasses must meet the requirements of the standard Practice for Occupational and Educational Eye and Face Protection (ANSI Z.87.1 1989) and must be equipped with side shields. Safety glasses with side shields do not provide adequate protection from splashes. Therefore, when the potential for a splash hazard exists, other eye protection and/or face protection must be worn.

Splash goggles with splash proof sides or a face shield must be used when protection from a chemical splash is needed.

Face shields afford protection to the face and neck. Face shields must be worn if there is an explosion or implosion (pressure or vacuum) hazard and when transferring cryogenic liquids.

Special eye protection is available for protection against laser, ultraviolet (UV), welding and brazing, or intense light sources.

Eye protection must be made available to employees and visitors, **at no cost to them**, when the potential for eye injury exists.

If you have any questions regarding the selection of appropriate face protection, call EH&S.

Use of Respirators

Respirators are designed to protect only against specific types of substances and in certain concentration ranges, depending on the type of equipment used.

Respirator selection is based on the hazard and the protection factor required.

Types of respiratory protective equipment include:

- particle-removing air purifying respirators
- gas and vapor-removing air purifying respirators
- air supplied respirators

You should familiarize yourself with the limitations of each type of respiratory protective equipment used and the signals for respirator failure (odor breakthrough, filter clogging, etc.).

Respirators are not to be used except in conjunction with a written respiratory protection program. If your work requires the use of a respirator, you must receive special training from qualified personnel. Contact EH&S for a copy of the University's written program and training information.

Protection of Skin and Body

Skin and body protection require protective clothing and include protection of various parts of the body either completely or partially.

Eye and face injuries are prevented by the use of the following:

- safety glasses with side shields for dust and flying object protection
- chemical splash goggles for chemical splash, spray and mist protection
- face and neck shield for head and neck protection (these devices must always be used with safety glasses or goggles).

Where there is no immediate danger to the skin from contact with a hazardous chemical, but where it is undesirable to have the employee or student expose himself in his street clothes, laboratory coats, coveralls, aprons or protective suits shall be worn. These garments should not leave the laboratory, except for laundering or disposal.

Chemical protective clothing in the form of disposable work suits should be provided when there is a high potential for gross contamination. Special attention must be given to sealing all openings in the clothing. Tape can be used for this purpose. Caps should be worn to protect hair from contamination.

Exposures to strong acids and acid gases, organic solvents and strong oxidizing agents, radioactive material, carcinogens, and mutagens require the use of protective equipment that prevents skin contamination. In these situations, impervious protective equipment must be used. Examples include:

- rubber gloves
- rubber boots
- rubberized suits
- special protective equipment

Protective garments are not equally effective for every hazardous chemical. See Table 1, Chemical Resistance Chart, for assistance in selecting the appropriate garment. Some chemicals will "break through" the garment in a very short time. Therefore, garment selection is based on the specific chemical used. Check with your supervisor, or EH&S if you are uncertain as to which materials will provide an adequate barrier to chemicals.

	Natural Rubber	NBR Nitrile	Neoprene	PVC	Pvc/ Nitrile
Acetic Acid	E	G	E	E	E
Acetone	E	P	G	P	F
Ammonium Hydroxide	E	E	E	E	E
Animal Fats	P	E	G	G	E
Alcohols (Most Common)	E	E	E	E	E
Butyl Acetate	P	P	P	F	F
Battery Acid	P	P	P	E	E
Bleach Solutions	F	F	F	E	E
Chromic Acid	P	P	P	E	E
Citric Acid	E	E	E	E	E
Creosote	P	E	G	F	G
Dimethylformaide	E	F	G	P	F
Glycols	E	E	E	E	E
Glycerine	E	E	E	E	E
Gasoline	P	E	G	F	G
Hydrochloric Acid (Conc.)	G	E	E	E	E
Hydrochloric Acid (Dil.)	E	E	E	E	E
Hexane	P	E	E	G	E
Kerosene	P	E	G	F	G
Plasticizers	P	G	F	P	F
Methylethyl Ketone	G	P	P	P	F
Methyl Isobutyl Ketone	P	P	P	P	F
Mineral Spirits	P	E	G	P	F
Naphtha	P	E	F	F	G
Nitric Acid (Conc.)	P	P	G	P	P
Nitric Acid (Dil.)	G	E	E	E	E

Key: E - EXCELLENT G - GOOD F - FAIR P - POOR (NOT RECOMMENDED)

Table 1
CHEMICAL RESISTANCE CHART

Adhesives					
Epoxy	E	E	E	E	E
Solvent Based	P	G	F	F	G
Water Based	E	E	E	E	E
Herbicides and Insecticides					
Oil Based	P	E	G	E	E
Water Based	E	E	E	E	E
Oils					
Animal	P	E	G	G	E
Cutting	P	G	F	G	E
Fuel	P	E	E	G	E
Hydraulic Petroleum	P	E	G	G	E
Hydraulic Ester	P	F	G	G	G
Mineral	P	E	G	E	E
Petroleum	P	E	E	E	E
Silicone	E	E	E	E	E
Vegetable	P	E	E	E	E

SECTION VI
CHEMICAL STORAGE AND TRANSPORTATION

Flammable and Combustible Liquid Storage

The storage of flammable and combustible liquids in a laboratory, shop, or building area must be kept to the minimum needed for research and operations. Flammable liquids have a flash point below 100°F. If more than 5 gallons of flammable liquids are stored outside safety cans per 100 square feet of area, a flammable-liquids storage cabinet is needed. Flammable-liquids storage cabinets are not intended for storage of anything other than flammable liquids.

The total quantity of flammable liquids permitted to be stored in a laboratory is 10 gallons per 100 square feet of laboratory space.

The maximum quantities of flammable liquids and flammable gases listed above will be reduced on a case-by-case basis if in the opinion of the Department of Environmental Health and Safety, a hazard is created by having such a volume of flammable liquids present.

Flammable Liquids Storage in a Cabinet

1. No more than 60 gallons of Class I flammable liquids (flash point below 100□F) or Class II combustible liquids (flash point between 100□ to 140□F) may be stored in a flammable-liquids storage cabinet.

2. No more than 120 gallons of a Class III combustible liquid (flash point between 140□F and 200□F) may be stored in a flammable-liquids storage cabinet.

3. Storage cabinets shall be designed and constructed to limit the internal temperature to not more than 325□F when subjected to a 10-minute fire test using the standard time temperature chart set forth in NFPA 251.

4. All flammable-liquids cabinets shall be labelled in conspicuous letters "Flammable."

5. Storage cabinets shall be constructed of at least No. 18 gauge sheet iron and shall be double walled with 1-1/2 inch air space. Joints shall be riveted, welded, or made tight by some equally effective means. The door shall be provided with a three point lock, and the door sill shall be raised at lease 2 inches above the bottom of the cabinet.

6. All flammable liquid storage cabinets must be grounded. A ground cable of 3/8" copper brain or a 12 gauge copper conductor can be used.

The ground must be tested and resistance to ground cannot exceed one megohm. The grounding cable must be connected to a building structural member or an electrical building ground. Due to increased use of plastic piping, (which breaks the ground) water pipes must not be used for grounding.

7. The NFPA Technical Committee on General Storage of Flammable Liquids considers that providing vents to storage cabinets reduces the limited fire protection provided by such cabinets because a single walled duct will transmit heat faster than a double-walled cabinet. Ventilation of storage cabinets is recommended only when highly odoriferous conditions exist. Ventilation requires a steel duct and an appropriate exhaust fan discharging to an appropriate location outside the building.

9. All chemical storage in cabinets must be compatible.

Flammable Liquids Storage Outside of a Cabinet

Storage of flammable liquids outside of a storage cabinet should be avoided when possible. Flammable liquids that are not in use should be stored in an appropriate cabinet.

1. The maximum quantity of flammable liquids allowed in a laboratory outside of a storage cabinet and not stored in a safety can is 5 gallons per 100 square feet of laboratory space.

Transportation of Hazardous Chemicals

The transportation of hazardous chemicals in laboratory buildings provides the greatest potential for chemical exposure to the building occupants. Spills occurring outside storerooms and laboratories may lead to hazardous concentrations of vapors and gases being distributed throughout the building.

The following guidelines should be observed when transporting chemicals outside the laboratory:

1. Elevators

   a. Freight elevators shall be used where available to transport hazardous materials. Under no circumstances are passenger elevators to be used for the transportation of hazardous materials if freight elevators are available.

2. Flammable Liquids

   a. Flammable liquids shall be transported in rugged pressure-resistant safety

cans.

b. Original containers of flammable liquids shall be placed in an outside container or acid-carrying bucket.

c. No more than 5 gallons of flammable liquids in glass containers shall be transported on the freight elevator unless the original shipping carton (box) is used and the materials are on an appropriate cart.

3. Corrosive or Oxidizing Materials

a. Original glass shipping containers holding liquids acids and bases must be placed in an outside container or acid-carrying bucket.

b. Incompatible chemicals, for example chromic acid (oxidizing acid) and ethyl acetate (flammable liquid), should not be transported on the same cart unless they are in original shipping cartons and physically separated.

4. Water Reactive Chemicals

a. Wherever possible, use the original outside shipping containers (packaging) when transporting water reactive chemicals.

b. Once opened, water reactive chemicals must be placed in a rigid outside container or acid carrying bucket for transporting.

5. Pyrophoric (spontaneously igniting) Substances

a. Whenever possible, the original outside shipping container (packaging) must be used to transport pyrophoric substances.

b. Once opened, pyrophoric substances must be placed in a rigid outside container or acid carrying bucket for transporting.

6. Acutely Toxic Compounds (See list Appendix B)

a. Whenever possible, the original outside shipping container (packaging) must be used to transport acutely toxic compounds.

7. General

a. Chemicals substances and research materials must be clearly labelled with the correct chemical name when transported. Hand-written labels are acceptable; <u>chemical formulas and structural formulas alone are not acceptable.</u>

b. Carts used for chemical transport must have sides, on each shelf, that are high enough to retain the containers. Cart wheels must be large enough to prevent the carts from being caught in floor cracks, and door and elevator thresholds.

c. Personnel transporting chemicals must (at a minimum) wear chemical resistant gloves and safety glasses.

Questions concerning hazardous chemicals should be addressed to Environmental Health and Safety at 753-0404.

General Considerations for Chemical Storage

Carefully read the label before storing a hazardous chemical. The MSDS will also provide any special storage information and incompatibilities.

Do not store unsegregated chemicals in alphabetical order or incompatible chemicals in close proximity to each other.

Chemicals should be separately stored by chemical class as follows:

solids
- oxidizing solids
- flammable solids
- water reactive solids
- all other solids

liquids
- acid liquids
- caustic liquids
- oxidizing liquids
- perchloric acid solutions
- flammable or combustible liquids

gases
- toxic gases
- flammable gases
- oxidizing and inert gases

Once separated into hazard classes, chemicals may be stored alphabetically.

Use approved storage containers and safety cans for flammable liquids. Use spill trays under containers of strong corrosive reagents. Do not store liquids above eye level.

Ensure that all containers are properly labelled. For more information on chemical storage, contact your supervisor, instructor, Principal Investigator, or EH&S.

Chemical Stability

Stability refers to the susceptibility of the chemical to dangerous decomposition. Ethers and olefins 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 not been opened. Write the date received and date opened on all containers of ether.

Unless an inhibitor was added by the manufacturer, closed containers of ether should be discarded after 1 year.

Open containers of ether should be discarded within 6 months of opening. In the Department of Chemistry, refilled ether cans should be so labelled.

The label and MSDS will indicate if a chemical is unstable.

The following are examples of materials that may form explosive peroxides:

acetal
cyclohexane
decahydronaphtalene
diacetylene
dicyclopentadiene
diethyl ether
diethylene glycol
dimethyl ether
dioxane
divinyl acetylene
ethyl ether
terahydronaphthalene
isopropyl ether
methyl acetylene
tetrahydrofuran
vinylidene chloride
vinyl ether
ethylene glycol-dimethylether

For additional information on chemical stability, contact your supervisor, instructor or EH&S.

Shock Sensitive Chemicals

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

Some chemicals become increasingly shock sensitive with age. Write the date received and date opened on all containers of shock sensitive chemicals. Unless an inhibitor was added by the manufacturer, closed containers of shock sensitive materials should be discarded after one year. Open containers of shock sensitive materials should be discarded within six months of opening.

Table 2 lists materials that can be shock sensitive.

Table 2
Shock Sensitive Chemicals*

s of heavy metals	aluminum ophorite explosive	amatol	ammonal	ammonium nitrate
m perchlorate	ammonium picrate	ammonium salt lattice	butyl tetryl	calcium nitrate
cetylide	cyanuric triazide	cyclotrimethylenetrinitramine	cyclotetramethylenetranitramine	dinitroethyleneurea
cerine	dinitrophenol	dinitrophenolates	dinitrophenyl hydrazine	dinitrotoluene
lfone	dipicylamine	erythritol tetranitrates	explosive mixtures	fulminate of mercury compounds
of silver	fulminating gold	fulminating mercury	fulminating platinum	gelatinized nitrocellulose
	guanyl nitrosamino guanyltetrazene	guanyl nitrosamino guanylidene hydrazine	guanylidene	heavy metal azides
	hexanitrodiphenyl-amine	hexanitrostilbene	hexogen	hydrazinium nitrate
acid	lead azide	lead mannite	lead mononitro-resorcinate	lead picrate
	lead styphnate	magnesium ophorite	mannitol hexanitrate	mercury oxalate
artrate	mononitrotoluene	nitroaminotetrozole	nitrated carbohydrate	nitrated glucoside
olyhydric alcohol	nitrogen trichloride	nitrogen tri-iodide	nitroglycerin	nitroglycide
l	nitroguanidine	nitroparaffins	nitronium perchlorate	nitrourea
mine nitrates	organic nitramines	organic peroxides	picramic acid	picramide
	picric acid	picryl chloride	picryl fluoride	polynitro aliphatic compounds
m nitroaminotetrazole	silver acetylide	silver azide	silver styphnate	silver tetrazene

* This list is not all inclusive. Review the Material Safety Data Sheet for reactivity information concerning the chemicals you use.

Compressed Gases

Carefully read the label before using or storing compressed gas. The MSDS will provide any special hazard information. Always use the minimum size cylinder required to perform the work.

Cylinders of compressed gases must be handled as high energy sources. When storing or moving a cylinder, have the cap securely in place to protect the stem. Use suitable racks, straps, chains or stands to support cylinders. Compressed gas cylinders pose a crush hazard to hands and feet.

Do not expose cylinders to temperature extremes.

Always use the correct regulator. Do not use a regulator adapter. Oil or grease on the high pressure side of an oxygen cylinder can cause an explosion. Do not lubricate an oxygen regulator.

Cylinders of toxic, flammable or reactive gases should be stored and used in a fume hood or with local ventilation.

Never bleed a cylinder completely empty. Leave a slight pressure to keep contaminants out.

Always wear safety glasses when handling compressed gases.

For more information, contact your supervisor, instructor, Principal Investigator, or EH&S.

Designated Areas

All locations within the laboratory where acutely toxic, carcinogenic, or reproductive hazards are stored or handled should be demarcated with caution signs. Storage areas must be segregated from other chemical storage. This includes all fume hoods and bench tops where the acutely toxic, carcinogenic, or reproductive hazards are handled.

The use of a designated area for handling and storage of these three chemical classes will minimize the exposure to laboratory workers and prevent accidental contact by untrained students, faculty, staff and administrators.

Flammable Gas Cylinders

The storage of flammable gas cylinders is limited to two (2) type 1 (10" x 50") cylinders per 500 square feet of unsprinklered laboratory space.

Liquefied flammable gas containers should be limited to two (2) 9" x 30" cylinders per

500 square feet of unsprinklered laboratory space or three (3) 9" x 30" cylinders per 500 square feet of sprinkled laboratory space.

SECTION VII
ROOM NUMBER SIGNS

Each laboratory should have a room number sign that provides safety information to visitors and housekeeping personnel (see Figure 1). The Principal Investigator is responsible for assuring that appropriate warning information is included on this sign.

Untrained students, faculty, staff and administrators shall not enter a designated area, except when accompanied by an authorized user of the facility.

Custodians are permitted to enter restricted or designated areas to perform routine tasks. However, labelled waste containers, other research equipment or materials, should not be handled.

Other support services, such as: University Police, Physical Plant, Health and Safety Personnel, etc., are permitted to enter a designated area. Support services should avoid disturbing the following areas:

- fume hoods
- biological safety cabinets

- placarded equipment
- chemicals or materials on laboratory benches

Support personnel shall contact an authorized user of the facility or EH&S before performing work that may involve any of the above items. Contact EH&S if emergency response or service is required in a designated area.

Immediately report any unusual conditions to EH&S or University Police, such as:

- spills
- leaks
- fires
- injury
- contamination

For additional information regarding designated areas, contact your supervisor, instructor, Principal Investigator, or EH&S.

Figure 1
Laboratory Room Number Sign

NORTHERN ILLINOIS UNIVERSITY
EHS
ENVIRONMENTAL HEALTH & SAFETY

The following hazards may be found in this room.

	Contact
James Gable	753-1610 W 751-3017 Cell

Michele Crase	753-9251 W 762-1187 Cell

Dave Scharenberg	753-1093 W 761-5316 Cell

Room #: _____

Laboratory Owner: _____

IN CASE OF EMERGENCY CALL 911

SECTION VIII
WASTE DISPOSAL

Hazardous chemical disposal must be according to procedures established by EH&S. Your department may also have procedures you are required to follow. Contact your supervisor, instructor or EH&S before disposing of any hazardous chemical.

Unless approved by the EH&S, disposal of chemicals by way of the sanitary sewer system is not permitted.

Disposal of radioactive materials and etiological agents or cultures require special procedures. Contact the EH&S before proceeding.

SECTION IX
Material Safety Data Sheets

The Material Safety Data Sheet (MSDS) is the hazard communication tool that provides details on all important aspects of chemical use, handling, and storage. Review both the appropriate *Standard Operating Procedure* and the MSDS when working with a chemical for the first time or when training staff. The Department of Environmental Health and Safety and the Department of Chemistry maintain MSDSs for chemicals used at the University. MSDSs can be obtained by calling 753-0404 (EH&S) or 753-6854 (Chemistry).

The OSHA Hazard Communication standard (29 CFR 1910.1200) requires manufacturers to provide MSDSs at no cost. Information is divided into ten sections.

Section I of the MSDS lists information identifying the manufacturer and the product. It includes:

- manufacturer's name, address and telephone number
- number to call in case of emergency
- chemical name and synonyms
- trade name and synonyms
- Chemical Abstract Service (CAS) number that is a unique identification number for chemical reagents.
- Date of preparation.

If your work requires an understanding of this chemical information, contact your supervisor or EH&S.

Section II describes the various hazardous ingredient(s) contained in the product, the percentages of ingredient(s), and exposure limits when appropriate. This will include all hazardous chemicals that comprise 1% or greater of the mixture. Carcinogens must be

listed if the concentrations are 0.1% or greater.

Section III describes the physical properties of the material. Physical properties include:

- boiling point
- specific gravity
- vapor pressure
- percent volatile
- vapor density
- evaporation rate
- solubility in water
- appearance and odor

Section IV describes the fire and explosion hazard data for the material and other fire and explosion data. The appropriate extinguishing agent for fires involving the material will be listed. Special fires involving the material will be listed. Special fire fighting procedures may also be listed.

Section V describes the known health hazard data for the material and exposure limits. Symptoms or the health effects of an overexposure are listed. This information will help the user and medical personnel recognize if an overexposure has occurred.

- threshold limit value (TLV)
- existing medical conditions that may be aggravated by exposure
- effects of overexposure (e.g., headache, nausea, narcosis, eye irritation, weakness, skin rashes, etc.)
- primary routes of exposure (i.e., inhalation, skin, ingestion)
- cancer or other special health hazards
- emergency and first aid procedures

Section VI describes reactivity data; that is, the material's ability to react and release energy or heat under special conditions or when it comes in contact with certain substances.

Section VII gives instructions for the steps to be taken in case of an accidental release or spill. The steps normally include information on containment, evacuation procedures, and waste disposal. The statements on the MSDS are general; more specific information is available from the appropriate *Standard Operating Procedure*.

Section VIII describes the protective equipment for the individual who might have to work with the substance. This section normally describes worst case conditions; therefore, the extent to which personal protective equipment is required is task dependent. Always review the appropriate *Standard Operating Procedure*. Equipment may include:

- respiratory equipment
- ventilation
- protective gloves
- eye protection
- other protective equipment (i.e., special clothing).

Section IX describes special handling and storage procedures to be taken with the material. Information may include statements such as: keep container closed; store in a cool, dry, well ventilated area; keep refrigerated; avoid exposure to sunlight.

Section X describes special precautions or miscellaneous information regarding the material, if any. In some cases, manufacturers may choose to withhold certain information on a MSDS provided the information is trade secret. Regardless of the existence of trade secrets, the MSDS must still contain all relevant hazard, protection, and health information.

Some MSDSs may not contain all ten sections or the information may be in a slightly different order. However, the basic information described above must be provided.

Some MSDSs are more complete than others. Do not assume everything you need to know is contained on the MSDS. Do not assume if a section is left blank that there is no risk.

SECTION X
CHEMICAL SPILLS

General Information

Anticipate spills by having the appropriate safety equipment on hand.

If a spill occurs, immediately alert personnel in the area and do what is necessary to protect life. Confine the spill if possible.

Call for assistance if the spill is large; a threat to personnel, students or the public; involves radioactive materials, corrosives, highly toxic, or reactive chemicals.

- Department of Environmental Health and Safety at 753-0404
- University Police 911 or 753-1212

The Department of Environmental Health and Safety or the Department of Chemistry are equipped to handle many spills that may occur at the University. If there is the slightest doubt how to proceed, do not hesitate to call for assistance.

For specific spill cleanup information, contact your supervisor, instructor, or EH&S.

Spill Cleanup Supplies

Spill of chemicals that do not pose a fire, toxic, or corrosive hazard, may be cleaned up by the laboratory worker. Use an absorbent material that will neutralize the spill if available. Examples of spill cleanup materials include:

- trisodium phosphate
- sand
- sodium bicarbonate for acids
- powdered citric acid for bases
- Oil-Dri," "Zorb-All," "Speedi-Dri"
- paper towels

A dustpan and brush should be used and rubber gloves and goggles should be worn during the cleanup. Decontaminate area with soap and water after cleanup. Place residue in a container for waste collection.

Contact your supervisor, instructor or EH&S for disposal information.

Notify all personnel in the area if a flammable, carcinogenic, reactive, toxic, or reproductive hazard is spilled. Extinguish flames and all other sources of ignition (such as brush-type motors.) Maintain fume hood ventilation, vacate the area and call for assistance.

Hazardous Spills

The following compounds are very hazardous. You should not clean them up yourself.

- aromatic amines
- nitrocompounds
- bromine
- carbon disulfide
- hydrazine
- cyanides
- nitriles
- ethers
- organic halides

If you spill an acutely toxic material listed in Appendix B, immediately contact University Police at 911 or 753-1212 and Environmental Health and Safety 753-0404.

Small spills of acids should be absorbed with "Oil-Dry," "Zorb-All," "Speedi-Dry" or other

clay type absorbent. Avoid contact with skin. Place residue in container for waste collection by EH&S. For specific cleanup information, contact your supervisor, instructor, or EH&S.
Smother alkali metal spills with powdered graphite or "Met-L-X."

SECTION XI
MEDICAL CONSULTATION

Employees and students must notify their immediate supervisor or instructor of all illness and injuries related to exposure to hazardous chemicals. Contact your supervisor, instructor, or the University Health Service if you have any questions regarding the procedure for treating a non-serious injury or illness.

Proceed as follows if you are injured and require medical consultation:

On-campus medical emergencies requiring an ambulance:

> Do not move a seriously injured person unless they are in further danger. Dial 911. Tell the dispatcher the location and nature of the emergency.

SECTION XII
PERSONAL CONTAMINATION

General Information

Do what is necessary to protect life. Remain Calm. The MSDS for the chemical will contain special first aid information. The Regional Poison Control Center may be contacted at (800) 252-2022.

Do not move an injured person unless they are in further danger. A blanket should be used immediately to protect the victim from shock and exposure.

Get medical attention promptly by calling:

- University Police 911 or 753-1212
- Poison Information Center
- University Health Service 753-1311

For specific instruction regarding personal contamination, contact your supervisor, instructor, or EH&S.

Chemicals Spilled Over a Large Area of the Body

Quickly remove all contaminated clothing while using the safety shower or other available source of water. Immediately flood the affected body area in cold water for at least 15 minutes. Wash off chemical with water but **do not use** neutralizing chemicals, unguents, creams, lotions, or salves.

Get medical attention promptly.

Chemicals on the Skin in Confined Areas

Immediately flush with cold water. If there is no visible burn, scrub area with warm water and soap. Remove all jewelry to facilitate removal of any residual material.

If a delayed action is noted (often the next day), report immediately for medical attention and explain carefully what chemicals were involved.

If the incident involves **Hydrofluoric acid (HF)**, seek immediate medical attention.

If there is any doubt, seek immediate medical attention.

Chemicals in the Eyes

Irrigate with plenty of cool water for at least 15 minutes. Simultaneously, check for and remove contact lenses.

Get medical attention promptly.

Smoke and Fumes

Anyone overcome with smoke or chemical fumes should be removed to uncontaminated air and treated for shock. If certified, follow standard CPR protocols. Get medical attention promptly.

Do not enter the area if a life threatening condition still exists, such as the presence of:

- oxygen depletion
- explosive vapors
- cyanide gas, hydrogen sulfide
- nitrogen oxides, carbon monoxide

Burning Clothing

Extinguish burning clothing by dousing with cold water, emergency shower, fire blanket or the drop-and-roll technique. Remove contaminated clothing. If possible, send

clothing with the victim. Wrap injured person to prevent shock.

Get medical attention promptly.

Ingestion of Hazardous Chemicals

Identify the chemical ingested and Call University Police 911 or 753-1212. Wrap injured person to prevent shock.

Provide the ambulance crew and physician the chemical name and any other relevant information.

SECTION XIII
FIRE AND FIRE RELATED EMERGENCIES

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

Activate the building alarm (fire pull station); if not available or operational, verbally notify persons in the building.

Notify University Police 753-1212 or 911 or from a safe location.

Isolate the area and evacuate the building:

- Shut down equipment in the immediate area (if possible).
- Close doors to isolate the area.
- Use a portable fire extinguisher to: assist oneself or another to evacuate, or control a small fire, if possible.

Identify yourself as the person who notified University Police and provide the fire or police teams with the details of the problem upon their arrival. Special hazard information you may know is essential. If the fire alarms are ringing in your building:

- evacuate the building.
- move away from the building to a designated area.
- stay clear of driveways, sidewalks and other means of access to the building.

If you are a supervisor, account for your employees and report any missing persons to the emergency personnel at the scene. Assist emergency personnel as may be requested.

Do not reenter the building until directed to do so. Follow any special procedures established for your unit.

SECTION XIV
INDUSTRIAL TOXICOLOGY OVERVIEW

Chemical Toxicity

Toxicology is the study of the nature and action of poisons. Toxicity is the ability of a chemical molecule or compound to produce injury once it reaches a susceptible site in or on the body. Toxicity hazard is the probability that injury will occur considering the manner in which the substance is used.

Dose-Response Relationships

The potential toxicity (harmful action) inherent in a substance is manifest only when that substance comes in contact with a living biological system. A chemical normally thought of as "harmless" will evoke a toxic response if added to a biological system in sufficient amount. The toxic potency of a chemical is defined by the relationship between the dose (the amount) of the chemical and the response that is produced in a biological system.

Routes of Entry into the Body

There are three main routes by which hazardous chemicals enter the body:

- absorption through the **respiratory tract** through inhalation.
- absorption or injection through the **skin[2] or eyes**.
- absorption through the **digestive tract**. This can occur through eating or smoking with contaminated hands or in contaminated work areas.

Most exposure standards, Threshold Limit Values **(TLVs)** and Permissible Exposure Limits **(PELs)**, are based on the inhalation route of exposure. They are normally expressed in terms of either parts per million (ppm) or milligrams per cubic meter (mg/m^3) concentration in air.

If a significant route of exposure for a substance is through skin contact, the MSDS will have a "skin" notation associated with the listed exposure limit. Examples include: some pesticides, carbon disulfide, phenol, carbon tetrachloride, dioxane, mercury, thallium compounds, ethylene, hydrogen cyanide.

[2] Chemicals dissolved in dimethyl sulfoxide (DMSO) pose a serious skin absorption hazard. DMSO greatly increases the transport of solute through the skin.

Health Effects

Acute poisoning is characterized by rapid absorption of the substance and the exposure is sudden and severe. Normally, a single large exposure is involved. Examples: carbon monoxide or cyanide poisoning.

Chronic poisoning is characterized by prolonged or repeated exposures of a duration measured in days, months or years. Symptoms may not be immediately apparent. Examples: lead or mercury poisoning and pesticide exposure.

Local refers to the site of action of an agent and means the action takes place at the point or area of contact. The site may be skin, mucous membranes, the respiratory tract, gastrointestinal system, eyes, etc. Absorption does not necessarily occur. Examples: strong acids or alkalis.

Systemic refers to a site of action other than the point of contact and presupposes absorption has taken place. For example, an inhaled material may act on the liver. Examples: arsenic affects the blood, nervous system, liver, kidneys and skin; benzene affects the bone marrow.

Cumulative poisons are characterized by materials that tend to build up in the body as a result of numerous chronic exposures. The effects are not seen until a critical body burden is reached. Examples: heavy metals.

Synergistic responses: When two or more hazardous material exposures occur the resulting effect can be greater than the effect of the individual exposures. Example: exposure to both asbestos and tobacco smoke.

Other Factors Affecting Toxicity

Rate of entry and route of exposure; that is, how fast the toxic dose is delivered and by what means. Age can affect the capacity to repair tissue damage. Previous exposures can lead to tolerance, increased sensitivity or make no difference.

State of health, physical condition, and life style, can affect the toxic response. Preexisting disease can result in increased sensitivity.

SECTION XV
NOTICES TO EMPLOYEES

The University is required to advise you of your rights regarding the Hazard Communication Standard and the Chemical Hygiene Plan. This manual meets the requirement in part. In addition, standard "Notice to Employee" poster will be posted at locations where notices are normally posted. It is to your advantage to know your rights. Take time to read the "Notice to Employee" form posted in your work area.

EMPLOYEE RIGHTS

Employees who may be exposed to hazardous chemicals have access to the following

information where appropriate: chemical exposure information

- workplace chemical lists
- Material Safety Data Sheets

In addition, employees and students shall receive training on the hazards of chemicals and on the measures they can take to protect themselves from those hazards.

The employer must provide employees with appropriate personal protective equipment. Students may be required to purchase common items such as laboratory aprons or goggles. However, special items such as respirators, face shields, gloves, will be provided by the employer.

EDUCATIONAL PROGRAMS

Upon appointment, the University will provide an education and training program for employees using or handling chemicals. Additional instruction is required whenever the potential for exposure to hazardous chemicals is altered or whenever new information concerning a chemical is received. New or newly assigned employees must be provided training before working with, or in a work area containing hazardous chemicals. For students, training may be required for each course. Training programs shall include, as appropriate, the following:

- interpreting labels and MSDSs
- location of hazardous chemicals
- a description of the acute and chronic effects of chemicals
- safe handling procedures
- personal protective equipment
- cleanup procedures
- waste disposal

In an area or laboratory where a large variety of hazardous chemicals are stored or used, the University may substitute generic training for chemical specific training. The contents of this manual meet the requirements of 29 CFR 1910.1200, Hazard Communication Standard and 29 CFR 1910.1450, the Chemical Hygiene Plan.

The University is required to keep a record of training sessions provided to employees. You may be requested to sign a ledger verifying your attendance at a training session.

If you do not understand the material provided or discussed, contact your supervisor, instructor or EH&S.

SECTION XVI
STANDARD OPERATING PROCEDURES

Standard operating procedures (SOP) are intended to provide you with general guidance on how to safely work with a specific class of chemicals or type of hazard. While SOPs provide only general guidance, observance of all the safety practices listed in them is mandatory. If compliance with all the requirements of a specific standard operating procedure is not possible, the Principal Investigator must develop a written procedure that will be used in its place. This alternate procedure must provide at least the same level of protection as the SOP it replaces. The Department of Environmental Health and Safety is available to provide guidance during the development of alternate procedures.

In order to provide flexibility, standard operating procedures are generic in nature. They address the use and handling of substances by hazard class only. In some instances multiple SOPs may be applicable for a specific chemical (i.e., both the SOPs for flammable liquids and carcinogens would apply to benzene). If you have questions concerning the applicability of any item listed in this procedure contact the Department of Environmental Health and Safety (753-0404) or the Principal Investigator of your laboratory.

There are currently twelve standard operating procedures written for the university. Additional SOPs will be added on an annual basis. Current SOPs are available for:

- Acutely toxic gases
- Acutely toxic chemicals
- Carcinogens
- Compressed gases
- Corrosive chemicals
- Flammable liquids
- Oxidizing chemicals
- Pyrophoric chemicals
- Reactive solids
- Reactive liquids
- Reproductive hazards
- +Water sensitive chemicals

Standard Operating Procedures are available in the appendix of this document.

SECTION XVII

GLOSSARY

ACGIH
The American Conference of Governmental Industrial Hygienists (ACGIH) is a voluntary membership organization of professional industrial hygiene personnel in governmental or educational institutions. The ACGIH develops and publishes recommended occupational exposure limits each year called Threshold Limit Values (TLVs) for hundreds of chemicals, physical agents, and biological exposure indices.

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

CUTE EXPOSURE
An intense exposure over a relatively short period of time.

ANSI
The American National Standards Institute is a voluntary membership organization (run with private funding) that develops consensus standards nationally for a wide variety of devices and procedures.

ASPHYXIANT
A chemical (gas or vapor) that can cause death or unconsciousness by suffocation. Simple asphyxiants such as nitrogen, either use up or displace oxygen in the air. They become especially dangerous in confined or enclosed spaces. Chemical asphyxiants, such as carbon monoxide and hydrogen sulfide, interfere with the body's ability to absorb or transport oxygen to the tissues.

BOILING POINT
The temperature at which the vapor pressure of a liquid equals atmospheric pressure or at which the liquid changes to a vapor. The boiling point is usually expressed in degrees Fahrenheit. If a flammable material has a low boiling point, it indicates a special fire hazard.

"C" OR CEILING
A description usually used with a published exposure limit. It refers to the concentration that should not be exceeded, even for an instant. It may be written as TLV-C or Threshold Limit Value - Ceiling. See also THRESHOLD LIMIT VALUE.

CARCINOGEN
A substance or physical agent that may cause cancer in animals or humans.

C.A.S. NUMBER
Identifies a particular chemical by the Chemical Abstracts Service, a service of the American Chemical Society that indexes and compiles abstracts of worldwide chemical literature called "Chemical Abstracts."

CC
Cubic centimeter, a volumetric measurement that is also equal to one milliliter (mL).

CHEMICAL
An element or a compound, produced by chemical reactions on a large scale for direct industrial and consumer use, or for reaction with other chemicals.

CHEMICAL REACTION
A change in the arrangement of atoms or molecules to yield substances of different composition and properties. SEE REACTIVITY

CHP
Chemical Hygiene Plan; a document such as this one, required under OSHA regulations.

CHRONIC
Persistent, prolonged, or repeated conditions.

CHRONIC EXPOSURE
A prolonged exposure occurring over a period of days, weeks, or years.

COMBUSTIBLE
According to the DOT and NFPA, combustible liquids are those having a flash point at or above 100^{o}F (37.8^{0}C), or liquids that will burn. They do not ignite as easily as flammable liquids. However, combustible liquids can be ignited under certain circumstances, and must be handled with caution. Substances, such as wood, paper, etc., are termed "Ordinary Combustibles."

CONCENTRATION
The relative content of a component; strength (for example, ten thousand parts per million is equal to one percent).

CORROSIVE
A substance defined by DOT, as causing visible destruction or permanent changes in human skin tissue at the site of contact, or is highly corrosive to steel.

CUBIC METER (m^3)

A measure of volume in the metric system (one meter by one meter by one meter).

CUTANEOUS
Pertaining to or affecting the skin.

EH&S
NIU Department of Environmental Health and Safety, located in the Dorland Building, 3-0404.

DECOMPOSITION
The breakdown of a chemical or substance into different parts or simpler compounds. Decomposition can occur due to heat, chemical reaction, decay, etc.

DERMAL
Pertaining to, or affecting the skin.

DERMATITIS
An inflammation of the skin.

DESIGNATED AREA
Means an area that may be used for work with select carcinogens, reproductive toxins, or substances that have a high degree of acute toxicity. A designated area may be an entire laboratory, an area of a laboratory, or a device such as a laboratory hood. Designated areas must be demarcated with designated area caution tape (part number S1728T) and/or posted with designated area caution signs. Storage areas must be segregated from other chemical storage. This includes all fume hoods and bench tops where the acutely toxic, carcinogenic, or reproductive hazards are handled.

DILUTION VENTILATION
See GENERAL VENTILATION

DOT
The United States Department of Transportation (the federal agency that regulates the labelling and transportation of hazardous materials).

DYSPNEA
Shortness of breath; difficult or labored breathing.

EPA
The Environmental Protection Agency (the governmental agency responsible for administration of laws to control and reduce pollution of air, water, and land systems).

EPA NUMBER
The number assigned to chemicals (typically hazardous wastes) regulated by the

Environmental Protection Agency (EPA).

EPIDEMIOLOGY
The study of diseases in populations.

ERYTHEMA
A reddening of the skin.

EVAPORATION RATE
The rate at which a material is converted to vapor (evaporates) at a given temperature and pressure compared to the evaporation rate of water. Health and fire hazard evaluations of materials involve consideration of evaporation rates as one aspect of the evaluation.

EXPLOSIVE
Means a chemical that causes a sudden, almost instantaneous release of pressure, gas and, heat when subjected to sudden shock, pressure or high temperature.

^{o}F
Degrees, Fahrenheit. A temperature scale in which water freezes at 32^{o} and boils at 212^{o} .

FLAMMABLE LIQUID
According to the DOT and NFPA, a flammable liquid is one that has a flash point below 100^{o}F (37.8^{o}C). See FLASH POINT.

FLASHPOINT
The lowest temperature at which a liquid gives off enough vapor to form an ignitable mixture and burn when a source of ignition (sparks, open flames, cigarettes, etc.) is present. Two tests are used to determine the flash point: open cup and closed cup. The test method is indicated on the MSDS after the flash point.

g
See GRAM (sometimes abbreviated gm).

GENERAL VENTILATION
Also known as general dilution ventilation, this is a system of ventilation consisting of either natural or mechanically induced fresh air movements to mix with a dilute contaminants in the workroom air. Dilutional ventilation is not the preferred method to control contaminants that are highly toxic; when there may be corrosion problems from the contaminant; when the worker is close to where the contaminant is being generated; or where fire or explosion hazards are generated close to sources of ignition.

g/kg
See GRAMS PER KILOGRAM

GRAM (g) or (gm)
A metric unit of weight. One ounce equals 28.4 grams.

GRAMS PER KILOGRAM (g/kg)
This indicates the dose of a substance given to test animals in toxicity studies. For example, a dose may be 2 grams (of substance) per kilogram of body weight (of the experimental animal).

HAZARDOUS MATERIAL
Any substance or compound that has the capability of producing adverse effects on the health and safety of humans or the environment.

IGNITABLE
A solid, liquid, or compressed gas that has a flash point of less than 140^{o}F. Ignitable material may be regulated by the EPA as a hazardous waste, as well.

INCOMPATIBLE
The term applied to two substances, to indicate that one material cannot be mixed or stored with the other, without the possibility of a dangerous reaction.

INGESTION
Taking a substance into the body through the mouth.

INHALATION
The breathing in of an airborne substance that may be in the form of gases, fumes, mists, vapors, dusts, or aerosols.

INHIBITOR
A substance that is added to another to prevent, or slow down an unwanted reaction or change.

IRRITANT
A substance that produces an irritating effect when in contact with skin, eyes, nose, or respiratory system.

kg
See KILOGRAM

KILOGRAM (Kg)
A unit of weight in the metric system equal to 2.2 pounds.

L
See LITER (sometimes abbreviated Lt)

LD50
See LETHAL DOSE 50

LEL
See LOWER EXPLOSIVE LIMIT

LETHAL CONCENTRATION 50
The concentration of an air contaminant (LC50) that kills 50 percent of the test animals in a group, within the first 30 days following exposure.

LETHAL DOSE 50
A calculated dose of a substance which is expected to cause the death of 50% of the entire defined experimental animal population.

LEL
See LOWER EXPLOSIVE LIMIT
LITER (L)
A measure of volume. One quart approximately equals 0.946 liters.

LOCAL EXHAUST VENTILATION
(Also known as exhaust ventilation)
A ventilation system that captures, and removes the contaminants, at the point they are being produced, before they escape into the workroom air. The system consists of hoods, ductwork, a fan, and possibly an air cleaning device. Advantages of local exhaust ventilation over general ventilation include: requires less air volume; more economical over the long term. However, the system must be properly designed, with properly designed and located hoods, and correctly sized fans and duct work.

LOWER EXPLOSIVE LIMIT
The lower limit of flammability of a gas or vapor. It is usually expressed in percentage of gas or vapor in air by volume.

M^3
See CUBIC METER

MELTING POINT
The temperature at which a solid changes to a liquid. A melting range may be given for mixtures.

mgSee MILLIGRAM
MILLIGRAMS PER CUBIC METER
Units used to measure (mg/m^3) concentration of dusts, gases, mists, and fumes in air.

MILLIGRAMS PER KILOGRAM
This indicates the dose of a substance (mg/kg) given to test animals in toxicity studies. For example, a dose may be 2 milligrams (of substance) per kilogram of body weight (of

the experimental animal).

MILLILITER (mL)
A metric unit used to measure VOLUME. One milliliter equals one cubic centimeter. One thousand milliliters equal one liter.

mL
See MILLILITER

MSHA
The Mine Safety and Health Administration; a federal agency that regulates the mining industry in the safety and health area.

MUTAGEN
Anything that can cause a change (or mutation) in the genetic material of a living cell.

NARCOSIS
Stupor or unconsciousness caused by exposure to a chemical.

NFPA
The National Fire Prevention Association is a voluntary membership organization whose aims are to promote and improve fire protection and prevention. NFPA has published 16 volumes of codes known as the National Fire Codes. Within these codes is Standard No. 704, "Identification of the Fire Hazards of Materials." This is a system that rates the hazard of a material during a fire. These hazards are divided into health, flammability, and reactivity hazards and appear in a well-known diamond system using from zero through four to indicate the severity of the hazard.

NIOSH
The National Institute of Occupational Safety and Health is a federal agency that among its various responsibilities, trains occupational health and safety professionals. NIOSH conducts research on health and safety concerns and tests and certifies respirators for work place use.

ODOR THRESHOLD
The minimum concentration of a substance at which a majority of test subjects can detect and identify the substance's characteristic odor.

ORAL
Having to do with the mouth.

OSHA
The Occupational Safety and Health Administration - a federal agency under the Department of Labor that publishes and enforces safety and health regulations for most

businesses and industries in the United States.

OXIDATION
The process of combining oxygen a with some other substance or a chemical change in which an atom loses electrons.

OXIDIZER
Is a substance that gives up oxygen easily, to stimulate combustion of organic material.

OXYGEN DEFICIENCY
An atmosphere having less than 21% oxygen.

PEL
See PERMISSIBLE EXPOSURE LIMIT

PERMISSIBLE EXPOSURE LIMIT (PEL)
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 OSHA REGULATIONS 1910.1000. SEE ALSO TLV.

PERSONAL PROTECTIVE EQUIPMENT
Any device or clothing worn by the worker to protect against hazards in the environment. Examples are: respirators, gloves, and chemical splash goggles.

POLYMERIZATION
A chemical reaction in which two or more small molecules combine to form larger molecules.

ppm
Parts (of vapor or gas) per million (parts of air) by volume.

REACTIVITY
A substance's susceptibility to undergoing a chemical reaction or change that may result in dangerous side effects. Examples include explosion, burning, and corrosive or toxic emissions. The conditions that cause the reaction, such as heat, other chemicals, or dropping, will usually be specified as "Conditions to Avoid" when a chemical's reactivity is discussed on a MSDS.

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

RESPIRATORY HAZARD
A particular concentration of an airborne contaminant that, when it enters the body by way of the respiratory system, or by being breathed into lungs, results in some bodily

function impairment.

SENSITIZER
A substance that may cause no reaction in a person during initial exposures, but subsequent exposures will cause an allergic response to the substance.

SHORT TERM EXPOSURE LIMIT
Represented as STEL or TLV-STEL, this is: a maximum concentration to which workers can be exposed for a 15 minute period, four times a day, with at least one hour between exposures.

SKIN
This designation sometimes appears alongside a TLV or PEL. It refers to the likelihood of absorption of the chemical through the skin and eyes.

STEL
See SHORT TERM EXPOSURE LIMIT.

SUBSTANCE
Any chemical entity.

SYNONYM
Another name by which the same chemical may be known.

SYSTEMIC
Spread throughout the body (affecting many or all body systems or organs, not localized in one spot or area).

TERATOGEN
An agent or substance that may cause physical defects in the developing embryo or fetus when a pregnant female is exposed to the substance.

THRESHOLD LIMIT VALUE
Airborne concentrations of substances published 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) that are based on evidence from industrial experience, animal studies, or human studies when they exist. There are three different types of TLVs. They are: Time Weighted Average (TLV-TWA), Short Term Exposure Limit (TLV-STEL), and Ceiling TLV-C). See also PEL.

TIME WEIGHTED AVERAGE
The average concentration, over a given work period (e.g., 8-hour workday), of a

person's exposure to a chemical or an agent. The average is determined by sampling for the contaminant throughout the time period. Represented as TLV-TWA.

TLV
See THRESHOLD LIMIT VALUE

TOXICITY
The potential of a substance to exert a harmful effect, on humans or animals, and a description of the effect and the conditions or concentration, under which the effect takes place.

TRADE NAME
The commercial name or trademark by which a chemical is known. One chemical may have a variety of trade names depending on the manufacturers or distributors involved.

TWA
See TIME WEIGHTED AVERAGE

UEL
See UPPER EXPLOSIVE LIMIT

UNSTABLE LIQUID
A liquid that in its pure state or as commercially produced, will react vigorously in some hazardous way under shock conditions (i.e., dropping), certain temperatures, or pressures.

UPPER EXPLOSIVE LIMIT (UEL)
(Also known as Upper Flammable Limit) It is the highest concentration (expressed in percentage of vapor or gas in the air by volume) of a substance that will burn or explode, when an ignition source is present. Theoretically, above this limit, the mixture is said to be too "rich" to support combustion. The range between the LEL and the UEL, constitutes the flammable range, or explosive range of a substance. For example, if the LEL is 1 ppm and UEL is 5 ppm, then the explosive range of the chemical is 1 ppm to 5 ppm. See also LEL.

VAPOR
The gaseous form of substances that are normally in the liquid or solid state (at normal room temperature and pressure). Vapors evaporate into the air from liquids.

SECTION XVIII
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APPENDICES

Appendix A
Acutely Toxic Gases*

NAME	CAS#	NAME	CAS#
arsenic pentafluoride	7784-36-3	oxygen diflouride	7783-41-7
arsine	7784-42-1	phosgen	75-45-5
baron trifluoride	7636-06-2	phosphine	1498-40-4
chlorine	7782-50-5	phosphorus pentafluoride	7641-19-0
diazomethane	334-88-3	selenium hexafluoride	7783-79-1
diborane	19287-45-7	silicon tetrafluoride	7783-61-1
fluorine	7681-49-4	stibine	10025-91-9
methyl mercaptan	74-93-1	sulfur tetrafluoride	7783-60-0

* This list is provided as a guide and is not all inclusive. Carefully review Material Safety Data Sheets before working with chemicals.

Appendix B
Acutely Toxic Chemicals*

Acrolein	Acrylyl chloride	2-Aminopyridine
Benzyl chloride	Bromine	Chlorine dioxide
Chlorine trifluoride	Chlorpicrin	Cyanogen chloride
Cyanuric fluoride	Decaborane	Dichloro acetylene
Dimethyl disulfide	Dimethylsulfate	Dimethylsulfide
Ethylene chlorohydrin	Ethylene fluorohydrin	Hexamethylene diisocyanate
Hexamethyl phosphoramide	Iodine	Iron pentacarbonyl
Isopropyl formate	Methacryloyl chloride	Methacryloxyethyl isocyanate
Methyl acrylonitrile	Methyl chloroformate	Methylene biphenyl isocyanate
Methyl fluoroacetate	Methyl fluorosulfate	Methyl hydrazine
Methyltrichlorosilane	Methyl vinyl ketone	Nickel carbonyl
Nitrogen tetroxide	Nitrogen trioxide	Organo Tin compounds
Osminum tetroxide	Oxygen difluoride	Ozone
Pentaborane	Perchloromethyl mercaptan	Phosphorus oxychloride
Phosphorous trichloride	Sarin	Sulfur monochloride
Sulfur pentafluoride	Sulfuryl chloride	Tellurium hexafluoride
Tetramethyl succinonitrile	Tetranitromethane	Thionyl chloride
Toluene-2,4-diisocyanate	Trichloro (chlormethyl) silane	

* This list is provided as a guide and is not all inclusive. Carefully review Material Safety Data Sheets before working with chemicals.

Appendix C
Select Carcinogens*

Name	CAS#	Name	CAS#
Arsenic and Arsenic compounds	7440-38	Asbestos	12001-29-5
Azathioprine	446-86-6	Benzene	71-43-2
Benzidine	92-87-5	N,N-bis(2-chloroethyl)-2-naphthylamine Bis(chloromethyl)ether	494-03-1
1,4-Butanediol dimethylsulfonate (myleran)	55-98-1	Certain combined chemotherapy for lymphomas	
Chlorambucil	305-03-3	Chloromethyl methyl ether (technical grade)	107-30-2
Chromium and chromium compounds	7440-47-3	Conjugated estrogens	
Melphalan	148-82-3	Methoxsalen with ultra-violet A therapy (PUVA)	
2-Napthylamine	91-59-8	Soots, tars, and mineral oils	
Thorium dioxide	1314-20-1	Vinyl chloride	75-01-4

* This list is provided as a guide and is not all inclusive. Carefully review Material Safety Data Sheets before working with chemicals.

Suspected Carcinogens*

Name	CAS#	Name	CAS#
2-Acetylaminofluorene	53-96-3	Acrylonitrile	105-13-1
Adriamycin	232-14-92-8	Aflatoxins	1402-68-2
2-Aminanthraquinone	117-79-3	1-Amino-2-methylanthraquinone	82-28-0
Amitrole	61-82-5	o-Anisidine	140-57-8
o-Anisidine hydrochloride	134-29-2	Aramite	140-57-8
Benz(a)anthracene	50-32-8	Benzotrichloride	98-07-7
Benzo(a)pyrene	50-32-8	Benzotrichloride	98-07-7
Beryllium and beryllium compounds	7440-41-7	Bischloroethyl nitrosourea	154-93-8
Cadmium and cadmium compounds	7440-43-9	Carbon tetrachloride	56-23-5
1-(2Chloroethyl)-3-cyclohexyl-1 - nitrosourea (CCNU)	130-10-47-4	Chloroform	67-66-3
4-Chloro-o-phenylenediamine	95-83-0	p-Cresidine	120-71-8
Cupferron	135-20-6	Cycasin	14901-08-7
Dacarbazine	4342-03-4	DDT	50-29-3
2,4-Diaminoanisole sulfate	39156-41-7	2,4-Diaminotoluene	95-80-7
Dibenz(a,h) acridine	226-36-8	Dibenz(a,j)acridine	224-42-0
Dibenz(a,h)anthracene	53-70-3	7H-Dibenzoc(c,g)Carbazole	194-59-2
Dibenzo(a,h)pyrene	189-64-0	Dibenzp(a,i)pyrene	89-55-9
1,2-Dibromo-3-chloropropane	96-12-8	1,2-Dibromoethane(EDB)	106-93-4

Suspected Carcinogens
Continued

3,3'-Dichlorobenzidine	91-94-1	1,2-Dibromoethane (EDB)	107-06-2
Diepoxybutane	1464-53-5	Di(2-ethylhexyl)phthalate	117-81-7
Diethyl sulfate	64-67-5	3,3'-Dimethoxybenzidine	119-90-4
4-Dimethylaminoazobenzene	60-11-7	3,3'-Dimethylbenzidine	119-93-7
Dimethylcarbamoyl chloride	79-44-7	1,1-Dimethylhydrazine	57-14-7
Dimethyl sulfate	77-78-1	1,4-Dioxane	123-91-1
Direct Black	381937-37-7	Direct Blue	62602-46-2
Epichlorohydrin	106-89-8	Estrogens (not conjugated:) 1. Estradiol 17B	50-28-2
Estrogens (not conjugated 2. Estrone	53-16-7	Estrogens (not conjugated): 3. Ethinylestradiol5	7-63-6
Estrogens (not conjugated): 4 Mestranol	72-33-3	Ethylene oxide	75-21-8
Ethylene thiourea	96-45-7	Formaldehyde (Formalin solutions)	50-00-0
Hexachlorobenzene	118-74-1	Hexamethylphosphoramide	680-31-9
Hydrazine and hydrazine sulfate	10034-93-2	Hydrazobenzene	302-01-2
Indeno(1,2,3-cd)pyrene	193-39-5	Iron dextran complex	9004-66-4
Kepone(Chlordecone)	143-50-0	Lead acetate and lead phosphate	301-04-2
Lindane and other hexachlorocyclohexane isomers	58-89-9	2-Methylaziridine (propyleneimine)	75-55-8
4,4'-Methylenebis(2-chloroaniline) (MBOCA)	101-144	4,4'-Methylenebix(N,N-dimethyl) benzenamine	101-61-1

Suspected Carcinogens
Continued

4,4'-Methylenedianiline	101-77-9	4,4'-Methylenedianiline dihydrochloride	13552-44-8
Methyl iodide	74-88-4	Metronidazole	443-48-1
Michler's ketone	90-94-8	Mirex	2385-85-5
Nickel and nickel compounds	7440-02-0	Nitrilotriacetic acid	139-13-9
5-Nitro-o-anisidine	99-59-2	Nitrofen	1836-75-5
Nitrogen mustard	51-75-2	2-Nitropropane	79-46-9
N-Nitrosodi-n-butylamine	924-16-3	N-Nitrosodiethanolamine	1116-54-7
N-Nitrosodiethyl-amine	64-69-7	N-Nitrosodimethyl-amine	39885-14-8
p-Nitrosodiphenylamine	158-10-5	N-Nitrosodi-n-propylamine	621-64-7
N-Nitroso-N-ethylurea	759-73-9	N-Nitroso-N-methylurea	684-93-5
N-Nitrosomethylvinylamine	4549-40-0	N-Nitrosomopholine5	9-89-2
N-Nitrosonornicotine	16543-55-8	N-Nitrosopiperdine	100-75-4
N-Nitrosopyrrolidine	930-55-2	N-Nitrososarcosine	13256-22-9
Norethisterone	3836-23-5	Oxymetholone	434-07-1
Phenacetin	62-44-2	Phenazopyridine hydrochloride	136-40-3
Phenytoin	57-41-0	Sodium salt of phenytoin	630-93-3
Polybrominated biphenyls	59536-65-1	Polychlorinated biphenyls	1336-36-3
Procarbazine	671-16-9	Procarbazine hydrochloride	366-70-1
Progesterone	57-83-0	1,3-Propane sultone	1120-71-4
B-Propiolactone	530-30-0	Propythiouracil	51-52-5

Suspected Carcinogens
Continued

Reserpine	50-55-5	Saccharin	81-07-2
Safrole	94-59-7	Selenium sulfide	446-34-6
Streptozocin	18883-66-4	Sulfallate	95-06-7
2,3,7,8-Tetrachlorodibenzo-p-dioxin(TCDD)	1746-01-6	Thioacetamide	62-55-5
Thiourea	62-56-5	Toluene diisocyanate	584-84-9
o-Toluidine	95-53-4	o-Toluidine hydrochloride	636-21-5
Toxaphene	8001-35-2	2,4,6-Trichlorophenol	88-06-2
Tris(1-aziridinyl)phosphine sulfide	52-24-4	Tris(2,3-dibromopropyl)phosphate	126-72-7
Urethane	51-79-6		

Appendix D
Reproductive Hazards*

Name	CAS#	Name	CAS#
Acetaldehyde	75-07-0	Hydrazine(s)	302-01-2
Arsenic	7440-38-2	Hexafluoroacetone	684-16-2
Aniline	62-53-3	Halothane	151-67-7
Aflatoxins		Karathane	131-72-6
Benzene	71-43-2	Lead (inorganic compounds)	7439-92-1
Benzp(a)pyrene	50-32-8	2-Methoxyethanol	109-86-4
Carbon disulfide	75-15-0	2-Methoxyethyl acetate	110-49-6
Chloroform	67-66-3	Methyl chloride	74-87-3
Chloroprene	126-99-8	N-Methyl-2-pyrrolidone	872-50-4
Dimethyl formamide	68-12-2	Propylene glycol monomethyl ether	107-98-2
Di-sec-octyl-phthalate	117-81-7	Propylene glycol monomethyl ether acetate	108-65-6
Dinitrooctyl phenol	63149-81-5	Propylene oxide	75-56-9
Dithane	111-54-6	Trichloroethylene	79-01-6
2-Ethoxy ethanol	110-80-5	RH-7592	
2-Ethoxyethyl acetate	111-15-9	Systhane/RH-3866	88671-89-0
Ethylene thiourea	96-45-7	TOK (herbicide)	1836-75-5
2-Ethylhexanol	104-76-7	Toluene	108-88-3
Glycol ethers		Vinyl chloride	75-01-4

*This list is provided as a guide and is not all inclusive. review Material Safety Data Sheets before using

Appendix E
Chemical Hygiene Work Plan
(Sample Document)

Standard Operating Procedure	Acutely Toxic Gases	Acutely Toxic Chemicals	Carcinogens	Compressed Gases	Corrosive Chemicals	Flammable Liquids
See CHP	Page 71	Page 67	Page 75	Page 80	Page 83	Page 87
Cylinders Secured		NA	NA		NA	NA
Decontamination Procedure				NA		
Designated Area				NA	NA	NA
Emergency Procedure						
Eye Protection						
Eyewash					NA	
Fume Hood						
Gloves (dry) Box				NA	NA	NA
Gloves (type)				NA		
Hazard Assessment						
Protective Apparel						
Safety Shielding						
Safety Shower						
Signs/Label						
Special Storage						
Special Ventilation						
Spill Response						
Vacuum Protection				NA	NA	

Appendix E
Chemical Hygiene Work Plan
(Sample Document)

See CHP	Oxidizing Chemicals	Pyrophoric Chemicals	Reactive Liquids	Reactive Solids	Reproductive Hazards	Water Sensitive Chemicals
Cylinders Secured	Page 91	Page 95	Page 99	Page 103	Page 107	Page 112
Decontamination Procedure	NA	NA	NA	NA	NA	NA
Designated Area						
Emergency Procedure	NA	NA	NA	NA		NA
Eye Protection						
Eyewash						
Fume Hood						
Gloves (dry) Box						
Gloves (type)	NA					NA
Hazard Assessment						
Protective Apparel						
Safety Shielding						
Safety Shower						
Signs/Label						
Special Storage						
Spill Response						
Vacuum Protection						
Waste Disposal			NA			NA

NORTHERN ILLINOIS UNIVERSITY
STANDARD OPERATING PROCEDURES FOR:

ACUTELY TOXIC CHEMICALS

Standard operating procedures (SOP) are intended to provide you with general guidance on how to safely work with a specific class of chemical or hazard. This SOP is generic in nature. It addresses the use and handling of substances by hazard class only. In some instances multiple SOPs may be applicable for a specific chemical (i.e., both the SOPs for flammable liquids and carcinogens would apply to benzene). If you have questions concerning the applicability of any items listed in this procedure contact the Department of Environmental Health and Safety 753-0404 or the Principal Investigator of your laboratory. Specific written procedures are the responsibility of the Principal Investigator.

If compliance with all the requirements of this standard operating procedure is not possible, the Principal Investigator must develop a written procedure that will be used in its place. This alternate procedure must provide the same level of protection as the SOP it replaces. The Department of Environmental Health and Safety is available to provide guidance during the development of alternate procedures.

A list of acutely toxic chemicals is included in Appendix B of the chemical hygiene plan.

Securing of gas cylinders

Not applicable

Decontamination procedures

Personnel: Wash hands and arms with soap and water immediately after handling acutely toxic chemicals.

Area: Decontamination procedures vary depending on the material being handled. The toxicity of some materials can be neutralized with other reagents. All surfaces should be wiped with the appropriate cleaning agent following dispensing or handling. Waste materials generated should be treated as a hazardous waste.

Equipment: Decontaminate vacuum pumps or other contaminated equipment (glassware) before removing them from the designated area.

Designated area

The room number sign for the laboratory must contain a *Designated Areas Within* identifier.

All locations within the laboratory where acutely toxic chemicals are handled should be posted with designated area caution signs. This includes all fume hoods and bench tops where the acutely toxic chemicals are handled.

Where feasible acutely toxic chemicals should be manipulated over plastic-backed disposable paper work surfaces. These disposable work surfaces minimize work area contamination and simplify clean up.

Emergency procedure

Emergency procedures which address response actions to fires, explosions, spills, injury to staff, or the development of sign and symptom of overexposure must be developed. The procedures should address as a minimum the following:

Who to contact: (University Police, and Department of Environmental Health and Safety, Principal Investigator of the laboratory including evening phone number)

The location of all safety equipment (showers, eye wash, fire extinguishers, etc.)

The method used to alert personnel in nearby areas of potential hazards

Special first aid treatment required by the type of acutely toxic material(s) handled in the laboratory.

Eye protection

Eye protection must be worn at all times when handling acutely toxic chemicals. Ordinary (street) prescription glasses do not provide adequate protection. (Contrary to popular opinion these glasses cannot pass the rigorous test for industrial safety glasses.) Adequate safety glasses must meet the requirements of the Practice for Occupational and Educational Eye and Face Protection (ANSI.Z.87. 1 1989) and must be equipped with side shields. Safety glasses with side shields do not provide adequate protection from splashes, therefore, when the potential for splash hazard exists other eye protection and/or face protection must be worn.

Eye wash

Where the eyes or body of any person may be exposed to acutely toxic chemicals, suitable facilities for quick drenching or flushing of the eyes and body shall be provided within the work area for immediate emergency use. Bottle type eyewash stations are

not acceptable.

Fume hood

Manipulation of acutely toxic chemicals should be carried out in a fume hood. If the use of a fume hood proves impractical refer to the section on special ventilation.

All areas where acutely toxic chemicals are stored or manipulated must be labelled as a designated area.

Glove (dry) box

Certain acutely toxic chemicals must be handled in a glove box rather than a fume hood. The Department of Environmental Health and Safety (3-0404) or the Principal Investigator will determine if this is required.

Gloves

Gloves should be worn when handling acutely toxic chemicals. The selection of glove materials should be made from Table 1 of this document.

Hazard assessment

Hazard assessment should focus on proper use and handling procedures, the education of employees concerning the health risk posed by acutely toxic materials, and on the demarcation of designated areas.

Protective apparel

Lab Coats, closed toed shoes and long sleeved clothing should be worn when handling acutely toxic chemicals. Additional protective clothing should be worn if the possibility of skin contact is likely.

Safety shielding

Safety shielding is required any time there is a risk of explosion, splash hazard or a highly exothermic reaction. All manipulations of acutely toxic hood with the sash in the lowest feasible position. Portable shields, which provide protection to all laboratory occupants, are acceptable.

Safety shower

A safety or drench shower should be available in a nearby location where the acutely toxic chemicals are used.

Signs and labels

Doorways: The room number sign must contain a *Designated Area Within Caution* where carcinogens, reproductive hazards, and/or acutely toxic chemicals are stored or used.

Containers: All acutely toxic chemicals must be clearly labelled with the correct chemical name. Handwritten labels are acceptable; chemical formulas and structural formulas are not acceptable. A label for acutely toxic chemicals is available.

Special storage

Acutely toxic chemicals must be stored in a designated area.

Special ventilation

Manipulation of acutely toxic chemicals outside of a fume hood may require special ventilation controls in order to minimize exposure to the material. Fume hoods provide the best protection against exposure to acutely toxic chemicals in the laboratory and are the preferred ventilation control device. Where possible handle acutely toxic chemicals in a fume hood. If the use of a fume hood proves impractical, attempt to work in a glove box or in an isolated area on the laboratory bench top.

If available, consider using a Biological Safety Cabinet. The biological safety cabinet is designed to remove the acutely toxic chemicals before the air is discharged into the environment. Acutely toxic chemicals that are volatile must not be used in a biological safety cabinet unless the cabinet is vented to the outdoors.

If your research does not permit the handling of acutely toxic chemicals in a fume hood, biological safety cabinet, or glove box, you must contact the Department of Environmental Health and Safety.

All areas where acutely toxic chemicals are stored or manipulated must be labelled as a designated area.

Spill response

Anticipate spills by having the appropriate clean up equipment on hand. The appropriate clean up supplies can be determined by consulting the Material Safety Data Sheet. This should occur prior to the use of any acutely toxic chemical.

In the event of a spill alert personnel in the area that a spill has occurred. Do not attempt to handle a large spill of acutely toxic chemicals. Vacate the laboratory immediately and call for assistance.

- Department of Environmental Health & Safety 3-0404
- University Police 911 or 3-1212 (This is a 24 hour service.)

Remain on the scene, but at a safe distance, to receive and direct safety personnel when they arrive.

Vacuum protection

Evacuated glassware can implode and eject flying glass and splattered chemicals. Vacuum work involving acutely toxic chemicals must be conducted in a fume hood, glove box or isolated in an acceptable manner.

Mechanical vacuum pumps must be protected using cold traps and, where appropriate, filtered to prevent particulate release. The exhaust for the pumps must be vented into an exhaust hood.

Waste disposal

All materials contaminated with acutely toxic chemicals should be disposed of as a hazardous waste. Wherever possible, attempt to design research in a manner that reduces the quantity of waste generated. Questions regarding waste pick up should be directed to the Department of Environmental Health and Safety. This office can also assist you in minimizing waste generation.

STANDARD OPERATING PROCEDURES FOR: ACUTELY TOXIC GASES

Standard operating procedures (SOP) are intended to provide you with general guidance on how to safely work with a specific class of chemical or hazard. This SOP is generic in nature. It addresses the use and handling of substances by hazard class only. In some instances multiple SOPs may be applicable for a specific chemical (i.e., both the SOPs for flammable liquids and carcinogens would apply to benzene). If you have questions concerning the applicability of any items listed in this procedure contact the Department of Environmental Health and Safety 3-0404 or the Principal Investigator of your laboratory. Specific written procedures are the responsibility of the Principal Investigator.

If compliance with all the requirements of this standard operating procedure is not possible, the Principal Investigator must develop a written procedure which must provide the same level of protection as the SOP it replaces. The Department of Environmental Health and Safety is available to provide guidance during the development of alternate procedures.

A list of acutely toxic gases is included in Appendix B of the chemical hygiene plan.

Securing of gas cylinders

Cylinders of compressed gases must be handled as high energy sources. When storing or moving a cylinder, have the cap securely in place to protect the stem. Use suitable racks, straps, chains or stands to support cylinders.

Decontamination procedures

Personnel: Wash hands and arms with soap and water immediately after handling acutely toxic gases.

Designated area

The room number sign for the laboratory must contain a *Designated Areas Within* identifier.

All locations within the laboratory where acutely toxic gases are handled should be demarcated with designated area caution tape and/or posted with designated area caution signs.

This includes all fume hoods and bench tops where the acutely toxic gases are handled.

Emergency procedure

Emergency procedures which address response actions to fires, explosions, spills, injury to staff, or the development of sign and symptom of overexposure must be developed. The procedures should address as a minimum the following:

Who to contact: (University Police, and Department of Environmental Health and Safety, Principal Investigator of the laboratory including evening phone number)

The location of all safety equipment (showers, eye wash, fire extinguishers, etc.)

The method used to alert personnel in nearby areas of potential hazards

Special first aid treatment required by the type of acutely toxic material

Eye protection

Eye protection must be worn at all times when handling acutely toxic gases. Ordinary (street) prescription glasses do not provide adequate protection. (Contrary to popular opinion these glasses cannot pass the rigorous test for industrial safety glasses.) Adequate safety glasses must meet the requirements of the Practice for Occupational and Educational Eye and Face Protection (ANSI Z.87. 1 1989) and must be equipped with side shields. Safety glasses with side shields do not provide adequate protection from splashes; therefore, when the potential for splash hazard exists other eye protection and/or face protection must be worn.

Eyewash

Where the eyes or body of any person may be exposed to acutely toxic gases, suitable facilities for quick drenching or flushing of the eyes and body shall be provided within the work area for immediate emergency use. Bottle type eyewash stations are not acceptable.

Fume hood

Manipulation of acutely toxic gases should typically be carried out in a fume hood. All areas where acutely toxic gases are stored or manipulated must be labelled as a designated area.

Glove (dry) box

Some processes involving acutely toxic gases may be performed in a properly vented glove box rather than a fume hood.

Gloves

Gloves should be worn when handling acutely toxic gases. The selection of glove materials should be made from Table 1 of this document.

Hazard assessment

Hazard assessment should focus on the education of employees concerning the health risk posed by acutely toxic gases, on proper use and handling procedures, the demarcation of designated areas, and emergency evacuation and notification procedures in the event of a spill.

Protective apparel

Lab coats, closed toed shoes and long sleeved clothing should be worn when handling acutely toxic gases. The need for additional protective equipment will be determined by the Department of Environmental Health and Safety on a case-by-case basis.

Safety shielding

Safety shielding is required any time there is a risk of explosion, splash hazard or a highly exothermic reaction. All manipulations of acutely toxic gases which pose this risk should occur in a fume hood with the sash in the lowest feasible position. Portable shields, which provide protection to all laboratory occupants, are acceptable.

Safety shower

A safety or drench shower should be available in a nearby location where the acutely toxic gases are used.

Signs and labels

Doorways: The room number sigh must contain a *Designated Area Within Caution* where carcinogens, reproductive hazards, and/or acutely toxic chemicals are stored or used.

Containers: All acutely toxic gas cylinders must be clearly labelled with the correct chemical name.

Handwritten labels are acceptable; chemical formulas and structural formulas are not acceptable. A label for acutely toxic gases is available.

Special storage

Acutely toxic gases must be stored in a designated area. Special ventilation of the stored cylinders is required and must be approved by the Department of Environmental Health and Safety.

Continuous monitoring devices which will alert staff of a release of the acutely toxic gas is required for certain gases.

The quantity of an acutely toxic gas that may be stored in a laboratory will be determined on a case-by-case basis by the Department of Environmental Health and Safety.

Special ventilation

Manipulation of toxic gases outside of a fume hood will require special ventilation

controls in order to minimize exposure to the material. Fume hoods provide the best protection against exposure to acutely toxic gases in the laboratory and are the preferred ventilation control device. Always attempt to handle acutely toxic gases in a fume hood. If your research does not permit the handling of acutely toxic gases in your fume hood you must contact the Department of Environmental Health and Safety to review the adequacy of all special ventilation.

Spill response

In the event of an escape of gas alert personnel in the area that a spill has occurred. Do not attempt to handle a spill of acutely toxic gases. Vacate the laboratory immediately and call for assistance.

- Department of Environmental Health and Safety 3-0404
- University Police 911 or 3-1212 (This is a 24 hour service.)

Remain on the scene, but at a safe distance, to receive and direct safety personnel when they arrive.

Vacuum protection

Not applicable

Waste disposal

All empty or partially filled acutely toxic gas cylinders should be returned to the supplier. If the supplier does not accept empty or partially filled cylinders, contact the Department of Environmental Health and Safety concerning disposal.

STANDARD OPERATING PROCEDURES FOR: CARCINOGENS

Standard operating procedures (SOP) are intended to provide you with general guidance on how to safely work with a specific class of chemical or hazard. This SOP is generic in nature. It addresses the use and handling of substances by hazard class only. In some instances multiple SOPs may be applicable for a specific chemical (i.e., both the SOPs for flammable liquids and carcinogens would apply to benzene). If you have questions concerning the applicability of any items listed in this procedure contact the Department of Environmental Health and Safety 3-0404 or the Principal Investigator of your laboratory. Specific written procedures are the responsibility of the Principal Investigator.

If compliance with all the requirements of this standard operating procedure is not possible, the Principal Investigator must develop a written procedure that will be used in

its place. This alternate procedure must provide the same level of protection as the SOP it replaces. The Department of Environmental Health and Safety is available to provide guidance during the development of alternate procedures.

A carcinogen commonly describes any agent that can initiate or speed the development of malignant or potentially malignant tumors, malignant neoplastic proliferation of cells, or cells that possess such material. A listing of carcinogenic materials can be found in Appendix C.

Securing of gas cylinders

Not applicable

Decontamination procedures

Personnel: Wash hands and arms with soap and water immediately after handling carcinogens.

Area: Decontamination procedures vary depending on the material being handled. The toxicity of some materials can be neutralized with other reagents. All surfaces should be wiped with the appropriate cleaning agent following dispensing or handling. Waste materials generated should be treated as hazardous waste.

Equipment: Decontaminate vacuum pumps or other contaminated equipment (glassware) before removing them from the designated area.

Designated area

The room number sign for the laboratory must contain a *Designated Areas Within* identifier.

All locations within the laboratory where carcinogens are handled should be demarcated with designated area caution tape and/or posted with designated area caution signs. This includes all fume hoods and bench tops where the carcinogens are handled.

Where feasible, carcinogens should be manipulated over plastic-backed disposable paper work surfaces. These disposable work surfaces minimize work area contamination and simplify clean up.

Emergency procedure

Emergency procedures which address response actions to fires, explosions, spills, injury to staff, or the development of sign and symptom of overexposure must be developed. The procedures should address as a minimum the following:

Who to contact: (University Police, and Department of Environmental Health and Safety, Principal Investigator of the laboratory including evening phone number)

The location of all safety equipment (showers, eye wash, fire extinguishers, etc.)

The method used to alert personnel in nearby areas of potential hazards

Special first aid treatment required by the type of carcinogens handled in the laboratory.

Eye protection

Eye protection in the form of safety glasses must be worn at all times when handling carcinogens. Ordinary (street) prescription glasses do not provide adequate protection. (Contrary to popular opinion these glasses cannot pass the rigorous test for industrial safety glasses.) Adequate safety glasses must meet the requirements of the Practice for Occupational and Educational Eye and Face Protection (ANSI Z.87.1 1989) and must be equipped with side shields. Safety glasses with side shields do not provide adequate protection from splashes; therefore, when the potential for splash hazard exists other eye protection and/or face protection must be worn.

Eyewash

Where the eyes or body of any person may be exposed to carcinogens, suitable facilities for quick drenching or flushing of the eyes and body shall be provided within the work area for immediate emergency use. Bottle type eyewash stations are not acceptable.

Fume hood

Manipulation of carcinogens should be carried out in a fume hood. If the use of a fume hood proves impractical refer to the section on special ventilation.

All areas where carcinogens are stored or manipulated must be labelled as a designated area.

Glove (dry) box

Certain carcinogens must be handled in a glove box rather than a fume hood. The Department of Environmental Health and Safety (3-0404) or the Principal Investigator will determine if this is required.

Gloves

Gloves must be worn when handling carcinogens. The selection of glove materials should be made from Table 1 of this document.

Hazard assessment

Hazard assessment should focus on proper use and handling techniques, education of laboratory workers concerning the health risks posed by carcinogens, and the demarcation of designated areas.

Protective apparel

Lab coats, closed toed shoes and long sleeved clothing should be worn when handling carcinogens. Additional protective clothing should be worn if the possibility of skin contact is likely.

Safety shielding

Safety shielding is required any time there is a risk of explosion, splash hazard or a highly exothermic reaction. All manipulations of carcinogens which pose this risk should occur in a fume hood with the sash in the lowest feasible position. Portable shields, which provide protection to all laboratory occupants, are acceptable.

Safety shower

A safety or drench shower should be available in a nearby location where the carcinogens are used.

Signs and labels

Doorways:	The room number sign must contain a *Designated Area Within Caution* where carcinogens, reproductive hazards, and/or acutely toxic chemicals are stored or used.
Containers:	All containers of carcinogens must be clearly labelled with the correct chemical name. Handwritten labels are acceptable; chemical formulas and structural formulas are not acceptable.

Special storage

Carcinogens must be stored in a designated area.

Special ventilation

Manipulation of carcinogens outside of a fume hood may require special ventilation controls in order to minimize exposure to the material. Fume hoods provide the best protection against exposure to carcinogens in the laboratory and are the preferred ventilation control device. When possible, handle carcinogens in a fume hood. If the use of a fume hood proves impractical, attempt to work in a glove box or on an isolated area on the bench top.

If available, consider using a Biological Safety Cabinet. The biological safety cabinet is designed to remove particulates (the carcinogen) before the air is discharged into the environment. Carcinogens that are volatile must not be used in a biological safety cabinet unless the cabinet is vented to the outdoors.

If your research does not permit the handling of carcinogens in a fume hood, biological safety cabinet, or glove box, you must contact the Department of Environmental Health and Safety.

All areas where carcinogens are stored or manipulated must be labelled as a designated area.

Spill response

Anticipate spills by having the appropriate clean up equipment on hand. The appropriate clean up supplies can be determined by consulting the Material Safety Data Sheet. This should occur prior to the use of any carcinogen.

In the event of a spill alert personnel in the area that a spill has occurred. Do not attempt to handle a large spill of carcinogenic material. Vacate the laboratory immediately and call for assistance.

- Department of Environmental Health and Safety 3-0404
- University Police 911 or 3-1212 (This is a 24 hour service.)

Remain on the scene, but at a safe distance, to receive and direct safety personnel when they arrive.

Vacuum protection

Evacuated glassware can implode and eject flying glass and splattered chemicals. Vacuum work involving carcinogens must be conducted in a fume hood, glove box or isolated in an acceptable manner.

Mechanical vacuum pumps must be protected using cold traps and, where appropriate, filtered to prevent particulate release. The exhaust for the pumps must be vented into an exhaust hood.

Waste disposal

All materials contaminated with carcinogens should be disposed of as hazardous waste. Wherever possible, attempt to design research in a manner that reduces the quantity of waste generated. Questions regarding waste pick up should be directed to the Department of Environmental Health and Safety. This office can also assist you in minimizing waste generation.

STANDARD OPERATING PROCEDURES FOR: COMPRESSED GASES

Standard operating procedures (SOP) are intended to provide you with general guidance on how to safely work with a specific class of chemical or hazard. This SOP is generic in nature. It addresses the use and handling of substances by hazard class only. In some instances multiple SOPs may be applicable for a specific chemical (i.e., both the SOPs for flammable liquids and carcinogens would apply to benzene). If you have questions concerning the applicability of any item listed in this procedure contact the Department of Environmental Health and Safety (3-0404) or the Principal Investigator of your laboratory. Specific written procedures are the responsibility of the Principal Investigator.

If compliance with all the requirements of this standard operating procedure is not possible, the Principal Investigator must develop a written procedure that will be used in its place. This alternate procedure must provide the same level of protection as the SOP it replaces. The Department of Environmental Health and Safety is available to provide guidance during the development of alternate procedures.

Additional requirements may apply if the materials is an acutely toxic compressed gas. Please refer to the SOP for acutely toxic gases if applicable.

Securing of gas cylinders

Cylinders of compressed gases must be handled as high energy sources. They pose a serious hazard if the cylinder valve is dislodged. When storing or moving a cylinder, have the cap securely in place to protect the stem. Use suitable racks, straps, chains or stands to support cylinders.

Decontamination procedures

Not applicable

Designated area

Compressed gas cylinders which contain acutely toxic gases must be stored in a designated area. See the SOP for acutely toxic compressed gases.

Emergency procedure

Emergency procedures which address response actions to fires, explosions, spills, injury to staff, or the development of sign and symptoms of overexposure must be developed. The procedures should address as a minimum the following:

Who to contact: (University Police, and Department of Environmental Health and

Safety, Principal Investigator of the laboratory including evening phone number)

The location of all safety equipment (showers, eye wash, fire extinguishers, etc.)

The method used to alert personnel in nearby areas of potential hazards

Special first aid treatment required by the type of compressed gas handled in the laboratory

Eye protection

Eye protection must be worn at all times when handling compressed gases. Ordinary (street) prescription glasses do not provide adequate protection. (Contrary to popular opinion these glasses cannot pass the rigorous test for industrial safety glasses.) Adequate safety glasses must meet the requirements of the Practice for Occupational and Educational Eye and Face Protection (ANSI Z87.1 1989) and must be equipped with side shields.

Eyewash

Not applicable

Fume hood

Manipulation of compressed gases should typically be carried out in a fume hood if the compressed gas is an irritant, oxidizer, asphyxiant, or has other hazardous properties.

Glove (dry) box

Not applicable

Gloves

Not applicable

Hazard assessment

Hazard assessment for work with compressed gases should assure that all staff understand proper use and handling precautions; that all pressurized equipment is properly shielded; regulators are not interchanged between different gas types; all hose connections are properly secured and are appropriate for the pressure(s) used.

Protective apparel

Lab coats, closed toed shoes and long sleeved clothing should be worn when handling compressed gases.

Safety shielding

Safety shielding is required any time there is a risk of explosion, splash hazard or a highly exothermic reaction. All manipulations of compressed gases which pose this risk should occur in a fume hood with the sash in the lowest feasible position. Portable shields, which provide protection to all laboratory occupants, are acceptable.

Safety shower

Not applicable

Signs and labels

Containers: All compressed gases must be clearly labelled with the correct chemical name. Handwritten labels are acceptable; chemical formulas and structural formulas are not acceptable. The compressed gas cylinder should be labelled to indicate if the container is full or empty.

Special storage

Cylinders should be stored in an upright position and secured to a wall or laboratory bench through the use of chains or straps. Cylinder caps should remain on the cylinder at all times unless a regulator is in place. Cylinders should be stored in areas where they will not become overheated. Avoid storage near radiators, areas in direct sunlight, steam pipes and heat releasing equipment such as sterilizers.

Transport compressed gas cylinders on equipment designed for this function. Never carry or "walk" cylinders by hand.

Special ventilation

Manipulation of compressed gas that is an irritant, oxidizer, asphyxiant, or has other hazardous properties outside of a fume hood may require special ventilation controls in order to minimize exposure to the material. Fume hoods provide the best protection against exposure to compressed gases in the laboratory and are the preferred ventilation control device. If you have questions contact the Department of Environmental Health and Safety to review the adequacy of all special ventilation.

Spill response

In the event of a spill of a compressed gas that is an irritant, oxidizer, asphyxiant, or has other hazardous properties all personnel in the area should be alerted. Vacate the laboratory immediately and call for assistance.

< Department of Environmental Health and Safety 753-0404
< University Police 911 or 753-1212 (This is a 24 hour service.)

Remain on the scene, but at a safe distance, to receive and direct safety personnel when they arrive.

Vacuum protection

Not applicable

Waste disposal

All empty or partially filled compressed gas cylinders should be returned to the supplier. If the supplier does not accept empty or partially filled cylinders, contact the Department of Environmental Health and Safety concerning disposal.

STANDARD OPERATING PROCEDURES FOR: CORROSIVE CHEMICALS

Standard operating procedures (SOP) are intended to provide you with general guidance on how to safely work with a specific class of chemical or hazard. This SOP is generic in nature. It addresses the use and handling of substances by hazard class only. In some instances multiple SOPs may be applicable for a specific chemical(i.e., both the SOPs for flammable liquids and carcinogens would apply to benzene). If you have questions concerning the applicability of any item listed in this procedure contact the Department of Environmental Health and Safety 753-0404 or the Principal Investigator of your laboratory. Specific written procedures are the responsibility of the Principal Investigator.

If compliance with all the requirements of this standard operating procedure is not possible, the Principal Investigator must develop a written procedure that will be used in its place. This alternate procedure must provide the same level of protection as the SOP it replaces. The Department of Environmental Health and Safety is available to provide guidance during the development of alternate procedures.

Corrosive chemicals are substances that cause visible destruction or permanent changes in human skin tissue at the site of contact, or are highly corrosive to steel. The major classes of corrosives include strong acids, bases, and dehydrating agents.

Securing of gas cylinders

Not applicable

Decontamination procedures

Personnel: Immediately flush contaminated area with copious amounts of water after contact with corrosive materials. Remove any jewelry to facilitate removal of chemicals. If a delayed response is noted report immediately for medical attention. Be prepared to detail what chemicals were involved.

If the incident involves **Hydrofluoric acid (HF)**, seek immediate medical attention.

If there is any doubt about the severity of the injury, seek immediate medical attention.

Area: Decontamination procedures vary depending on the material being handled. The corrosivity of some materials can be neutralized with other reagents. Special neutralizing agents should be on hand to decontaminate areas.

Designated area

Not applicable

Emergency procedure

Emergency procedures which address response actions to fires, explosions, spills, injury to staff, or the development of sign and symptom of overexposure must be developed. The procedures should address as a minimum the following:

Who to contact: (University Police, and Department of Environmental Health and Safety, Principal Investigator of the laboratory including evening phone number)

The location of all safety equipment (showers, spill clean up supplies, eye wash, fire extinguishers, etc.)

The method used to alert personnel in nearby areas of potential hazards

Special first aid treatment required by the type of corrosive material(s) handled in the laboratory.

Eye protection

Eye protection must be worn at all times when handling corrosive materials. Ordinary (street) prescription glasses do not provide adequate protection. (Contrary to popular opinion these glasses cannot pass the rigorous test for industrial safety glasses.) Adequate safety glasses must meet the requirements of the Practice for Occupational and Educational Eye and Face protection (ANSI Z 87.1 1989 and must be equipped with side shields. Safety glasses with side shields do not provide adequate protection from splashes; therefore, when the potential for splash hazard exists other eye protection and/or face protection must be worn. It is recommended that face shields be worn when a splash potential exists with corrosive materials.

Eyewash

Where the eyes or body of any person may be exposed to corrosive chemicals, suitable facilities for quick drenching or flushing of the eyes and body shall be provided within the work area for immediate emergency use. Bottle type eyewash stations are not acceptable.

Fume hood

Manipulation of corrosive substances should be carried out in a fume hood if corrosive vapor production is anticipated.

Glove (dry) box

Not applicable

Gloves

Gloves should be worn when handling corrosive materials. The selection of glove materials should be made from Table 1 of this document.

Hazard assessment

Hazard assessment should include instruction on proper use and handling; spill control; and splash protection.

Protective apparel

Lab coats, closed toed shoes and long sleeved clothing should be worn when handling corrosive materials. Additional protective clothing should be worn if the possibility of skin contact is likely.

Safety shielding

Safety shielding is required any time there is a risk of explosion, splash hazard or a highly *exothermic* reaction. All manipulations of corrosive materials which pose this risk should occur in a fume hood with the sash in the lowest feasible position. Portable shields, which provide protection to all laboratory occupants, are acceptable.

Safety shower

A safety or drench shower should be available in a nearby location where the corrosive material is used.

Signs and labels

Containers: All corrosive chemicals must be clearly labelled with the correct chemical name. Handwritten labels are acceptable; chemical formulas and structural formulas are not acceptable.

Special storage

Segregate the various types of corrosives. Separate acids and bases. Liquids and solids should also be separated. Specially designed corrosion resistant cabinets should be used for the storage of large quantities of corrosive materials. Store corrosives on plastic trays. Do not store corrosive materials on high cabinets or shelves.

Special ventilation

Manipulation of some corrosive materials outside of a fume hood may require special ventilation controls in order to minimize exposure to the material. Fume hoods provide the best protection against exposure to corrosive materials in the laboratory and are the preferred ventilation control device.

Spill response

Anticipate spills by having the appropriate clean up equipment on hand. The appropriate clean up supplies can be determined by consulting the Material Safety Data Sheet. This should occur prior to the use of any corrosive chemical. Corrosive spill controls neutralize the hazardous nature of the spilled material. Acids and bases require different types of spill control materials.

In the event of a spill, all personnel in the area should be alerted. Do not attempt to handle a large spill of corrosive materials. Vacate the laboratory immediately and call for assistance.

< Department of Environmental Health and Safety 753-0404

< University Police 911 or 753-1212 (This is a 24 hour service.)

Remain on the scene, but at a safe distance, to receive and direct safety personnel when they arrive.

Vacuum protection

Not applicable

Waste disposal

Most corrosive materials are hazardous wastes. Questions regarding waste disposal should be directed to the Department of Environmental Health and Safety.

STANDARD OPERATING PROCEDURES FOR: FLAMMABLE LIQUIDS

Standard operating procedures (SOP) are intended to provide you with general guidance on how to safely work with a specific class of chemical or hazard. This SOP is generic in nature. It addresses the use and handling of substances by hazard class only. In some instances multiple SOPs may be applicable for a specific chemical (i.e., both the SOPs for flammable liquids and carcinogens would apply to benzene). If you have questions concerning the applicability of any item listed in this procedure contact the Department of Environmental Health and Safety (753-0404) or the Principal Investigator of your laboratory. Specific written procedures are the responsibility of the Principal Investigator.

If compliance with all the requirements of this standard operating procedure is not possible, the Principal Investigator must develop a written procedure that will be used in its place. This alternate procedure must provide the same level of protection as the SOP it replaces. The Department of Environmental Health and Safety is available to provide guidance during the development of alternate procedures.

Flammable liquids are chemicals that have a flash point below 100^{o}F (38.7^{o}C) and a vapor pressure that does not exceed 40 psig at 100^{o}F.

Securing of gas cylinders

Not applicable

Decontamination procedures

Personnel: Wash hands and arms with soap and water immediately following any skin contact with flammable liquids.

Designated area

Not applicable

Emergency procedure

Emergency procedures which address response actions to fires, explosions, spills, injury to staff, or the development of sign and symptom of overexposure must be developed. The procedures should address as a minimum the following:

Who to contact: (University Police, and Department of Environmental Health and Safety, Principal Investigator of the laboratory including evening phone number)

The location of all safety equipment (showers, eye wash, fire extinguishers, etc.)

The method used to alert personnel in nearby areas of potential hazards

Special spill control materials required by the type of flammable liquids handled in the laboratory

Eye protection

Eye protection in the form of safety glasses must be worn at all times when handling flammable liquids. Ordinary (street) prescription glasses do not provide adequate protection. (Contrary to popular opinion these glasses cannot pass the rigorous test for industrial safety glasses.) Adequate safety glasses must meet the requirements of the Practice for Occupational and Educational Eye and Face Protection (ANSI Z.87.1 1989) and must be equipped with side shields. Safety glasses with side shields do not provide adequate protection from splashes; therefore, when the potential for splash hazard exists other eye protection and/or face protection must be worn.

Eyewash

Where the eyes or body of any person may be exposed to flammable liquids suitable facilities for quick drenching or flushing of the eyes and body shall be provided within the work area for immediate emergency use. Bottle type eyewash stations are not acceptable.

Fume hood

When possible experiments involving greater than 500 mL of flammable liquids should be carried out in a fume hood.

Glove (dry) box

Not applicable

Gloves

Gloves should be worn when handling flammable liquids. The selection of glove materials should be made from Table 1 of this document.

Hazard assessment

Hazard assessment for work involving flammable liquids should thoroughly address the issues of proper use and handling, fire safety, chemical toxicity, storage, and spill response.

Protective apparel

Lab coats, closed toed shoes and long sleeved clothing should be worn when handling flammable liquids. Additional protective clothing should be worn if the possibility of skin contact is likely.

Safety shielding

Safety shielding is required any time there is a risk of explosion, splash hazard or a highly exothermic reaction. All manipulations of flammable liquids which pose this risk should occur in a fume hood with the sash in the lowest feasible position. Safety shielding is required any time there is a risk of explosion, splash hazard or a highly exothermic reaction. Portable shields, which provide protection to all laboratory occupants, are acceptable.

Safety shower

A safety or drench shower should be available in a nearby location where the flammable liquids are used.

Signs and labels

Containers: All flammable liquids must be clearly labelled with the correct chemical name. Handwritten labels are acceptable; chemical formulas and structural formulas are not acceptable.

Special storage

The storage of flammable and combustible liquids in a laboratory, shop or building area must be kept to the minimum needed for research and/or operations. If more than 5 gallons of flammables are present outside of safety cans per 100 square feet of area, a flammable-liquids storage cabinet is required. Flammable-liquids storage cabinet is required. Flammable-liquids storage cabinet is required. Flammable-liquids storage cabinets are not intended for the storage of highly toxic materials, acids, bases, compressed gases or pyrolytic chemicals.

Where feasible (if the quality of the solvent will not be adversely affected) transfer flammable liquids from glass bottles into metal safety cans.

Special ventilation

Manipulation of flammable liquids outside of a fume hood may require special ventilation controls in order to minimize exposure to the material. Fume hoods provide the best protection against exposure to flammable liquids in the laboratory and are the preferred ventilation control device. Always attempt to handle large quantities of flammable liquids in a fume hood. If your research does not permit the handling of large quantities of flammable liquids in your fume hood, contact the Department of Environmental Health and Safety to review the adequacy of all special ventilation.

Spill response

Anticipate spills by having the appropriate clean up equipment on hand. The appropriate clean up supplies can be determined by consulting the Material Safety Data Sheet. This should occur prior to the use of any flammable liquids. Spill supplies for flammable liquids are designed to control the liquids portion of the spill and minimize the production of flammable vapors. Never use paper towels on large spills of flammable liquids because it exacerbates vapor production.

In the event of a spill all personnel in the area should be alerted. Turn off all sources of ignition. Do not attempt to handle a large spill of flammable liquids. Vacate the laboratory immediately and call for assistance.

- Department of Environmental Health and Safety 753-0404
- University Police 911 or 753-1212 (This is a 24 hour service.)

Remain on the scene, but at a safe distance, to receive and direct safety personnel when they arrive.

Vacuum protection

Evacuated glassware can implode and eject flying glass, and splattered chemicals. Vacuum work involving flammable liquids must be conducted in a fume hood, glove box or isolated in an acceptable manner.

Mechanical vacuum pumps must be protected using cold traps and, where appropriate, filtered to prevent particulate release. The exhaust for the pumps must be vented into an exhaust hood. Vacuum pumps should be rated for use with flammable liquids.

Waste disposal

Some flammable liquids are hazardous wastes. Questions regarding waste disposal should be directed to the Department of Environmental Health and Safety.

STANDARD OPERATING PROCEDURES FOR: OXIDIZING CHEMICALS

Standard operating procedures (SOP) are intended to provide you with general guidance on how to safely work with a specific class of chemical or hazard. This SOP is generic in nature. It addresses the use and handling of substances by hazard class only. In some instances multiple SOPs may be applicable for a specific chemical (i.e., both the SOPs for flammable liquids and carcinogens would apply to benzene). If you have questions concerning the applicability of any item listed in this procedure contact the Department of Environmental Health and Safety (753-0404) or the Principal Investigator of your laboratory. Specific written procedures are the responsibility of the Principal Investigator.

If compliance with all the requirements of this standard operating procedure is not possible, the Principal Investigator must develop a written procedure that will be used in its place. This alternate procedure must provide the same level of protection as the SOP it replaces. The Department of Environmental Health and Safety is available to provide guidance during the development of alternate procedures.

Oxidizing chemicals are materials that spontaneously evolve oxygen at room temperature or with slight heating or promote combustion. This class of chemicals includes peroxides, chlorates, perchlorates, nitrates, and permanganates. Strong oxidizers are capable of forming explosive mixtures when mixed with combustible, organic or easily oxidized materials. Examples of strong oxidizers are listed at the end of this SOP.

Securing of gas cylinders

Not applicable

Decontamination procedures

Personnel: Wash hands and arms with soap and water immediately after handling oxidizing chemicals.

Area: Carefully clean work area after use. Paper towels or similar materials contaminated with strong oxidizing chemicals may pose a fire risk.

Designated area

Not applicable

Emergency procedure

Emergency procedures which address response actions to fires, explosions, spills, injury to staff, or the development of sign and symptom of overexposure must be developed. The procedures should address as a minimum the following:

Who to contact: (University Police, and Department of Environmental Health and Safety, Principal Investigator of the laboratory including evening phone number)

The location of all safety equipment (showers, spill equipment, eye wash, fire extinguishers, etc.)

The method used to alert personnel in nearby areas of potential hazards

Special first aid treatment required by the type of oxidizing chemicals material(s) handled in the laboratory

Eye protection

Eye protection in the form of safety glasses must be worn at all times when handling oxidizing chemicals. Ordinary (street) prescription glasses do not provide adequate protection. (Contrary to popular opinion these glasses cannot pass the rigorous test for industrial safety glasses.) Adequate safety glasses must meet the requirements of the Practice for Occupational and Educational Eye and Face Protection (ANSI Z.87.1 1989) and must be equipped with side shields. Safety glasses with side shields do not provide adequate protection from splashes; therefore, when the potential for splash hazard exists other eye protection and/or face protection must be worn.

Eyewash

Where the eyes or body of any person may be exposed to oxidizing chemicals, suitable facilities for quick drenching or flushing of the eyes and body shall be provided within the work area for immediate emergency use. Bottle type eyewash stations are not acceptable.

Fume hood

The use of certain concentrations of perchloric acid must be performed in a fume hood equipped with wash down facilities. Contact the Department of Environmental Health and Safety for fume hood requirements.

Glove (dry) box

Not applicable

Gloves

Gloves should be worn when handling oxidizing chemicals. The selection of glove materials should be made from Table 1 of this document.

Hazard assessment

Hazard assessment should address proper use and handling techniques, fire safety, storage, and waste disposal issues.

Protective apparel

Lab coats, closed toed shoes and long sleeved clothing should be worn when handling oxidizing chemicals. Additional protective clothing should be worn if the possibility of skin contact is likely.

Safety shielding

Safety shielding is required any time there is a risk of explosion, splash hazard or a highly exothermic reaction. All manipulations of oxidizing chemicals which pose this risk should occur in a fume hood with the sash in the lowest feasible position. Portable shields, which provide protection to all laboratory occupants are acceptable.

Safety shower

A safety or drench shower should be available in a nearby location where the oxidizing chemicals are used.

Signs and labels

Containers: All oxidizing chemicals must be clearly labelled with the correct chemical name. Handwritten labels are acceptable; chemical formulas and structural formulas are not acceptable.

Special storage

Oxidizers should be stored in a cool and dry location. Keep oxidizers segregated from all other chemicals in the laboratory. Minimize the quantities of strong oxidizers stored in the laboratory.

Never return excess chemicals to the original containers. Small amounts of impurities may be introduced into the container which may cause a fire or explosion.

Special ventilation

The use of certain concentrations of perchloric acid must be performed in a fume hood equipped with wash down facilities. Contact the Department of Environmental Health and Safety for fume hood requirements.

Spill response

Anticipate spills by having the appropriate clean up equipment on hand. The appropriate clean up supplies can be determined by consulting the Material Safety Data Sheet. This should occur prior to the use of any oxidizing chemicals. Spill control materials for oxidizers are designed to be inert and will not react with the reagent. Never use paper towels or other inappropriate materials which are combustible. The waste materials generated during spill cleanup may pose a fire risk and should not remain in the laboratory overnight unless it is stored in an appropriate container.

In the event of a spill, alert personnel in the area that a spill has occurred. Do not attempt to handle a large spill of oxidizing chemicals. Vacate the laboratory immediately and call for assistance.

- Department of Environmental Health and Safety 753-0404
- University Police 911 or 753-1212 (This is a 24 hour service.)

Remain on the scene, but at a safe distance, to receive and direct safety personnel when they arrive.

Vacuum protection

Evacuated glassware can implode and eject flying glass, and splattered chemicals.

Vacuum work involving oxidizing chemicals must be conducted in a fume hood, glove box or isolated in an acceptable manner.

Mechanical vacuum pumps must be protected using cold traps and, where appropriate, filtered to prevent particulate release. The exhaust for the pumps must be vented into an exhaust hood.

Waste disposal

All materials contaminated with oxidizing chemicals pose a fire hazard and should be disposed of as hazardous waste. Alert the Department of Environmental Health and Safety if you generate wastes contaminated by oxidizers. Do not let contaminated wastes remain in the laboratory overnight unless proper containers are provided.

Examples of Strong Oxidizers

Ammonium perchlorate	Ammonium permanganate
Barium peroxide	Bromine
Calcium chlorate	Calcium hypochlorite
Chlorine trifluoride	Chromium anhydride
Chromic acid	Dibenzoyl peroxide
Fluorine Hydrogen peroxide	
Mangesium peroxide	Nitrogen trioxide
Perchloric acid	Potassium bromate
Potassium chlorate	Potassium peroxide
Propyl nitrate	Sodium chlorate
Sodium chlorite	Sodium perchlorate
Sodium peroxide	

Source: CRC Handbook of Laboratory Safety, 3rd edition.

STANDARD OPERATING PROCEDURES FOR:

PYROPHORIC CHEMICALS

Standard operating procedures (SOP) are intended to provide you with general guidance on how to safely work with a specific class of chemical or hazard. This SOP is generic in nature. It addresses the use and handling of substances by hazard class only. In some instances multiple SOPs may be applicable for specific chemical (i.e., both the SOPs for flammable liquids and carcinogens would apply to benzene). If you have questions concerning the applicability of any item listed in this procedure contact the Department of Environmental Health and Safety 753-0404 or the Principal Investigator of your laboratory. Specific written procedures are the responsibility of the Principal Investigator.

If compliance with all the requirements of this standard operating procedure is not possible, the Principal Investigator must develop a written procedure that will be used in its place. This alternate procedure must provide the same level of protection as the SOP it replaces. The Department of Environmental Health and Safety is available to provide guidance during the development of alternate procedures.

Pyrophoric chemicals are liquids and solids that will ignite spontaneously in air at about 130□F. Titanium dichloride and phosphorus are examples of phrophoric solids; tributylaluminum and related compounds are examples of pyrophoric liquids.

Securing of gas cylinders

Not applicable

Decontamination procedures

Personnel: Wash hands and arms with soap and water immediately following any skin contact with pyrophoric chemicals.

Designated area

Not applicable

Emergency procedure

Emergency procedures which address response actions to fires, explosions, spills, injury to staff, or the development of sign and symptom of overexposure must be developed. The procedures should address as a minimum the following:

Who to contact: (University Police, and Department of Environmental Health and

Safety, Principal Investigator of the laboratory including evening phone number)

The location of all safety equipment (showers, eye wash, fire extinguishers, etc.)

The method used to alert personnel in nearby areas of potential hazards

Special spill control materials required by the type of pyrophoric chemicals handled in the laboratory.

Eye protection

Eye protection must be worn at all times when handling pyrophoric chemicals. Ordinary (street) prescription glasses do not provide adequate protection. (Contrary to popular opinion these glasses cannot pass the rigorous test for industrial safety glasses.) Adequate safety glasses must meet the requirements of the Practice for Occupational and Educational eye and Face Protection (ANSI Z 87.1 1989) and must be equipped with side shields. Safety glasses with side shields do not provide adequate protection from splashes; therefore, when the potential for splash hazard exists other eye protection and/or face protection must be worn.

Eyewash

Where the eyes or body of any person may be exposed to pyrophoric chemicals, suitable facilities for quick drenching or flushing of the eyes and body shall be provided within the work area for immediate emergency use. Bottle type eyewash stations are not acceptable.

Fume hood

Many pyrophoric chemicals release noxious or flammable gases and should be handled in a hood. In addition some pyrophoric materials are stored under kerosene (or other flammable solvents), therefore the use of a fume hood is required to prevent the release of flammable vapors in the laboratory. Glove boxes may also be used (see special ventilation).

Glove (dry) box

Glove boxes may be used to handle pyrophoric chemicals if inert or dry atmospheres are required.

Gloves

Gloves should be worn when handling pyrophoric chemicals. The selection of glove materials should be made from Table 1 of this document.

Hazard assessment

Hazard assessment for work involving pyrophoric chemicals should thoroughly address the issue of fire safety (including the need for Class D fire extinguishers), proper use and handling techniques, chemical toxicity, storage, and spill response.

Protective apparel

Lab coats, closed toed shoes and long sleeved clothing should be worn when handling pyrophoric chemicals. Additional protective clothing should be worn if the possibility of skin contact is likely.

Safety shielding

Safety shielding is required any time there is a risk of explosion, splash hazard or a highly exothermic reaction. All manipulations of pyrophoric chemicals which pose this risk should occur in a fume hood with the sash in the lowest feasible position. Portable shields, which provide protection to all laboratory occupants, are acceptable.

Safety shower

A safety or drench shower should be available in a nearby location where the pyrophoric chemicals are used.

Signs and labels

Containers: All pyrophoric chemicals must be clearly labelled with the correct chemical name. Handwritten labels are acceptable; chemical formulas and structural formulas are not acceptable.

Special storage

Pyrophoric chemicals should be stored under an atmosphere of inert gas or under kerosene as appropriate. Do not store pyrophoric chemicals with flammable materials or in a flammable-liquids storage cabinet. Store these materials away from sources of ignition. Minimize the quantities of pyrophoric chemicals stored in the laboratory.

Never return excess chemicals to the original container. Small amounts of impurities may be introduced into the container which may cause a fire or explosion.

Special ventilation

Always attempt to handle pyrophoric chemicals in a fume hood or glove box. If your research does not permit the handling of pyrophoric chemicals in a fume hood or glove box, you must contact the Department of Environmental Health and Safety to review the adequacy of all special ventilation.

Spill response

Anticipate spills by having the appropriate clean up equipment on hand. The appropriate clean up supplies can be determined by consulting the Material Safety Data

Sheet. This should occur prior to the use of any pyrophoric chemicals. Spill control materials for pyrophoric chemicals are designed to be inert and will not react with the reagent.

In the event of a spill alert personnel in the area that a spill has occurred. Do not attempt to handle a large spill of pyrophoric chemicals. Turn off all ignition sources and vacate the laboratory immediately. Call for assistance.

- Department of Environmental Health and safety 753-0404
- University Police 911 or 753-1212 (This is a 24 hour service.)

Remain on the scene, but at a safe distance, to receive and direct safety personnel when they arrive.

Vacuum protection

Evacuated glassware can implode and eject flying glass, and splattered chemicals. Vacuum work involving pyrophoric chemicals must be conducted in a fume hood or isolated in an acceptable manner.

Mechanical vacuum pumps must be protected using cold traps and, where appropriate, filtered to prevent particulate release. The exhaust for the pumps must be vented into an exhaust hood. Vacuum pumps should be rated for use with pyrophoric chemicals.

Waste disposal

All materials contaminated with pyrophoric chemicals should be disposed of as hazardous waste. Alert the Department of Environmental Health and Safety if you generate wastes contaminated with pyrophoric chemicals. These wastes may pose a flammability risk and should not remain in the laboratory overnight.

STANDARD OPERATING PROCEDURES FOR: REACTIVE LIQUIDS

Standard operating procedures (SOP) are intended to provide you with general guidance on how to safely work with a specific class of chemical or hazard. This SOP is generic in nature. It addresses the use and handling of substances by hazard class only. In some instances multiple SOPs may be applicable for a specific chemical (i.e., both the SOPs for flammable liquids and carcinogens would apply to benzene). If you have questions concerning the applicability of any item listed in this procedure contact the Department of Environmental Health and Safety (753-0404) or the Principal Investigator of your laboratory. Specific written procedures are the responsibility of the Principal Investigator.

If compliance with all the requirements of this standard operating procedure is not

possible, the Principal Investigator must develop a written procedure that will be used in its place. This alternate procedure must provide the same level of protection as the SOP it replaces. The Department of Environmental Health and Safety is available to provide guidance during the development of alternate procedures.

Reactive liquids are chemicals that react vigorously with moisture or oxygen or other substances.

Securing of gas cylinders

Not applicable

Decontamination procedures

Personnel: Wash hands and arms with soap and water immediately after handling reactive liquids.

Area: Carefully clean work area after use.

Equipment: Decontaminate vacuum pumps or other contaminated equipment (glassware) before removing them from the designated area.

Designated area

Not applicable

Emergency procedure

Emergency procedures which address response actions to fires, explosions, spills, injury to staff, or the development of signs and symptoms of overexposure must be developed. The procedures should address as a minimum the following:

Who to contact: (University Police, and Department of Environmental Health and Safety, Principal Investigator of the laboratory including evening phone number)

The location of all safety equipment (showers, spill equipment, eye wash, fire extinguishers, etc.)

The location and quantity of all reactive liquids in the laboratory

The method used to alert personnel in nearby areas of potential hazards

Special first aid treatment required by the type of reactive liquids handled in the laboratory

Eye protection

Eye protection in the form of safety glasses must be worn at all times when handling reactive liquids. Ordinary (street) prescription glasses do not provide adequate protection. (Contrary to popular opinion these glasses cannot pass the rigorous test for industrial safety glasses.) Adequate safety glasses must meet the requirements of the Practice for Occupational and Educational Eye and Face Protection ANSI Z.897.1 1989) and must be equipped with side shields. Safety glasses with side shields do not provide adequate protection from splashes; therefore, when the potential for splash hazard exists other eye protection and/or face protection must be worn.

Eyewash

Where the eyes or body of any person may be exposed to reactive liquids, suitable facilities for quick drenching or flushing of the eyes and body shall be provided within the work area for immediate emergency use. Bottle type eyewash stations are not acceptable.

Fume hood

Many reactive liquids will ignite or liberate combustible gas when exposed to water vapor or air. The use of a fume hood is recommended to prevent the buildup of flammable gases.

Glove (dry) box

A glove box may be used to handle reactive liquids if an inert or dry atmosphere is required.

Gloves

Gloves should be worn when handling reactive liquids. The selection of glove materials should be made from Table 1 of this document.

Hazard assessment

Hazard assessment of work involving reactive liquids should address proper use and handling techniques, fire safety (including the need for Class D fire extinguishers), storage, the specific reactive nature of the material (such as water and air reactivity), and waste disposal issues.

Protective apparel

Lab coats, closed toed shoes and long sleeved clothing should be worn when handling reactive liquids. Additional protective clothing should be worn if the possibility of skin contact is likely.

Safety shielding

Safety shielding is required any time there is a risk of explosion, splash hazard or a highly exothermic reaction. All manipulations of reactive liquids that pose this risk should occur in a fume hood with the sash in the lowest feasible position. Portable shields, which provide protection to all laboratory occupants are acceptable.

Safety shower

A safety or drench shower should be available in a nearby location where the reactive liquids are used.

Signs and labels

Containers: All reactive liquids must be clearly labelled with the correct chemical name. Handwritten labels are acceptable; chemical formulas and structural formulas are not acceptable.

Special storage

Reactive liquids should be stored in a cool and dry location. Keep reactive liquids segregated from all other chemicals in the laboratory. Minimize the quantities of reactive liquids stored in the laboratory.

Date all containers upon receipt. Examine storage containers frequently. Dispose of any container that exhibits salt build up on its exterior. Dispose of all reactive liquids whenever they are no longer required for current research.

Never return excess chemicals to the original container. Small amounts of impurities may be introduced into the container that may cause a fire or explosion.

Special ventilation

Special ventilation may be required if these materials are used outside a fume hood. If your research does not permit the handling of reactive liquids in a fume hood you must contact the Department of Environmental Health and Safety to review the adequacy of all special ventilation.

Spill response

Anticipate spills by having the appropriate clean up equipment on hand. The appropriate clean up supplies can be determined by consulting the Material Safety Data

Sheet. This should occur prior to the use of any reactive liquids. Spill control materials for reactive liquids are designed to be inert and will not react with the reagent.

In the event of a spill alert personnel in the area that a spill has occurred. Do not attempt to handle a spill of reactive liquids. Turn off all ignition sources and vacate the laboratory immediately. Call for assistance.

< Department of Environmental Health and Safety 753-0404
< University Police 911 or 753-1212 (This is a 24 hour service.)

Remain on the scene, but at a safe distance, to receive and direct safety personnel when they arrive.

Vacuum protection

Not applicable

Waste disposal

all materials contaminated with reactive liquids should be disposed of as hazardous waste. Alert the Department of Environmental Health and Safety if you generate wastes contaminated by reactive liquids. These wastes may pose a flammability risk and should not remain in the laboratory overnight.

STANDARD OPERATING PROCEDURES FOR: REACTIVE SOLIDS

Standard operating procedures (SOP) are intended to provide you with general guidance on how to safely work with a specific class of chemical or hazard. This SOP is generic in nature. It addresses the use and handling of substances by hazard class only. In some instances multiple SOPs may be applicable for a specific chemical (i.e., both the SOPs for flammable liquids and carcinogens would apply to benzene). If you have questions concerning the applicability of any item listed in this procedure contact the Department of Environmental Health and Safety (753-0404) or the Principal Investigator of your laboratory. Specific written procedures are the responsibility of the Principal Investigator.

If compliance with all the requirements of this standard operating procedure is not possible, the Principal Investigator must develop a written procedure that will be used in its place. This alternate procedure must provide the same level of protection as the SOP it replaces. The Department of Environmental Health and Safety is available to provide guidance during the development of alternate procedures.

Reactive solids are chemicals that react vigorously with moisture and other substances.

The most common reactive solids include sodium, potassium and lithium metals, acid anhydrides and acid chlorides.

Securing of gas cylinders

Not applicable

Decontamination procedures

Personnel: Wash hands and arms with soap and water immediately after handling reactive solids.

Area: Carefully clean work area after use.

Designated area

Not applicable

Emergency procedure

Emergency procedures which address response actions to fires, explosions, spills, injury to staff, or the development of sign and symptom of overexposure must be developed. The procedures should address as a minimum the following:

Who to contact: (University Police, and Department of Environmental Health and Safety, Principal Investigator of the laboratory including evening phone number)

The location of all safety equipment (showers, spill equipment, eye wash, fire extinguishers, etc.)

The location and quantity of all reactive solids in the laboratory

The method used to alert personnel in nearby areas of potential hazards

Special first aid treatment required by the type of reactive solids material(s) handled in the laboratory.

Eye protection

Eye protection must be worn at all times when handling reactive solids. Ordinary (street) prescription glasses do not provide adequate protection. (Contrary to popular opinion these glasses cannot pass the rigorous test for industrial safety glasses.) Adequate safety glasses must meet the requirements of the Practice for Occupational

and Educational Eye and Face protection (ANSI Z.87.1 1989) and must be equipped with side shields. Safety glasses with side shields do not provide adequate protection from splashes; therefore, when the potential for splash hazard exists other eye protection and/or face protection must be worn.

Eyewash

Where the eyes or body of any person may be exposed to reactive solids, suitable facilities for quick drenching or flushing of the eyes and body shall be provided within the work area for immediate emergency use. Bottle type eyewash stations are not acceptable.

Fume hood

Many reactive solids will liberate hydrogen when they react with water. The use of a fume hood id recommended to prevent the buildup of combustible gases.

Glove (dry) box

Glove boxes may be used to handle reactive solids if inert or dry atmospheres are required.

Gloves

Gloves should be worn when handling reactive solids. The selection of glove materials should be made from Table 1 of this document.

Hazard assessment

Hazard assessment of work involving reactive solids should address proper use and handling techniques, fire safety (including the need for Class D fire extinguishers), storage, potential peroxide formation, water and air reactivity, and waste disposal issues.

Protective apparel

Lab coats, closed toed shoes and long sleeved clothing should be worn when handling reactive solids. Additional protective clothing should be worn if the possibility of skin

Safety shielding

Safety shielding is required any time there is a risk of explosion, splash hazard or a highly exothermic reaction. All manipulations of reactive solids which pose this risk should occur in a fume hood with the sash in the lowest feasible position. Portable shields, which provide protection to all laboratory occupants, are acceptable.

Safety shower

A safety or drench shower should be available in a nearby location where the reactive solid is used.

Signs and labels

Containers: All reactive solids must be clearly labelled with the correct chemical name. Handwritten labels are acceptable; chemical formulas and structural formulas are not acceptable.

Special storage

Reactive solids should be stored in a cool and dry location. Keep reactive solids segregated from all other chemicals in the laboratory. Minimize the quantities of reactive solids stored in the laboratory.

Date all containers upon receipt. Potassium will form peroxides and superoxides when stored under oil at room temperature. Examine storage containers frequently. Dispose of any container that exhibits salt build up on its exterior. Dispose of all reactive solids whenever they are no longer required for current research.

Never return excess chemicals to the original container. Small amounts of impurities may be introduced into the container which may cause a fire or explosion.

Special ventilation

Special ventilation is required if these materials are used outside of a fume hood or glove box. If your research does not permit the handling of reactive solids in a fume hood or glove box, you must contact the Department of Environmental Health and Safety to review the adequacy of all special ventilation.

Spill response

Anticipate spills by having the appropriate clean up equipment on hand. The appropriate clean up supplies can be determined by consulting the Material Safety Data Sheet. This should occur prior to the use of any reactive solids chemical. Spill control materials for reactive solids are designed to be inert and will not react with the reagent.

In the event of a spill, alert personnel in the area that a spill has occurred. Do not attempt to handle a large spill of reactive solids. Turn off all ignition sources and vacate the laboratory immediately. Call for assistance.

- Department of Environmental Health and Safety 753-0404
- University Police 911 or 753-1212 (This is a 24 hour service.)

Remain on the scene, but at a safe distance, to receive and direct safety personnel when they arrive.

Vacuum protection

Not applicable

Waste disposal

All materials contaminated with reactive solids should be disposed of as hazardous waste. Alert the Department of Environmental Health and Safety if you generate wastes contaminated by reactive solids. These wastes may pose a flammability risk and should not remain in the laboratory overnight.

STANDARD OPERATING PROCEDURES FOR: REPRODUCTIVE HAZARDS

Standard operating procedures (SOP) are intended to provide you with general guidance on how to safely work with a specific class of chemical or hazard. This SOP is generic in nature. It addresses the use and handling of substances by hazard class only. In some instances multiple SOPs may be applicable for a specific chemical (i.e., both the SOPs for flammable liquids and carcinogens would apply to benzene). If you have questions concerning the applicability of any items listed in this procedure contact the Department of Environmental Health and Safety (753-0404) or the Principal Investigator of your laboratory. Specific written procedures are the responsibility of the Principal Investigator.

If compliance with all the requirements of this standard operating procedure is not possible, the Principal Investigator must develop a written procedure that will be used in its place. This alternate procedure must provide the same level of protection as the SOP it replaces. The Department of Environmental Health and Safety is available to provide guidance during the development of alternate procedures.

Reproductive hazards are substances which affect the reproductive capabilities including chromosomal damage (mutagens) and effects on the fetus (tetratogens). A list of reproductive hazards is included in Appendix D of this document.

Securing of gas cylinders

Not applicable

Decontamination procedures

Personnel: Wash hands and arms with soap and water immediately after handling reproductive hazards.

Area: Decontamination procedures vary depending on the material being handled. The toxicity of some materials can be neutralized with other reagents. All surfaces should be wiped with the appropriate cleaning agent following dispensing or handling. Waste materials generated should be treated as hazardous waste.

Equipment: Decontaminate vacuum pumps or other contaminated equipment (glassware) before removing them from the designated area.

Designated area

The room number sign for the laboratory must contain a *Designated Areas Within* identifier.

All locations within the laboratory where reproductive hazards are handled should be posted with designated area caution signs. This includes all fume hoods and bench tops where the reproductive hazards are handled.

Where feasible, reproductive hazards should be manipulated over plastic-backed disposable paper work surfaces. These disposable work surfaces minimize work area contamination and simplify clean up.

Emergency procedure

Emergency procedures which address response actions to fires, explosions, spills, injury to staff, or the development of sign and symptom of overexposure must be developed. The procedures should address as a minimum the following:

Who to contact: (University Police, and Department of Environmental Health and Safety, Principal Investigator of the laboratory including evening phone number)

The location of all safety equipment (showers, eye wash, fire extinguishers, etc.)

The method used to alert personnel in nearby areas of potential hazards

The location and quantity of all reproductive hazards stored in the laboratory

Special first aid treatment by the type of reproductive hazards handled in the laboratory

Eye protection

Eye protection in the form of safety glasses must be worn at all times when handling reproductive hazards. Ordinary (street) prescription glasses do not provide adequate protection. (Contrary to popular opinion these glasses cannot pass the rigorous test for industrial safety glasses.) Adequate safety glasses must meet the requirements of the American Standard Practice for Occupational and Educational Eye and Face Protection (ANSI Z.87.1 1989) and must be equipped with side shields. Safety glasses with side shields do not provide adequate protection from splashes; therefore, when the potential for a splash hazard exists other eye protection and/or face protection must be worn.

Eyewash

Where the eyes or body of any person may be exposed to reproductive hazards, suitable facilities for quick drenching or flushing of the eyes and body shall be provided within the work area for immediate emergency use. Bottle type eyewash stations are not acceptable.

Fume hood

Manipulation of reproductive hazards should be carried out in a fume hood. If the use of a fume hood proves impractical refer to the section on special ventilation.

All areas where reproductive hazards are stored or manipulated must be labelled as a designated area.

Glove (dry) box

Gloves must be worn when handling reproductive hazards. The selection of glove materials should be made from Table 1 of this document.

Hazard assessment

Hazard assessment should focus on proper handling techniques, education of laboratory workers concerning the health risks posed by reproductive hazards, and the demarcation of designated areas.

Protective apparel

Lab coats, closed toed shoes and long sleeved clothing should be worn when handling reproductive hazards. Additional protective clothing should be worn if the possibility of skin contact is likely.

Safety shielding

Safety shielding is required any time there is a risk of explosion, splash hazard or a highly exothermic reaction. All manipulations of reproductive hazards which pose this risk should be performed in a fume hood with the sash in the lowest feasible position. Portable shields, which provide protection to all laboratory occupants, are acceptable.

Safety shower

A safety or drench shower should be available in a nearby location where the reproductive hazards are used.

Signs and labels

Doorways: The room number sign must contain a *Designated Area Within Caution* where carcinogens, reproductive hazards, and/or acutely toxic chemicals are stored or used.

Containers: All containers of reproductive hazards must be clearly labeled with the correct chemical name. Handwritten labels are acceptable; chemical formulas and structural formulas are not acceptable.

Special storage

Reproductive hazards must be stored in a designated area.

Special ventilation

Manipulation of reproductive hazards outside of a fume hood may require special ventilation controls in order to minimize exposure to the material. Fume hoods provide the best protection against exposure to reproductive hazards in the laboratory and are the preferred ventilation control device. When possible, handle reproductive hazards in a fume hood. If the use of a fume hood proves impractical attempt to work in a glove box or on an isolated area of the bench top.

If available, consider using a Biological Safety Cabinet. The biological safety cabinet is designed to remove particulates (the reproductive hazard) before the air is discharged into the environment. Reproductive hazards that are volatile must not be used in a biological safety cabinet unless the cabinet is vented to the outdoors.

If your research does not permit the handling of reproductive hazards in a fume hood, biological safety cabinet, or glove box, you must contact the Department of Environmental Health and Safety.

All areas where reproductive hazards are stored or manipulated must be labeled as a designated area.

Spill response

Anticipate spills by having the appropriate clean up equipment on hand. The appropriate clean up supplies can be determined by consulting the Material Safety Data Sheet. This should occur prior to the use of any reproductive hazard.

In the event of a spill alert personnel in the area that a spill has occurred. Do not attempt to handle a spill of reproductive hazards. Vacate the laboratory immediately and call for assistance.

- Department of Environmental Health and Safety 753-0404
- University Police 911 or 753-1212 (This is a 24 hour service.)

Remain on the scene, but at a safe distance, to receive and direct safety personnel when they arrive.

Vacuum protection

Evacuated glassware can implode and eject flying glass, and splattered chemicals. Vacuum work involving reproductive hazards must be conducted in a fume hood, glove box or isolated in an acceptable manner.

Mechanical vacuum pumps must be protected using cold traps and, where appropriate, filtered to prevent particulate release. The exhaust for the pumps must be vented into an exhaust hood.

Waste disposal

All materials contaminated with reproductive hazards should be disposed of as a hazardous waste. Wherever possible, attempt to design research in a manner that reduces the quantity of waste generated. Questions regarding waste pick up should be directed to the Department of Environmental Health and Safety. This office can also assist you in minimizing waste generation.

STANDARD OPERATING PROCEDURES FOR:

WATER SENSITIVE CHEMICALS

Standard operating procedures (SOP) are intended to provide you with general guidance on how to safely work with a specific class of chemical or hazard. This SOP is generic in nature. It addresses the use and handling of substances by hazard class only. In some instances multiple SOPs may be applicable for a specific chemical (i.e., both the SOPs for flammable liquids and carcinogens would apply to benzene). If you have questions concerning the applicability of any item listed in this procedure contact the Department of Environmental Health and Safety (753-0404) or the Principal Investigator of your laboratory. Specific written procedures are the responsibility of the Principal Investigator.

If compliance with all the requirements of this standard operating procedure is not possible, the Principal Investigator must develop a written procedure that will be used in its place. This alternate procedure must provide the same level of protection as the SOP it replaces. The Department of Environmental Health and Safety is available to provide guidance during the development of alternate procedures.

Water sensitive chemicals are chemicals that react vigorously with moisture. The most common water sensitive chemicals include sodium, potassium, lithium metals and aluminum alkyls.

Securing of gas cylinders

Not applicable

Decontamination procedures

Personnel: Wash hands and arms with soap and water immediately after handling water sensitive chemicals.

Area: Carefully clean work area after use.

Designated area

Not applicable

Emergency procedure

Emergency procedures which address response actions to fires, explosions, spills, injury to staff, or the development of sign and symptom of overexposure must be developed. The procedures should address as a minimum the following:

Who to contact: (University Police, and Department of Environmental Health and Safety, Principal Investigator of the laboratory including evening phone number)

The location of all safety equipment (showers, spill equipment, eye wash, fire extinguishers, etc.)

The location and quantity of all water sensitive chemicals in the laboratory

The method used to alert personnel in nearby areas of potential hazards

Special first aid treatment required by the type of water sensitive chemicals handled in the laboratory

Eye protection

Eye protection in the form of safety glasses must be worn at all times when handling water sensitive chemicals. Ordinary (street) prescription glasses do not provide adequate protection. (Contrary to popular opinion these glasses cannot pass the rigorous test for industrial safety glasses.) Adequate safety glasses must meet the requirements of the American Standard Practice for Occupational and Educational Eye and Face Protection (ANSI Z.87. 1 1989 and must be equipped with side shields. Safety glasses with side shields do not provide adequate protection from splashes; therefore, when the potential for splash hazard exists other eye protection and/or face protection must be worn.

Eyewash

Where the eyes or body of any person may be exposed to water sensitive chemicals, suitable facilities for quick drenching or flushing of the eyes and body shall be provided within the work area for immediate emergency use. Bottle type eyewash stations are not acceptable.

Fume hood

Many water sensitive chemicals will liberate hydrogen when they react with water. The use of a fume hood is recommended to prevent the buildup of combustible gases.

Glove (dry) box

A glove box may be used to handle water sensitive chemicals when a dry atmosphere is required.

Gloves

Gloves should be worn when handling water sensitive chemicals. The selection of glove materials should be made from Table 1 of this document.

Hazard assessment

Hazard assessment of work involving water sensitive chemicals should address proper use and handling techniques, fire safety (including the need for Class D fire extinguishers), storage, water reactivity, and waste disposal issues.

Protective apparel

Lab coats, closed toed shoes and long sleeved clothing should be worn when handling water sensitive chemicals. Additional protective clothing should be worn if the possibility of skin contact is likely.

Safety shielding

Safety shielding is required any time there is a risk of explosion, splash hazard or a highly exothermic reaction. All manipulations of water sensitive chemicals which pose this risk should occur in a fume hood with the sash in the lowest feasible position. Portable shields, which provide protection to all laboratory occupants, are acceptable.

Safety shower

A safety or drench shower should be available in a nearby location where the water sensitive chemicals is used.

Sign and labels

Containers: All water reactive chemicals must be clearly labelled with the correct chemical name. Handwritten labels are acceptable; chemical formulas and structural formulas are not acceptable.

Special storage

Water sensitive chemicals should be stored in a cool and dry location. Keep water sensitive chemicals segregated from all other chemicals in the laboratory. Minimize the quantities of water sensitive chemicals stored in the laboratory.

Date all containers upon receipt. Potassium will form peroxides and superoxides when stored under oil at room temperature. Examine storage containers frequently. Dispose of any container that exhibits salt build up on its exterior. Dispose of all water sensitive chemicals whenever they are no longer required for current research.

Never return excess chemicals to the original container. Small amounts of impurities may be introduced into the container which may cause a fire or explosion.

Special ventilation

Special ventilation is required if these materials are used outside of a fume hood. If your research does not permit the handing of water sensitive chemicals in a fume hood you must contact the Department of Environmental Health and Safety to review the adequacy of all special ventilation.

Spill response

Anticipate spills by having the appropriate clean up equipment on hand. The appropriate clean up supplies can be determined by consulting the Material Safety Data Sheet. This should occur prior to the use of any water sensitive chemicals. Spill control materials for water sensitive chemicals are designed to be inert and will not react with the reagent. Do not put water on the spill.

In the event of a spill alert personnel in the area that a spill has occurred. Do not attempt to handle a large spill of water sensitive chemicals. Turn off all ignition sources and vacate the laboratory immediately. Call for assistance.

- Department of Environmental Health and Safety 753-0404
- University Police 911 or 753-1212 (This is a 24 hour service.)

Remain on the scene, but at a safe distance, to receive and direct safety personnel when they arrive.

Vacuum protection

Not applicable

Waste disposal

All materials contaminated with water sensitive chemicals should be disposed of as hazardous waste. Alert the Department of Environmental Health and Safety if you generate wastes contaminated by water sensitive chemicals. These wastes may pose a flammability risk and should not remain in the laboratory overnight.

NOTE: Appendix F and the following procedures were deleted from the document. On the possibility that it might be needed for future use I put it here rather than have to retype it. 1/12/95

Appendix F
Notification of the Use of
Acutely Toxic, Carcinogenic, or Reproductive Hazards

Instructions: Please complete this form and return it to the Department of Environmental Health and Safety.

Principal Investigator:
Room/Building:
Phone:
Department:

Notification: In accordance with the requirements of the University Chemical Hygiene Plan, this document serves as notification to the Department of Environmental Health and Safety of the use of the following class(es) of chemicals:

	Used	Not Used
Carcinogens or suspected carcinogens		
Acutely toxic chemicals		
Acutely toxic gases		
Reproductive hazards		

Statement of compliance

I have reviewed the requirements of the University's Chemical Hygiene Plan and the applicable Standard Operating Procedures as they apply to carcinogens, acutely toxic chemicals, and reproductive hazards and have complied with all applicable requirements where appropriate.

Signature: _____ Date:

Notification Number_____
To be completed by EH&S

Protective apparel

Lab coats, closed toed shoes and long sleeved clothing should be worn when handling acutely toxic gases. The need for additional protective equipment will be determined by the Department of Environmental Health and Safety on a case-by-case basis.

Safety shielding

Safety shielding is required any time there is a risk of explosion, splash hazard or a highly exothermic reaction. All manipulations of acutely toxic gases which pose this risk should occur in a fume hood with the sash in the lowest feasible position. Portable shields, which provide protection to all laboratory occupants, are acceptable.

Safety shower

A safety or drench shower should be available in a nearby location where the acutely toxic gases are used.

Signs and labels

Doorways: The room number sigh must contain a *Designated Area Within Caution* where carcinogens, reproductive hazards, and/or acutely toxic chemicals are stored or used.

Containers: All acutely toxic gas cylinders must be clearly labelled with the correct chemical name. Handwritten labels are acceptable; chemical formulas and structural formulas are not acceptable. A label for acutely toxic gases is available.

Special storage

Acutely toxic gases must be stored in a designated area. Special ventilation of the stored cylinders is required and must be approved by the Department of Environmental Health and Safety.

Continuous monitoring devices which will alert staff of a release of the acutely toxic gas is required for certain gases. The Department of Environmental Health and Safety will contact you concerning this requirement after receipt of the notification form in Appendix F.

The quantity of an acutely toxic gas that may be stored in a laboratory will be determined on a case-by-case basis by the Department of Environmental Health and Safety.

Special ventilation

Manipulation of toxic gases outside of a fume hood will require special ventilation controls in order to minimize exposure to the material. Fume hoods provide the best protection against exposure to acutely toxic gases in the laboratory and are the preferred ventilation control device. Always attempt to handle acutely toxic gases in a fume hood. If your research does not permit the handling of acutely toxic gases in your fume hood you must contact the Department of Environmental Health and Safety to review the adequacy of all special ventilation.

Spill response

In the event of an escape of gas alert personnel in the area that a spill has occurred. Do not attempt to handle a spill of acutely toxic gases. Vacate the laboratory immediately and call for assistance.

- Department of Environmental Health and Safety 3-0404
- University Police 911 or 3-1212 (This is a 24 hour service.)

Remain on the scene, but at a safe distance, to receive and direct safety personnel when they arrive.

Vacuum protection

Not applicable

Waste disposal

All empty or partially filled acutely toxic gas cylinders should be returned to the supplier. If the supplier does not accept empty or partially filled cylinders, contact the Department of Environmental Health and Safety concerning disposal.