UNIVERSITY AT ALBANY
State University of New York

CHEMICAL HYGIENE PLAN

LABORATORY SAFETY AND HAZARDOUS WASTE DISPOSAL GUIDE

Prepared by

University at Albany
State University of New York

Office of Environmental Health & Safety

Updated Spring 2009

Table of Contents

TABLE OF CONTENTS (Cont'd.)

V. SAFE CHEMICAL STORAGE

VI. SAFE PROCEDURES FOR GENERAL CATEGORIES OF CHEMICALS

VII. LABORATORY WASTE DISPOSAL

VIII. APPENDICES

PREFACE

Safety is a serious subject - especially when dealing with chemical and hazardous materials. Safe practice requires that users of chemicals and hazardous materials have a knowledge of potential hazards and a readiness to maintain safe conditions. It demands mutual responsibility and the full cooperation of everyone in the area. This cooperation means that each student, instructor, principal investigator, researcher, teaching assistant, graduate assistant, etc., must observe **ALL** safety precautions and procedures.

The University at Albany has had a long and continuous commitment in providing a safe and healthful environment for all its community members. To further promote this strong commitment, members of the Office of Environmental Health & Safety have prepared this manual with assistance from the Departments of Biology, Chemistry, Fine Arts, Geology, and Physics, and the Office for Research to serve as a guideline for safe practices and procedures in the University's laboratories, art studios, and all other areas where chemicals and hazardous materials are used or store**d.* This manual is the Chemical Hygiene Plan as mandated by OSHA 29CFR 1910.1450**.

The safety and well being of individuals working, learning and conducting research in these areas is directly dependent upon the information contained within this manual. Adherence to these guidelines will contribute greatly toward achieving a safe and healthful environment.

The information contained in this manual has been compiled by sources believed to be reliable. However, no warranty, guarantee, or representation is made by the University at Albany as to the correctness or sufficiency of any information herein; nor can it be assumed that all necessary warnings and precautionary measures are contained in this manual, or that other additional information or measures may not be required or desirable because of particular or exceptional conditions or circumstances, or because of new or changed legislation.

When in doubt, because of particular or exceptional conditions or circumstances, contact the Office of Environmental Health & Safety in Chemistry B73 at 442-3495.

THE NYS RIGHT-TO-KNOW LAW & THE FEDERAL HAZ-COM STANDARD

The University at Albany, State University of New York adheres to Chapter 551 of the Laws of New York State, commonly referred to as the Right-To-Know Law and 29CFR 1910.1200, entitled, The Hazard Communication Standard. Both pieces of registration require employers to institute certain safety training programs for employees and giving employees rights pertaining to information on toxic substances used in the workplace. Contact the Office of Environmental Health & Safety, if you have concerns regarding those laws.

* Guidelines covering the safe handling and disposal of radioactive materials can be found in the Radiation Safety Manual. Please contact the Office of Environmental Health and Safety in Chemistry B73 - 442-3495.

FOR UNIVERSITY POLICY REGARDING:

ANIMAL WELFARE **HUMAN SUBJECTS RESEARCH** **BIOSAFETY**	Adrienne Bonilla Research Compliance Officer Office of Research MSC 312
ASBESTOS ABATEMENT **MEDICAL WASTE** **AIR EMISSIONS** **EMERGENCY PLANNING**	Vincent T. Franconere Director of Environmental Health and Safety Chemistry B73
CHEMICAL SAFETY **CHEMICAL HYGIENE PLAN** **BIOSAFETY**	Lisa A. Donohue Assistant Director of EH&S Chemistry B73
CODE ADMINISTRATION	William H. Dosch Director of Code Administration Chemistry B73
FIRE SAFETY **CODE COMPLIANCE**	Karl G. Kilts Code Compliance Manager/Fire Protection Supervisor Chemistry B73
HAZARDOUS AND UNIVERSALWASTE	Nayan Gosai Hazardous Waste Specialist Chemistry B73
RADIATION SAFETY **RADIOACTIVE WASTE** **LASER SAFETY**	Eric R. Call Radiation Safety Officer Chemistry B73
OCCUPATIONAL SAFETY **BLOODBORNE PATHOGENS**	Nora Baynes Occupational Health and Safety Specialist Chemistry B73
SYRINGE USAGE **GLASSWARE DISPOSAL**	Christian P. Olsen Technical Services Chemistry 109

OFFICE OF ENVIRONMENTAL HEALTH AND SAFETY

DIRECTOR
Vincent T. Franconere, Chem. B73

ASSISTANT DIRECTOR/CHEMICAL SAFETY OFFICER
Lisa A. Donohue, Chem. B73

HAZARDOUS WASTE SPECIALIST
Nayan A. Gosai, Chem. B73

OCCUPATIONAL HEALTH AND SAFETY SPECIALIST
Nora Baynes, Chem. B73

RADIATION SAFETY OFFICER
Eric R. Call, Chem. B73

CODE ADMINISTRATION DIRECTOR
William H. Dosch, Chem. B73

CODE ADMINISTRATION ASSISTANT
Tonia Gross, Chem. B73

BUILDING CODE SPECIALIST
Karen Guastella, Chem. B73

CODE COMPLIANCE MANAGER/FIRE PROTECTION SUPERVISOR
Karl G. Kilts, Chem. B73

FIRE PROTECTION TECHNICIAN/LIFE SAFETY EDUCATOR
Gregory P. Amyot, Chem. B73

SECRETARY/MSDS COORDINATOR
Andrea Downey, Chem. B73

OFFICE'S MAIN PHONE #..... 442-3495
EHS WEBSITE……www.albany.edu/ehs/

RESPONSIBILITIES

Each principal investigator shall be responsible for controlling hazards in his/her research laboratories.[1] Specifically, this shall include: following the safety procedures, practices, policies and rules set forth by this manual, developing specific safety procedures to be followed when working in a laboratory with particularly hazardous substances, following all state and federal regulations, training employees in safe practices, correcting work errors and defective conditions, encouraging a safety attitude in the laboratory, and investigating the circumstances surrounding an accident if it occurs.[2]

Each laboratory worker shall be responsible for complying with the safety procedures, practices, policies and rules set by the principal investigator, state and federal governments and this manual, and shall report all accidents to the principal investigator.

Each instructor shall be responsible for controlling hazards in his/her teaching laboratories. Specifically, this shall include: following the safety procedures, practices and rules set forth by this manual, training students in safe practices, correcting work errors and defective conditions, encouraging a safety attitude in the laboratory, and investigating the circumstances surrounding an accident if it occurs.[2]

Each student shall be responsible for complying with the safety procedures, practices and rules set by their instructor and this manual, and shall report all accidents to their instructor.

All University community members are responsible for reporting any perceived health or safety hazards on campus, as well as any suspected work-related illnesses or health problems to the Office of Environmental Health and Safety.

[1] A laboratory in this manual shall mean any place where hazardous materials or chemicals are used or stored.

[2] In all cases of personal injury/accident, a "Supervisor's Report of Employee's Alleged Accident" - Form PS-1 for faculty/staff or a "Report of Student/Public Accident or Public Injury" - Form LP-5 for students/visitors must be filled out. The employee accident form is available on-line at http://hr.albany.edu/content/empacc.doc Both accident reports are available in the Department Chair's Office or at the EH&S Office in Chem. B73.

I. EMERGENCY PROCEDURES

A. EMERGENCY PHONE NUMBERS

FIRE - POLICE - MEDICAL: 911
(If using a cell phone on campus, dial 442-3131 for UPD*)

IN CASE OF FIRE:

Pull alarm box at nearest exit.

Evacuate building.

If no alarm box, dial 911

***UPD – University Police Department**

EMERGENCY BLUE LIGHT PHONES CAN ALSO BE USED TO CONTACT UPD. Just pickup the receiver and UPD will respond.

B. MEDICAL EMERGENCY PROCEDURES

IN CASE OF MEDICAL EMERGENCY:

1. Give immediate First aid or CPR (Cardiopulmonary Resuscitation). See below.

2. Call 911.
   If indicated, an ambulance will be summoned.

3. Speak slowly and clearly.

4. Give the nature of the emergency.

5. Give the location of the emergency.

6. Give the number and condition of victims.

7. Give the phone number you are using and your name.

8. Hang up last, after the dispatcher does.

IN CASE OF CHEMICAL POISONING:

1. Follow the same procedures as for Medical Emergency above.

2. Take MSDS* with victim.

FIRST AID

The emergency phone number on campus is:

911 for FIRE – POLICE - MEDICAL

(Dial 442-3131 for University Police Department, if using a cell phone on campus)

*Material Safety Data Sheet (MSDS)

MEDICAL EMERGENCY PROCEDURES (Cont'd.)

GENERAL FIRST AID INSTRUCTIONS

In the event of an injury or other emergency, it is important to summon professional assistance immediately. The following instructions are intended only as guidelines for untrained people in providing assistance to the victim during the first few minutes, until professional assistance arrives. It is preferable to have a person trained in First Aid, Cardiopulmonary Resuscitation (CPR) and Automated External Defibrillators (AEDs) providing assistance during the first few minutes. The Office of Environmental Health and Safety urges each department to consider having several people trained in First Aid, CPR and AEDs . Contact Employees Benefits Office at 437-4700 for First Aid , CPR and AED training.

1. Effect rescue only if it can be safely done and it is necessary to prevent victim from further injury while summoning an ambulance. Otherwise, do not move the victim or allow him/her to move until the injuries have been assessed.

2. Ensure an adequate airway.

3. Ensure adequate breathing (give mouth-to-mouth or mouth-to-nose respiration, if necessary).

4. Check for circulation by feeling for a pulse at the neck or wrist, if absent begin CPR (Cardiopulmonary Resuscitation), if you are trained to do so.

5. Control severe bleeding by the use of direct pressure.

THERMAL BURNS

1. Submerge the burned area in cold water (except for third-degree burns). This will significantly reduce both swelling and pain. A third-degree burn is one in which tissue damage has occurred.

2. Apply a dry sterile dressing.

3. Do not break any blisters.

4. Do not use any commercial sprays or home remedies (butter, etc.).

5. Seek medical attention (University Health Center or Hospital.)

MEDICAL EMERGENCY PROCEDURES (Cont'd.)

CHEMICALS IN THE EYE

1. Flush the eye with copious amounts of water for at least 15 minutes being careful not to wash the chemical into the other eye. Use an eyewash fountain if one is available. Another person should assist the victim by holding open the victim's eye while it is being flushed.

2. Seek medical attention and have the chemical's MSDS accompany the victim.

CHEMICAL BURNS

1. Brush any chemicals off the skin with a clean cloth, gloved hand, etc. Flush the affected area with copious amounts of water for at least 15 minutes. If necessary, cut off or use tweezers to remove chemically soaked clothing; avoid touching contaminated areas of clothing. Continue to flush skin for several minutes more after clothing has been removed.

2. Apply a sterile dressing.

3. Seek medical attention and have the chemical's MSDS accompany the victim.

4. All chemically contaminated clothing must be thoroughly washed prior to re-wearing.

*Material Safety Data Sheet (MSDS)

NOTE
In the event of an accident or injury, ***always*** notify the principal investigator, instructor, supervisor or other person in charge as soon as possible. In all cases of personal injury/accident, a *"Supervisor's Report of Employee's Alleged Accident"* (Form PS-1 for faculty/staff) or a *"Report of Student/Public Accident or Public Injury*" (Form LP-5 forstudent/visitor) must be filled out. The employee accident form is available on-line at http://hr.albany.edu/content/empacc.doc These forms are also available in the Department Chair's Office or in the EH&S Office in Chem. B73.

MEDICAL EMERGENCY PROCEDURES (Cont'd.)

POISONING BY MOUTH: IF VICTIM IS *CONSCIOUS*

1. Call for medical assistance (911)

2. After medical help has been summoned, call the Poison Control Center at 1-800-222-1222.

3. Save the label or container of the suspected poison for identification and for possible transportation with the victim to a medical facility. Also, take the MSDS to the medical facility. If the victim vomits, save the vomited material for analysis.

POISONING BY MOUTH: IF VICTIM IS *UNCONSCIOUS*

1. Maintain an open airway, adequate breathing. Give artificial respiration or CPR (Cardiopulmonary Resuscitation) if indicated.

2. Call for medical assistance (911).

3. After medical help has been summoned, call the Poison Control Center at 1-914-366-3000.

4. **DO NOT** give liquids to an unconscious or convulsing victim.

5. Save the label or container of the suspected poison for identification and for possible transportation with the victim to a medical facility. Also, take the MSDS to the medical facility. Save all vomited material.

> **NOT**E: Instructions on labels for treatment of poisoning may be outdated or incorrect and should only be followed after consulting a physician.

*Material Safety Data Sheet (MSDS)

POISON CONTROL CENTER
HUDSON VALLEY POISON CONTROL CENTER
1-914-366-3000

C. EVACUATION PROCEDURES

University buildings are to be evacuated immediately under the following conditions:

a) Fire alarm;

b) Power outage affecting chemical fume hoods;

c) When notified by a senior physical plant representative, University Police Department or person of authority in the building;

d) Treat to life and health as determined by individual good judgment, e.g., hazardous material spill, dangerous gas leak, explosion, natural disaster, etc.

If you are asked to evacuate the building or hear a fire alarm, do the following:

a) Stop work immediately;

b) Put out all flames or heat sources;

c) Rapidly proceed to the nearest exit in an orderly manner and close all doors behind you;

d) NEVER USE ELEVATORS;

e) Principal investigators and instructors check to see that employees and students have vacated their workplace, if conditions permit;

f) Reconvene outside and away from the building to insure everyone has left the building;

g) If you know of someone who is having trouble leaving the building, REPORT it immediately to someone in authority who is handling the emergency;

h) NEVER re-enter the building until a senior physical plant representative and/or building fire marshal has given the okay.

TREAT ALL ALARMS AS THE REAL THING.
ASSUME NOTHING!!

D. EMERGENCY PROCEDURES FOR A RADIATION CONTAMINATION OR EXPOSURE INCIDENT

I. Injuries Involving Radiation Hazards

A. Notification (day or night)

1. Call 911, University Police Department
2. Tell the person who answers:
    a. Someone has been injured in _____ Building, Room _____.
    b. Radioactivity and/or radiation exposure is involved.
    c. Your name.
    d. Telephone extension being used.

B. Care of the Injured

1. Apply first aid, if necessary.
2. Measure exposed skin and clothing for contamination.
3. Remove significantly contaminated clothing and, if necessary, clothe individual in an uncontaminated laboratory coat.
4. Stay with individual with assistance arrives and advise on the extent of the contamination.

C. Contamination control procedures while awaiting assistance:

1. For a localized non-volatile liquid spill:
    a. Cordon off or guard spill area against re-entry; drop absorbent paper onto spill.
    b. Assemble potentially contaminated persons in one location of the laboratory and monitor them for contamination.
    c. Require everyone possibly involved to wait until the Radiation Safety Officer or designee arrives.
2. For a release of powdered material, volatile liquid, or gaseous activity:
    a. Evacuate personnel immediately, turning off any equipment that normally needs constant attention, **if** time permits.
    b. Assemble personnel immediately outside the room and instruct them to stay in one location, to prevent the spread of contamination.
    c. Close and, if possible, lock the room doors to prevent re-entry. If the hood fans are off, try to seal accessible openings into the laboratory to prevent further escape of airborne activity to the corridor.
    d. Isolate the adjacent corridors against traffic and spectators.
    e. Wait for the Radiation Safety Officer or designee to arrive.

II. Contamination Incident Without Injury

A. Notification (day or night)

1. Call 911, University Police Department
2. Tell the person who answers:
    a. Radiation contamination incident in _____ Building, Room _____.
    b. Your name.
    c. Telephone extension being used.

B. Contamination control procedures while awaiting assistance: SEE I.C. above.

E. CHEMICAL SPILL PROCEDURES

EMERGENCY SPILLS - VOLATILE, FLAMMABLE, FUMING OR TOXIC MATERIALS

1. Leave the bottle, carton, etc., right where it falls.
DO NOT attempt to handle the substance with bare hands

2. Alert room occupants, turn off all ignition sources, and immediately evacuate the area.
Close the door behind you to prevent further building contamination.

3. Pull the building fire alarm box at the nearest exit to alert other building occupants and to summon aid (University Police Department and Power Plant).
Leave the building and call 2-3444. Give your name, building name, room number of spill and nature and extent of the spill. State if medical aid is needed.

4. As soon as possible, notify the Office of Environmental Health and Safety at 2-3495.
Give the name of the chemical spilled, the amount spilled, manufacturer and any other pertinent information available.

5. The Office of Environmental Health and Safety will supervise cleanup by properly trained and equipped personnel.

6. No one is to enter the area for general housekeeping cleanup until the EH&S Office has declared the area to be decontaminated and safe.

NON-EMERGENCY SPILLS

1. Leave the bottle, carton, etc., right where it falls.

2. DO NOT attempt to handle the substance with bare hands.

3. Alert room occupants to the spill. If flammable liquid is involved, turn off ignition sources.

4. Contact the Office of Environmental Health and Safety at 2-3495.

5. Give the name of the chemical spilled, manufacturer, the amount spilled, and any other pertinent information available.

6. The Office of Environmental Health and Safety will advise on the correct cleanup procedures.
In special instances, the Office of Environmental Health and Safety may perform minor cleanup procedures in the interest of safety. These cleanup procedures will be performed in conjunction with the personnel involved.

***Spill cleanup kits for small spills are available through the Office of Environmental Health and Safety.**

CHEMICAL SPILL PROCEDURES (Cont'd.)

CHEMICAL SPILL FIRST AID PROCEDURES

If an individual becomes contaminated with a spilled chemical, particularly if the words TOXIC, ACID, CAUSTIC or CORROSIVE appear:

1. Brush any dry chemicals off the skin and clothing with a clean cloth, gloved hand, etc.

2. Flush the affected area with copious amounts of water for at least 15 minutes, using the nearest safety shower, or in the case of eye contamination, the nearest eye wash fountain. If necessary, cut off or use tweezers to remove chemically contaminated clothing, being careful not to touch contaminated areas. Continue to flush skin for several minutes after clothing has been removed. NOTE: You may have to bodily hold the individual under the running water. If the individual's eyes are affected, you may have to hold their eyes open while they are being flushed.
DO NOT BECOME CONTAMINATED YOURSELF!

3. Seek medical help by calling 911 or by taking the individual to the University Health Center.

4. Later, have the individual fill out a personal injury/accident form, LP-5 form for students/visitors and PS-1 form for faculty/staff. These forms are available in the Department Chair's Office or in the EH&S Office in Chemistry B73. The employee accident form is available on-line at http://hr.albany.edu/content/empacc.doc

5. All contaminated clothing must be thoroughly washed before being worn again.

***Always read a chemical's Material Safety Data Sheet (MSDS) before using. The MSDS will review chemical spill first aid procedures.**

II. FIRE SAFETY

A. FIRE PROTECTION

One of the more serious problems that can confront an individual in a laboratory is the spectra of a fire. Electrical equipment, open flames, static electricity, burning tobacco, lighted matches and hot surfaces can all cause ignition of flammable materials. Flammable liquids, powders of combustible solids, compressed and liquified gases are always prevalent; and therefore, caution should be exercised whenever an open flame is required for any particular experiment.
Fire falls into four main classes:

Class A - ordinary solid combustibles, such as paper, wood, textiles, etc.

Class B - flammable liquids, such as gasoline, oil, solvents, etc.

Class C - A fire where an electrical current is present, or where a shock hazard could be a reality

Class D - burning metals, such as sodium, potassium, metal hydrides, etc.

Each type of fire requires an extinguisher specifically applicable to controlling that particular fire:

Class A - water extinguisher or an ABC dry chemical fire extinguisher

Class B - carbon dioxide, BC dry chemical or ABC dry chemical fire extinguisher

Class C - carbon dioxide, BC dry chemical or ABC dry chemical fire extinguisher

Class D - met-1-x fire extinguisher (available on the second and third floors of Chemistry)

Flammable substances are those that readily catch fire and burn in air. A flammable liquid does not itself burn; it is the vapors from the liquid that burn. The rate at which different liquids produce flammable vapors depends on their vapor pressure, which increases with temperature. The degree of fire hazard depends also on the ability to form combustible or explosive mixtures with air, the ease of ignition of these mixtures, and the relative densities of the liquid with respect to water and of the gas with respect to air. These properties can usually be found on a chemical's Material Safety Data Sheet (MSDS).

These concepts can be evaluated and compared in terms of a number of properties:

Flash Point:

The lowest temperature, as determined by standard tests, at which a liquid gives off vapor in sufficient concentration to form an ignitable mixture with air near the surface of the liquid within the test vessel. Many common laboratory solvents and chemicals have flash points that are lower than room temperature.

FIRE PROTECTION – (Cont'd.)

Ignition Temperature:

The minimum temperature required to initiate or cause self-sustained combustion independent of the heat source.

Limits of Flammability:

a) Lower Flammable Limit (Lower explosive limit LEL) is the minimum concentration (percent by volume) of the vapor in air below which a flame is not propagated when an ignition source is present. Below this concentration, the mixture is too lean to burn.

b) Upper Flammable Limit (Upper explosive limit UEL) is the maximum concentration (percent by volume) of the vapor in air above which a flame is not propagated when an ignition source is present. Above this concentration, the mixture is too rich to burn.

Autoignition:

Takes place when a substance reaches its ignition temperature without the application of external heat. Materials susceptible to autoignition include oily rags, dust accumulations, organic materials mixed with strong oxidizing agents (such as nitric acid, chlorates, permanganates, peroxides, and persulfates), alkali metals such as sodium and potassium, finely divided pyrophoric metals, and phosphorus. See Appendix A.

The basic precautions for the safe handling of flammable materials include the following:

1. Flammable substances should be handled only in areas free of ignition sources.

2. Flammable substances should never be heated by using an open flame. Preferred heat sources include steam baths, water baths, oil baths, heating mantles, and hot air baths.

3. Before lighting a flame, remove all flammable substances from the immediate area. Check all containers
of flammable materials in the area to ensure that they are tightly closed.

4. When transferring flammable liquids in metal equipment, static generated sparks should be avoided by bonding from container to container and the use of ground straps. The grounding straps must go to an earth ground. Be sure the clamps on all straps are hitting metal and not just the paint on the containers.

5. Notify other occupants of the laboratory in advance of lighting a flame.

6. Store flammable materials properly. Use a flammable liquid storage cabinet whenever possible. Flammable liquid storage cabinets can be requested through the Office Environmental Health & Safety. See Section V.A. for guidelines on the proper storage of flammable liquids.

7. When volatile, flammable materials may be present, use only non-sparking electrical equipment.

8. Ventilation is one of the most effective ways to prevent the formation of flammable mixtures. An exhaust hood should be used whenever appreciable quantities of flammable substances are

FIRE PROTECTION – (Cont'd.)

transferred from one container to another, allowed to stand in open containers, or handled in any other way.

Compressed or liquified gases present hazards in the event of fire because the heat will cause the pressure to increase and may rupture the container. Leakage or escape of flammable gases can produce an explosive atmosphere in the laboratory. Acetylene, hydrogen, ammonia, hydrogen sulfide and carbon monoxide are especially hazardous. When a liquified gas is used in a closed system, pressure may buildup, so that adequate venting is required. If the liquid is flammable (i.e., hydrogen), explosive concentrations may develop. Any, or all, of the three problems, flammability, toxicity, and pressure buildup, may come serious.

Suspensions of oxidizable particles (such as magnesium powder, zinc dust, or flowers of sulfur) in the air constitute of powerful explosive mixture. Care should be exercised in handling these materials to avoid exposure to ignition sources. See Appendix A.

B. PHYSICAL PROPERTIES OF COMMON FLAMMABLE LIQUIDS

					Flammable Volume	Limit % by in air
Chemical	Class	Flash Point (°C)	Boiling Point (°C)	Ignition Temp (°C)	Upper	Lower
Acetaldehyde	1A	-37.8	21.1	175	4	60
Acetone	1B	-17.8	56.7	465	2.6	12.8
Benzene	1B	-11.1	80	560	1.3	7.1
Carbon disulfide	1B	-30	46.1	80	1.3	50
Cyclohexane	1B	-20	81.7	245	1.3	8
Diethyl ether	1A	-45	35	160	1.9	36
Ethyl alcohol	1B	12.8	78.3	365	3.3	19
n-Heptane	1B	-3.9	98.3	215	1.05	6.7
n-Hexane	1B	-21.7	68.9	225	1.1	75
Isopropyl alcohol	1B	11.7	82.8	398.9	2	120
Methyl alcohol	1B	11.1	64.9	385	6.7	360
Methyl ethyl ketone	1B	-6.1	80	515.6	1.8	10
Pentane	1A	-40	36.1	260	1.5	7.8
Styrene	1B	32.2	146.1	490	1.1	6.1
Toluene	1B	4.4	11.06	480	1.2	7.1
p-Xylene	1C	27.2	138.3	530	1.1	7

C. IN THE EVENT OF A FIRE, FOLLOW THESE PROCEDURES

1. Notify laboratory occupants to evacuate.

2. Pull the building alarm box at the nearest exit.
   Evacuate the building.
   DO NOT USE ELEVATORS.
   Close all doors behind you.[1]
   If no alarm box, dial 911

3. Notify the Office of Environmental Health and Safety at 2-3495 as soon as possible regarding the nature of the fire and materials involved.

4. If a person's clothing should catch fire, douse the individual with water (use a safety shower if one is readily available) or have the individual drop to the floor and roll. If necessary, physically restrain the person and roll them around the floor to smother the flames.

5. Learn the location and the use of the nearest fire extinguisher, types of fire extinguishers available and the procedures for exiting during a fire. Look in building corridors for appropriate evacuation routes.[2] Only use a fire extinguisher after you have established a safe exit route and you feel you are capable of putting out the fire.

PLAY IT SAFE! Know your limitations; do not compromise you life in a hazardous situation.

6. Contact the Office of Environmental Health and Safety for any problems concerning fire safety related items at 2-3495.

[1] The doors within a building, especially in stairwells and in corridors, are required to meet State Fire Code. Doors in stairwells must never be propped open. Open doors will allow the spread of smoke and fire to the exits, rendering them useless. Doors in corridors are smoke partitions; they separate areas limiting the spread of smoke, fire, or fumes to adjacent areas. This serves two purposes: limiting damage and/or contamination and extending escape time. Do not prop them open.

[2] Building corridors and stairwells are fire exits. **NO material shall be placed in any exitwa**y. This includes furniture, equipment, boxes, etc.

D. FIRE EXTINGUISHER USAGE PROCEDURES:

1. Pull the alarm box - this will evacuate the building and summon aid.

2. Fight a small fire only (rule of thumb-no larger than a small trash can) and only use a fire extinguisher, if you have been trained and feel confident in using one. Always place the fire extinguisher between you and the fire. If the fire gets large, get out! Close doors to slow the fire spread. Stay between the fire and an exit. **Do not let fire block your escape path in case it goes out of control.**

3. Make sure you use the correct type of fire extinguisher (see page 20). Make sure you do not use one type extinguisher on another type fire; it may make the fire worse.

4. Learn how to **PASS**.

P ULL
Pull the pin. Some units require the releasing of a lock latch, pressing a puncture lever, or other motion.

A IM
Aim the extinguisher nozzle (horn or hose) at the base of the fire.

S QUEEZE
Squeeze or press the handle.

S WEEP
Sweep from side to side at the base of the fire until it goes out. Shut off the extinguisher. Watch for reflash and reactivate the extinguisher, if necessary. Foam and water extinguishers require slightly different action. Read the instructions.

III. SAFETY PROCEDURES FOR LABORATORY OPERATIONS

A. GENERAL SAFETY PROCEDURES

1. New York State Education Law Section 409-A requires the use of eye protection when working in a laboratory. Chemical splash goggles should be worn wherever chemicals are used or stored. Contact lenses are prohibited. Particulate matter, liquids, vapors, and gases can lodge behind contact lenses and cause considerable eye damage before they can be washed out with water from an eyewash fountain. Visitors must wear eye protection while in laboratories.

2. Adult visitors in laboratories must be accompanied by a faculty or staff member or a graduate student. Children are **PROHIBITED** in all laboratories. **All laboratories must be locked when unattended.**

3. Avoid unnecessary exposure to all chemicals. Wear lab coats or aprons and gloves to protect clothing and skin. Lab coats are preferable to aprons as they cover your arms. Outside of the laboratory, except when transporting chemicals and/or hazardous materials, lab coats and gloves serve no purpose, could spread contamination and should be left behind in the laboratory. Shorts, cut-offs, halter tops and sandals MAY NOT be worn in the laboratory area.

4. Label all containers of chemicals, including waste chemicals. Include your name, the chemicals used, their concentrations and date prepared on the label of all solutions. Put the opening date and disposal date on all materials that degrade such as peroxides and ethers. Never use any substance from an unlabeled or inadequately labeled container.

5. Use laboratory fume hoods when handling flammable, toxic, or noxious agents. Before conducting any work in a fume hood, first check to see if the fume hoods is operating.*

IF NO AIR MOVEMENT IS EVIDENT,
IMMEDIATELY CONTACT THE POWER PLANT AT 2-3444.

6. Eating, drinking, and smoking are **PROHIBITED** in the laboratory areas.

7. Know the location of the nearest safety shower, eyewash station, fire extinguisher and spill kits. Keep them clean and unobstructed.

8. Mouth suction must NEVER be used to fill pipettes, start siphons, or for any other purpose.

9. Never perform experimental work in the laboratory alone, or at least without another person within easy call. Make sure that person knows you are working alone and have that person check up on you periodically. No undergraduate laboratory work is to be carried out in the absence of an instructor. Perform only authorized experiments. Unapproved variations are prohibited. Research people who are responsible for their own experimental programs should inform others working in the area of the chemicals being used and the possible hazards involved. All reactions are to be attended or made fail-safe if left alone or overnight. Reactions should be labeled with the name and phone number of the contact person in case of an emergency.
*Vaneometers are available through the Office of Environmental Health and Safety.

GENERAL SAFETY PROCEDURES (Cont'd.)

10. Work with materials only when you know their flammability, reactivity, corrosiveness and toxicity. Before working with any chemical, review the manufacturer's Material Safety Data Sheet (MSDS) (for additional information contact the Office of Environmental Health and Safety - Chemistry B73). Read all labels thoroughly.

11. All known poisons and known carcinogens should be handled with extreme care and kept under lock and key.

12. A women who works in a laboratory while pregnant should be especially careful to avoid contact with chemicals, particularly those that are embryotoxic or teratogenic. If there is any possibility that you may be pregnant or considering pregnancy, it is suggested that you consult with your physician concerning possible hazards from exposure to chemicals in the laboratory.

13. Apparatus attached to a ring-stand should be positioned so that the system's center of gravity is over the base and not to one side - the lower the better, but with adequate room for removing burners or baths.

14. Provide a vent for chemicals that are to be heated. Prior to heating a liquid, place boiling stones in vessels (other than test tubes). Use a thermometer in a boiling liquid if there is the possibility of dangerous exothermic decomposition, as in some distillations. This will provide warning and may allow time to remove the heat and apply external cooling.

15. Fire polish all glass tubing and rods. Use the proper techniques for inserting and removing a glass tube from a stopper. Shortcuts can lead to a severely punctured hand. Protect hands with gloves, towel, or tubing holder when inserting or removing tubing from stoppers. Lubricate the tubing with water or glycerine. Keep hand on tubing close to the stopper and out of line with the end of the tube.

16. **NEVER** look down the opening of a vessel unless it is empty.

17. Use beaker covers to prevent splattering when heating liquids on a hot plate. Keep a pair of tongs conveniently at hand - a specific pair of tongs for the dish, crucible, beaker, casserole, or flask being used.

18. **NEVER** pour ether, petroleum ether, or other flammable, water-immersible liquids into sinks to be washed down with water. Fires have been caused in laboratories by vapors returning through the drainage system. It is also illegal to put most chemicals down the drain. See Hazardous Waste Disposal Procedures - Section VII.

GENERAL SAFETY PROCEDURES (Cont'd.)

19. Before opening any bottle on which the lid or top is stuck, first make sure there are no additional hazards with opening the bottle such as peroxide formation or pressure buildup in the bottle. If there are no additional hazards associated with opening the bottle, wrap the bottle with a towel and place it in a metal container before cutting the lid. Use the same precautions when opening an ampoule, and at the same time, be careful that the liquid in the ampoule is cold. NEVER open an ampoule containing a flammable liquid by heating the tip with a flame. When opening bottles which may be under pressure (e.g., hydrochloric acid, formic acid or ammonium hydroxide), cover the bottle with a towel to divert any chemical spray, and open under a fume hood.

20. When transferring chemicals, make certain the container is compatible with the chemical.

21. Adequate traps must be used in vacuum systems in which mechanical pumps are used, to prevent corrosion of the pump. Do not release the vacuum in any apparatus when the temperature is above 150°C. The hot vapors may explode.

22. Use only the necessary length of rubber or other flexible tubing and keep it to the rear of the set-up. The water pressure at the University increases at night and has caused several water supply lines to pop off and flood laboratories. Thus, all connecting hoses, especially water supply lines, MUST be fastened with either clamps or wires.

23. Do not mix incompatible chemicals. If in doubt, always check the chemical's Material Safety Data Sheet (MSDS) or a source book before mixing chemicals. Always add a reagent slowly; never "dump it in." Observe what takes place when the first amount is added and wait a few moments before adding more; some reactions take time to start.

ALWAYS ADD ACIDS TO WATER CAUTIOUSLY, WHILE STIRRING.
NEVER POUR WATER INTO ACID

24. Appropriate eye protection must be worn when working with lasers or other optical sources. Contact the Radiation Safety Officer (Chemistry B73) at 2-3495 for additional information.

B. HOUSEKEEPING

1. Set up and label separate waste receptacles for paper and glass. Oily rags and other oil-impregnated materials
should be stored in an approved, covered, metal container and disposed of by calling the EH&S Office at 2-3495. DO NOT PUT NOXIOUS MATERIALS IN THE TRASH. Contact the Office of Environmental Health and Safety for proper disposal.

2. Empty chemical containers are to be triple rinses with water, or the appropriate solvent depending on the chemical, and taken down to the C.A.S. Scientific Stores for disposal. The custodial staff is not responsible for the disposal of these containers. See Section VII.D.

3. Aisles and hallways should not be obstructed. Benches, tables, desks, and fume hoods are work areas, not storage space. Keep work areas clean. Keep drawers and cabinets closed. **Keep all chemicals off the floor. Do not store chemicals overhead.**

4. Equipment with moving parts (gears, belts, pulleys) MUST be equipped with protective guards.

5. Centrifuge tubes should be in good condition - no chips or other flaws. Tubes should be balanced when in use.

6. Oven temperature regulators should be checked periodically to ensure that they are working reliably.

7. Use undamaged, clean glassware - no chips or other flaws.

8. Dewar flasks should be taped when in use or enclosed in metal mesh to protect personnel from flying glass. In general, if apparatus is likely to shatter, either because of pressure or vacuum, surround it with mesh or cloth to limit the travel of particles and to protect personnel.

9. Do not attempt to catch glassware if it is dropped or knocked over. Glass apparatus should be set well back from the front edge of the work bench to lessen the risk of injury if there is an accidental breakage of glass.

10. Sink traps and floor drains should be kept filled with water at all times to prevent escape of sewer gases into the laboratory. Such gases may be toxic or flammable and may be ignited, causing flash fires. A little vegetable oil may be poured down drains that are not used on a regular basis. This will prevent their traps from drying out and odors from escaping.

11. Chemicals should not be poured down the drain or put in the trash. See Hazardous Waste Disposal Procedures - Section VII.

12. Each water supply outlet within the laboratory should be equipped with either a vacuum breaker or a back-flow prevention device. No auxiliary plumbing should be connected to a water distribution line unless adequate back-flow prevention is provided.

HOUSEKEEPING (Cont'd.)

13. Keep all safety showers and eyewash stations clean and unobstructed. **INSPECT AND FLUSH EYEWASH STATIONS WEEKLY and denote date on the attached inspection tag.** If the eyewash is not working properly, contact the Shop Coordinator's Office at 2-3480. If you need an eyewash and/or safety shower installed, contact the Office of Environmental Health and Safety in Chemistry B73.

14. A sign should be fastened on the outside of the door of every laboratory and chemical storage area. This sign should contain the names and phone numbers of the people who should be notified in the event of an emergency. These signs are available from the Office of Environmental Health & Safety in Chemistry B73.

15. Appropriate warning signs should be posted near any dangerous equipment, reaction, experiment or condition. See Appendix on Designated Areas.

16. Keep laboratory doors closed at ALL times. Leaving a laboratory door open interferes with the air flow of the fume hoods, disrupts the building's air handling system and allows various odors to circulate around the building. Laboratory doors must be locked, if the laboratory is unattended. Also, keep building fire doors CLOSED at all times.

17. Clean up all spilled chemicals, water, and broken glassware immediately. Keep floors unobstructed, dry, and free from slippery materials. DO NOT STORE CHEMICALS IN GLASS CONTAINERS ON THE FLOOR.

18. Keep caps and lids of chemical containers closed when not in use as this prevents contamination and vapor escape.

19. Before leaving the laboratory, turn off all services not in use such as water, electricity, gases and vacuums. Bunsen burners should not be left burning when not in use. They should be turned off at the petcocks. Do not depend upon turning a gas burner off at its base.

20. Use only the necessary length of rubber or other flexible tubing and keep it to the rear of the set-up. All connecting hoses, especially water supply lines MUST be fastened with either clamps or wire.

NOTE: Water pressure may increase at night.

21. The contents of refrigerators in laboratories should be reviewed and inspected at regular intervals with should not exceed six months. Do not store materials in open containers in the refrigerator. Food and chemicals must NOT be stored together in a refrigerator because of the possibility of contamination. Refrigerators/Freezers should be explosion proof if storing flammable materials. See Refrigerators- Section V.F.

22. Keep all air vents unobstructed at all times. DO NOT COVER THEM. It will affect the air flow of the fume hoods.

23. DO NOT BLOCK WINDOWS IN DOORS, particularly on laboratory doors, as this poses a potential life threatening hazard in the event of a fire or chemical spill. In the event of an emergency evacuation, personnel checking the building for occupants cannot see into the rooms.

C. TRANSPORTATION OF HAZARDOUS MATERIALS

Transporting hazardous substances from one location to another within the University can be a serious safety and health problem. Individuals could be unduly exposed through carelessness or neglect. For these reasons, extra precautions are not only prudent, but necessary.

RULES FOR TRANSPORTING HAZARDOUS MATERIALS

1. Unbreakable containers must be used to transport bulk amounts of chemicals.

2. All liquid chemicals in glass containers MUST be transported in bottle carriers. These carriers are available either for loan or purchase from CAS Scientific Stores. The Stores will not release any toxic or hazardous chemical unless it is in an unbreakable carrier or in a bottle carrier.

3. All compressed gas cylinders, including empties, MUST be secured upright to a cylinder hand truck with the cylinder valve cap in place. This includes cryogenic tanks.

4. Whenever transporting liquid nitrogen tanks (or any cryogenic that is venting) in elevators, make sure another person is waiting for you when you exit the elevator. This will ensure that you have someone available to summon help should the elevator break down and/or you are overcome by the over-venting of the gas. If at all possible, no one should ride in an elevator with a venting cryogenic tank.

5. When transporting chemicals and/or compressed gases for University use in vehicles, on or off-campus, contact the Office of Environmental Health & Safely for the appropriate procedures and paper work. Chemicals and/or compressed gasses should **not** be transported in personal vehicles.

D. FUME HOOD PRACTICES

Improper fume hood practices often render the hood useless and unsafe. The hoods are only ***secondary safety devices*** and must be used in conjunction with good laboratory safety practices. The following information will help the user attain a higher degree of safety:

1. Prior to fume hood usage, become familiar with the location of the nearest exit, emergency shower, eyewash station and fire extinguisher, and be sure the pathways to these locales are unobstructed.

2. **Verify that the hood is operating properly before each usage**. Use the installed airflow monitor, a vaneometer, or a piece of tissue to check for airflow. A reading of 80 - 150 fpm on the monitor or vaneometer indicates good airflow. **DO NOT USE THE HOOD IF ADEQUATE AIRFLOW IS NOT INDICATED.** Notify the other occupants in the lab of the problem and immediately contact the Power Plant at 2-3444 (24 hours). If you need a vaneometer, contact the Office of Environmental Health and Safety in Chemistry B73.

3. **DO NOT USE HOODS ON FRIDAY MORNINGS BETWEEN 7:30 am & NOON.** Every Friday morning between 7:30 am and noon the Academic HVAC crew inspects the machinery in the air monitors in the Biology, Chemistry including the Ion Implanter, Earth Science, Fine Arts and Physics buildings. (If Friday is a holiday, Monday is the inspection day.) In order to protect the HVAC maintenance crew while they are in the monitors where the fume hood exhaust fans are located, it is mandated that on Friday mornings the fume hoods not be used until noon. Be sure all chemicals in the hood are in sealed containers. Also, do not send anything toxic up the vacuum lines that exhaust on the roof during this time frame.

4. Always wear safety goggles, gloves and a lab coat when working around the hood.

5. KEEP THE HOOD UNCLUTTERED; THE MORE CLUTTERED A HOOD, THE MORE AIR FLOW DISTURBANCES POSSIBLE.

6. Keep experimental apparatus away from the edge of the hood - at least four (4) inches behind the face of the hood, and well away from the back (blocking the baffles will disturb the airflow pattern.)

7. Position the sash appropriately to ensure a minimum face velocity of 80 - 100 feet per minute (fpm). Reducing the open face will increase the face velocity plus provide protection to the user. Keep your head outside the hood and keep the sash closed when the hood is not in use.

8. Try not to store chemicals in the hood - chemicals stored inside the hood disturb the airflow pattern (especially when blocking baffles), and reduce the available working space. Evaporation of chemical waste up the fume hood is an illegal form of hazardous waste disposal. All hazardous waste containers in a hood should be kept sealed, unless they are actively being used (actually pouring waste into the container.)

9. **Do not use perchloric acid in laboratory fume hoods.** Perchloric acid must only be used in hoods designed especially for it. Contact the Office of Environmental Health and Safety for proper perchloric acid usage procedures.

E. DISTILLATION PROCEDURES

Performing a distillation is a common procedure in laboratories. But the fact that it is common, means that people tend to overlook the inherent hazards. Following the same rules that should be heeded in order to keep distillations safe.

1. Always use either round-bottomed flasks or kettles of Pyrex supported with a tripod or bench jack, with a neck clamp for added security. To prevent an over-violent reaction, place boiling chips or an ebullator in the distillation flask or bottle.

2. Provide a vent in every distillation system and check to see that it does not become plugged. Otherwise, an explosion may occur.

3. Before starting a distillation process, check all joints and connections to see that they are greased and tight. Secure glass joints with wire or clamps to prevent vapor leakage. Be certain that the coolant is flowing and that a receiver of adequate capacity is in place.

4. Perform all flammable liquid distillations, extractions, and washing operations in a fume hood. Use an electric heating mantel or a water or steam bath for heating - never use an open flame or hot plate. Before distilling ethers or acetal, destroy all peroxides that may be present. See Appendices A and G.

5. When distillations are performed under reduced pressure, inert gas should be introduced by an ebullator. On vacuum stills, be certain that the contents of the system have cooled below the boiling point before releasing the vacuum.

6. Avoid overheating still bottoms at end of distillation. When stopping a distillation, first shut off the heat. Turn off the coolant only after all vapors disappear from the condenser.

Taken from the M.I.T. Accident Prevention Guide, Vol. 4

F. ELECTRICAL SAFETY

1. All electrical connections should be grounded.

2. Electrical equipment service cords should be in good condition. Frayed cords or exposed wires should be repaired by qualified personnel. Control switches and thermostats should also be in good working order. Special attention should be paid to cables from the power supply to the gels in the gel electrophoresis equipment. These cables must be in good condition, otherwise there is potential for electric shock. Check the cables periodically, and replace when they are worn.

3. Avoid overloading circuits. Do not use multiple outlet plugs for additional connections. Approved UL listed power strips should be used in place of extension cords or multiple outlet plugs.

4. Do not handle any electrical connections with wet hands or when standing in or near water. The placement of connections should be such that there is no danger or chemical or water spillage on wires or equipment. Do not allow electrical cords to drape down into the troughs between lab benches (as in the Biology building), as they often have water running through them.

5. Do not use electrical equipment, such as mixers or hotplates, around flammable liquids.

6. Do not try to repair equipment yourself. All repairs should be done by qualified personnel.

7. Never try to bypass any safety device on a piece of electrical equipment.

8. In case of fire on or near any electrical equipment, pull building fire alarm box and if possible, dial 911.

9. Use only BC or ABC fire extinguishers for fires on or near any electrical equipment.

10. Temporary electrical connections should be carefully placed - they should not be run across the floor without protective covering nor left hanging overhead. **Temporary connections should not take the place of installing permanent connection**s. Heavy items should not be placed on top of electrical cords.

11. Do **NOT** store flammable or volatile liquids in refrigerators/freezers that are not explosion proof.

For electrical assistance, contact the University Shop Coordinator's Office at 2-3480.

ELECTRICAL SAFETY (Cont'd.)

IN THE EVENT OF ELECTRICAL SHOCK:

1. Do not touch victim until victim is out of contact with live current.

2. Unplug or turn off current or circuit breaker, if possible.

3. Immediately call 911. State that you have a possible electrocution and request the Fire Department and Medical Assistance.

4. Follow Medical Emergency Procedures.

G. APPROVAL

The principal investigator must obtain **prior** approval from the Office of Environmental Health and Safety, and when necessary, the Department Chair, Radiation Safety Committee, Animal Welfare Committee, Human Subjects IRB, Biomedical IRB, Biosafety Committee (IBC), etc., for particular laboratory operations, procedures, or activities that involve the following:

1. A newly introduced hazardous chemical substance of moderate chronic or high acute toxicity;

2. Working with a substance of known high chronic toxicity;

3. Working with the 25 OHSA regulated chemicals listed in Section VI.A.;

4. Working with radioactive materials.

5. Working with drugs, animals, human subjects, human pathogens, human bodily fluids, etc.

Consultation with the above bodies may be appropriate to ensure that the toxic material is effectively contained during the experiments, safety protocols are established and that the waste material can be and is disposed of in a safe and legal manner. See page 6.

H. RESPIRATORY PROTECTION

Respiratory protective equipment should not be used as a substitute for adequate exhaust ventilation or other engineering control methods. But when it is clearly impractical to remove harmful dusts, fumes, mists, vapors, or gases at their source, or when emergency protection against occasional and brief exposure is needed, people should have respiratory protective equipment available and should be trained on how to use it.

There are several types of situations for which respiratory protection should be used:

a) oxygen deficient atmospheres;

b) gaseous toxic contaminant is present;

c) particulate toxic contaminant is present;

d) both particulate and gaseous toxic contaminants are present;

e) nuisance dusts;

f) gaseous contaminant is present below toxic levels.

There are a variety of respirators available and each has a particular application. For example, a dust mask is not effective where a toxic gas or an oxygen deficient atmosphere is present. Therefore, it is important to understand the hazardous situation and to choose suitable respiratory protective equipment. The University has a Respiratory Protection Program managed by the Office of Environmental Health and Safety involving medical exams, training, and the proper selection and fitting of respirators. If you need a respirator, contact the EH&S Office in Chemistry B73. Medical approval by a doctor is required before an employee or student can wear a respirator, as respirators put a strain on the respiratory and cardio-vascular system. The EH&S Office as part of the University's respiratory Protection Program will make arrangements for this medical approval.

The types of respirators currently available at the University include the following:

Chemical Cartridge Respirators

These consist of a half or full facepiece connected directly to cartridge filters. Air contaminated by a toxic gas or vapor is purified by the chemicals in the cartridges. The length of time that a chemical cartridge respiratory provides protection depends upon the type of cartridge, the concentration of the gas or vapor, and the activity of the user. The respirator offers resistance to breathing.

Particulate Filter Respirators

These consist of a half or full facepiece either with particulate filters attached or the respirator itself may be made out of the filter material. The filter removes toxic particulates but offers resistance to breathing.

RESPIRATORY PROTECTION (Cont'd.)

Combination Respirators

These respirators offer protection against both particulate and gaseous contaminants but present breathing resistance.

If Departments suspect that a situation exists in their laboratories that requires either the emergency or routine use of respiratory protection, they should contact the Office of Environmental Health and Safety for an evaluation of the need for respirators and the type to be used.

Departments may request respirators from the Office of Environmental Health and Safety to be used on a short-term or emergency basis. If the need for respirators is expected to be long-term, Departments should consider purchasing respirators, on the advice and approval of the Office of Environmental Health and Safety. In either case, respirators should be available at all times to the people who work in hazardous locations or situations where respiratory protection is required. Only people who have gone through the University's Respiratory Protection Program will be allowed to use them.

I. MEDICAL CONSULTATION AND MEDICAL EXAMS

Any laboratory personnel who works with hazardous chemicals has the right to receive medical attention, including any follow-up examination which the examining physician determines to be necessary, under the following circumstances:

1. Whenever a lab worker develops signs or symptoms associated with a hazardous chemical to which they were exposed to in the laboratory.

2. When exposure monitoring reveals an exposure level routinely above the action level or the permissible exposure level (PEL), where no action level exists.
See Appendix C.

3. Whenever an event takes place in the work area such as a spill, leak, explosion, or other occurrence resulting in the likelihood of a hazardous exposure.

4. Whenever an employee is required to wear a respirator as part of their job duties. See H. Respiratory Protection above.

J. PROVISIONS FOR EMPLOYEE INFORMATION AND TRAINING

INFORMATION

The Chemical Hygiene Plan contains all of the *information* requirements described in Paragraph F of 1910.1450.

TRAINING

There are various on-going training activities for laboratory personnel:

New Employee Orientation:

The Office of Environmental Health and Safety conducts new lab employee safety orientation training several times a year. This training complies with the training requirements of 1910.1450, and explains the emergency and safety services in the buildings.

LAB SAFETY TRAINING:

The Office of Environmental Health and Safety routinely trains on various topics pertaining to lab safety during their meet and munch sessions in the science buildings.

If you have a need for customized training or require training on a particular safety topic, contact the Office of Environmental Health and Safety at 2-3495.

IV. MATERIAL SAFETY DATA SHEETS

A. HOW TO READ AND UNDERSTAND AN MSDS

SECTION 1: CHEMICAL IDENTIFICATION

The first section of the MSDS helps you identify the product. It lists the name of the product, any trade names, and the chemical manufacturer's name and address. This section may also list an emergency phone number.

SECTION 2: HAZARDOUS INGREDIENTS

This section lists what's in the product that can harm you. It also lists the concentration of the substance to which you can safely be exposed, often listed as the permissible exposure limit (PEL) or the threshold limit value (TLV). These safe exposure limits are usually figured for average exposures over a typical work shift.

SECTION 3: PHYSICAL DATA

This section describes the product's appearance, odor, and other characteristics. Percent volatile, for instance is how much of the chemical evaporates at room temperature. Sulphuric acid has a low percent volatile, but it can be harmful if inhaled. Respiratory protection or extra ventilation may be needed.

SECTION 4: FIRE AND EXPLOSION DATA

This section explains the temperature at which the substance ignites, called the flash point. A substance is considered FLAMMABLE if its flash point is below 100°F.
If it's COMBUSTIBLE, it ignites 100°F or above. The lower the flash point, the more likely a substance will ignite. This section also lists extinguishing media - what will put out the fire safely - such as water spray, foam, or other type of fire extinguisher.

SECTION 5: HEALTH HAZARDS

This section lists symptoms of overexposure, such as a skin rash, burn, headache, or dizziness. It also tells you first aid and emergency procedures in case of overexposure, such as flushing your exposed skin with running water for 15 minutes. It may also list any medical conditions that can be aggravated by exposure to the chemical.

SECTION 6: REACTIVITY DATA

Here you will find whether the product reacts with other materials or under certain conditions. Incompatibility lists the materials, such as water or other products, that cause the product to burn, explode, or release dangerous gases. Instability lists the other conditions, such as heat or direct sunlight, that can cause a dangerous reaction.

HOW TO READ AN MSDS (Cont'd.)

SECTION 7: SPILL OR LEAK PROCEDURES

This section tells you what to use to clean up an accidental spill or leak. No matter what the product is, always notify the principal investigator or supervisor right away. Before cleaning up a spill, you may need to wear respiratory protection, gloves, safety goggles, or protective clothing.

This section may also include notes on how to dispose of the material safely. Be sure to consult the Office of Environmental Health & Safety for the correct disposal procedures. See Section VII.

SECTION 8: SPECIAL PROTECTION AND SPECIAL PRECAUTIONS

Here you will find a listing of any personal protective equipment (respiratory protection, gloves, eye protection) you need to work safely with the product. If protective equipment is needed, this section may list the specific types that are recommended, such as a full face mask respirator, rubber gloves, and chemical safety goggles. This also will list any other special precautions to follow when handling the material. This may include what to have nearby to clean up a spill or put out a fire, and what safety signs to post near the chemical. This section also lists any other health and safety information not covered in other parts of the MSDS.

B. TOXIC CHEMICALS

A toxic chemical is one that has the potential for injuring the human body or its systems by direct chemical
action. Almost any substance is toxic when taken in excess of "tolerable" limits. See Appendix C.
A person may be exposed to a toxic chemical in a number of different ways. The four **PRIMARY ROUTES OF ENTRY** are:

1. ***Absorption*** - Direct chemical contact with the skin or eyes is the most common type of chemical exposure. The substance can enter the bloodstream through the outer layers of the skin, contact with eyes, through hair follicles, or surface openings from cuts and bruises.

2. ***Inhalation*** - Inhalation of chemicals into the respiratory passages and lungs.

3. ***Ingestion*** - Ingestion of chemicals either directly or indirectly by contamination of hands, food, or drink.

4. ***Injection*** - Injection of the chemicals into the body through syringes, puncture wounds, or broken glassware.

The effects of the toxic chemical may be *local* or *systemi*c, *acute* or *chroni*c. Knowing what these terms mean is useful and can usually be found on the chemical's MSDS.

Local Toxicity

The effect a substance has on the body tissues directly exposed to it. For example, an acid exhibits local toxicity because it can cause burns of the skin, eyes, mouth, or stomach, if it comes in contact with them and can cause irritation of the respiratory tract.

Systemic Toxicity

The effect a substance has on body tissues after it has been absorbed into the bloodstream. For example, mercury exhibits systemic toxicity because it effects the brain, kidneys, gums, and teeth after it has been inhaled or ingested.

Acute Effect

Short term exposure. A single dose in which the body's ability to protect itself is overcome by the substance. Acute exposures are usually reversed over a period of time. Benzene is an example of a substance with an acute toxic effect, causing irritation of skin and eyes and narcosis.

Chronic Effect

Long term exposure. Low level exposure over a long period of time in which the rate of exposure is greater than the body's ability to protect itself. Chronic effects often do not appear until years later. Benzene also exhibits chronic toxicity, producing severe anemia and possibly cancer.

C. CATEGORIES OF RELATIVE TOXICITY OF CHEMICALS AND ASSOCIATED SIGNAL WORDS

CATEGORIES OF ACUTE TOXICITY

Catagories of Relative Toxicity	Signal Word on Chemical Label	Oral LD50 a mg/kg	Dermal LD50 b mg/kg	Inhalation LC50 c mg/liter	Probable Oral Lethal Dose for 150 lb human
Highly Toxic	Danger	0 - 50	0 - 200	0 - 200	A few drops to a teaspoonful
Moderately Toxic	Warning	50 - 500	200 - 2000	200 - 2000	One teaspoonful to one once
Slightly Toxic	Caution	500	2000- 20000	- - -	One once to one pint or one pound
Relatively Toxic	None	5000	20000	- - -	Over one pint or one pound

[a] L_{D50} is the commonly used measure of acute oral and dermal toxicity. It means the Lethal Dose for 50 percent of the subjects receiving the
dose is expressed in milligrams of substance per kilogram of body weight of the subject.
[b] L_{C50} is the commonly used measure of acute inhalation toxicity. It means the Lethal Concentration of 50 percent of the subjects receiving the
dose and is expressed in milligrams of substance per liter of air breathed by the subject.
[c] In addition, the word "**POISO**N" and the skull and crossbones must be displayed with the word "**DANGER**!" for highly toxic chemicals.

D. PEL'S AND TLV'S

PEL (Permissible Exposure Limit) and TLV (Threshold Limit Value) are standards or guidelines that establish certain levels of a substance to which nearly all workers may be repeatedly exposed, day after day, without adverse effects. PEL's are legal standards, established by OSHA, while TLV's are guidelines recommended by the American Conference of Governmental Industrial Hygienists (ACGIH). These exposure limits, expressed in parts per million (ppm) or milligrams per cubic meter (mg/m^3), are based on a time weighted average for an 8 hour day/40 hour work week. These limits can be found on a chemical's Material Safety Data Sheet (MSDS). The important thing to remember about PEL's and TLV's is that the lower the number, the more dangerous the substance. (for a listing of PEL's, see Appendix C.)

Before using a chemical, the researcher should be familiar with the hazards of the chemical. This information is most readily obtained from the chemical's label and the manufacturer's MSDS. The chemical label is provided by the manufacturer with:

a) information on the type of hazard a chemical presents, whether toxic, flammable, explosive, oxidizing, corrosive, or some other hazard;

b) a signal word indicating the relative hazard, DANGER, WARNING, or CAUTION (see previous page);

c) instructions on how to use the chemical safely; and

d) instructions on emergency measures, such as first aid, fire fighting, and spill clean up.

After becoming familiar with the properties of a toxic chemical, the researcher should plan his or her experiment to include protective clothing and equipment, special laboratory practices, and procedures for emergencies.

The Office of Environmental Health and Safety in Chemistry B73 is available to help researchers evaluate their exposure to toxic chemicals.

Good sources of information on toxic chemicals, besides the MSDS, are:

Dangerous Properties of Industrial Materials, edited by N. Irving Sax;

Registry of Toxic Effects of Chemical Substances, offered by NIOSH; and

Threshold Limit Values for Chemical Substances and Physical Agents; by ACGIH.

V. SAFE CHEMICAL STORAGE

A. CHEMICAL STORAGE GUIDELINES: IN RELATION TO NEW YORK STATE FIRE CODE REQUIREMENTS

There is no easy ABC solution to the problems associated with the storage of chemicals, including flammable and combustible liquids. The basic approach is to limit the amount of flammable liquids to reduce the risk of accidents, and more importantly, to reduce the consequences of accidents. Reducing the quantity of flammable solvents to the limits set by fire codes will enhance overall laboratory safety and minimize the risks of major fires and/or injuries.

In essence, the storage of flammable or combustible liquids are to be limited to amounts needed for the day to day operation of the labs. Laboratories were not designed or intended to be long term storage areas for large quantities of solvents. The storage of solvents for convenience unnecessarily increases the risk of accidents with severe consequences.

1. Maximum storage of flammable and combustible liquids shall not exceed 120 gallons (45 liters) inside a flammable storage cabinet.

2. The maximum number of flammable storage cabinets within a maintained fire area is three (3). A fire area is defined as a room or rooms separated from other rooms and corridors by a fire rated enclosure with opening protectives (doors, vents, slide up doors), which must self-close and latch. The fire area shall not exceed 5000 sq. ft.

3. Flammable and combustible liquids will not be stored in/or block egress from any lab or storage area.

4. The maximum amount of flammable liquids stored outside of an approved storage cabinet is 35 gallons/132.5 liters. Of these 35 gallons, 25 gallons/95 liters must be in safety cans; the remaining 10 gallons/38 liters may be in other permissible containers.

5. No safety can shall exceed 2 gallons/8 liters in instructional (undergraduate) labs. 5 gallon/18.9 liter safety cans may be used in any other lab using chemicals. 55 gal. drums of solvent for use in labs are prohibited from being purchased.

6. Solvents with a flash point (see MSDS) of 100°F or less shall not be transferred between metal containers unless the containers are electrically bonded to a ground source.

7. These solvents are commonly stored in laboratories in excessive quantities. This practice must be controlled.

   Amines Alcohols
   Aldehydes Ketones
   Esters Ethers
   Halides (except methylene chloride - practically nonflammable)
   Hydrocarbons

CHEMICAL STORAGE GUIDELINES (Cont'd.)

8. Incompatible chemicals shall be physically separated to prevent accidental contact.

    Examples: Acids & Bases
    Acids & Solvents
    Organics & Inorganics
    Water Sensitive Chemicals
    Oxidizing Agents & Organics
    Oxidizing Agents & Flammables
    Organic Acids & Inorganic Acids
    Oxidizing Agents & Reducing Agents
    Oxidizing Agents & Dehydrating Agents

9. Containers of materials that may become hazardous upon prolonged storage should be dated when first opened. At six month intervals, the chemicals shall be evaluated or tested for continued safe use (i.e., peroxides).

10. One way to achieve safe storage of chemicals is to adopt a method suggested by the chemical manufacturers. For example, Fisher Scientific uses color-coding to signify groups of chemicals, which may be stored together. Whether the color code is used or not, the main idea is the separation of incompatible chemicals. Attached is a list of commonly used chemicals grouped together as compatibles. It follows that the chemicals within the group shall not be stored with chemicals within another group due to possible unfavorable reactions.

11. COMPRESSED OR LIQUIFIED GASES - Only gas cylinders necessary for current lab requirements shall be in the lab. All Gas cylinders shall be securely restrained to prevent falling over, whether empty or full. Also, all gas cylinders must have valve caps in place when not being used, if appropriate. Regulators should be removed and valve caps put back on any gas cylinder not being used again within one week. Cylinder contents, which create a health hazard (such as neurotoxins, poisons, etc.), shall be stored so that they will not contaminate breathing air.

This table shows the maximum allowable size of various containers for flammable and combustible liquids. Always consult the MSDS for properties of the class of liquid being used. Class is based on flash point.

MAXIMUM [1] ALLOWABLE SIZE OF VARIOUS CONTAINERS FOR FLAMMABLE AND COMBUSTIBLE LIQUIDS

Liquid Classification	Glass or Approved Plastic	Metal (Other than DOT Drums)	Safety Cans
Class 1A (Flash point below 22.8°C, Boiling point below 37.8° C)	1 pint	1 gallon	2 gallons
Class 1B (Flash point below 22.8°C, Boiling point below 37.8° C)	1 quart[2]	5 gallons	5 gallons
Class 1C (Flash point below 22.8°C, Boiling point below 37.8° C)	1 gallon	5 gallons	5 gallons
Class II (Flash point at or above 37.8°C and below 60°C)	1 gallon	5 gallons	5 gallons
Class II (Flash point at or above 60°C and below 93.3°C)	1 gallon	5 gallons	5 gallons

[1] Maximum Capacity - Not more than 60 gallons of Class I or Class II liquids, nor more than 120 gallons of Call III liquids may be stored in a storage cabinet.

[2] 1 gallon is allowed if the substance cannot be kept in metal or if the procedure requires more.
1 pint = 473 mL; 1 quart = 946 mL; 1 gallon = 3.8 liters.

FLAMMABLE LIQUID STORAGE GUIDELINES
Part I - General

MAXIMUM CAPACITY WITHIN CONTAINERS

Definition: **Flammable Liquids**

Class 1A = Flash Point <73°F and Boiling Point <100°F
Class 1B = Flash Point <73°F and Boiling Point >100°F
Class 1C = Flash Point >73°F and Boiling Point <100°F

Combustible Liquids

Class II = Flash Point - Between 100 and 140°F
Class IIIA = Flash Point - Between 140° and 200°F
Class IIIB = Flash Point - 200°F +

MAXIMUM CAPACITY WITHIN CONTAINERS

Container	Class 1A	Class 1B	Class 1C	Class II	Class III
Glass	1 pt[1]	1 qt[1]	1 gal	1 gal	5 gal
Non-DOT Drum	1 gal	5 gal	5 gal	5 gal	5 gal
Plastic Drum	1 gal	5 gal	5 gal	5 gal	5 gal
Safety Can	2 gal	5 gal	5 gal	5 gal	5 gal
DOT Drum	60 gal	60 gal	60 gal	60 gal	60 gal
NFPA Tank	660 gal	660 gal	660 gal	660 gal	660 gal

1 Class 1A and Class 1B may be in glass if ACS analytical reagent grade is required, then the limit is one (1) gallon.

MAXIMUM STORAGE IN CABINETS

The maximum total of Class I, II and/or IIIA liquids stored in a flammable storage cabinet may not exceed 120 gallons (454 liters). Of this MAXIMUM TOTAL (120 gallons), not more than 60 gallons may be of Class I and/or Class II liquids. The maximum number of approved flammable liquid storage cabinets per room is three (3).

FLAMMABLE LIQUID STORAGE GUIDELINES (Cont'd.)

MAXIMUM ALLOWED OUTSIDE CABINET/
FLAMMABLE LIQUID STORAGE ROOM

Class	Quantity
Class I or II	Non-safety container shall not exceed one (1) gallon for either
Class I and II	No more than 10 gallons in safety containers, total
Class I and II	No more than 25 gallons in safety containers plus non-safety Containers in combination
Class III	NOT more than 60 gallons

1. Storage will be limited to that required for operation of office equipment, maintenance, demonstration and laboratory work.

2. Liquids used for building maintenance, painting . . . may be stored temporarily in closed containers outside of storage cabinets or separate inside storage areas . . . not to exceed a ten (10) day supply at anticipated rates of consumption.

3. Criteria for inside storage room.

Automatic Protection	Rating	Maximum Area	Total per Square Feet
Yes	2 hour	500 sq. ft.	10 gallons
No	2 hour	500 sq. ft.	4 gallons
Yes	1 hour	150 sq. ft.	5 gallons
No	1 hour	150 sq. ft.	2 gallons

Must Have:

1. Liquidtite floors;
2. Liquidtite wall to floor joint;
3. 2 hour rated walls with 1½ hour rated door assembly; OR
   3 hour rated walls with 3 hour rated door assembly, etc.
4. Non-Combustible liquidtite raised sills at doors 4" or more;
5. Listed electrical equipment as per NFPA-70;
6. Continuous exhaust system to the exterior, not less than 150 CFM, with a shut down alarm.

FLAMMABLE LIQUID STORAGE GUIDELINES (Cont'd.)

4. General Storage

A. Containers of 30 gallons plus, shall not be stacked over one container high.
B. Storage of any flammable or combustible liquids shall not block exits.
C. Class I liquids will not preclude egress from an area, should a fire occur.

5. Where other factors substantially increase or decrease the hazard, the authority having jurisdiction may modify the quantities specified.

FLAMMABLE LIQUID STORAGE GUIDELINES
Part II - Instructional Laboratories Using Chemicals

MAXIMUM QUANTITIES OF FLAMMABLE AND COMBUSTIBLE LIQUIDS IN INSTRUCTIONAL LABORATORIES

Storage: **Maximum** amount of flammable liquids located outside of the flammable liquid storage cabinets is as follows:

35 gallons/132.5 liters
of these 35 gallons (132.5 liters), 25 gallons/ 95 liters **MUST** be in approved safety cans, the remaining 10 gallons/38 liters may be in other permissible containers.

Flammable Liquid Storage Cabinets: Maximum number of cabinets is three (3) with 120 gallons/454.2 liters of flammable liquids per cabinet.

NO individual storage container may exceed 5 gallons/19 liters.
AND
NO individual storage container for Class 1A liquids may exceed 2 gallons/8 liters.
AND
NO SAFETY CAN may ever exceed 2 gallons/8 liters.

All laboratories shall have a one hour separation from all other areas. All doors leading to the common corridor (hallway) MUST close by themselves (self-closure) and latch.

Access to all room exits shall be maintained at all times. Doors are to be kept clear and unlocked from inside the laboratory.
All laboratories shall have:
1. Portable Fire Extinguishers, which are immediately accessible;
2. The ability to hear building fire alarms;
3. An emergency evacuation plan formulated by the laboratory staff and practiced at regular intervals.

FLAMMABLE LIQUID STORAGE GUIDELINES (Cont'd.)

COMPRESSED OR LIQUIFIED GAS CYLINDER STORAGE (NFPA 45 Section 8-2)

1. The total number of cylinders shall be reduced to three (3), 10" x 50" cylinders or two (2), 9" x 30" cylinders, or ten (10), 2" x 12" cylinders or up to 25, 2" x 12" cylinders by special exception. (Stated sizes or equivalent volume is permitted.)

2. Cylinders with a Health Hazard Rating of three or four (short exposure: serious temporary or residual injury may occur) is limited to three (3), 5" x 15" cylinders.

3. ALL cylinders shall be individually secured in place to prevent falling.

4. Oxygen cylinders must be 20' from combustible materials when in storage. They shall also be 20" from fuel gas cylinders separated by a non-combustible barrier.

5. Caps shall be in place to protect valves while not connected for use.

6. Empty containers will be properly disposed of and shall not be allowed to be stored.

7. All containers will be properly labeled as to their content. If the contents are changed, the labels must also be changed. However, this is not recommended since the chance of mixing inter-reactive materials is substantially increased.

NOTE: Above excerpts are from NFPA 45 - "LABORATORIES USING CHEMICALS" Code and Fire Code, State of New York.

B. STORAGE OF CHEMICALS

1. DO NOT OVERSTOCK CHEMICALS.

2. KEEP QUANTITIES OF ALL CHEMICAL MATERIALS TO A MINIMUM.

3. Purchase ONLY the smallest quantity necessary to complete your experiment and/or research project.

4. Storage Conditions - Flammable liquids must be stored in flammable storage cabinets or explosion-proof refrigerators, if refrigeration storage is necessary. Eliminate all ignition sources (flame, heat from radiators, etc.) from storage area or locate storage area away from fire hazards. See Section V.F.

5. Chemicals should be stored ***with labels facing out***, in metal cabinets or on secured, level metal shelves (excluding perchloric acid). **No storage on the floor or higher than eye/face level is allowe**d. Large containers should be stored towards the back and bottom of shelves. Keep chemicals away from shelf and counter top edges. If possible, shelves where chemicals are being stored should have protective edges to prevent chemicals from falling off. **DO NOT STORE IMCOMPATIBLE CHEMICALS TOGETHE**R. See Sections V. C., D., E.

6. Containers of perchloric acid should be kept on trays of glass, ceramic, or polyethylene materials of sufficient capacity to hold all of the acid in case containers should leak. Perchloric acid forms a contact explosive when in contact with metals. In general, acids should be stored on trays (polyethylene) with sufficient capacity to hold a leaking container's contents.

7. Store dichromate cleaning solutions in cool areas, away from other chemicals. Keep the bottle caps slightly loosened. See Appendix C.

8. Fume hoods should not be used as a storage area. Chemicals stored in a fume hood interfere with the hood's proper airflow.

9. Keep caps and lids of chemical containers closed when not in use as this prevents contamination and vapor escape.

10. Ethers should be stored in dark, cool, well-ventilated storage areas. Ethers with low flash points should be stored in an explosion-proof refrigerator. See Appendix G.

11. DO NOT USE THE FLOOR FOR STORAGE. DO NOT STORE CHEMICALS OVERHEAD.

12. POISONS AND DRUGS MUST ONLY BE STORED IN LOCKED CABINETS.

C. SUGGESTED SHELF STORAGE PATTERN

INORGANIC	ORGANIC
INORGANIC #10 Sulfur, Phosphorus, Arsenic, Phosphorus Pentoxide	ORGANIC #2 Alcohols, Glycols, Etc. (Store Flammables in a dedicated cabinet)
INORGANIC #2 Halides, Sulfates, Sulfites, Thiosulfates, Phosphates, Etc.	ORGANIC #3 Hydrocarbons, Esters, Etc (Store Flammables in a dedicated cabinet)
INORGANIC #3 Amides, Nitrates, (No Ammonium Nitrate), Nitrites, Etc.	ORGANIC #4 Ethers, Ketones, Etc. (Store Flammables in a dedicated cabinet)
INORGANIC #1 Metals and Hydrides (Store away from any water)	ORGANIC #5 Epoxy Compounds, Isocyanates
INORGANIC #4 Hydroxides, Oxides, Silicates, Etc.	ORGANIC #7 Sulfides, Polysulfides, Etc.
INORGANIC #7 Arsenates, Cyanides, Etc. (Store above acids)	ORGANIC #8 Phenol, Cresols
INORGANIC #5 Sulfides, Selenides, Phosphides, Carbides, Nitrides, Etc.	ORGANIC #6 Peroxides, Azides, Etc.
INORGANIC #8 Borates, Chromates, Managanates, Permanganates, Etc.	ORGANIC #1 Acids, Anhydrides, Peracids, Etc
.INORGANIC #6 Chlorates, Perchlorates, Chlorites, Perchloric Acid, Peroxides, Etc.	MISCELLANEOUS
INORGANIC #9 Acids, except Nitric (Acids are best stored in dedicated cabinets)	MISCELLANEOUS (Nitric Acid)

STORE ALL POISONS IN LOCKED CABINETS.

D. COMPATIBILITY CHART

"X" Represents Unsafe Combinations

CHEMICALS NOT ON CHART:

Carbon Bisulfide forms an unsafe combination with groups 1, 4, 19, 20, & epichlorohydrin.

Epichlorohydrin forms an unsafe combination with groups 1, 2, 3, 4, 14, 15, 19, 20, 23, 24, & carbon bisulfide.

Motor Fuel antiknock compounds form unsafe combinations with groups 1, 4, 5, 6, 7, 15, 19, & 20.

Inorganic Acids	1																						
Organic Acids	X	2																					
Caustics	X	X	3																				
Amines and Alkoamines	X	X		4																			
Halogenated Compounds	X		X	X	5																		
Alcohols, Glycols, and Glycol Ethers	X					6																	
Aldehydes	X	X	X	X		X	7																
Ketones	X		X	X			X	8															
Saturated Hydrocarbons									9														
Aromatic Hydrocarbons	X									10													
Olefins	X				X						11												
Petroleum Oils												12											
Esters	X		X	X									13										
Monomers and Polymerizable Esters	X	X	X	X	X	X								14									
Phenols			X	X			X							X	15								
Alkylene Oxides	X	X	X	X		X	X							X	X	16							
Cyanohydrins	X	X	X	X	X		X									X	17						
Nitriles	X	X	X	X												X		18					
Ammonia	X	X					X	X					X	X	X	X	X		19				
Halogens			X			X	X	X	X	X	X	X	X	X	X				X	20			
Ethers	X													X						X	21		
Phosphorus, elemental	X	X	X																	X		22	
Sulfur, molten									X	X	X	X				X						X	23
Acid Anhydrides	X		X	X		X	X							X		X	X	X	X					24

E. INCOMPATIBLE CHEMICALS

Separate storage areas should be provided for "Incompatible Chemicals" - chemicals which may react together and thereby create a hazardous condition. Some examples of incompatible chemicals are listed below. MSDSs also provide information on incompatibles. NOTE: This list is not complete, nor are all incompatible substances shown.

EXAMPLES OF INCOMPATIBLE CHEMICALS

CHEMICAL	KEEP OUT OF CONTACT WITH:
Acetic Acid	Chromic acid, nitric acid, hydroxyl compounds, ethylene glycol, perchloric acid, peroxides, permanganates.
Acetone	Concentrated nitric and sulfuric acid mixtures.
Acetylene	Chlorine, bromine, copper, fluorine, iodine, silver, mercury, and their compounds.
Alkali and alkaline metals, i.e., powdered aluminum or magnesium, sodium, potassium, calcium, lithium	Water, carbon tetrachloride, or other chlorinated hydro carbons, carbon dioxide, the halogens. ***Use only "D" fire extinguishers on these chemicals.***
Ammonia, anhydrous	Mercury (in manometers for instance), chlorine, calcium hypochlorite, iodine, bromine, and hydrofluoric acid (anhydrous).
Ammonium nitrate	Acids, metal powders, flammable liquids, chlorates, nitrites, sulfur, finely divided organic or combustible materials.
Aniline	Nitric acid, hydrogen peroxide.
Cumene hydroperoxide	Acids, organic or inorganic.
Cyanides	Acids
Flammable liquids	Ammonium nitrate, chromic acid, hydrogen peroxide, nitric acid, sodium peroxide, the halogens.

EXAMPLES OF INCOMPATIBLE CHEMICALS (Cont'd.)

CHEMICAL	KEEP OUT OF CONTACT WITH
Hydrazine	Hydrogen peroxide, nitric acid, any other oxidants.
Hydrocarbons (butane, propane, benzene, gasoline, turpentine, etc.)	Fluorine, chlorine, bromine, chromic acid, sodium peroxide.
Hydrocyanic acid	Nitric acid, alkali.
Hydrofluoric acid, anhydrous	Ammonia, aqueous or anhydrous.
Hydrogen peroxide	Copper, chromium, iron, most metals or their salts, alcohols, acetone, organic materials, aniline, nitromethane, flammable liquids, combustible materials.
Hydrogen sulfide	Fuming nitric acid, oxidizing gases.
Hypochlorites	Acids, activated carbon.
Iodine	Acetylene, ammonia (aqueous or anhydrous), hydrogen.
Mercury	Acetylene, fulminic acid, ammonia

EXAMPLES OF INCOMPATIBLE CHEMICALS (Cont'd.)

CHEMICAL	KEEP OUT OF CONTACT WITH:
Nitrates	Sulfuric acid, organic materials
Nitric acid (concentrated)	Acetic acid, acetone, alcohol, aniline, chromic acid, hydrocyanic acid, hydrogen sulfide, flammable liquids, flammable gases, copper, brass, heavy metals, tars, and nitratable substances
Nitrates	Acids
Nitroparaffins	Inorganic bases, amines
Oxalic acid	Silver, mercury
Oxygen	Oils, grease, hydrogen, flammable liquids, solids or gases
Perchloric acid*.*	Acetic anhydride, bismuth and its alloys, alcohol, paper, wood, grease, oils, organic materials, organic amines or anti-oxidants ***Use only in a fume hood designed for perchloric acids***
Peroxides, organic	Acids (organic or mineral), flammable liquids, easily oxidized substances, avoid friction, store cold
Phosphorus (white)	Air, oxygen, alkalis, reducing agents
Potassium	Carbon tetrachloride, carbon dioxide, water

EXAMPLES OF INCOMPATIBLE CHEMICALS (Cont'd.)

CHEMICAL	KEEP OUT OF CONTACT WITH:
Potassium chlorate	Sulfuric and other acids
Potassium perchlorate (see also Chlorates)	Sulfuric and other acids
Potassium permanganate	Glycerin, ethylene glycol, benzeldehyde, sulfuric acid, any free acid
Selenides	Reducing agents
Silver	Acetylene, oxalic acid, tartaric acid, ammonium compounds, fulminic acid
Sodium	Carbon tetrachloride, carbon dioxide, water. See also alkali metals.
Sodium azide	Sodium azide is self –reactive. It will decompose at 275C. Benzoyl chloride, potassium hydroxide, bromine, carbon disulfide, chromyl chloride, copper, dibromomalononitrile, dimethyl sulfate, lead, nitric acid, silver, mercury. **Reacts with lead, silver, mercury to form shock sensitive and explosive metal azides.**
Sodium nitrite	Ammonium nitrate and other ammonium salts
Sodium peroxide	Any oxidizable substance, such as ethanol, methanol, glacial acetic acid, acetic anhydride, benzaldehyde, carbon disulfide, glycerol, ethylene glycol, ethyl acetate, methyl acetate and furfural
Sulfides	Acids

VI. SAFE PROCEDURES FOR GENERAL CATEGORIES OF CHEMICALS

A. CARCINOGENS

Specific regulations have been established by the Occupational Health and Safety Administration (OSHA) regarding the handling of certain compounds designated as carcinogenic. Anyone contemplating work or who are working with materials on this list should consult the Environmental Health & Safety Office in Chemistry B73 for the regulations, necessary approvals, training, working conditions, monitoring, record keeping and medical surveillance.

The Federal Government has issued very detailed regulations for the 25 chemicals listed below. Any laboratory personnel who use or handle any of these chemicals should contact the Office of Environmental Health & Safety for detailed information:

2-Acetylaminofluorene
Acrylonitrile
4-Aminodiphenyl
Asbestos
Benzidine
Bis-Chloromethyl Ether
Coke Oven Emissions
Coal Tar Pitch Volatiles
Cotton Dust
1,2-Dibromo-3-Chloropropane
3,3'-Dichlorobenzidine (and its' salts)
4-Dimethylaminoazobenzene
Ethyleneimine
Ethylene Oxide
Formaldehyde
Inorganic Arsenic
Lead
Methyl Chloromethyl Ether
4,4-Methylene-bis(2-chloroaniline)
Alpha-Naphthylamine
Beta-Naphthylamine
4-Nitrobiphenyl
N-Nitrosodimethylamine
Beta-Propiolactone
Vinyl Chloride

It is imperative that the Material Safety Data Sheet be consulted before using ANY chemical.

B. PROCEDURES FOR USING COMPRESSED GASES

Compressed gases are defined by the U.S. Department of Transportation as any material or mixtures having in the container either an absolute pressure exceeding 40 psi at 20°C (70°F) or an absolute pressure exceeding 104 psi at 54.4°C (130°F), or both; or any liquid flammable material having a Reid vapor pressure exceeding 40 psi at 37.8°C (100°F).

For the purposes of safety, all volatile materials and mixtures packaged in cylinders should be considered compressed gases. The use of compressed gases may give rise to the following hazards:

1. Equipment failure and/or leakage may occur, resulting in the diffusion of gases and contamination of the atmosphere. This contamination can cause toxic or anesthetic effects, asphyxiation, or explosive concentrations of flammable gases.

2. The flash point of a flammable gas under pressure is always lower than ambient or room temperature; thus, leaking gas can rapidly form an explosive mixture with air.

3. Upon rapid expansion, low-boiling point materials can cause frostbite on contact with living tissue.

4. Some compressed gases are corrosive, irritating, or reactive.

5. A compressed gas cylinder without a protective cylinder valve cap may release its contents with great force when dropped. If a cylinder is punctured, it may also release its contents with great force. Cylinders have been propelled through walls and roofs.

Because of these hazards, precautions need to be taken in the handling, storage, and use of compressed gas cylinders.

RULES FOR HANDLING COMPRESSED GASES

1. When cylinders are received, they should be inspected to determine if:
    a. cylinder valve protection caps are in place;
    b. cylinder and valves are in serviceable condition and show no corrosion.

2. ***Always*** use a cylinder hand truck for transport. If transporting compressed gases in a vehicle, contact the Office of Environmental Health & Safety for instructions. Personal vehicles should never be used to transport compressed gases or chemicals to be used at the University of Albany.

3. **ALL *Cylinders should be individually chained or otherwise secured in an upright position at all time***s. Use cylinders in an upright position only. Securing brackets and straps are available for sale in CAS Scientific Stores.

4. Do not drop cylinders, full or empty, or permit them to fall against each other.

PROCEDURES FOR USING COMPRESSED GASES (Cont'd.)

5. Leave cylinder valve caps on cylinders until secured and ready for use.

6. All valves should be closed when not in use.

7. Regulators must be used to control pressures to operating requirements. Use the proper regulator for the particular gas. Never force a regulator onto a compressed gas cylinder Only materials recommended for the particular gas service involved shall be used in piping, fittings or equipment. Regulators should be removed from a compressed gas cylinder if the gas will not be used again within a week.

8. Always consider cylinders to be full and handle accordingly.

9. The cylinders of nonliquified gases should be considered empty while positive pressure (25 psig or greater) still remains in order to prevent suck back and contamination.

10. Cylinders containing liquified gases should never be completely emptied in order to prevent suck back and contamination.

11. Oxidizers must not be used in contact with oils, grease or other hydrocarbons.

12. Flammables must not be exposed to flames, sparks or arcs including static electricity, hot surfaces or oxidizers. Bond and ground all cylinders and piping containing flammable gases to prevent the hazards caused by the buildup of static electricity.

13. Nonflammables must not be allowed to displace air in confined workspaces so that there is not sufficient oxygen for breathing.

14. When corrosive gases are being used, the cylinder valve stem should be worked frequently to prevent freezing.

15. Highly toxic gases or pyrophoric gases require special handling. Prior approval must be gotten from the Office of Environmental Health and Safety before using these gases. Safe handling protocols including emergency response procedures must be written by the lab, with consultation from the Environmental Health and Safety Office, when using these gases. These gases may require the use of vented gas handling cabinets with emergency shutoffs and gas detection monitors with alarms.

16. Contact the Environmental Health and Safety Office at 2-3495 for proper disposal instructions for compressed gas cylinders that are no longer wanted or that are empty. Compressed gas cylinders can **not** be thrown in the regular trash when empty, as they are still considered a hazardous material and may have to be disposed of as hazardous waste.

Safety devices are available to prevent suck back and relieve sudden pressure increases.

PROCEDURES FOR USING COMPRESSED GASES (Cont'd.)

STORING COMPRESSED GASES:

1. Store cylinders in a fire-resistant, cool, dry, and adequately ventilated area. Rust will damage cylinders and will often cause the valve caps to stick. Cylinders should be adequately secured in an upright position (so that they can't fall over) while being stored.

2. The storage area should not contain any sources of ignition.

3. Storage area temperature should not exceed 100°F.

4. Floor should be level.

5. Floor should be designed to protect cylinders from dampness.

6. Cylinders should be protected from weather extremes and direct sunlight.

7. Store gases supporting combustion (O_2, C l_2, etc.) at least 25 feet from fuel gases, preferably in another storage area.

8. Highly toxic gases and pyrophoric gases may require storage in vented gas handling cabinets along with emergency shutoffs and gas detection monitors and alarms.

HAZARD DATA FOR COMMON COMPRESSED GASES

GAS	Threshold Limit Values (ppm)	Flammability Limits in Air (Percent by Volume)	Major Hazards
Acetylene	Not established (nontoxic, produces anesthetic effects)	2.5-81.0	Flammable; asphyxiant
Ammonia	50	15 - 28	Toxic
Argon	Not established (nontoxic)	None	Asphyxiant
Boron trifluoride	1	None	Toxic; causes burns
1,3-Butadiene	1000	2 - 11.5	Flammable; skin irritant
Butane	Not established (nontoxic produces anesthetic effects)	1.9 - 8.5	Flammable
Carbon dioxide	5000	None	Asphyxiant
Carbon monoxide	50	12.5 - 74.0	Flammable; toxic
Chlorine	1	None	Toxic; severe irritant; causes burns; corrosive
Ethane	Not established (nontoxic produces anesthetic effects)	3.0 - 12.5	Flammable; asphyxiant
Ethylene	Not established (nontoxic produces anesthetic effects)	31. - 32.0	Flammable; asphyxiant
Ethylene oxide	50	3.0 - 100.0	Flammable; toxic; can cause burns when trapped by clothing or shoes
Helium	Not established (nontoxic)	None	Asphyxiant
Hydrogen	Not established (nontoxic)	4.0 - 75.0	Flammable; asphyxiant
Hydrogen bromide	3	None	Toxic; causes burns; corrosive
Hydrogen chloride	5	None	Toxic; causes burns; corrosive
Hydrogen fluoride	3	None	Toxic; causes severe slow healing burns; corrosive
Hydrogen sulfide	10	4.3 - 45.0	Toxic; flammable; irritant
Methane	Not established (nontoxic)	5.3 - 14.0	Flammable; asphyxiant
Methyl bromide	20	13.5 - 14.5	Toxic; causes burns
Methyl chloride	100	10.7 - 17.4	Toxic; flammable
Methyl mercaptan	0.5	Unknown	Toxic; flammable
Nitrogen	Not established (nontoxic)	None	Asphyxiant
Nitrogen dioxide	5	None	Toxic; corrosive
Oxygen	Nontoxic	None	Highly reactive
Phosgene	0.1	None	Toxic
Propane	Not established (nontoxic produces anesthetic effects)	2.2 - 9.5	Flammable; asphyxiant
Sulfur dioxide	5	None	Toxic; causes burns
Vinyl chloride	500	4.0 - 22.0	Flammable; causes burns

Source: Manufacturing Chemists Association, Guide for Safety in the Chemical Laboratory (New York, Van Nostrand Reinhold Company, 1972). Copyright 1972 by Manufacturing Chemists Association; reprinted by permission of the publisher.

PROCEDURES FOR USING COMPRESSED GASES (Cont'd.)

OTHER TIPS FOR SAFE HANDLING OF COMPRESSED GASES:

1. Oily (not specially cleaned) fittings should never be used with oxygen. Oxygen under pressure will rapidly oxidize oil or grease and result in an explosion. Equipment specifically ***"cleaned for oxygen servic***e" must be used.

2. Acetylene can explode if not properly regulated. An automatic pressure regulator is the only type of recommended control. Acetylene can explode with extreme violence if ignited. It can also form explosive compounds in contact with copper or brass.

3. Regulators can leak and build pressure within a closed gas delivery system. A pressure relief device should be employed. A trap should be inserted in outlet lines to prevent liquid from flowing back into the cylinders.

4. Open the cylinder valve only after connecting the regulator to the cylinder using a proper CGA* regulator.

5. Only equipment suitable for pressures involved can be used with high pressure gases. The pressure ratings for all containers and hardware must be known and equipment must not be used where limits will be exceeded. Glass equipment should not be pressurized. A general rule is: do not apply pressure greater than ten (10) inches of water, if you are not wearing protective equipment.

6. Never mix gases in a cylinder. Explosion, contamination, corrosion, and other hazards can result. Never try to refill gas cylinders or transfer gas from one cylinder to another.

7. To prevent corrosion, regulators, valves, and fittings used in compressed gas systems, which conduct corrosive gases, should be flushed with nitrogen or dry air after each use.

8. Corrosive gases should be stored for the shortest possible time period, preferably under three months. They cylinder valve stem of corrosive gases should be worked frequently to prevent freezing.

9. The cylinder valve cap should always be firmly in place when the cylinder is not in use. Empty cylinders must be returned with valve protection caps on.

10. Any system should be leak tested before it is used. To check for leaks, spread soap over all joints. They system is leaking if any bubbles appear.

11. The researcher is responsible for knowing the characteristics of the gases he/she uses: toxicity, flammability, compatibility with materials and other gases. Consult the gases' Material Safety Data Sheets. See page 68 - Hazard Data for Common Compressed Gases.

PROCEDURES FOR USING COMPRESSED GASES (Cont'd.)

OTHER TIPS FOR SAFE HANDLING OF COMPRESSED GASES:

12. When disposing of empty cylinders, contact the Office of Environmental Health & Safety for disposal procedures. Empty cylinders **DO NOT** go in the trash.

13. If necessary, clean out the cylinder valve opening before connecting it to an oxygen regulator or a charging line. This can be done by briefly opening the cylinder valve. Do not stand in front of the valve opening during such a ***"blow out***", nor place your hand across it. A ***"blow out***" must under no circumstances take place close to an open fire or any source of ignition, e.g., during welding.

14. When using regulators, always check that the adjustment screw has been turned far enough to allow it to move freely in its threads prior to opening the cylinder valve. With the adjustment screw in this position, the regulator is closed.

15. Never use pliers or a similar tool to open a cylinder valve. Some valves are opened with a special key and others are equipped with hand wheels. It is dangerous to force the valve open by knocking or heating.

16. Initials and stamps engraved on the cylinder shells must not be changed or obliterated. Labels and tags should not be removed.

17. Compressed Breathing Air must at least meet the requirements for Grade D air as described in ANSI/CGA commodity specification for air.

CGA: Compressed Gas Association

C. PROCEDURES FOR HANDLING CRYOGENICS

The principal hazards posed by the use of cryogenic liquids and systems are burns from human contact with cryogens; pressure buildup in unvented spaces; and fires, explosions, and asphyxiation, which can result from the evaporation of cryogens.

RULES FOR HANDLING CRYOGENICS

1. The appropriate eye and skin protection must be worn whenever cryogenic liquids are handled, to avoid splashes in the eyes and on the skin. The gloves should be rated for cryogenic liquids.

2. Clothing or jewelry that can trap cryogenic liquids next to the skin should be avoided; for example, wristwatches, rings, etc.

3. In the event of a splash, immediately flood the areas and clothing affected with water. For prolonged exposures, seek medical treatment.

4. Cryogenic liquids are capable of causing asphyxiation by displacing the air necessary for the support of life, especially when they are used in a confined area. **Therefore, they should be used only in well ventilated areas.** Whenever transporting tanks of cryogenics that are venting in elevators, make sure another person is waiting for you to exit the elevator. This will insure that you have someone available to summon help should the elevator break down and/or you are overcome by the over-venting of the gas. If at all possible, no one should ride in an elevator with a venting cryogenic tank.

5. Venting should be provided to avoid quick and violent pressure changes when cryofluids vaporize.

6. Exposed glass areas of glass dewars should be taped to prevent the spread of broken glass should the container implode.

7. Handle combustible cryogens such as liquid hydrogen and liquid natural gas (LNG) in the same way combustible gases are handled; provide ventilation, keep away from open flames and other ignition sources, prohibit smoking, and discharge vent gases to a safe location.

8. Handle cryogenic storage containers carefully since they are fragile and expensive.

D. PROCEDURES FOR HANDLING ETHERS AND PEROXIDIZABLE MATERIALS

Ethers have toxic, flammable, and explosive properties and are dangerous, if not handled properly. They are widely used in laboratories on campus. The vapors, when inhaled, produce a depression of the central nervous system.

The most common ethers, methyl and ethyl, are particularly dangerous fire hazards because of their low flash points. Thus, it is necessary to prohibit open flames, electrical sparks, heat sources, and oxidizing agents when they are being used.

Ethers and other peroxidizable materials such as dioxane and tetrahydrofuran can form explosive peroxides, especially after the container has been opened and stored for a length of time. Frequently, an inhibitor has been added by the manufacturer to retard the formation of peroxides, but peroxides may form nevertheless during storage even if the container has never been opened.

1. Ethers should always be handled in a fume hood. This will protect laboratory occupants from inhaling the vapors and will prevent explosive vapor concentrations from forming.

2. Ethers should be stored in flammable storage cabinets. Ethers with low flash points should be stored in explosion proof refrigerators. See Section V.F.

3. **Ethers and peroxidizable materials should be ordered only in small quantities and must be dated upon receipt and when opened. USE ETHERS AND PEROXIDIZABLE MATERIALS UP PROMPTLY AFTER OPENING. See Appendix G.**

4. **DO NOT STORE ETHERS IN GROUND GLASS-STOPPERED BOTTLES.**

5. Do not ***move*** or ***open*** any bottle or can of ether or any peroxidizable compound that has exceeded its expiration date or is of questionable age. If you find such a container, immediately contact the Office of Environmental Health & Safety in Chemistry B73, which will arrange for its proper disposal. See Appendix G for the Recognition and Handling of Peroxidizable Compounds.

6. Ethers and peroxidizable materials, once they have gone past their expiration date, are dangerous and are extremely expensive to dispose of. A team of high hazard specialists has to be called in to handle the old peroxidizable material basically as a potential bomb. **WATCH THE AGE OF YOUR PEROXIDIZABLE MATERIALS!!!!!**

E. PROCEDURES FOR HANDLING MERCURY

Mercury and mercury-containing compounds are highly toxic to humans. Poisoning may be produced by inhaling mercury vapor, fume or dust; it may also be produced by ingestion of mercury or absorption of mercury through the skin. Organic mercury compounds are extremely toxic.

Acute mercury poisoning, caused by exposure to a high level of mercury over a short period of time, is accompanied by a metallic taste in the mouth, marked salivation, swelling of gums, vomiting, and bloody diarrhea. Consult MSDS on symptoms of mercury exposure.
Chronic mercury poisoning, caused by exposure to low levels of mercury over a long period of time, may show the same symptoms as seen in acute poisoning, but these are usually less pronounced and not always recognizable as poisoning. Chronic poisoning affects the nervous system, causing a marked tremor, unsteady gait, and personality changes.

Mercury is commonly used in labs in such items as thermometers, fluorescent lamps, manometers, recording instruments, batteries, and diffusion pumps. Exposure to mercury can arise in the following ways:

1. When a mercury spill occurs and is not cleaned up promptly or correctly, the mercury scatters into many droplets, thus increasing the surface area of the mercury and the rate of evaporation. The rate of evaporation may exceed the capacity of the room's ventilation to dilute it. If you accidentally spill mercury, contact the Office of Environmental Health and Safety for assistance in cleaning up the spill. The Office supplies mercury spill kits for small spills. See the following page.

2. When mercury is used in elevated temperatures, it evaporates quickly. A common occurrence is the breaking of thermometers in ovens by bumping or by raising the oven temperature above the thermometer's capacity, resulting in high levels of mercury vapor.

3. In systems where mercury is under pressure and ruptures may occur, mercury can impact at high velocities. This atomizes the mercury, which could result in high levels of mercury vapor being released, should a rupture occur in the system.

4. Mercury and mercury contaminated materials are considered hazardous wastes by the EPA and must be disposed of as such. See Section VII - Hazardous Waste Disposal Procedures.

5. The University at Albany is in the process of trying to go to a mercury free environment whenever possible. The Environmental Health and Safety Office will replace mercury thermometers with mercury free thermometers, free of charge, whenever possible. Contact the Assistant Director of EH&S for details.

6. **All fluorescent tubes, thermostats, computer monitors and batteries, because of their mercury, lead or heavy metal content , are NOT to go out in the trash. Contact the Environmental Health and Safety Office for disposal procedures.**

PROCEDURES FOR HANDLING MERCURY (Cont'd.)

GUIDELINES FOR HANDLING MERCURY

1. Place a tray or other container under all mercury sources to contain any spills that may occur.

2. If a spill should occur, clean it up promptly and properly:

    a. Pick up all visible mercury by gentle sweeping and a trapped vacuum line attached to a tapered glass tube or needle-nose pipette. Avoid scattering or breaking up the mercury droplets.

    b. Spread a mercury-spill product over the affected area to pick up any microscopic droplets that may remain; sweep up the waste and dispose of as a hazardous waste. Mercury "sponges" may also be used. These spill cleanup items are available through the Office of Environmental Health & Safety in Chemistry B-73.

    c. Call the Office of Environmental Health & Safety at 2-3495 so that the room can be surveyed for persistent mercury contamination.

    d. Do not use a broom or an ordinary vacuum cleaner to clean up the spill. They will only scatter the droplets further. The Office of Environmental Health & Safety has a mercury vacuum cleaner designed specifically to clean up mercury spills.

3. Store mercury in unbreakable plastic bottles. Keep containers sealed in a cool, well ventilated area.

4. Use mercury only in a well ventilated area. Practice good housekeeping to prevent spilled mercury from accumulating.

5. Always wear personal protective equipment when handling mercury, especially protective gloves and goggles, and never eat, drink or smoke where mercury is being used.

6. Organic mercury compounds are extremely toxic and can be absorbed through the skin. Always consult an MSDS before handling any mercury or mercury compound.

F. PROCEDURES FOR HANDLING ACIDS & ALKALIS

Acids and alkalis are corrosive and reactive chemicals. They can cause corrosion of the materials with which they are in contact, including metal containers, structures, and equipment. They can also cause serious burns and eye damage to the people working with them. When in contact with certain metals or chemicals, they can react, releasing toxic fumes or hydrogen.

Acids and alkalis should be stored in cool, well ventilated areas, away from each other, metals, flammables, and oxidizing materials. Their storage areas should be regularly checked for spills and leaks, and suitable spill cleanup materials should be readily available. (Spill cleanup kits are available in the Office of Environmental Health & Safety in Chemistry B73). Protective clothing should be worn whenever acids or alkalis are handled.

SUGGESTIONS FOR SAFE USE AND STORAGE

1. When combining an acid with water, ***pour the acid into the water - stirring slowl***y, never the reverse.

2. Cap bottles securely and store them on lower shelves to reduce the chance of accidental breakage. **Do not store acids and alkalis together. Do not store organics with acids or alkalis. Do not store organic acids with inorganic acids. See Section V.**

3. Do not leave residues on a bottle or a laboratory bench where another person may come in contact with them. Clean up spills promptly.

4. Wear protective clothing when handling acids or alkalis - this includes the appropriate gloves, apron, chemical splash goggles and/or a face shield.

5. If you have been splashed with acids or alkalis, immediately remove any clothing that may have been saturated. If the splash is in your eye, flush the eye immediately and gently for at least 15 minutes with copious amounts of water. If the splash is on the body, flood the area with copious amounts of running water for at least 15 minutes - a safety shower is intended for this purpose. When alkaline materials have been splashed in the eye, immediate and repeated washings are necessary in order to prevent the alkali from penetrating deeply. Seek medical assistance. See Section I-E.

PROCEDURES FOR HANDLING ACIDS & ALKALIS (Cont'd.)

FOUR ACIDS REQUIRING SPECIAL HANDLING BECAUSE OF THEIR EXTREME HAZARDS

1. ***Nitric Aci***d: *Nitric acid* is corrosive and its oxides are highly toxic. *Nitric acid* is also an oxidizing agent that forms flammable and explosive compounds with many materials - for example, ethers and other flammable materials, acetone, and combustible materials. Paper towels used to wipe up a *nitric acid* spill can ignite spontaneously when dry. *Nitric acid* should be used only in a hood and should be stored away from combustible materials. Consult a MSDS on *Nitric Acid* and its many hazards.

2. ***Perchloric aci***d: *Perchloric acid* forms highly explosive and unstable compounds with many combustible materials and with metals. Unstable perchlorate compounds may collect in the duct work of improperly installed fume hoods and cause fire or violent explosions. **Therefore, *perchloric acid* should be used with extreme caution and only in a fume hood designed for its use - a perchloric acid hood has corrosion-resistant ductwork and washdown facilities.** Only minimum quantities should be kept, with no more than a one pound bottle in the laboratory. The container should be stored on a glass tray that is deep enough to hold the contents of the bottle. No flammables or organic solvents should be used in a *perchloric acid* hood. Perchloric acid should not be kept for more than a year since explosive crystals may form. Discolored *perchloric acid* should not be touched, it is most likely contaminated and could be dangerous. Contact the Office of Environmental Health & Safety for proper disposal.

3. ***Picric Aci***d: *Picric acid* can form explosive compounds with many combustible materials. It is especially reactive with metals or metallic salts. *Picric acid* may lose water and become unstable during extended storage periods. Never open a bottle of dry or contaminated *picric acid* as an explosion could occur from the friction produced. If you find a container of *picric acid* that appears old and dry, **DO NOT TOUCH IT**. Immediately contact the Office of Environmental Health & Safety in Chemistry B73. Picric acid should be stored away from combustible materials and should not be kept for extended periods. Do not use metal spatulas to dispense *picric aci*d.

4. ***Hydrofluoric Aci***d: *Hydrofluoric acid* is extremely corrosive and will even attack glass. It is volatile and its vapors may affect the skin and eyes. Burns from hydrofluoric acid heal slowly and with great difficulty. The Office of Environmental Health and Safety will provide calcium glutonate gel for immediate use on HF burns. H*ydrofluroic acid* should be used only in a fume hood while wearing protective clothing. Polyethylene containers must be used for storing hydrofluoric acid and for reactions employing *hydrofluoric aci*d. Care should be taken to avoid contacting *hydrofluoric acid* with metals or ammonia since toxic fumes may result. Hydrofluoric Handling Guidelines are available from the EH&S Office.

CONSULT AN MSDS WHENEVERY WORKING WITH ANY OF THESE COMPOUNDS

G. PROCEDURES FOR HANDLING ALKALI METALS

Alkali metals react violently with water, decomposing the water to give off hydrogen which may be ignited by the heat of reaction. The alkali metals can also ignite spontaneously in air, especially when the metal is in powdered form and/or the air is moist.

SUGGESTIONS FOR SAFE USE AND STORAGE

1. Store alkali metals under mineral oil or kerosene in unbreakable containers or covered glass containers. Avoid using oils that contain sulfur since a hazardous reaction may occur.

2. Ordinary fire extinguishers are ineffective on an alkali metal fire. Use only the special, dry powder extinguisher intended for alkali metals - Class D - Combustible Metal. These extinguishers can be found in the corridors of the second and third floor of Chemistry. If you are using alkali metals and need a fire extinguisher, contact the Office of Environmental Health & Safety.

3. Any waste alkali metals should be place in a labeled, leak proof container, covered with mineral oil, and disposed of properly. See Section VII.

H. PROCEDURES FOR HANDLING NONTOXIC, NOXIOUS ODORS

In the event your laboratory produces a nontoxic, noxious odor, make certain all fume hood fans in the laboratory are on, raise the fume hoods' sashes approximately one foot, and leave the laboratory, closing the door behind you. Do not open the laboratory's windows and doors to ventilate the laboratory as this allows the odor to travel to other floors and buildings. If the procedures outlined above are followed, the fume hoods will effectively exhaust the odor out of the laboratory. Do not return to the laboratory until the odor has dissipated.

In the event your laboratory produces a nontoxic, noxious odor while using the sink, as when washing out dirty glassware, follow the same procedures outlined above and be sure to leave the water running in the sink until the odor has dissipated.

If you are aware that your work is going to create a nontoxic, noxious odor, contact the Office of Environmental Health & Safety and try to perform your experiment after normal working hours.

DO NOT DISPOSE OF NOXIOUS MATERIALS IN THE TRASH

CONTACT THE OFFICE OF ENVIRONMENTAL HEALTH & SAFETY FOR PROPER DISPOSAL PROCEDURES

VII. LABORATORY WASTE DISPOSAL

A. HAZARDOUS WASTE DISPOSAL PROGRAM
UNIVERSITY AT ALBANY, STATE UNIVERSITY OF NEW YORK

The U.S. Environmental Protection Agency (EPA) has developed, under the Resource Conservation and Recovery Act of 1976 (RCRA), a complex set of regulations to control hazardous wastes. The University is currently holding a permit issued by the EPA as a hazardous waste generator. This permit allows the University, within strict EPA and DEC guidelines, to manage all hazardous waste on campus.
The Office of Environmental Health & Safety has instituted the following Hazardous Waste Disposal Program, in order to handle the hazardous waste generated on campus. This program is coordinated by the University's Chemical Safety Officer and the University's Hazardous Waste Specialist.

State law (Chapter 719 of the laws of 1981) established criminal penalties for the unlawful possession, handling, and disposing of hazardous wastes. Representation and indemnification under section 17 of the Public Officer's Law would not be available in cases of liability imposed under criminal statues. Because of the possibilities of personal liability and prison terms, campus personnel are advised to familiarize themselves with the University's Hazardous Waste Disposal Program for the proper storage and disposal of hazardous wastes. The procedures stated below are to be followed by campus generators when identifying, storing and disposing of hazardous waste:

1. **IDENTIFICATION**

The responsibility for the identification of hazardous waste (waste chemicals, waste chemical containing products, and out-of-date chemicals) within the University necessarily rests with the faculty and staff who have created the waste (generators) in research and instruction. See the following pages for the definitions of generator and hazardous waste. The Chemical Safety Officer and the Hazardous Waste Specialist will provide assistance in the identification of hazardous waste.

2. **LABELING AND STORAGE**

All containers of hazardous waste must be properly labeled with free labels provided by the Office of Environmental Health & Safety in Chemistry B73. The waste chemicals must be identified by their **proper chemical name (not formulas**), including proportions of a mixture. The label must say **"HAZARDOUS WASTE**". ***The label must be completed before it will be accepted for disposal by the Office of Environmental Health & Safet***y. The University is liable for the mislabeling of hazardous waste. Do not date the waste as the EHS Office will date it, when it is put into the Hazardous Waste Room. Once a container is **full,** you must call the EHS Office at 2-3495 **as soon as possible**. All waste must be kept in **sealed containers** at all times, unless you are actively pouring into the container. Zip-loc bags for dry debris must also be labeled and sealed**. It is illegal to evaporate waste.** Do not mix incompatible wastes. Ensure the waste container is compatible with the waste and use the appropriately sized container, as our disposal costs are somewhat determined by the container size.

HAZARDOUS WASTE DISPOSAL PROGRAM (Cont'd.)

3. **UNKNOWNS**

Unknown chemicals cannot be accepted for disposal by the Office of Environmental Health & Safety. The EHS Office has no way of disposing of unknowns. If the person wishing to dispose of the waste chemicals cannot trace down the identity of the waste, the Office of Environmental Health & Safety can have the University's Hazardous Waste Disposal Company identify them for a substantial cost to the generator. For this reason, the Office of Environmental Health & Safety strongly encourages Departments and Researchers, that have either departing faculty, staff or students, to have these departing persons identify any waste they may have generated before they leave. The Office of Environmental Health & Safety will assist in the identification of hazardous waste and arranging for its storage and ultimate disposal. The Office of Environmental Health & Safety is not responsible for cleaning abandoned laboratories of waste chemicals.

4. **STORAGE, PACKAGING AND COORDINATING DISPOSAL**

All chemical wastes must be packaged by the generator in a manner, which will allow them to be transported and stored without danger of spillage, escape of dangerous vapors, or hazardous reaction. Again, all wastes must be properly labeled. Once a container of hazardous waste is **full** or ready to be disposed of, the Hazardous Waste Specialist **must be contacted as soon as possible** at 2-3495. The Hazardous Waste Specialist will then pick up the waste container within three days and will either put it into storage or pour if off in the Hazardous Waste Room. Another container of the same waste stream can **not** be utilized, until the full waste container has been picked up. Do not accumulate any waste in your lab for longer than 2 months. This does not include full containers of waste, which must be disposed of immediately. **Routine disposal of hazardous waste through the EH&S Office is encouraged and its free!**

5. **TRANSPORTATION**

The Hazardous Waste Specialist in the Office of Environmental Health & Safety **must** be contacted at 2-3495, in order to arrange for a pickup of hazardous waste..

6. **CHARGE BACK**

The Office of Environmental Health and Safety pays for the disposal of routinely generated hazardous waste. The EHS Office tries to reduce the cost of hazardous waste disposal in many ways: by bulking waste chemicals when possible, disposing of full lab packs, using a bid process for contracting with a waste disposal company and by brokering usable chemicals. Even with these combined efforts, the cost for the disposal of waste chemicals far exceeds their original purchase price. It is thus recommended that the researcher order only the amount of a particular chemical that can be used within a year and/or by a particular research project. This will ultimately save the University money and it is definitely safer to store smaller amounts of chemicals. <u>The researcher and/or researcher's Department is responsible for all associated costs for the clean out of a researcher's lab when they leave the University.</u> Chemical clean outs of labs or other areas are not considered routinely generated hazardous wastes.

B. DEFINITIONS

GENERATOR

A generator is anyone who disposes of waste that is defined by the Environmental Protection Agency (EPA) to be a "hazardous waste". You are a generator if, in your work/research at the University, you produce or find a hazardous chemical that you intend to discard. It is your responsibility to ensure that this waste is handled correctly as described in the above Hazardous Waste Disposal Program. Be aware that there are substantial civil and criminal penalties for any person, company, corporation, institution, association, etc. who improperly disposes of hazardous waste.

HAZARDOUS WASTE

A waste is defined by EPA to be hazardous, if it meets ANY of the following:

1. It is a "solid waste or a combination of solid wastes (a solid waste includes semi-solid, liquid, or contained gaseous material) which, because of its concentration, quantity, or physical, chemical, or infectious characteristics, may cause or significantly contribute to an increase in mortality, or an increase in serious irreversible or incapacitating illness, or may pose a substantial present or potential hazard to human health, or the environment when improperly treated, stored, transported, or disposed of, or otherwise managed."

2. It is included in lists of specifically identifiable compounds published by EPA. See Appendix F – EPA Hazardous Waste List.

3. It is a listed waste mixed with nonhazardous materials.

4. It has the characteristics of being ignitable, corrosive, reactive, or EP Toxicity, as defined by EPA. See below.

5. It is personally known to you to be hazardous based upon knowledge of the materials or processes used in producing the waste.

6. The four characteristics that determine if a waste is hazardous are as follows:
    a. ***Characteristic of Ignitability***

        1. It is a liquid, other than an aqueous solution containing less than 24% alcohol by volume, and has a flash point of less than 60°C (140°F).
        2. It is not a liquid and is capable, under standard temperature and pressure, of causing fire through friction, absorption of moisture, or spontaneous chemical changes and when ignited burns so vigorously and persistently that it creates a hazard.

HAZARDOUS WASTE DEFINITIONS (Cont'd.)

3. It is an ignitable compressed gas; any material or mixture having in the container an absolute pressure exceeding 40 p.s.i. at 70°F or any liquid flammable material having a vapor pressure exceeding 40 p.s.i. absolute at 100°F.
4. It is an oxidizer; a substance such as a chlorate, permanganate, inorganic peroxide, or a nitrate, that yields oxygen readily to stimulate the combustion of organic matter.

b. ***Characteristic of Corrosivity***

1. It is aqueous and has a pH less than or equal to 2, or greater than or equal to 12.5, as determined by a pH meter.
2. It is a liquid and corrodes steel (SAE 1020) at a rate greater than 6.35 mm (0.250 inches) per year at a test temperature of 55°C (130°F) as determined by test methods specified by the National Association of Corrosion Engineers.

c. ***Characteristic of Reactivity***

1. It is normally unstable and readily undergoes violent change without detonating.
2. It reacts violently with water.
3. It forms potentially explosive mixtures with water.
4. When mixed with water, it generates toxic gases or vapors in a quantity sufficient to present a danger to human health or the environment.
5. It is a cyanide or sulfide-bearing waste which, when exposed to pH conditions between 2 and 12.5, can generate toxic gases or vapors in a quantity sufficient to present danger to human health or the environment.
6. It is capable of detonation or explosive reaction if it is subjected to a strong initiating source or if heated under confinement.
7. It is readily capable of detonation or explosive decomposition or reaction at standard temperature and pressure.
8. It is a Class A, Class B, or Forbidden Explosive as defined in the code of Federal Regulations, Title 49, Part 173.

d. ***Characteristic of EP (Extraction Procedure) Toxicity***

A solid waste exhibits the characteristic of EP toxicity if, using the test methods described by EPA, the extract from a representative sample of the waste contains any of the contaminants listed below at a concentration equal to or greater than the respective value given. Where the waste contains less than 0.5 percent filterable solids, the waste itself, after filtering using EPA methodology, is considered to be the extract.

EPA Hazardous Waste Number	Contaminant	Max Concentration (mg/L)
D004	Arsenic	5
D005	Barium	100
D006	Cadmium	1
D007	Chromium	5
D008	Lead	5
D009	Mercury	0.2
D010	Selenium	1
D011	Silver	5
D012	Endrin (1,2,3,4,10,10-hexachloro-1,7-epoxy-1,4,4a,5,6,7,8, 8a-octahydro-1,4-endo, endo-5,8-dimethano naphthalene)	0.02
D013	Lindane (1,2,3,4,5,6-hexachlorocyclohexane, gamma isomer)	0.4
D014	Methoxychlor (1,1,1-Trichloro-2,2-bis [p-methoxyphenyl] ethane)	10
D015	Toxaphene (C10H10Cl8, Technical chlorinated camphene, 67-69% chlorine)	0.5
D016	2,4-D, (2,4-Dichlorophenoxy-acetic acid)	10
D017	2,4,5-TP Silvex 2-(2,4,5-Trichlorophenoxy) propionic acid	1
D018	Benzene	0.5
D019	Carbon Tetrachloride	0.5
D020	Chlordane	0.03
D021	Chlorobenzene	100
D022	Chloroform	6
D023	o-Cresol	200
D024	m-Cresol	200
D025	p-Cresol	200
D026	Cresol	200
D027	1,4-Dichlorobenzene	7.5
D028	1,2-Dichloroethane	0.5
D029	1,1-Dichloroethylene	0.7
D030	2,4-Dinitrotoluene	0.13
D031	Heptachlor (and its epoxide)	0.008
D032	Hexachlorobenzene	0.13
D033	Hexachlorobutadiene	0.5
D034	Hexachloroethane	3
D035	Methyl Ethyl Ketone	200
D036	Nitrobenzene	2
D037	Pentachlorophenol	100
D038	Pyridine	5
D039	Tetrachloroethylene	0.7
D040	Trichloroethylene	0.5
D041	2,4,5-Trichlorophenol	400
D042	2,4,6-Trichlorophenol	2
D043	Vinyl Chloride	0.2

C. HAZARDOUS WASTE LABEL – SAMPLE

HAZARDOUS WASTE

FEDERAL LAW PROHIBITS IMPROPER DISPOSAL

SUNY AT ALBANY GENERATOR INFORMATION

NAME _____

DEPT_____ BLDG & RM_____

CHEMICAL NAME(S)	% OF VOLUME
1._____	_____
2._____	_____
3._____	_____

TOTAL VOLUME_____

HANDLE WITH CARE
CONTAINS HAZARDOUS OR TOXIC WASTES

D. EMPTY CHEMICAL CONTAINER and GLASSWARE DISPOSAL POLICY

In order to dispose of empty chemical containers (bottles, used glassware or cans), they must be:

1. Triple rinsed, with water or the appropriate solvent, depending on the chemical residues in the containers.* This is done in order to prevent a potential hazardous materials incident, when the containers are transported and crushed for disposal;

2**. The containers' labels made illegible;**

3. The tops taken off the clean containers and the containers taken to the C.A.S. Stores in Chemistry B13 for disposal. Call C.A.S. Stores at 2-4409 before you bring down your empty containers, so you can be sure someone is there to receive them.

Empty chemical containers MUST NOT be left in the tunnel or in corridors. The C.A.S. Stores personnel will handle the disposal of all clean, empty chemical containers. Small pieces of clean glassware or broken glassware should be placed in a container specifically for glassware disposal. Cardboard boxes, lined with plastic bags, specifically for glassware disposal, can gotten for free from C.A.S. Stores. Once these boxes are full, they can be taken back down to C.A.S. Stores for disposal. The custodial staff is not responsible for the disposal of empty chemical containers or broken glassware.

A compressed gas cylinder is considered empty when the pressure in the cylinder approaches atmospheric. Compressed gas cylinders are still considered hazardous materials even when empty. If you have empty lecture size gas cylinders or smaller to dispose of, contact the Office of Environmental Health & Safety. Disposal of larger size gas cylinders is handled through C.A.S. Stores in Chemistry B13.

If you have any questions on the disposal of any type of waste or container, call the Office of Environmental Health & Safety at 2-3495.

---

* The rinsate from Acute Hazardous Waste Containers (P Listed Wastes) is also considered a hazardous waste. The solvent you use to rinse a container may also be considered a hazardous waste.

E. DISPOSAL OF REGULATED MEDICAL WASTE

Regulated medical waste is regulated by the NYS Department of Health. For more information on Managing Regulated Medical Waste, go to http://www.health.state.ny.us/facilities/waste/

A. ***Regulated Medical Waste***: "Regulated medical waste shall mean any of the following waste which is generated in the diagnosis, treatment, or immunization of human beings or animals, in research pertaining thereto, or in production and testing of biologicals, provided however, that regulated medical waste shall not include hazardous waste identified or listed pursuant to Section 27-0903 of the Environmental Conservation Law. . ." and includes those items listed below.

SUBCATEGORY	**DESCRIPTION**
1. Cultures and Stocks	**"**This waste shall include cultures and stocks of agents infectious to humans, and associated biologicals, cultures from medical or pathological laboratories, cultures and stocks of infectious agents from research and industrial laboratories, wastes from the production of biologicals, discarded live or attenuated vaccines, or culture dishes and devices used to transfer, inoculate or mix cultures**."** (This includes but is not limited to those agents that cause communicable diseases and those agents designated as requiring biosafety level II – IV in the CDC/NIH Manual for Biosafety in Microbiological and Biomedical Laboratories. (http://www.cdc.gov/od/ohs/biosfty/bmbl4/bmbl4s2.htm)
2. Pathological Wastes	"This waste shall include tissue, organs, and body parts (except teeth and the contiguous structures of bone and gum), body fluids that are removed during surgery, autopsy, or other medical procedures, or specimens of body fluids and their containers, and discarded material saturated with such body fluids other than urine, provided that the Commissioner, by duly promulgated regulation, may exclude such discarded material saturated with body fluids from this definition if the commissioner finds that it does not pose a significant risk to public health. This waste shall not include urine or fecal materials submitted for other than diagnosis of infectious diseases."
3. Human Blood and Blood Products	This waste shall include: (I) discarded waste human blood, discarded blood components (e.g. serum and plasma), containers with free flowing blood or blood components or discarded saturated material containing free flowing blood or blood components; and (II) materials saturated with blood or blood products provided that the Commissioner, by duly promulgated regulation, may exclude such material saturated

	with blood or blood products from this definition if the Commissioner finds that it does not pose a significant risk to public health."
4. Sharps	"This waste shall include but not be limited to discarded unused sharps and sharps used in animal or human patient care, medical research, or clinical or pharmaceutical laboratories, hypodermic, intravenous, or other medical needles, hypodermic or intravenous syringes to which a needle or other sharp is still attached, Pasteur pipettes, scalpel blades, or blood vials. This waste shall include, but not be limited to, other types of broken or unbroken glass (including slides and cover slips) in contact with infectious agents. This waste shall not include those parts of syringes from which sharps are specifically designed to be easily removed and from which sharps have actually been removed, and which are intended for recycling or other disposal, so long as such syringes have not come in contact with infectious agents."
5. Animal Waste	This waste shall mean discarded materials including carcasses, body parts, body fluids, blood, or bedding originating from animals known to be contaminated with infectious agents (i.e. zoonotic organisms) or from animals inoculated during research, production of biologicals, or pharmaceutical testing with infectious agents."

B. ***"Biologicals"*** means preparations made from living organisms and their products, including vaccines, cultures, etc. intended for use in diagnosing, immunizing, or treating humans or animals or in research pertaining thereto.

C. ***"Laboratory"*** means any research, analytical, or clinical facility that performs health care related analysis or service. This includes medical, pathological, pharmaceutical, and other research, commercial, or industrial laboratories.

D. *"Infectious Agents"* means any organisms that cause disease or an adverse health impact to humans, except that the Commissioner may prescribe by regulation additional infectious agents as may be necessary to protect health and the environment.
If any waste generated in your laboratories fits the definitions above, it is "regulated medical waste" and must be handled and disposed of accordingly. Regulated Medical Waste must be **red-bagged**. The red bags, which have the universal biohazard symbol are available for purchase from C.A.S. Stores in Chemistry B13. The University has an agreement with Stericycle for pick up and disposal of this type of waste. Currently, the University Health Center and the Animal Facility are the primary generators of medical waste. If you have regulated medical waste to dispose of, please contact the EH&S Office at 2-3495 for further instructions.*****REGULATED MEDICAL WASTE CAN NOT BE AUTOCLAVED AND PUT IN THE REGULAR TRASH FOR DISPOSAL AT THE UNIVERSITY AT ALBANY.**

F. HANDLING PROCEDURES FOR SHARPS, GLASS and BIOHAZARDOUS AUTOCLAVED WASTE

Sharps Needles, syringes, and scalpel blades, etc. appear to most always be considered regulated medical waste under the "sharps" category (see Section E. above), and must be disposed of in the red plastic sharps containers available for purchase through C.A.S. Stores. C.A.S. Stores charges a small fee for the sharps container, which includes the cost of the container's disposal as regulated medical waste. When the container is full, bring it back to C.A.S. Stores for proper disposal as regulated medical waste. This is also required to comply with the University's policy "Guidelines for the Procurement, Storage, Use, and Destruction and Disposal of Hypodermic Supplies". The University has a contract with Stericycle for pick up and disposal of this type of waste.

Glass Any glass items you wish to dispose of, which do not fall into the categories of regulated medical waste and that do not need to be treated otherwise (e.g. autoclaved), should be placed in a container separate from other lab trash. The glass items should be as clean as possible. Most laboratories already have some type of container dedicated to glass disposal, only. If you don't have a separate container for glass, a sturdy cardboard box lined with a heavy plastic bag is suitable. These are available for free from the C.A.S. Stores in Chemistry B13. The reason for separating glass from other trash, to avoid puncture wounds, should be obvious. All boxes used for glass disposal should be labeled "Clean Glass Only." When the lined cardboard box is full of glass, please seal the box with tape and take to C.A.S. Stores for disposal.

Biohazardous Autoclaved Waste Any culture dishes, test tubes, Pasteur pipettes, etc., that do NOT categorize as **"regulated medical waste" (See Section E. above)** should be placed in an **orange autoclave bag labeled with the universal biohazard symbol prior to autoclaving.** When you are ready to autoclave a full, orange bag, put copious amounts of autoclave indicator tape on the bag before you run it through the autoclave. The indicator tape signals that the orange bag has been through the autoclave and that the materials inside have been inactivated. Once the orange autoclave bag has been through the autoclave, it should be placed in a **dark, opaque** garbage bag for disposal in the regular trash. The orange autoclave bags, indicator tape and dark, opaque garbage bags are available for purchase from C.A.S. Stores.

*****REGULATED MEDICAL WASTE CAN NOT BE AUTOCLAVED AND PUT IN THE REGULAR TRASH FOR DISPOSAL AT THE UNIVERSITY AT ALBANY.**

If you have any questions regarding laboratory waste disposal, please feel free to contact the Office of Environmental Health & Safety at 2-3495.

VIII. APPENDICES

APPENDIX A. - REACTIVE CHEMICALS

Reactive chemicals are substances, which under certain ambient or induced conditions, enter into violent reactions with spontaneous generation of large quantities of heat, light, gases (flammable and nonflammable), or toxicants that can be destructive to lives and property. The types of reactive chemicals have been loosely categorized:

1. ***Explosive*** - Many substances, when mixed, are potentially explosive (such as hydrazines and nitric acid). In general, protect these substances from shock, elevated temperatures, rapid temperature changes, and other reactive chemicals. Some examples: nitroglycerin, nitrocellulose, organic peroxides and metal azides.

2. ***Oxidizing and Reducing Substances*** - In many oxidizing and reducing reactions, both agents must be present. However, in some cases, one or the other substance creates a hazard by coming into contact with a normally innocuous substance. The reactions tend to generate heat and are often explosive. Some oxidizing agents: oxygen, perchloric acid, nitric acid, inorganic peroxides, nitrites, nitrates, hydrides, butadiene, peracetic acid and peroxy acids. Some reducing agents: hydrogen, metallic hydrides, alkali metals, and pyrophoric agents such as activated zinc and phosphorus.

3. ***Water Sensitive Substances*** - These chemicals react with water, steam, and moisture in the air to evolve heat and/or flammable or explosive gases. Isolate water-sensitive substances from other reactive compounds. Store them in a cool, waterproof area. No water should service the storage area. Some substances that liberate heat only are: strong acids and bases, acid anhydrides and sulfides. Some substances that liberate flammable gases are: alkali metals, hydrides, nitrides, carbides, and anhydrous metallic salts.

4. ***Acid Sensitive Substances*** - These chemicals react with acid to evolve heat, flammable and/or explosive gases, and toxicants. Some examples are: alkali metals, hydroxides, carbonates, carbides, nitrides, arsenic and related elements, cyanides, sulfides, and structural alloys (most metals).

5. ***Special Organic Compounds*** - These compounds are unstable and may decompose spontaneously or through contact with the immediate environment (air, water, and other reactants). Some examples: diazonium compounds, diazomethane, chlorination intermediates, butadiene, nitration intermediates, organic sulfates, polymerization reactions, and highly nitrated compounds.

6. ***Pyrophoric Agents*** - Pyrophoric agents burn when exposed to air. In general, they require absolute protection against air. Examples: phosphorus and activated zinc.

REACTIVE CHEMICALS (Cont'd.)

The following is a list of some specific HIGHLY REACTIVE CHEMICALS and their associated hazards (Note - this is not all inclusive):

HYDROFLUORIC ACID - This is a very insidious material. After any contact with a solution of hydrofluoric acid, even if there is no immediate pain, the area should be flushed with copious amounts of water for at least 5 minutes then apply calcium glutonate gel (available from the Environmental Health and Safety Office in Chemistry B73.) Consult a physician promptly.

PHENOL - When phenol is dissolved in organic solvents it is readily absorbed into the blood stream, resulting in serious or fatal poisoning. If phenol is accidentally spilled, flush area with copious amounts of water for at least 15 minutes. Consult a physician promptly.

BROMINE - Bromine can be measured volumetrically with little hazard. Keep a dilute sodium bisulfite solution on hand to destroy any accidentally spilled bromine.

HYDROGEN CYANIDE - Hydrogen cyanide should always be used under a hood. Liquid hydrogen cyanide is best kept over anhydrous calcium chloride. It thus remains water-white for months. Formation of a yellow color in the liquid indicates the lot should be destroyed.

PERCHLORATES - Perchlorates should be handled only by persons thoroughly familiar with the hazards involved. Do not use magnesium perchlorate as a desiccant, except in the standard procedure for the determination of carbon and hydrogen.

DICHROMATE CLEANING SOLUTION - Dichromate cleaning solution is an extremely corrosive agent. Never transfer the cleaning solution from a pipette washer by pouring. Use a siphon. Follow these precautions when using the cleaning solution:

a. Keep the bottle caps loosened;
b. Store the solutions in a cool area, away from other chemicals;
c. Keep protective equipment available in case of a spill (i.e., respirator, acid-resistant gloves, spill clean up kit, etc.);
d. Dichromate cleaning solutions are considered hazardous waste.

PHOSPHORUS TRIHALIDES - Containing moisture, may under certain circumstances, form some phosphine when heated, and explode violently when exposed to air. Red phosphorus and hydriodic acid may also form explosive compounds. These materials should be heated in an atmosphere of carbon dioxide.

REACTIVE CHEMICALS (Cont'd.)

PHOSPHORUS OXYCHLORIDE - A serious accident occurred when this chemical was being distilled under vacuum. The vacuum changed and water ran back into the phosphorus oxychloride and the mixture exploded. This chemical should be distilled at normal pressure. If it is absolutely necessary to use a vacuum; adequate traps should be provided between the water pump and the received. (Other chemicals in the same category are: SO_2Cl_2, $SOCl_2$, S_2Cl_2, PCl_2, etc. Similar precautions should be employed in all vacuum distillations in which a water pump is used, because sudden loss of pressure will force water back up into the apparatus being evacuated. A Bunsen valve in the trap will avoid much of this difficulty.

BENXOYL PEROXIDE - when dry, benzoyl peroxide is easily ignited and sensitive to shock. It will decompose spontaneously at temperatures above 50°C. It must be stored in a cool place. Keep away from all sources of heat. Do not subject it to friction or grinding in the dry state, since the heat generated will cause it to explode. This chemical is desensitized by the addition of at least 20% by weight of water (from DuPont Safety Manual).

ALUMINUM CHLORIDE - Should be considered a potentially dangerous material. If moisture is present, sufficient decomposition to build up considerable pressure may result. If a bottle is to be opened after long standing, enclose it completely in a heavy towel and place the covered bottle in a metal container before opening the lid. Be sure to wear protective equipment.
AMMONIA and MERCURY - In contact, these chemicals have been known to form explosive compounds (Ind. Eng. Chem., New Edition, 1932).

HYDROXYL AMINE DERIVATIVES - Particularly those related to hydroxy aminic acid, should be treated as explosive compounds. Distillation of products in which they may be present should be conducted behind screens with all safety precautions taken. Acid salts of hydroxyl amine are explosive; hydroxyl amine is not, but may contain residual salts.

CYANOGEN BROMIDE - Is explosive in the solid state unless it is absolutely white. Do not keep bottles of it tightly stoppered.

PYRUVIC ACID - Has been reported to blow up while standing on the shelf.

o-NITROBENZOYL CHLORIDE - Has exploded violently upon attempted distillation (Ind. Eng. Chem., New Ed., 23, 2394, (1945):JACS 68, 344, (1946)).

NITRILES - Nitriles react similarly to hydrogen cyanide and should be handled under a hood. Any part of the body which has come in contact with any of these materials should be flushed with copious amounts of water for at least 15 minutes. Consult a physician promptly. Nitrile compounds in a vapor state are very toxic when inhaled and the same precautions used with hydrogen cyanide are necessary.

ACRYLONITRILE (VINYL CYANIDE) - Is a very active poison. It is fatal immediately when breathed in a concentration of 270 ppm. (In. Hygiene and Toxicology, February, 1942, pg. 255).

REACTIVE CHEMICALS (Cont'd.)

NITRIC OXIDE, NITROGEN DIOXIDE and ITS POLYMERS - Are produced when nitric acid reacts with organic materials. They are extremely dangerous because they give no warning. Never inhale them. If you do inhale them accidentally, get to fresh air, and consult a physician immediately.

DOWTHERM AND ALLIED HEAT-TRANSFER AIDS - While not active poisons, these have a cumulative effect which results in bodily changes after long exposure. They are readily absorbed by the skin and by clothing, particularly leather and wool. If exposed, wash the exposed parts and the clothing. Low concentrations of the vapor are detectable by odor when the exposure is infrequent, but continual exposure desensitizes the olfactory nerves so the odor is no longer apparent. Such exposure should be avoided.

PHOSGENE - Phosgene is extremely dangerous because its symptoms are delayed for 4 to 8 hours, when small but toxic amounts are inhaled. If accidentally inhaled, consult a physician promptly.

CYANURIC CHLORIDE - Cyanuric chloride is a lachrymator and may cause severe burns of the mucous
membranes. Use only in a well-ventilated hood. When distilling it, use of the same precautions as for other acid chlorides.

EPICHLOROHYDRIN - Undiluted epichlorohydrin is intensely irritating to the skin. Because of the potential
nephrotic effects, persons working with this materials on a continuing basis should undergo medical supervision. (Univ. Calif., the Toxicity of Epichlorohydrin, 1941, pamphlet, in Library).

DIMETHYL SULFATE - Dimethyl sulfate is an extremely reactive material, especially when it comes in contact with the skin or mucous membranes. A very short time of contact with the mucous membranes will result in painful burns. If it comes in contact with the eye, sight will be impaired if it is not removed immediately. Flush the eye and/or skin with copious amounts of water for at least 15 minutes. Consult a physician promptly.

DIOXANE - Dioxane appears to be a poisonous compound with a delayed reaction. This material should be handled cautiously and not inhaled. Dioxane can readily form dangerous peroxides. See Appendix G. In addition to precautions to be taken during its distillation, condensation of its distilled vapors should be done with water above 12°C to prevent plugging the condenser.

BENZENE, TOLUENE, and CARBON TETRACHLORIDE - These chemicals are readily absorbed through intact skin, as well as through the respiratory tract. Do not handle them carelessly. Use only in a fume hood. Benzene and carbon tetrachloride are suspected or confirmed human carcinogens.

Always consult a chemical's Material Safety Data Sheet before using it

APPENDIX B. GLOVE SELECTION

The following links are for companies that may supply gloves to laboratories at the University at Albany. Available on each website are chemical compatibility charts for the gloves supplied by each specific company. Please use them to verify that the gloves being used to handle a specific chemical are providing proper protection to the wearer. It is important to note that all chemicals may not be listed on the charts, and that two similar gloves supplied by two different companies may not provide the same level of protection. It is important, therefore, to use the compatibility chart for the manufacturer of the glove being used.

NORTH – http://ezguide.northsafety.com/
BEST – http://www.chemrest.com/
ANSELL Protective Products – http://www.ansell-edmont.com/
MICROFLEX – http://www.microflex.com/products/glovechem/a.asp

Glove Suppliers Without Compatibility Charts

The following are websites for glove suppliers who at this point do not have glove compatibility charts available. Please ensure that prior to using gloves from these companies, the customer service/ technical assistance department is contacted using the links below.

Fisher Scientific – http://www.fishersci.com/
Gaurdian – http://www.guardian-mfg.com/

APPENDIX C. – PEL LIST

Air contaminants. - 1910.1000
CLICK ABOVE

APPENDIX D. - OSHA

Occupational exposure to hazardous chemicals in laboratories. - 1910.1450
CLICK ABOVE

APPENDIX E. - Laboratory Safety Checklist

SP = Serious Problem X = Problem Exists ___ = Condition is O.K. Date of Inspection_____

Department: Building: Room: _____ Principal Investigator: Phone: _____

AREAS OF INSPECTION COMMENTS CORRECTION

1. ___ Emergency Notification _____

2. ___ Other Door Signs _____

3. ___ Personal Protection (Goggles, gloves, aprons, lab coats) _____

4. ___ Fire Extinguishers _____

5. ___ Eyewash _____

6. ___ Shower _____

7. ___ Hoods _____

8. ___ Housekeeping (Aisle/floor, shelves/cabinets, bench tops, hoods) _____

9. ___ Labels on Containers _____

10. ___ Storage(Volume of flammables, peroxides, corrosives,compatibles, wastes, refrigerators) _____

_____

11. ____Compressed Gas Cylinders _____

12.____Guarding _____

13. ____Food, Drink, Smoking _____

14. ____Electrical Cords, Wires, Grounds _____

15.____ Lab Doors locked when unattended _____

16. ____ Notes/Other Areas of Concern _____

_____

Inspected by: _____Date_____

Copy given to: _____Date_____

(Print Name and Signature)

(Copies (3 white -- Principal Investigator; Canary -- Office of Environmental Health and Safety; Pink -- Department Chair Principal Investigator returns White Copy with corrected problem dates to Environmental Health and Safety Office Chemistry B73

APPENDIX F. - EPA HAZARDOUS WASTE LIST

(e) The commercial chemical products, manufacturing chemical intermediates or off-specification commercial chemical products or manufacturing chemical intermediates referred to in paragraphs (a) through (d) of this section, are identified as acute hazardous wastes (H) and are subject to be the small quantity exclusion defined in Sec. 261.5(e).

[Comment: For the convenience of the regulated community the primary hazardous properties of these materials have been indicated by the letters T (Toxicity), and R (Reactivity). Absence of a letter indicates that the compound only is listed for acute toxicity.]

These wastes and their corresponding EPA Hazardous Waste Numbers are:

Chemical No.	Hazardous Waste Abstracts No.	Substance
P023	107-20-0	Acetaldehyde, chloro
P002	591-08-2	Acetamide, N-(aminothioxomethyl)
P057	640-19-7	Acetamide, 2-fluoro
P058	62-74-8	Acetic acid, fluoro-, sodium salt
P002	591-08-2	1-Acetyl-2-thiourea
P003	107-02-8	Acrolein
P070	116-06-3	Aldicarb
P203	1646-88-4	Aldicarb sulfone
P004	309-00-2	Aldrin
P005	107-18-6	Allyl alcohol
P006	20859-73-8	Aluminum phosphide (R,T)
P007	2763-96-4	5-(Aminomethyl)-3-isoxazolol
P008	504-24-5	4-Aminopyridine
P009	131-74-8	Ammonium picrate (R)
P119	7803-55-6	Ammonium vanadate
P099	506-61-6	Argentate(1-), bis(cyano-C)-, potassium
P010	7778-39-4	Arsenic acid
P012	1327-53-3	Arsenic oxide
P011	1303-28-2	Arsenic oxide
P011	1303-28-2	Arsenic pentoxide
P012	1327-53-3	Arsenic trioxide
P038	692-42-2	Arsine, diethyl
P036	696-28-6	Arsonous dichloride, phenyl
P054	151-56-4	Aziridine
P067	75-55-8	Aziridine, 2-methyl-
P013	542-62-1	Barium cyanide
P024	106-47-8	Benzenamine, 4-chloro-
P077	100-01-6	Benzenamine, 4-nitro-
P028	100-44-7	Benzene, (chloromethyl)-
P042	51-43-4	1,2-Benzenediol, 4-[1-hydroxy-2-(methylamino)ethyl]-, (R)-
P046	122-09-8	Benzeneethanamine, alpha,alpha-dimethyl-
P014	108-98-5	Benzenethiol
P127	1563-66-2	7-Benzofuranol, 2,3-dihydro-2,2-dimethyl-, methylcarbamate.
P188	57-64-7	Benzoic acid, 2-hydroxy-, compd. with (3aS-cis)-1,2,3,3a,8,8a-hexahydro-1,3a,8-trimethylpyrrolo[2,3-b]indol-5- yl methylcarbamate ester (1:1).
P001	[1]81-81-2	2H-1-Benzopyran-2-one, 4-

		hydroxy-3-(3- oxo-1-phenylbutyl)-, salts, when present at concentrations greater than 0.3%
P028	100-44-7	Benzyl chloride
P015	7440-41-7	Beryllium powder
P017	598-31-2	Bromoacetone
P018	357-57-3	Brucine
P045	39196-18-4	2-Butanone, 3,3-dimethyl-1-(methylthio)-, O-methylamino)carbonyl] oxime
P021	592-01-8	Calcium cyanide
P021	592-01-8	Calcium cyanide Ca(CN)
P189	55285-14-8	Carbamic acid, [(dibutylamino)-thio]methyl-, 2,3-dihydro-2,2-dimethyl- 7-benzofuranyl ester.
P191	644-64-4	Carbamic acid, dimethyl-, 1-[(dimethyl- amino)carbonyl]- 5-methyl-1H- pyrazol- 3-yl ester.
P192	119-38-0	Carbamic acid, dimethyl-, 3-methyl-1-(1-methylethyl)-1H- pyrazol-5-yl ester.
P190	1129-41-5	Carbamic acid, methyl-, 3-Methylphenyl ester.
P127	1563-66-2	Carbofuran.
P022	75-15-0	Carbon disulfide
P095	75-44-5	Carbonic dichloride
P189	55285-14-8	Carbosulfan.
P023	107-20-0	Chloroacetaldehyde
P024	106-47-8	p-Chloroaniline
P026	5344-82-1	1-(o-Chlorophenyl)thiourea
P027	542-76-7	3-Chloropropionitrile
P029	544-92-3	Copper cyanide
P029	544-92-3	Copper cyanide Cu(CN)
P202	64-00-6	m-Cumenyl methylcarbamate.
P030	.....	Cyanides (soluble cyanide salts), not otherwise specified
P031	460-19-5	Cyanogen
P033	506-77-4	Cyanogen chloride
P033	506-77-4	Cyanogen chloride (CN)Cl
P034	131-89-5	2-Cyclohexyl-4,6-dinitrophenol
P016	542-88-1	Dichloromethyl ether
P036	696-28-6	Dichlorophenylarsine
P037	60-57-1	Dieldrin
P038	692-42-2	Diethylarsine
P041	311-45-5	Diethyl-p-nitrophenyl phosphate
P040	297-97-2	O,O-Diethyl O-pyrazinyl phosphorothioate
P043	55-91-4	Diisopropylfluorophosphate (DFP)
P004	309-00-2	1,4,5,8-Dimethanonaphthalene, 1,2,3,4,10,10-hexa- chloro- 1,4,4a, 5,8,8a,-hexahydro-, (1alpha,4alpha, 4abeta,5alpha,8alpha,8 abeta)-
P060	465-73-6	1,4,5,8-Dimethanonaphthalene, 1,2,3,4,10,10-hexa- chloro- 1,4,4a,5,8,8a-hexahydro-,(1alpha, 4alpha,4abeta,5beta,8beta,8ab eta)-
P037	60-57-1	2,7:3,6-Dimethanonaphth[2,3-b]oxirene, 3,4,5,6,9,9-hexachloro-1a,2,2a,3,6,6a,7,7a-octahydro-, (1aalpha,2beta,2aalpha,3beta,6beta,6a alpha,7beta, 7aalpha)-
P051	[1]72-20-8	2,7:3,6-Dimethanonaphth [2,3-b]oxirene, 3,4,5,6,9,9-hexachloro-1a,2,2a,3,6,6a,7,7a-octahydro-,

		1aalpha,2beta,2abeta,3alpha,6alpha,6abeta,7beta, 7aalpha)-, & metabolites
P044	60-51-5	Dimethoate
P046	122-09-8	alpha,alpha-Dimethylphenethylamine
P191	644-64-4	Dimetilan
P047	[1]534-52-1	4,6-Dinitro-o-cresol, salts
P048	51-28-5	2,4-Dinitrophenol
P020	88-85-7	Dinoseb
P085	152-16-9	Diphosphoramide, octamethyl-
P111	107-49-3	Diphosphoric acid, tetraethyl ester
P039	298-04-4	Disulfoton
P049	541-53-7	Dithiobiuret
P185	26419-73-8	1,3-Dithiolane-2-carboxaldehyde, 2,4-dimethyl-, O- [(methylamino)-carbonyl]oxime.
P050	115-29-7	Endosulfan
P088	145-73-3	Endothall
P051	72-20-8	Endrin
P051	72-20-8	Endrin, metabolites
P042	51-43-4	Epinephrine
P031	460-19-5	Ethanedinitrile
P194	23135-22-0	Ethanimidothioc acid, 2-(dimethylamino)-N-[[(methylamino) carbonyl]oxy]-2-oxo-, methyl ester.
P066	16752-77-5	Ethanimidothioic acid, N-[[(methylamino)carbonyl]oxy]-, methyl ester
P101	107-12-0	Ethyl cyanide
P054	151-56-4	Ethyleneimine
P097	52-85-7	Famphur
P056	7782-41-4	Fluorine
P057	640-19-7	Fluoroacetamide
P058	62-74-8	Fluoroacetic acid, sodium salt
P198	23422-53-9	Formetanate hydrochloride.
P197	17702-57-7	Formparanate
P065	628-86-4	Fulminic acid, mercury(2+) salt (R,T)
P059	76-44-8	Heptachlor
P062	757-58-4	Hexaethyl tetraphosphate
P116	79-19-6	Hydrazinecarbothioamide
P068	60-34-4	Hydrazine, methyl-
P063	74-90-8	Hydrocyanic acid
P063	74-90-8	Hydrogen cyanide
P096	7803-51-2	Hydrogen phosphide
P060	465-73-6	Isodrin
P192	119-38-0	Isolan.
P202	64-00-6	3-Isopropylphenyl N-methylcarbamate.
P007	2763-96-4	3(2H)-Isoxazolone, 5-(aminomethyl)-
P196	15339-36-3	Manganese, bis (dimethylcarbamodithioato-S,S')-,
P196	15339-36-3	Manganese dimethyldithiocarbamate.
P092	62-38-4	Mercury, (acetato-O)phenyl-
P065	628-86-4	Mercury fulminate (R,T)
P082	62-75-9	Methanamine, N-methyl-N-nitroso-
P064	624-83-9	Methane, isocyanato-
P016	542-88-1	Methane, oxybis[chloro-
P112	509-14-8	Methane, tetranitro- (R)
P118	75-70-7	Methanethiol, trichloro-
P198	23422-53-9	Methanimidamide, N,N-dimethyl-N'-[3-[[(methylamino)-carbonyl]oxy]phenyl]-monohydrochloride.
P197	17702-57-7	Methanimidamide, N,N-dimethyl-N'-[2-methyl-4-[[(methylamino) carbonyl] oxy]phenyl]-

P050	115-29-7	6,9-Methano-2,4,3-benzodioxathiepin, 6,7,8,9,10,10- hexachloro-1,5,5a,6,9, 9a-hexahydro-, 3-oxide
P059	76-44-8	4,7-Methano-1H-indene, 1,4,5,6,7,8,8- heptachloro-3a,4,7,7a- tetrahydro
P199	2032-65-7	Methiocarb
P066	16752-77-5	Methomyl
P068	60-34-4	Methyl hydrazine
P064	624-83-9	Methyl isocyanate
P069	75-86-5	2-Methyllactonitrile
P071	298-00-0	Methyl parathion
P190	1129-41-5	Metolcarb
P128	315-8-4	Mexacarbate
P072	86-88-4	alpha-Naphthylthiourea
P073	13463-39-3	Nickel carbonyl
P073	13463-39-3	Nickel carbonyl Ni(CO)(T-4)-
P074	557-19-7	Nickel cyanide
P074	557-19-7	Nickel cynaide Ni(CN)
P075	[1]54-11-5	Nicotine, salts
P076	10102-43-9	Nitric oxide
P077	100-01-6	p-Nitroaniline
P078	10102-44-0	Nitrogen dioxide
P076	10102-43-9	Nitrogen oxide NO
P078	10102-44-0	Nitrogen oxide NO
P081	55-63-0	Nitroglycerine (R)
P082	62-75-9	N-Nitrosodimethylamine
P084	4549-40-0	N-Nitrosomethylvinylamine
P085	152-16-9	Octamethylpyrophosphoramide
P087	20816-12-0	Osmium oxide OsO(T-4)-
P087	20816-12-0	Osmium tetroxide
P088	145-73-3	7-Oxabicyclo[2.2.1]heptane-2,3- dicarboxylic acid
P194	23135-22-0	Oxamyl
P089	56-38-2	Parathion
P034	131-89-5	Phenol, 2-cyclohexyl-4,6-dinitro-
P048	51-28-5	Phenol,2,4-dinitro-
P047	[1]534-52-1	Phenol, 2-methyl-4,6-dinitro-, salts
P020	88-85-7	Phenol, 2-(1-methylpropyl)-4,6- dinitro-
P009	131-74-8	Phenol, 2,4,6-trinitro-, ammonium Salt (R)
P128	315-18-4	Phenol, 4-(dimethylamino)-3,5- dimethyl- , methylcarbamate (ester)
P199	2032-65-7	Phenol, (3,5-dimethyl-4-(methylthio), methylcarbamate
P202	64-00-6	Phenol, 3-(1-methylethyl)-, methyl carbamate
P201	2631-37-0	Phenol, 3-methyl-5-(1-methylethyl)-, methyl carbamate
P092	62-38-4	Phenylmercury acetate
P093	103-85-5	Phenylthiourea
P094	298-02-2	Phorate
P095	75-44-5	Phosgene
P096	7803-51-2	Phosphine
P041	311-45-5	Phosphoric acid, diethyl 4- Nitrophenyl ester
P039	298-04-4	Phosphorodithioic acid, O,O-diethyl S-[2-(ethylthio)ethyl] ester
P094	298-02-2	Phosphorodithioic acid, O,O-diethyl S-[(ethylthio)methyl] ester
P044	60-51-5	Phosphorodithioic acid, O,O-dimethyl S-[2-(methylamino)-2-oxoethyl] ester
P043	55-91-4	Phosphorofluoridic acid, bis(1-

		methylethyl) ester
P089	56-38-2	Phosphorothioic acid, O,O-diethyl O-(4-nitrophenyl) ester
P040	297-97-2	Phosphorothioic acid, O,O-diethyl O-pyrazinyl ester
P097	52-85-7	Phosphorothioic acid,O-[4-[(dimethylamino)sulfonyl]phenyl] O,O-dimethyl ester
P071	298-00-0	Phosphorothioic acid, O,O,-dimethyl O-(4-nitrophenyl) ester
P204	57-47-6	Physostigmine.
P188	57-64-7	Physostigmine salicylate
P110	78-00-2	Plumbane, tetraethyl-
P098	151-50-8	Potassium cyanide
P098	151-50-8	Potassium cyanide K(CN)
P099	506-61-6	Potassium silver cyanide
P201	2631-37-0	Promecarb
P070	116-06-3	Propanal, 2-methyl-2-(methylthio)-, O-[(methylamino)carbonyl]oxime
P203	1646-88-4	Propanal, 2-methyl-2-(methyl-sulfonyl)-,O-[(methylamino)carbonyl] oxime
P101	107-12-0	Propanenitrile
P027	542-76-7	Propanenitrile, 3-chloro-
P069	75-86-5	Propanenitrile, 2-hydroxy-2-methyl-
P081	55-63-0	1,2,3-Propanetriol, trinitrate (R)
P017	598-31-2	2-Propanone, 1-bromo-
P102	107-19-7	Propargyl alcohol
P003	107-02-8	2-Propenal
P005	107-18-6	2-Propen-1-ol
P067	75-55-8	1,2-Propylenimine
P102	107-19-7	2-Propyn-1-ol
P008	504-24-5	4-Pyridinamine
P075	54-11-5	Pyridine, 3-(1-methyl-2-pyrrolidinyl)-,(S)-, salts
P204	57-47-6	Pyrrolo[2,3-b]indol-5-ol, 1,2,3,3a,8,8a-hexahydro-1,3a,8-trimethyl-,methylcarbamate (ester), (3aS-cis)-.
P114	12039-52-0	Selenious acid, dithallium(1+) salt
P103	630-10-4	Selenourea
P104	506-64-9	Silver cyanide
P104	506-64-9	Silver cyanide Ag(CN)
P105	26628-22-8	Sodium azide
P106	143-33-9	Sodium cyanide
P106	143-33-9	Sodium cyanide Na(CN)
P108	[1]57-24-9	Strychnidin-10-one, salts
P018	357-57-3	Strychnidin-10-one, 2,3-dimethoxy-
P108	[1]57-24-9	Strychnine, salts
P115	7446-18-6	Sulfuric acid, dithallium(1+) salt
P109	3689-24-5	Tetraethyldithiopyrophosphate
P110	78-00-2	Tetraethyl lead
P111	107-49-3	Tetraethyl pyrophosphate
P112	509-14-8	Tetranitromethane (R)
P062	757-58-4	Tetraphosphoric acid, hexaethyl ester
P113	1314-32-5	Thallic oxide
P113	1314-32-5	Thallium oxide
P114	12039-52-0	Thallium(I) selenite
P115	7446-18-6	Thallium(I) sulfate
P109	3689-24-5	Thiodiphosphoric acid, tetraethyl ester
P045	39196-18-4	Thiofanox
P049	541-53-7	Thioimidodicarbonic diamide [(H2N)C(S)]NH

P014	108-98-5	Thiophenol
P116	79-19-6	Thiosemicarbazide
P026	5344-82-1	Thiourea, (2-chlorophenyl)-
P072	86-88-4	Thiourea, 1-naphthalenyl-
P093	103-85-5	Thiourea, phenyl-
P185	26419-73-8	Tirpate
P123	8001-35-2	Toxaphene
P118	75-70-7	Trichloromethanethiol
P119	7803-55-6	Vanadic acid, ammonium salt
P120	1314-62-1	Vanadium oxide V2O5
P120	1314-62-1	Vanadium pentoxide
P084	4549-40-0	Vinylamine, N-methyl-N-nitroso-
P001	[1]81-81-2	Warfarin, salts, when present at concentrations greater than 0.3%
P205	137-30-4	Zinc, bis(dimethylcarbamodithioato-S,S')
P121	557-21-1	Zinc cyanide
P121	557-21-1	Zinc cyanide Zn(CN)2
P122	1314-84-7	Zinc phosphide Zn3P2, when present at concentrations greater than 10% (R,T)
P205	137-30-4	Ziram

[1]CAS Number given for parent compound only.

(f) The commercial chemical products, manfacturing chemical intermediates, or off-specification commercial chemical products referred to in paragraphs (a) through (d) of this section, are identified as toxic wastes (T), unless otherwise designated and are subject to the small quantity generator exclusion defined in Sec. 261.5 (a) and (g).

[Comment: For the convenience of the regulated community, the primary hazardous properties of these materials have been indicated by the letters T (Toxicity), R (Reactivity), I (Ignitability) and C (Corrosivity). Absence of a letter indicates that the compound is only listed for toxicity.]

These wastes and their corresponding EPA Hazardous Waste Numbers are:

Chemical No.	Hazardous Waste Abstracts No.	Substance
U394	30558-43-1	A2213
U001	75-07-0	Acetaldehyde (I)
U034	75-87-6	Acetaldehyde, trichloro-
U187	62-44-2	Acetamide, N-(4-ethoxyphenyl)-
U005	53-96-3	Acetamide, N-9H-fluoren-2-yl-
U240	[1]94-75-7	Acetic acid, (2,4-dichlorophenoxy)- Salts, esters
U112	141-78-6	Acetic acid ethyl ester (I)
U144	301-04-2	Acetic acid, lead(2+) salt
U214	563-68-8	Acetic acid, thallium(1+) salt see F027 93-76-5 Acetic acid, (2,4,5-trichlorophenoxy)-
U002	67-64-1	Acetone (I)
U003	75-05-8	Acetonitrile (I,T)
U004	98-86-2	Acetophenone
U005	53-96-3	2-Acetylaminofluorene
U006	75-36-5	Acetyl chloride (C,R,T)
U007	79-06-1	Acrylamide
U008	79-10-7	Acrylic acid (I)
U009	107-13-1	Acrylonitrile
U011	61-82-5	Amitrole

U012	62-53-3	Aniline (I,T)
U136	75-60-5	Arsinic acid, dimethyl-
U014	492-80-8	Auramine
U015	115-02-6	Azaserine
U010	50-07-7	Azirino[2,3 ls-thn-eq 3,4] pyrrolo [1,2-a]indole-4,7-dione, 6-amino-8-[[(aminocarbonyl)oxy]methyl]-1,1a,2,8,8a,8b-hexahydro-8a-methoxy-5-methyl-, [1aS-(1aalpha, 8beta, 8aalpha,8balpha)]-
U280	101-27-9	Barban
U278	22781-23-3	Bendiocarb
U364	22961-82-6	Bendiocarb phenol
U271	17804-35-2	Benomyl
U157	56-49-5	Benz[j]aceanthrylene, 1,2-dihydro-3-methyl-
U016	225-51-4	Benz[c]acridine
U017	98-87-3	Benzal chloride
U192	23950-58-5	Benzamide, 3,5-dichloro-N-(1,1-dimethyl-2-propynyl)-
U018	56-55-3	Benz[a]anthracene
U094	57-97-6	Benz[a]anthracene, 7,12-dimethyl-
U012	62-53-3	Benzenamine (I,T)
U014	492-80-8	Benzenamine, 4,4-carbonimidoylbis[N,N-dimethyl-
U049	3165-93-3	Benzenamine, 4-chloro-2-methyl-, hydrochloride
U093	60-11-7	Benzenamine, N,N-dimethyl-4-(phenylazo)-
U328	95-53-4	Benzenamine, 2-methyl-
U353	106-49-0	Benzenamine, 4-methyl-
U158	101-14-4	Benzenamine, 4,4-methylenebis[2-chloro-
U222	636-21-5	Benzenamine, 2-methyl-, hydrochloride
U181	99-55-8	Benzenamine, 2-methyl-5-nitro-
U019	71-43-2	Benzene (I,T)
U038	510-15-6	Benzeneacetic acid, 4-chloro-alpha-(4-chlorophenyl)-alpha-hydroxy-, ethyl ester
U030	101-55-3	Benzene, 1-bromo-4-phenoxy-
U035	305-03-3	Benzenebutanoic acid, 4-[bis(2-chloroethyl)amino]-
U037	108-90-7	Benzene, chloro-
U221	25376-45-8	Benzenediamine, ar-methyl-
U028	117-81-7	1,2-Benzenedicarboxylic acid, bis(2-ethylhexyl) ester
U069	84-74-2	1,2-Benzenedicarboxylic acid, dibutyl ester
U088	84-66-2	1,2-Benzenedicarboxylic acid, diethyl ester
U102	131-11-3	1,2-Benzenedicarboxylic acid, Dimethyl ester
U107	117-84-0	1,2-Benzenedicarboxylic acid, dioctyl ester
U070	95-50-1	Benzene, 1,2-dichloro-
U071	541-73-1	Benzene, 1,3-dichloro-
U072	106-46-7	Benzene, 1,4-dichloro-
U060	72-54-8	Benzene, 1,1-(2,2-dichloroethylidene) bis[4-chloro-
U017	98-87-3	Benzene, (dichloromethyl)-
U223	26471-62-5	Benzene, 1,3-diisocyanatomethyl- (R,T)
U239	1330-20-7	Benzene, dimethyl- (I,T)
U201	108-46-3	1,3-Benzenediol

U127	118-74-1	Benzene, hexachloro-
U056	110-82-7	Benzene, hexahydro- (I)
U220	108-88-3	Benzene, methyl-
U105	121-14-2	Benzene, 1-methyl-2,4-dinitro-
U106	606-20-2	Benzene, 2-methyl-1,3-dinitro-
U055	98-82-8	Benzene, (1-methylethyl)- (I)
U169	98-95-3	Benzene, nitro-
U183	608-93-5	Benzene, pentachloro-
U185	82-68-8	Benzene, pentachloronitro-
U020	98-09-9	Benzenesulfonic acid chloride (C,R)
U020	98-09-9	Benzenesulfonyl chloride (C,R)
U207	95-94-3	Benzene, 1,2,4,5-tetrachloro-
U061	50-29-3	Benzene, 1,1-(2,2,2-trichloroethylidene)bis[4-chloro-
U247	72-43-5	Benzene, 1,1-(2,2,2-trichloroethylidene)bis[4- methoxy
U023	98-07-7	Benzene, (trichloromethyl)-
U234	99-35-4	Benzene, 1,3,5-trinitro-
U021	92-87-5	Benzidine
U202	[1]81-07-2	1,2-Benzisothiazol-3(2H)-one, 1,1-dioxide, salts
U278	22781-23-3	1,3-Benzodioxol-4-ol, 2,2-dimethyl-, methyl carbamate
U364	22961-82-6	1,3-Benzodioxol-4-ol, 2,2-dimethyl-,
U203	94-59-7	1,3-Benzodioxole, 5-(2-propenyl)-
U141	120-58-1	1,3-Benzodioxole, 5-(1-propenyl)-
U367	1563-38-8	7-Benzofuranol, 2,3-dihydro-2,2-dimethyl-
U090	94-58-6	1,3-Benzodioxole, 5-propyl-
U064	189-55-9	Benzo[rst]pentaphene
U248	[1]81-81-2	2H-1-Benzopyran-2-one,4-hydroxy-3-(3-oxo-1-phenyl-butyl)-, salts, when present at concentrations of 0.3% or less
U022	50-32-8	Benzo[a]pyrene
U197	106-51-4	p-Benzoquinone
U023	98-07-7	Benzotrichloride (C,R,T)
U085	1464-53-5	2,2-Bioxirane
U021	92-87-5	[1,1-Biphenyl]-4,4-diamine
U073	91-94-1	[1,1'-Biphenyl]-4,4'-diamine, 3,3'-dichloro-
U091	119-90-4	[1,1'-Biphenyl]-4,4'-diamine, 3,3'-dimethoxy-
U095	119-93-7	[1,1'-Biphenyl]-4,4'-diamine, 3,3'-dimethyl-
U225	75-25-2	Bromoform
U030	101-55-3	4-Bromophenyl phenyl ether
U128	87-68-3	1,3-Butadiene, 1,1,2,3,4,4-hexachloro-
U172	924-16-3	1-Butanamine, N-butyl-N-nitroso-
U031	71-36-3	1-Butanol (I)
U159	78-93-3	2-Butanone (I,T)
U160	1338-23-4	2-Butanone, peroxide (R,T)
U053	4170-30-3	2-Butenal
U074	764-41-0	2-Butene, 1,4-dichloro- (I,T)
U143	303-34-4	2-Butenoic acid, 2-methyl-, 7-[[2,3-dihydroxy-2-(1-methoxyethyl)-3-methyl-1-oxobutoxy]methyl]-2,3,5, 7a-tetrahydro-1H-pyrrolizin-1-yl ester, [1S-[1alpha(Z),7(2S*,3R*),7aalpha]]
U031	71-36-3	n-Butyl alcohol (I)
U136	75-60-5	Cacodylic acid
U032	13765-19-0	Calcium chromate

U372	10605-21-7	Carbamic acid, 1H-benzimidazol-2-yl, methyl ester
U271	17804-35-2	Carbamic acid, [1-[(butylamino)carbonyl]-1H-benzimidazol-2-yl] methyl ester
U280	101-27-9	Carbamic acid, (3-chlorophenyl)-, 4-chloro-2-butynyl ester
U238	51-79-6	Carbamic acid, ethyl ester
U178	615-53-2	Carbamic acid, methylnitroso-, ethyl ester
U373	122-42-9	Carbamic acid, phenyl-, 1-methylethyl ester
U409	23564-05-8	Carbamic acid, [1,2-phenylenebis (iminocarbonothioyl)]bis- dimethyl ester
U097	79-44-7	Carbamic chloride, dimethyl-
U389	2303-17-5	Carbamothioic acid, bis(1-methylethyl)S-(2,3,3-trichloro-2-propenyl)ester
U387	52888-80-9	Carbamothioic acid, dipropyl-, S-(phenylmethyl) ester
U114	[1]111-54-6	Carbamodithioic acid, 1,2-ethanediylbis-, salts, esters
U062	2303-16-4	Carbamothioic acid, bis(1-methylethyl)-, S-(2,3-dichloro-2-propenyl) ester
U279	63-25-2	Carbaryl
U372	10605-21-7	Carbendazim
U367	1563-38-8	Carbofuran phenol
U215	6533-73-9	Carbonic acid, dithallium(1+) salt
U033	353-50-4	Carbonic difluoride
U156	79-22-1	Carbonochloridic acid, methyl ester (I,T)
U033	353-50-4	Carbon oxyfluoride (R,T)
U211	56-23-5	Carbon tetrachloride
U034	75-87-6	Chloral
U035	305-03-3	Chlorambucil
U036	57-74-9	Chlordane, alpha/ gamma isomers
U026	494-03-1	Chlornaphazin
U037	108-90-7	Chlorobenzene
U038	510-15-6	Chlorobenzilate
U039	59-50-7	p-Chloro-m-cresol
U042	110-75-8	2-Chloroethyl vinyl ether
U044	67-66-3	Chloroform
U046	107-30-2	Chloromethyl methyl ether
U047	91-58-7	beta-Chloronaphthalene
U048	95-57-8	o-Chlorophenol
U049	3165-93-3	4-Chloro-o-toluidine, hydrochloride
U032	13765-19-0	Chromic acid, calcium salt
U050	218-01-9	Chrysene
U051	.....	Creosote
U052	1319-77-3	Cresol (Cresylic acid)
U053	4170-30-3	Crotonaldehyde
U055	98-82-8	Cumene (I)
U246	506-68-3	Cyanogen bromide (CN)Br
U197	106-51-4	2,5-Cyclohexadiene-1,4-dione
U056	110-82-7	Cyclohexane (I)
U129	58-89-9	Cyclohexane, 1,2,3,4,5,6-hexachloro-, (1alpha,2alpha,3beta,4alpha,5alpha,6beta)-
U057	108-94-1	Cyclohexanone (I)
U130	77-47-4	1,3-Cyclopentadiene, 1,2,3,4,5,5-hexachloro-
U058	50-18-0	Cyclophosphamide

U240	[1]94-75-7	2,4-D, salts, esters
U059	20830-81-3	Daunomycin
U060	72-54-8	DDD
U061	50-29-3	DDT
U062	2303-16-4	Diallate
U063	53-70-3	Dibenz[a,h]anthracene
U064	189-55-9	Dibenzo[a,i]pyrene
U066	96-12-8	1,2-Dibromo-3-chloropropane
U069	84-74-2	Dibutyl phthalate
U070	95-50-1	o-Dichlorobenzene
U071	541-73-1	m-Dichlorobenzene
U072	106-46-7	p-Dichlorobenzene
U073	91-94-1	3,3'-Dichlorobenzidine
U074	764-41-0	1,4-Dichloro-2-butene (I,T)
U075	75-35-4	1,1-Dichloroethylene
U079	156-60-5	1,2-Dichloroethylene
U025	111-44-4	Dichloroethyl ether
U027	108-60-1	Dichloroisopropyl ether
U024	111-91-1	Dichloromethoxy ethane
U081	120-83-2	2,4-Dichlorophenol
U082	87-65-0	2,6-Dichlorophenol
U084	542-75-6	1,3-Dichloropropene
U085	1464-53-5	1,2:3,4-Diepoxybutane (I,T)
U108	123-91-1	1,4-Diethyleneoxide
U028	117-81-7	Diethylhexyl phthalate
U395	5952-26-1	Diethylene glycol, dicarbamate.
U086	1615-80-1	N,N'-Diethylhydrazine
U087	3288-58-2	O,O-Diethyl S-methyl dithiophosphate
U088	84-66-2	Diethyl phthalate
U089	56-53-1	Diethylstilbesterol
U090	94-58-6	Dihydrosafrole
U091	119-90-4	3,3'-Dimethoxybenzidine
U092	60-11-7	p-Dimethylaminoazobenzene
U094	57-97-6	7,12-Dimethylbenz[a]anthracene
U095	119-93-7	3,3'-Dimethylbenzidine
U096	80-15-9	alpha,alpha-Dimethylbenzylhydroperoxide (R)
U097	79-44-7	Dimethylcarbamoyl chloride
U098	57-14-7	1,1-Dimethylhydrazine
U099	540-73-8	1,2-Dimethylhydrazine
U101	105-67-9	2,4-Dimethylphenol
U102	131-11-3	Dimethyl phthalate
U103	77-78-1	Dimethyl sulfate
U105	121-14-2	2,4-Dinitrotoluene
U106	606-20-2	2,6-Dinitrotoluene
U107	117-84-0	Di-n-octyl phthalate
U108	123-91-1	1,4-Dioxane
U109	122-66-7	1,2-Diphenylhydrazine
U110	142-84-7	Dipropylamine (I)
U111	621-64-7	Di-n-propylnitrosamine
U041	106-89-8	Epichlorohydrin
U001	75-07-0	Ethanal (I)
U404	121-44-8	Ethanamine, N,N-diethyl-
U174	55-18-5	Ethanamine, N-ethyl-N-nitroso-
U155	91-80-5	1,2-Ethanediamine, N,N-dimethyl-N'-2-pyridinyl-N'-(2-thienylmethyl)-
U067	106-93-4	Ethane, 1,2-dibromo-
U076	75-34-3	Ethane, 1,1-dichloro-
U077	107-06-2	Ethane, 1,2-dichloro-
U131	67-72-1	Ethane, hexachloro-
U024	111-91-1	Ethane, 1,1'-[methylenebis(oxy)]bis [2-chloro-
U117	60-29-7	Ethane, 1,1'-oxybis-(I)
U025	111-44-4	Ethane, 1,1'-oxybis[2-chloro-

U184	76-01-7	Ethane, pentachloro-
U208	630-20-6	Ethane, 1,1,1,2-tetrachloro-
U209	79-34-5	Ethane, 1,1,2,2-tetrachloro-
U218	62-55-5	Ethanethioamide
U226	71-55-6	Ethane, 1,1,1-trichloro-
U227	79-00-5	Ethane, 1,1,2-trichloro-
U410	59669-26-0	Ethanimidothioic acid, N,N'-[thiobis[(methylimino)carbonyloxy]] bis-dimethyl ester
U394	30558-43-1	Ethanimidothioic acid, 2-(dimethylamino)-N-hydroxy-2-oxo-, methyl ester
U359	110-80-5	Ethanol, 2-ethoxy-
U173	1116-54-7	Ethanol, 2,2'-(nitrosoimino)bis-
U395	5952-26-1	Ethanol, 2,2'-oxybis-, dicarbamate.
U004	98-86-2	Ethanone, 1-phenyl-
U043	75-01-4	Ethene,chloro-
U042	110-75-8	Ethene, (2-chloroethoxy)-
U078	75-35-4	Ethene, 1,1-dichloro-
U079	156-60-5	Ethene, 1,2-dichloro-, (E)-
U210	127-18-4	Ethene, tetrachloro-
U228	79-01-6	Ethene, trichloro-
U112	141-78-6	Ethyl acetate (I)
U113	140-88-5	Ethyl acrylate (I)
U238	51-79-6	Ethyl carbamate (urethane)
U117	60-29-7	Ethyl ether (I)
U114	[1]111-54-6	Ethylenebisdithiocarbamic acid, salts,esters
U067	106-93-4	Ethylene dibromide
U077	107-06-2	Ethylene dichloride
U359	110-80-5	Ethylene glycol monoethyl ether
U115	75-21-8	Ethylene oxide (I,T)
U116	96-45-7	Ethylenethiourea
U076	75-34-3	Ethylidene dichloride
U118	97-63-2	Ethyl methacrylate
U119	62-50-0	Ethyl methanesulfonate
U120	206-44-0	Fluoranthene
U122	50-00-0	Formaldehyde
U123	64-18-6	Formic acid (C,T)
U124	110-00-9	Furan (I)
U125	98-01-1	2-Furancarboxaldehyde (I)
U147	108-31-6	2,5-Furandione
U213	109-99-9	Furan, tetrahydro-(I)
U125	98-01-1	Furfural (I)
U124	110-00-9	Furfuran (I)
U206	18883-66-4	Glucopyranose, 2-deoxy-2-(3-methyl-3-nitrosoureido)-, D-
U206	18883-66-4	D-Glucose,2-deoxy-2-[(methylnitrosoamino) -carbonyl] amino]-
U126	765-34-4	Glycidylaldehyde
U163	70-25-7	Guanidine, N-methyl-N'-nitro-N-nitroso-
U127	118-74-1	Hexachlorobenzene
U128	87-68-3	Hexachlorobutadiene
U130	77-47-4	Hexachlorocyclopentadiene
U131	67-72-1	Hexachloroethane
U132	70-30-4	Hexachlorophene
U243	1888-71-7	Hexachloropropene
U133	302-01-2	Hydrazine (R,T)
U086	1615-80-1	Hydrazine, 1,2-diethyl-
U098	57-14-7	Hydrazine, 1,1-dimethyl-
U099	540-73-8	Hydrazine, 1,2-dimethyl-
U109	122-66-7	Hydrazine, 1,2-diphenyl-

U134	7664-39-3	Hydrofluoric acid (C,T)
U134	7664-39-3	Hydrogen fluoride (C,T)
U135	7783-06-4	Hydrogen sulfide
U135	7783-06-4	Hydrogen sulfide H2S
U096	80-15-9	Hydroperoxide, 1-methyl-1-phenylethyl-(R)
U116	96-45-7	2-Imidazolidinethione
U137	193-39-5	Indeno[1,2,3-cd]pyrene
U190	85-44-9	1,3-Isobenzofurandione
U140	78-83-1	Isobutyl alcohol (I,T)
U141	120-58-1	Isosafrole
U142	143-50-0	Kepone
U143	303-34-4	Lasiocarpine
U144	301-04-2	Lead acetate
U146	1335-32-6	Lead, bis(acetato-O)tetrahydroxytri-
U145	7446-27-7	Lead phosphate
U146	1335-32-6	Lead subacetate
U129	58-89-9	Lindane
U163	70-25-7	MNNG
U147	108-31-6	Maleic anhydride
U148	123-33-1	Maleic hydrazide
U149	109-77-3	Malononitrile
U150	148-82-3	Melphalan
U151	7439-97-6	Mercury
U152	126-98-7	Methacrylonitrile (I, T)
U092	124-40-3	Methanamine, N-methyl- (I)
U029	74-83-9	Methane, bromo-
U045	74-87-3	Methane, chloro- (I, T)
U046	107-30-2	Methane, chloromethoxy-
U068	74-95-3	Methane, dibromo-
U080	75-09-2	Methane, dichloro-
U075	75-71-8	Methane, dichlorodifluoro-
U138	74-88-4	Methane, iodo-
U119	62-50-0	Methanesulfonic acid, ethyl ester
U211	56-23-5	Methane, tetrachloro-
U153	74-93-1	Methanethiol (I, T)
U225	75-25-2	Methane, tribromo-
U044	67-66-3	Methane, trichloro-
U121	75-69-4	Methane, trichlorofluoro-
U036	57-74-9	4,7-Methano-1H-indene, 1,2,4,5,6,7,8,8-octachloro-2,3,3a,4,7,7a-hexahydro-
U154	67-56-1	Methanol (I)
U155	91-80-5	Methapyrilene
U142	143-50-0	1,3,4-Metheno-2H-Cyclobuta [cd]pentalen-2-one, 1,1a,3,3a, 4,5,5,5a,5b,6-decachlorooctahydro-
U247	72-43-5	Methoxychlor
U154	67-56-1	Methyl alcohol (I)
U029	74-83-9	Methyl bromide
U186	504-60-9	1-Methylbutadiene (I)
U045	74-87-3	Methyl chloride (I,T)
U156	79-22-1	Methyl chlorocarbonate (I,T)
U226	71-55-6	Methyl chloroform
U157	56-49-5	3-Methylcholanthrene
U158	101-14-4	4,4'-Methylenebis(2-chloroaniline)
U068	74-95-3	Methylene bromide
U080	75-09-2	Methylene chloride
U159	78-93-3	Methyl ethyl ketone (MEK) (I,T)
U160	1338-23-4	Methyl ethyl ketone peroxide (R,T)
U138	74-88-4	Methyl iodide
U161	108-10-1	Methyl isobutyl ketone (I)
U162	80-62-6	Methyl methacrylate (I,T)
U161	108-10-1	4-Methyl-2-pentanone (I)

U164	56-04-2	Methylthiouracil
U010	50-07-7	Mitomycin C
U059	20830-81-3	5,12-Naphthacenedione, 8-acetyl-10-[(3-amino-2,3,6-trideoxy)-alpha-L-lyxo-hexopyranosyl)oxy]-7,8,9,10-tetrahydro-6,8,11-trihydroxy-1-methoxy-, (8S-cis)-
U167	134-32-7	1-Naphthalenamine
U168	91-59-8	2-Naphthalenamine
U026	494-03-1	Naphthalenamine, N,N'-bis(2-chloroethyl)-
U165	91-20-3	Naphthalene
U047	91-58-7	Naphthalene, 2-chloro-
U166	130-15-4	1,4-Naphthalenedione
U236	72-57-1	2,7-Naphthalenedisulfonic acid, 3,3'-[(3,3'-dimethyl[1,1'-biphenyl]-4,4'-diyl)bis(azo)bis[5-amino-4-hydroxy]-, tetrasodium salt
U279	63-25-2	1-Naphthalenol, methylcarbamate
U166	130-15-4	1,4-Naphthoquinone
U167	134-32-7	alpha-Naphthylamine
U168	91-59-8	beta-Naphthylamine
U217	10102-45-1	Nitric acid, thallium(1+) salt
U169	98-95-3	Nitrobenzene (I,T)
U170	100-02-7	p-Nitrophenol
U171	79-46-9	2-Nitropropane (I,T)
U172	924-16-3	N-Nitrosodi-n-butylamine
U173	1116-54-7	N-Nitrosodiethanolamine
U174	55-18-5	N-Nitrosodiethylamine
U176	759-73-9	N-Nitroso-N-ethylurea
U177	684-93-5	N-Nitroso-N-methylurea
U178	615-53-2	N-Nitroso-N-methylurethane
U179	100-75-4	N-Nitrosopiperidine
U180	930-55-2	N-Nitrosopyrrolidine
U181	99-55-8	5-Nitro-o-toluidine
U193	1120-71-4	1,2-Oxathiolane, 2,2-dioxide
U058	50-18-0	2H-1,3,2-Oxazaphosphorin-2-amine, N,N-bis(2-chloroethyl)tetrahydro-, 2-oxide
U115	75-21-8	Oxirane (I,T)
U126	765-34-4	Oxiranecarboxyaldehyde
U041	106-89-8	Oxirane, (chloromethyl)-
		2 123-63-7 Paraldehyde
U183	608-93-5	Pentachlorobenzene
U184	76-01-7	Pentachloroethane
U185	82-68-8	Pentachloronitrobenzene (PCNB)
		See F027 87-86-5 Pentachlorophenol
U161	108-10-1	Pentanol, 4-methyl-
U186	504-60-9	1,3-Pentadiene (I)
U187	62-44-2	Phenacetin
U188	108-95-2	Phenol
U048	95-57-8	Phenol, 2-chloro-
U039	59-50-7	Phenol, 4-chloro-3-methyl-
U081	120-83-2	Phenol, 2,4-dichloro-
U082	87-65-0	Phenol, 2,6-dichloro-
U089	56-53-1	Phenol, 4,4'-(1,2-diethyl-1,2-ethenediyl)bis-, (E)-
U101	105-67-9	Phenol, 2,4-dimethyl-
U052	1319-77-3	Phenol, methyl-
U132	70-30-4	Phenol, 2,2'-methylenebis[3,4,6-trichloro-
U411	114-26-1	Phenol, 2-(1-methylethoxy)-, methylcarbamate
U170	100-02-7	Phenol, 4-nitro-See

		F027 87-86-5 Phenol, pentachloro-See F027 58-90-2 Phenol, 2,3,4,6-tetrachloro-See F027 95-95-4 Phenol, 2,4,5-trichloro-SeeF027 88-06-2 Phenol, 2,4,6-trichloro-
U150	148-82-3	L-Phenylalanine, 4-[bis(2-chloroethyl)amino]-
U145	7446-27-7	Phosphoric acid, lead(2+) salt (2:3)
U087	3288-58-2	Phosphorodithioic acid, O,O-diethyl S-methyl ester
U189	1314-80-3	Phosphorus sulfide (R)
U190	85-44-9	Phthalic anhydride
U191	109-06-8	2-Picoline
U179	100-75-4	Piperidine, 1-nitroso-
U192	23950-58-5	Pronamide
U194	107-10-8	1-Propanamine (I,T)
U111	621-64-7	1-Propanamine, N-nitroso-N-propyl-
U110	142-84-7	1-Propanamine, N-propyl- (I)
U066	96-12-8	Propane, 1,2-dibromo-3-chloro-
U083	78-87-5	Propane, 1,2-dichloro-
U149	109-77-3	Propanedinitrile
U171	79-46-9	Propane, 2-nitro- (I,T)
U027	108-60-1	Propane, 2,2'-oxybis[2-chloro-
U193	1120-71-4	1,3-Propane sultone
		See F027 93-72-1 Propanoic acid, 2-(2,4,5-trichlorophenoxy)-
U235	126-72-7	1-Propanol, 2,3-dibromo-, phosphate (3:1)
U140	78-83-1	1-Propanol, 2-methyl- (I,T)
U002	67-64-1	2-Propanone (I)
U007	79-06-1	2-Propenamide
U084	542-75-6	1-Propene, 1,3-dichloro-
U243	1888-71-7	1-Propene, 1,1,2,3,3,3-hexachloro-
U009	107-13-1	2-Propenenitrile
U152	126-98-7	2-Propenenitrile, 2-methyl- (I,T)
U008	79-10-7	2-Propenoic acid (I)
U113	140-88-5	2-Propenoic acid, ethyl ester (I)
U118	97-63-2	2-Propenoic acid, 2-methyl-, ethyl ester
U162	80-62-6	2-Propenoic acid, 2-methyl-, methyl ester (I,T)
U373	122-42-9	Propham
U411	114-26-1	Propoxur
U387	52888-80-9	Prosulfocarb
U194	107-10-8	n-Propylamine (I,T)
U083	78-87-5	Propylene dichloride
U148	123-33-1	3,6-Pyridazinedione, 1,2-dihydro-
U196	110-86-1	Pyridine
U191	109-06-8	Pyridine, 2-methyl-
U237	66-75-1	2,4-(1H,3H)-Pyrimidinedione, 5-[bis(2-chloroethyl)amino]-
U164	56-04-2	4(1H)-Pyrimidinone, 2,3-dihydro-6-methyl-2-thioxo-
U180	930-55-2	Pyrrolidine, 1-nitroso-
U200	50-55-5	Reserpine
U201	108-46-3	Resorcinol
U202	[1]81-07-2	Saccharin, salts
U203	94-59-7	Safrole
U204	7783-00-8	Selenious acid
U204	7783-00-8	Selenium dioxide
U205	7488-56-4	Selenium sulfide
U205	7488-56-4	Selenium sulfide SeS2 (R,T)
U015	115-02-6	L-Serine, diazoacetate (ester)
		See F027 93-72-1 Silvex (2,4,5-TP)

U206	18883-66-4	Streptozotocin
U103	77-78-1	Sulfuric acid, dimethyl ester
U189	1314-80-3	Sulfur phosphide (R)
		See F027 93-76-5 2,4,5-T
U207	95-94-3	1,2,4,5-Tetrachlorobenzene
U208	630-20-6	1,1,1,2-Tetrachloroethane
U209	79-34-5	1,1,2,2-Tetrachloroethane
U210	127-18-4	Tetrachloroethylene
		See F027 58-90-2 2,3,4,6-Tetrachlorophenol
U213	109-99-9	Tetrahydrofuran (I)
U214	563-68-8	Thallium(I) acetate
U215	6533-73-9	Thallium(I) carbonate
U216	7791-12-0	Thallium(I) chloride
U216	7791-12-0	Thallium chloride Tlcl
U217	10102-45-1	Thallium(I) nitrate
U218	62-55-5	Thioacetamide
U410	59669-26-0	Thiodicarb
U153	74-93-1	Thiomethanol (I,T)
U244	137-26-8	Thioperoxydicarbonic diamide [(H2N)C(S)]2S2, tetramethyl-
U409	23564-05-8	Thiophanate-methyl
U219	62-56-6	Thiourea
U244	137-26-8	Thiram
U220	108-88-3	Toluene
U221	25376-45-8	Toluenediamine
U223	26471-62-5	Toluene diisocyanate (R,T)
U328	95-53-4	o-Toluidine
U353	106-49-0	p-Toluidine
U222	636-21-5	o-Toluidine hydrochloride
U389	2303-17-5	Triallate
U011	61-82-5	1H-1,2,4-Triazol-3-amine
U408	118-79-6	2,4,6-Tribromophenol
U227	79-00-5	1,1,2-Trichloroethane
U228	79-01-6	Trichloroethylene
U121	75-69-4	Trichloromonofluoromethane
		See F027 95-95-4 2,4,5-Trichlorophenol
		See F027 88-06-2 2,4,6-Trichlorophenol
U404	121-44-8	Triethylamine
U234	99-35-4	1,3,5-Trinitrobenzene (R,T)
U182	123-63-7	1,3,5-Trioxane, 2,4,6-trimethyl-
U235	126-72-7	Tris(2,3-dibromopropyl) phosphate
U236	72-57-1	Trypan blue
U237	66-75-1	Uracil mustard
U176	759-73-9	Urea, N-ethyl-N-nitroso-
U177	684-93-5	Urea, N-methyl-N-nitroso-
U043	75-01-4	Vinyl chloride
U248	[1]81-81-2	Warfarin, salts, when present at concentrations of 0.3% or less
U239	1330-20-7	Xylene (I)
U200	50-55-5	Yohimban-16-carboxylic acid, 11,17-dimethoxy-18-[(3,4,5-trimethoxybenzoyl)oxy]-, methyl ester,(3beta,16beta,17alpha,18beta,20alpha)-
U249	1314-84-7	Zinc phosphide Zn3P2, when present at concentrations of 10% or less

[1] CAS Number given for parent compound only.

[45 FR 78529, 78541, Nov. 25, 1980]

Editorial Note: For Federal Register citations affecting Sec. 261.33, see the List of CFR Sections Affected in the Finding Aids section of this volume.

APPENDIX G. –MATERIALS LIABLE TO FORM PEROXIDES IN STORAGE

The following materials may form peroxides in storage, when in contact with air. Once a container is opened, the chemical should be tested for peroxides not less frequently than once every six months. ***This list is by no means all inclusive. Always refer to the material's MSDS for more information on whether it is a peroxide former. .***

- Aldehydes
- Ethers, especially cyclic ethers and those containing primary and secondary alcohol groups
- Compounds containing benzylic hydrogen atoms (particularly if the hydrogens are on tertiary carbon atoms)
- Compounds containing the allylic structure, including most alkenes.
- Vinyl and vinylidene compounds.

Among the more widely-used compounds which may form peroxides in storage are:

- acetal
- cumene
- cyclohexene
- cyclooctene
- decahydronaphthalene
- decalin
- diacetylene
- dicyclopentadiene
- diethyl ether
- diethylene glycol
- diisopropyl ether
- dimethyl ether
- dioxane
- divinyl acetylene
- ethylene glycol dimethyl ether (glyme)
- isopropyl ether
- methyl acetylene
- sodium amide
- tetrahydrofuran (THF)
- tetrahydronaphthalene
- tetralin
- vinyl acetate
- vinylidene chloride

Updated November 21, 2000.

FOR FURTHER INFORMATION ON THE RECOGNITION AND HANDLING OF PEROXIDIZABLE COMPOUNDS, PLEASE CONTACT THE EH&S OFFICE IN CHEMISTRY B73. There are several articles available on this topic that are too long to include in this manual.

APPENDIX H. - WASTE MINIMIZATION POLICY

In accordance with Federal and state regulations, the University at Albany is required to have an on-gong hazardous waste minimization program. Hazardous Waste Minimization is the reduction, to the extent feasible, of hazardous waste that is generated or subsequently treated, stored, or disposed. Waste minimization includes any source reduction or recycling activity undertaken by a generator that results in: (1) the reduction of total volume or quantity of hazardous waste; (2) the reduction of toxicity of hazardous waste; or (3) both, as long as the reduction is consistent with the goal of minimizing present and future threats to human health and the environment.

Over the last ten years, the University has undertaken several waste minimization activities. The Chemistry Department has significantly minimized the hazardous waste generated in their teaching labs by changing the types of experiments performed, by converting to less toxic chemicals and by performing microchemistry techniques. The Office of Environmental Health and Safety has been proactive in recycling waste and providing information when asked on the toxicity of chemicals before they are ordered. The EHS Office strongly encourages waste minimization efforts on campus and suggests the following:

1. **ALWAYS ORDER THE SMALLEST QUANTITY NEEDED OF ANY CHEMICAL** as it is safer to store and less expensive to dispose of smaller quantities. For the most part, it is more expensive to dispose a chemical correctly than it is to purchase it.

2. Whenever possible try to order the least toxic chemical required for your research. The Material Data Safety Sheet can provide you with this information or you can contact our office in Chemistry B73 at 2-3495.

3. When you are finished with a chemical and you are not intending on using it for another two years or so, do **not** hang on to it. Try to broker it to a fellow researcher. Old chemicals can pose a serious safety hazard especially when peroxidizable or highly reactive. See the University's Chemical Hygiene Plan, Appendix G.

4. Label all Chemical containers with their contents even if non-hazardous. Unknown chemicals are expensive to identify and could pose a potentially serious health and safety hazard.

5. **When leaving University employment, please contact the Office of Environmental Health and Safety so that we can facilitate appropriate chemical clean out of your labs.**

APPENDIX I. - IDENTIFICATION, CONTROL AND PROCEDURES FOR HANDLING OF EXTREMELY HAZARDOUS CHEMICALS

Procedures for identification, control, handling and disposal of hazardous chemicals is a major part of the University's Chemical Hygiene Plan. To reduce exposure to recognized risks and for compliance with the OSHA Standard "Occupational Exposures to Hazardous Chemicals in Laboratories," this appendix for handling extremely hazardous chemicals should be added to your Chemical Hygiene Plan.

DEFINITIONS of EXTREMELY HAZARDOUS CHEMICALS:

A chemical or substance generally regarded by the scientific community as having properties that represent substantial risks to humans associated with the use, storage or disposal of the chemical. This can include select carcinogens, reproductive toxins, extremely flammable liquids, reactive materials and extremely toxic chemicals. The select carcinogens are those picked by various governmental agencies and are included on the lists attached to this appendix. Reproductive toxins are chemicals which affect the reproductive capabilities including chromosomal damage (mutations), and/or have effects on fetuses (teratogenesis). Extremely flammable liquids have an NFPA rating of 4. Reactive chemicals have an NFPA rating of 3 or 4. Extremely toxic chemicals have an NFPA health rating of 4 and/or usually have a LD 50 in rodents of less than 25 mg/kg, when administered orally, although other factors can be included. NFPA ratings can be found on the substance's Material Safety Data Sheet (MSDS).

PROCEDURES FOR HANDLING EXTREMELY HAZARDOUS MATERIALS:

1. The precautions and procedures described in the University's Chemical Hygiene Plan for the safe handling of chemicals must be adhered too, in addition to the following specific laboratory procedures.

2. Before beginning a laboratory operation, one is required to read and understand information found on the Material Safety Data Sheets for every hazardous chemical used during the laboratory operation.

3. If extremely hazardous chemicals are used, then it is desirable that there be two persons present in the laboratory at all times.

4. Protect hands and forearms by wearing a lab coat and suitable long gloves. Always wear chemical splash goggles. AVOID any contact with hazardous chemicals.

5. All procedures involving hazardous chemicals must be performed in a fume hood or biological cabinet (or other suitable containment device.)

6. After handling or working with hazardous materials, wash hands and arms immediately. NEVER eat, drink, smoke, chew gum, apply cosmetics, take medicine, or store food in areas where hazardous chemicals are being used or stored.

7. All hazardous chemicals should be labeled with appropriate warnings (Cancer-Suspect Agent, Reactive, etc.) Label all research vessels.

8. Approved DESIGNATED AREA signs must be posted in all designated areas. A designated area "means an area which may be used for work with select carcinogens' (see attached lists), reproductive toxins or substances which have a high degree of acute toxicity. A designated area may be the entire laboratory, area of a laboratory or a device such as a laboratory fume hood." The DESIGNATED AREA signs attached to this appendix (on the next page) must be filled out with the appropriate information and posted by that area. If the chemicals used in that area change, the sign must also be changed. Additional signs are available in the Office of Environmental Health and Safety in Chemistry B73.

9. Written emergency procedures can be found in the MSDS for each hazardous chemical in the lab's MSDS notebook. (If the MSDS is not in the notebook, contact the Environmental Health and Safety Department for assistance in obtaining the MSDS or visit the EH&S Web page – Useful Links) Persons working in the lab must be familiar with these procedures before the chemical is worked with, in case of chemical spills and accidents. Refer to the University's Chemical Hygiene Plan for Chemical Spill Procedures.

10. The Office of Environmental Health and Safety should review laboratory procedures or experiments using extremely hazardous chemicals first. The EH&S Office may require additional procedures or requirements. Coordination with the EHS Department is essential prior to commencement of experiments utilizing extremely hazardous chemicals.

11. Laboratory vacuum pumps used with hazardous chemicals should be vented into a fume hood.

12. Hazardous and extremely hazardous chemical waste must be turned into the Office of Environmental Health and Safety for proper disposal. Refer to the University's Chemical Hygiene Plan for proper waste disposal procedures.

DESIGNATED AREA

FOR EXTREMELY HAZARDOUS CHEMICALS/SELECT CARCINOGENS/POTENTIALLY DANGEROUS REPRODUCTIVE TOXINS

CHEMICALS:

1._____

4._____

2._____

5._____

3._____

6._____

PRINCIPAL INVESTIGATOR:_____

EH&S 05/08

APPENDIX J. – FORMALDEHYDE POLICY

The Appendix reviews the OSHA standard 1910.1048 for Formaldehyde. The standard applies to all occupational exposures to formaldehyde, i.e. from formaldehyde gas, its solutions, and materials that release formaldehyde.

1. The University (employer) shall assure that no employee is exposed to an airborne concentration of formaldehyde which exceeds 0.75 parts formaldehyde per million parts of (0.75 ppm) as an 8-hour TWA – Permissible Exposure Limit (PEL). The University shall also assure that no employee is exposed to an airborne concentration of formaldehyde, which exceeds two parts formaldehyde per million parts of air (2 ppm), as a 15-minute Short Term Exposure Limit (STEL).

2. The University shall monitor their employees to determine their exposure to formaldehyde. The Office of Environmental Health and Safety will conduct all monitoring for formaldehyde. All principal investigators using formaldehyde (this includes formalin) in their research, in their teaching labs, or storing specimens in formaldehyde must notify the Office of Environmental Health and Safety in Chemistry B73, so that their employees receive the appropriate monitoring to determine their exposures. Employees include faculty, staff, lab assistants, graduate students and teaching assistants. Monitoring of the employee must be repeated if there is a change in usage of the formaldehyde, which may result in new or additional exposure formaldehyde. Principal investigators must inform the Office of Environmental Health and Safety if their employees show signs or symptoms of respiratory or dermal conditions associated with formaldehyde exposure.

3. The University will notify in writing the employees of their monitoring results within 15 days of receiving the results. If monitoring results are over the PEL or STEL the University will take the necessary actions as defined in 1910.1048.

4. The Office of Environmental Health and Safety will select and provide protective clothing and equipment based upon the form of formaldehyde to be encountered, to those employees exposed to formaldehyde. All contact of the eyes and skin with liquids, containing 1 percent or more formaldehyde, shall be prevented by the usage of other chemical protective clothing made of material impervious to formaldehyde and the use of other personal protective equipment, such as goggles and face shields, as appropriate to the operation. Contact with irritating or sensitizing materials shall be prevented to the extent necessary to eliminate the hazard.

5. In areas where formaldehyde is used, quick drench showers and acceptable eyewash facilities must be immediately available. The Office of Environmental Health and Safety will provide the showers and eyewashes where necessary upon notification.

APPENDIX J. – Formaldehyde Policy cont'd.

6. The principal investigator shall routinely conduct visual inspections to detect leaks or spills in areas where formaldehyde is used or stored. The Office of Environmental Health and Safety will do periodic monitoring in the above areas.

7. The University shall make medical surveillance available for all employees who develop signs and symptoms of overexposure to formaldehyde and for all employees exposed to formaldehyde in emergencies. This will be arranged through the Office of Environmental Health and Safety in Chemistry B73.

8. All containers of formaldehyde, all mixtures or solutions composed of greater than 0.1% formaldehyde, and materials capable of releasing formaldehyde into the air, under reasonably foreseeable conditions of use, at concentrations reaching or exceeding 0.1 ppm shall be labeled with the appropriate hazard warnings. The labeling is the responsibility of the user.

9. The Office of Environmental Health and Safety will provide annual training on the specific health hazards of formaldehyde, on the contents of this policy and the OSHA standard to all employees exposed to formaldehyde at or above 0.1 ppm.

10. All areas where formaldehyde is being used should be posted as a "Designated Area" as defined in Appendix I of the University's Chemical Hygiene Plan. If a Designated Area sign is required, please contact the Office of Environmental Health and Safety.

11. In order to eliminate exposure of employees to formaldehyde and its solutions, it should be used in a fume hood whenever possible.

If you have any questions, regarding this policy, please contact the Office of Environmental Health and Safety in Chemistry B73.