UNIVERSITY OF ARKANSAS
CHEMICAL HYGIENE PLAN

OFFICE OF ENVIRONMENTAL HEALTH AND SAFETY
FACILITIES MANAGEMENT DEPARTMENT

UNIVERSITY OF ARKANSAS

Revised February, 2012
EMERGENCY CONTACT INFORMATION

Revised 02/13/2012
FIRE EMERGENCY

WAYNE BRASHEAR

UNIVERSITY FIRE MARSHAL

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# RADIOLOGICAL INCIDENT

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<td>Julia Tchakhalian</td>
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* Call if the incident involves the Agriculture Farm.

** Call if the incident involves the Southwest Calibration Center at Engineering Research on 700 Research Center Boulevard.

*** Administrative Personnel
# CHEMICAL SPILL

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<td>Bill Durham</td>
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<td>William “Roy” Penney</td>
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INTRODUCTION
PURPOSE AND SCOPE

The University of Arkansas is committed to preserving and protecting the health and safety of students, faculty, staff, the surrounding community, and the environment. Believing that it is prudent to minimize all chemical exposure, the University's Toxic Substances Committee (TSC) and the Office of Environmental Health and Safety (EH&S) in accordance with Federal and State regulations provides this Chemical Hygiene Plan as guidance regarding the safe use, storage, and handling of chemicals that may be present in University laboratories. This Plan applies to all laboratories at the University of Arkansas where chemicals are stored or used. For purposes of this Plan, shops and studios are also considered to be laboratories. The 90-day hazardous waste accumulation facility is addressed separately in Appendix I.

REGULATORY AND POLICY REQUIREMENTS

The Chemical Hygiene Plan was written to conform with the Occupational Safety and Health Administration (OSHA) laboratory safety standard 29 CFR 1910.1450; the Resource Conservation and Recovery Act (RCRA) of 1984; and the Arkansas Department of Pollution Control and Ecology (ADPC&E) Regulation 23. The Plan is further supported by the University’s policy regarding the use of toxic substances in University facilities.

Toxic Substances Use on Campus; Fayetteville Policies and Procedures 727.1

The University of Arkansas is committed to the health and safety of its students, faculty and staff. It is recognized that during their work for the University, some people will be involved in activities that require the use of substances or materials that are hazardous or toxic in nature. The Environmental Health and Safety unit of Facilities Management Department has prepared the University of Arkansas Chemical Hygiene Plan. This document addresses the safe use of toxic substances in laboratories. In addition, it defines the minimum acceptable standard safety practices for execution of laboratory work for both research and teaching. The chemical hygiene plan is available from the EHS web page, click on “Environmental Health & Safety” button on the left hand side of the home page and then click on “Manuals, Policies, Plans & Programs” next click on the Chemical Hygiene Plan link.
According to OSHA, the chief executive officer (in this case, the Chancellor) of the institution has ultimate responsibility for chemical hygiene within the institution and, acting through administrative heads of units, is responsible for providing a safe, healthy and secure work environment for all those involved in University-sponsored activities. The Chancellor, along with the Provost and Vice Chancellors, will provide continuing support for institutional chemical hygiene. Additional support is provided by the TSC and by EH&S, specifically the Chemical Hygiene Officer (CHO), who is directly appointed by, and with a direct line of authority to the Chancellor or any member of the Chancellor’s staff in matters relating to chemical safety.

**Chemical Hygiene Officer (CHO)**

The CHO is responsible for assisting Principal Investigators, laboratory supervisors, and other employees with implementation of appropriate chemical hygiene policies and practices. The CHO also is responsible for monitoring procurement, use, and disposal of chemicals used in the lab, overseeing a program for regular audits of laboratories and other units using chemicals, helping project directors develop precautions and adequate facilities for specific projects, reviewing all accidents investigation reports and taking preventive measures, knowing the current legal requirements concerning regulated substances, and for seeking ways to improve the chemical hygiene program.

**Environmental Health and Safety**

The Chemical Hygiene Plan is a product of EH&S. It is reviewed annually by the TSC and any appropriate revisions are made by EH&S. EH&S provides timely and relevant information regarding safety and regulatory requirements, conducts regular compliance inspections, and collects hazardous waste for disposal, provides appropriate hazardous materials training, and manages the 90-day hazardous waste accumulation facility. Implementation of this chemical hygiene program is mandatory and is designed to minimize exposures. The plan is to be a regular, continuing effort in academic teaching laboratories as well as in research programs.
**Principle Investigator**

The Principal Investigator (PI) has the overall responsibility for compliance with the Chemical Hygiene Plan in his or her laboratory. The PI must know the legal requirements applicable to his or her laboratory and must assure that:

- Laboratory workers and others entering laboratory know and follow chemical hygiene standard operating procedures (SOP)
- A laboratory-specific contingency plan must be in place consisting of appropriate emergency procedures
- All laboratory hazards are identified and the laboratory posted accordingly.
- The hazardous waste satellite accumulation site(s) located in his or her area is properly managed.
- Appropriate laboratory attire is worn and that appropriate personal protective equipment is available.
- Appropriate training has been provided to all occupants of the laboratory.
- Unsafe conditions or inadequate facilities are reported to Facilities Management and/or EH&S.
- Accurate and timely chemical inventory records are maintained on EH&S online system and restricted quantities are not exceeded.
- Material Safety Data Sheets (MSDS) for all chemicals in the inventory are current and readily available at all times.
- Teaching labs must be supervised at all times. If the Teaching Assistant (TA) must leave, the laboratory must be left under the supervision of a qualified designee.
- Individual employee/student responsibility for maintaining a safe and clean work area should be emphasized by the PI or laboratory supervisor.

**Individual laboratory workers are responsible for:**

- Planning and conducting each operation in accordance with the standard operating procedures (SOP) outlined in the Chemical Hygiene Plan.
- Wearing appropriate personal protective equipment including, but not limited to, a lab coat or other protective clothing, safety glasses, and appropriate shoes in the laboratory. In particular, loose sleeved shirts and blouses should be avoided, as should sandals or open footwear of any type.
- Developing good laboratory hygiene habits.
- Promptly reporting unsafe behavior or conditions to the PI or to EH&S.
- No solitary work is permitted in laboratories. A "buddy system" will be used unless written permission is given by the PI or laboratory supervisor. Permission will be required for after hours work.
- Unattended operations - require careful prior planning and consideration and must have prior approval of the PI or laboratory supervisor.
- Eating, drinking, smoking, or the applying of cosmetics are not permitted in any laboratory. All food and drink materials, -- e.g., coffee cups, glasses -- are to be left outside the laboratory.
- Horseplay is not permitted.
- Pipetting by mouth suction is not permitted.
- Laboratory benches and work spaces must be kept clean and neat. Items such as coats and backpacks must be stored appropriately.
GENERAL CLASSES OF HAZARDOUS CHEMICALS
Flammable and combustible chemicals include liquids such as organic solvents, oils, greases, tars, oil base paints, and lacquers as well as flammable gases. Flammable and combustible liquids are defined by their flash points. The flash point of a liquid is the minimum temperature at which it gives off sufficient vapor to form an ignitable mixture with the air near its surface or within its containment vessel. As a general rule, the lower the flash point of a liquid, the greater the fire and explosion hazard. Flammable and combustible liquids are classified by and divided into classes by the National Fire Protection Association based on their flash points:

**Flammable Liquids (Class I)**

Liquids having flash points below 100°F (37.8°C) and having vapor pressures not exceeding 40 pounds per square inch (absolute) at 100°F (37.8°C). Flammable Class I liquids are subdivided as follows:

- **Class IA**: Liquids having flash points below 73°F (22.8°C) and boiling points below 100°F (37.8°C). Flammable aerosols (spray cans) are included in Class IA.
- **Class IB**: Liquids having flash points below 73°F (22.8°C) and having boiling points at or above 100°F (37.8°C).
- **Class IC**: Liquids having flash points at or above 73°F (22.8°C) and below 100°F (37.8°C). The boiling point is not considered.

**Combustible Liquids (Classes II and III)**

Liquids having flash points at or above 100°F (37.8°C). Combustible liquids in Classes II and III are subdivided as follows:

- **Class II**: Liquids having flash points at or above 100°F (37.8°C) and below 140°F (60.0°C).
- **Class IIIA**: Liquids having flash points at or above 140°F (60.0°C) and below 200°F (93.4°C).
- **Class IIIB**: Liquids having flash points at or above 200°F (93.4°C).

**Control Measures**

PIs and Supervisors are responsible for identifying flammable and combustible liquids used in their respective work areas. MSDS for specific compounds should be reviewed. An evaluation of the controls in place is necessary to limit employee exposures to these agents. For assistance in performing evaluations, contact EH&S at 575-5448.

Some operations involving flammable and combustible liquids may need to be approved by the EH&S and/or the TSC.

**Training and Information**
• Employees who handle or who may be exposed to hazardous materials must be trained in the specific hazards and controls of the materials being handled. Providing for area-specific training for handling flammable and combustible materials is the responsibility of the PI. EH&S is available to provide assistance.
• Primary and secondary containers must be labeled with the identity and classification of the substance.
• The entrance to the work area shall be posted with a caution placard (NFPA diamond) depicting the hazards.

Substitution / Chemical Management

• The PI or supervisor should determine whether a safer chemical alternative (i.e., materials with higher flash points and boiling points) is available.
• Keep working quantities of flammable and combustible liquids to a minimum.

Ventilation

• An explosion-proof fume hood or other appropriate exhaust ventilation system must be used when handling flammable and combustible liquids in a manner that may produce vapors. This includes procedures such as transfer operations, preparation of mixtures, blending, sonication, spraying, heating, and distilling.

Work Practices

• Control all ignition sources when handling flammable and combustible liquids.
• Electrically bond and ground containers when transferring Class I flammable liquids and other flammable and combustible liquids at temperatures above their flashpoints.
• Use a mechanical aid or a pipette bulb for pipetting.
• Open bottles or carboys slowly and carefully and wear protective equipment to guard hands, face, and body from splashes and vapors/gases.
• Wipe drips/residues from containers and work surfaces.
• Wash hands before leaving the work area and prior to consuming food/beverages.

Personal Protective Equipment (PPE)

General guidelines are presented below:
• At a minimum, safety glasses with side shields, laboratory coats (or appropriate coveralls in shop settings) and closed toed shoes will be worn when handling flammable and combustible materials.
• Additional PPE such as face shields, chemical aprons, disposable coveralls, chemically resistant gloves and respiratory protection must be worn as appropriate.

Storage
• Glass containers of no more than 1 gallon capacity may be used for Class IA or IB flammable liquids if such liquid would be rendered unfit for its intended use by contact with metal or would excessively corrode a metal container so as to create leakage hazard. **Note: this exemption does not apply to the accumulation of non-corrosive ignitable hazardous waste.**

• Flammable liquids must be stored in appropriately designed flammable liquid cabinets. Reagent bottles should be returned to the cabinets in a timely manner and should not accumulate on the bench top. Cabinet doors shall be kept in the closed position. Bulk storage of solvents should be done in areas specifically designed for this function. EHS personnel should be consulted if large quantities of flammable liquids are to be stored. Note that gravity flow shall not be used to transfer flammable liquids.

• A maximum of 180 gallons of flammable and combustible liquids with a flash point of < 140 °F can be stored in a fire area (room with one-hour fire rated walls and self closing 20-minute fire rated door). This amount must be stored in the following manner:
  
  • Not more than 10 gallons in containers or 25 gallons in safety cans shall be located outside a flammable storage cabinet.
  • Not more than 60 gallons in a flammable storage cabinet.
  • Not more than 3 flammable storage cabinets per laboratory.

• In addition to the 180 gallons as stated above, a maximum of 60 gallons of combustible liquids with a flash point 140 °F and < 200 °F can be stored outside of a flammable liquids cabinet.

• There is no gallon limit to combustible liquids with a flash point of 200 °F in a fire area.

**Spill Cleanup**

• Laboratory/Shop personnel may clean up small spills of flammable and combustible liquids provided that all of the following conditions are met:
  o The hazards of the material(s) are known, and appropriate precautions can be taken to prevent personal exposure.
  o Ensure that all ignition sources are controlled during clean up.
  o There is no potential of a release to the environment.
  o There are no personal injuries.
  o The clean up procedures are known and the proper equipment (e.g., PPE and spill cleanup materials) is available.
  o The spill can be cleaned up safely by two people in one hour or less.
  o The spill does not involve elemental mercury. Special cleanup and air monitoring is required. Contact an EH&S for assistance.
  o If all of these conditions are not met then EH&S (575-5448) should be summoned for spill response.

**Hazard Assessment**
The following factors need to be considered when assessing risks of working with flammable liquids, their hazards due to the toxic effects of chemicals, hazards due to flammability, explosion potential and reactivity.

Flammable liquids are those that readily catch fire and burn in air. For a fire to occur, three conditions must exist simultaneously: an oxidizing atmosphere, usually air, a concentration of flammable gas or vapor that is within, the flammable limits of the substance, and a source of ignition. In most situations, oxygen or air is present. Prevention of the coexistence of flammable vapors and an ignition source is the optimal way to deal with the hazard. When the vapor of a flammable liquid cannot be controlled, strict control of ignition sources is the only way to reduce the risk of flammability.

Other Considerations

- Never use combustible or reactive materials to clean up or absorb spills of flammable or combustible liquids. Laboratories and shop areas where flammable and combustible liquids are handled should have an adequate number of appropriate spill kits to meet anticipated needs. These are commercially available through VWR Scientific.
- An emergency eyewash and safety shower must be located in all areas where flammable and combustible liquids are used. In the event of skin or eye contact, flush the affected area for at least 15 minutes and report to the Health Center for evaluation and treatment.
Corrosive materials cause destruction of tissue through chemical action at the point of contact. As corrosive chemicals can be liquids, solids, or gases, corrosive effects can affect the skin, eyes, and respiratory tract. Examples of corrosive chemicals include: liquids such as acids and bases, bromine, and hydrogen peroxide; gases such as chlorine and ammonia; and solids such as phosphorous and phenol.

Control Measures

- PIs and Supervisors are responsible for identifying corrosive materials used in their respective work areas. An evaluation of the controls in place is necessary to limit employee exposures to these agents. MSDS for specific compounds should be reviewed. For assistance in performing evaluations, contact EH&S at 575-5448.

Training and Information

- Employees who handle or who may be exposed to hazardous materials must be trained in the specific hazards and controls of the materials being handled. Providing for area-specific training for handling corrosive materials is the responsibility of the PI. EH&S is available to provide assistance.
- Primary and secondary containers must be labeled with the identity and classification of the substance. The entrance to the work area shall be posted with a caution placard (NFPA diamond) depicting the hazards.
- Replenish first aid kit

Ventilation

- Strong acids or basis and other chemicals that can form mists/ vapors shall be handled in a fume hood. Refer to MSDS for proper handling of all chemicals. If the process does not permit the handling of such materials in a fume hood, contact Environmental Health and Safety at 575-5448 to review the adequacy of ventilation measures.

Work Practices

- Wherever hydrofluoric acid is used, ensure to have a calcium gluconate kit on-site. Contact EH&S for further information.
- Never pour water into acid. Slowly add the acid to the water and stir.
- Never empty carboys or drums of chemicals by means of air pressure. Use a tilting rack, a safety siphon, or a liquid pump.
- Open bottles or carboys slowly and carefully and wear protective equipment to guard hands, face, and body from splashes, vapors, gases and fumes.
- Clean drips from containers and bench tops. Skin contact with dry residue from chemicals like sodium hydroxide and potassium will result in burns.
- Corrosives should never be stored above eye level.
- Wash hands before leaving the work area and prior to consuming food/beverages.
Personal Protective Equipment

- Consult MSDS to determine the PPE required handling of each chemical.
- In general a minimum, safety goggles, long sleeve shirt and pants, chemically resistant gloves, and closed toed shoes will be worn when handling corrosive materials.
- Additional PPE such as face shields, chemical aprons, disposable coveralls, and respiratory protection must be worn as appropriate.

Storage

- Ensure secondary containment and segregation of incompatible chemicals per guidance within MSDS.
- Corrosive materials should be stored in approved metal cabinets and below eye level.
- Toxic substances must be segregated in a well identified area with local exhaust ventilation.
- Highly toxic chemicals or chemicals whose containers have been opened must be placed in unbreakable secondary containers.
- Stored chemicals must be examined periodically (at least annually) for replacement, deterioration, and container integrity.

Spill Cleanup

Laboratory/Shop personnel may clean up small spills of corrosive material provided that all of the following conditions are met:

- The hazards of the material(s) are known, and appropriate precautions can be taken to prevent personal exposure.
- There is no potential of a release to the environment.
- There are no personal injuries.
- The clean up procedures are known and the proper equipment (e.g., PPE and spill cleanup materials) is available. Corrosive spill controls neutralize the hazardous nature of the spilled material. Acids and bases require different types of spill control materials.
- The spill can be cleaned up safely by two people in one hour or less.
- The spill does not involve elemental mercury. Special cleanup and air monitoring is required.

If the above conditions are not met, then EH&S (575-5448) should be called to assist in spill cleanup procedure.
A carcinogen is an agent that can initiate or spread the development of malignant or potentially malignant cells or cells that possess such a material.

Compounds that are known to pose the greatest carcinogenic hazard are referred to as “selected carcinogens”, and they constitute another category of substances that must be handled as “particularly hazardous substances” according to the OSHA Laboratory Standard. A select carcinogen is defined in the OSHA Laboratory Standard as a substance that meets one of the following criteria:

- It is regulated by OSHA as a carcinogen
- It is listed as “known to be a carcinogen” in the latest Annual Report on Carcinogens issued by the National Toxicology Program (NTP)
- It is listed under Group 1 (“carcinogenic to humans”) by the International Agency for Research on Cancer (IARC)
- It is listed under IARC Group 2A (“probably carcinogenic to humans”) or 2B (“possible carcinogenic to humans”)

Examples of carcinogens and suspected carcinogens:

- 4-Nitrobiphenyl, Chemical Abstracts Service Register Number (CAS No.) 92933;
- alpha-Naphthylamine, CAS No. 134327;
- methyl chloromethyl ether, CAS No. 107302;
- 3,3'-Dichlorobenzidine (and its salts) CAS No. 91941;
- bis-Chloromethyl ether, CAS No. 542881;
- beta-Naphthylamine, CAS No. 91598;
- Benzidine, CAS No. 92875;
- 4-Aminodiphenyl, CAS No. 92671;
- Ethyleneimine, CAS No. 151564;
- beta-Propiolactone, CAS No. 57578;
- 2-Acetylaminofluorene, CAS No. 53963;
- 4-Dimethylaminoazo-benzene, CAS No. 60117; and
- N-Nitrosodimethylamine, CAS No. 62759.

The following link lists substances NIOSH considers to be potential occupational carcinogens.
http://www.cdc.gov/niosh/topics/cancer/npotocca.html

Signs and Labels

- All laboratories where carcinogenic materials are handled should have “carcinogen” sticker posted on the NFPA diamond at the laboratory entrance, inside the laboratory it should have a clearly marked designated area for working with carcinogens (this includes fume hoods and bench tops where carcinogens are handled).
Designated Area.

- Whenever possible, carry out all manipulations with carcinogens in a designated fume hood or glove box. If the use of a fume hood or glove box proves to be impractical in regards to the amounts or the techniques used, than the work can be carried out on a bench top.
- When possible, the work with carcinogens should be done over disposable paper towels to minimize work area contamination and simplify clean up.

Personal Protective Equipment

- Disposable nitrile gloves should be worn to protect against accidental hand contact from small quantities of most laboratory chemicals. For advice on glove chemical resistance please refer to MSDS or contact Chemical Hygiene Officer at 575-5448.
- Appropriate safety glasses with side shields must be worn at all times when working with carcinogens and must meet the requirements of the ANSI Z87.1-1989, "American National Standard Practice for Occupational and Educational Eye and Face Protection”. When necessary, face shields can be used.

Hazard Assessment

- When evaluating the carcinogenic potential of chemicals, it should be noted that exposure to certain combinations of compounds (not necessarily simultaneously) can cause cancer even at exposure levels where neither of the individual compounds would have been carcinogenic. For example, 1,8,9-Trihydroxyanthracene and certain phorbol esters are examples of “tumor promoters”. Although not carcinogenic themselves, they can dramatically amplify the carcinogenic effects of other compounds. At lower doses, natural protective systems prevent genetic damage. However, the individual susceptibility varies with respect to differences between individual genetic factors and exposure to chemicals within and outside of the laboratory.

Vacuum Equipment.

- Vacuum work involving carcinogens must be conducted in a fume hood, glove box or isolated in an acceptable manner (portable shields). Mechanical vacuum pumps must be protected using cold traps and, where appropriate, filtered to prevent particulate release. The exhaust for the pumps must be vented into an exhaust hood.

Waste Disposal.

- All materials contaminated with carcinogens should be disposed of as hazardous waste.

Decontamination Procedure.

- Wash your hands with liquid soap and rinse it thoroughly immediately after handling carcinogens.
- All surfaces must be wiped with the cleaning agent right after handling of carcinogen.
- Glassware that will be removed from designated area must be decontaminated and washed thoroughly.
Oxidizing chemicals are materials that readily yield oxygen or its equivalents to promote the combustion (oxidation) of organic matter. This class of chemicals may cause fire if in contact with flammables or combustibles materials without any source of ignition or oxygen. These chemicals may increase the spread and intensity of a fire and may cause noncombustible materials to burn rapidly. Oxidizers may react with other chemicals to produce toxic gas. Examples of strong oxidizer are organic peroxides, nitrates, perchlorates and permanganates.

Oxidizing liquids and solids are any liquids or solids that readily give off oxygen or other oxidizing substances (such as ozone or chlorine), or that chemically react to oxidize combustible materials. Oxidizing liquids and solids can be severe fire and explosion hazards.

**NFPA Class 1 Oxidizers (Relatively Stable)**

These chemicals may increase the burning rate of combustible materials that they contact.

<table>
<thead>
<tr>
<th>Oxidizer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aluminum Nitrate</td>
</tr>
<tr>
<td>Calcium Chlorate</td>
</tr>
<tr>
<td>Lithium Hypochlorite</td>
</tr>
<tr>
<td>Nitric Acid (70% or less concentration)</td>
</tr>
<tr>
<td>Potassium Nitrate</td>
</tr>
<tr>
<td>Sodium Nitrate</td>
</tr>
<tr>
<td>Sodium Peroxide</td>
</tr>
<tr>
<td>Strontium Peroxide</td>
</tr>
<tr>
<td>Sodium Persulfate</td>
</tr>
<tr>
<td>Hydrogen Peroxide Solution (8-27.5% by weight)</td>
</tr>
<tr>
<td>Magnesium Nitrate</td>
</tr>
<tr>
<td>Silver Nitrate</td>
</tr>
<tr>
<td>Sodium Dichloroisocyanurate</td>
</tr>
<tr>
<td>Barium Peroxide</td>
</tr>
<tr>
<td>Magnesium Perchlorate</td>
</tr>
<tr>
<td>Perchloric Acid Solution (less than 60% by weight)</td>
</tr>
<tr>
<td>Sodium Nitrate</td>
</tr>
<tr>
<td>Sodium Chlorate</td>
</tr>
<tr>
<td>Sodium Permanganate</td>
</tr>
<tr>
<td>Sodium Persulfate</td>
</tr>
<tr>
<td>Ammonium Persulfate</td>
</tr>
</tbody>
</table>

**NFPA Class 2 Oxidizers (moderately unstable)**

These may moderately increase the burning rate or may cause spontaneous ignition of the combustible materials that they contact.

<table>
<thead>
<tr>
<th>Oxidizer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chromic Acid</td>
</tr>
<tr>
<td>Potassium Permanganate</td>
</tr>
<tr>
<td>Sodium Peroxide</td>
</tr>
<tr>
<td>Sodium Persulfate</td>
</tr>
<tr>
<td>Trichloroisocyanuric Acid</td>
</tr>
<tr>
<td>Calcium Hypochlorite (50% or less by weight)</td>
</tr>
<tr>
<td>Hydrogen Peroxide (27.5% to 52% by weight)</td>
</tr>
<tr>
<td>Nitric Acid (more than 70% concentration)</td>
</tr>
<tr>
<td>Sodium Chloride (40% or less)</td>
</tr>
<tr>
<td>1,3-Dichloro-5,5-dimethylhydantoin</td>
</tr>
</tbody>
</table>
NFPA Class 3 Oxidizers (less stable than class 2)

These can severely increase the burning rate of the combustible materials they contact or they can undergo vigorous decomposition when in contact with a catalyst or exposed to heat.

<table>
<thead>
<tr>
<th>Ammonium Dichromate</th>
<th>Sodium Dichloroisocyanurate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Potassium Bromate</td>
<td>Hydrogen Peroxide (52% to 91% by weight)</td>
</tr>
<tr>
<td>Potassium Chlorate</td>
<td>Perchloric Acid (60% to 72% by weight)</td>
</tr>
<tr>
<td>Sodium Chlorate</td>
<td>Perchloric Acid (over 40% by weight)</td>
</tr>
</tbody>
</table>

NFPA Class 4 Oxidizers (unstable)

These can explode when in contact with a catalyst or when exposed to heat, shock or friction.

<table>
<thead>
<tr>
<th>Ammonium Perchlorate</th>
<th>Hydrogen Peroxide (more than 91% by weight)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ammonium Permanganate</td>
<td>Perchloric Acid Solution (more than 72.5% by weight)</td>
</tr>
</tbody>
</table>

Signs and Labels

- The NFPA diamond at the laboratory entrance should be appropriately marked and “oxidizers” sticker should be posted.
- All containers with oxidizing chemicals must be clearly labeled with the correct chemical name, the date chemical was received, and the date chemical was opened. Handwritten labels are acceptable; chemical formulas and structural formulas are not acceptable.

Personal Protective Equipment

- Eye protection (safety glasses) must be worn at all times when handling oxidizing chemicals. Adequate safety glasses must meet the requirements of the “Practice for Occupational and Educational Eye and Face Protection” (ANSI Z.87.1 1989) and must be equipped with side shields.
- Gloves should be worn when handling oxidizing chemicals. Disposable nitrile gloves provide adequate protection against accidental hand contact with small quantities of most laboratory chemicals.
- Lab coats closed, toed shoes and long sleeved clothing should be worn when handling oxidizing chemicals.
- Safety shielding is required any time there is a risk of explosion, splash hazard or a highly exothermic reaction. All manipulations of oxidizing chemicals which pose this risk should occur in a fume hood with the sash in the lowest feasible position.
Handling of Oxidizing Materials

- Use only minimum amount of oxidizer that necessary.
- Keep work area free of materials that could react with oxidizers.
- If reaction can be violent, use barriers to isolate it.
- All manipulations of oxidizing chemicals which pose this risk of explosion, splash hazard or a highly exothermic reaction should occur in a fume hood with the sash in the lowest feasible position. Portable shields, which provide protection to all laboratory occupants, are acceptable.
- The use of certain concentrations of perchloric acid must be performed in a fume hood equipped with wash down facilities.

Storage

- Oxidizers should be stored in a cool, dry location and well ventilated area.
- Keep oxidizers segregated from all other chemicals in the laboratory. Segregate oxidizing acids (nitric acid) from organic acids (acetic acid).
- Store separately to avoid contact with flammable and combustible materials and reducing agents.
- Secondary containers should be used when storing in wooden cabinets or shelves.
- Minimize the quantities of strong oxidizers stored in the laboratory.
- Never return excess chemicals to the original container. Small amounts of impurities may be introduced into the container which may cause a fire or explosion.

Vacuum Protection

- Vacuum work involving oxidizing chemicals must be conducted in a fume hood, glove box or isolated in an acceptable manner.
- Mechanical vacuum pumps must be protected using cold traps and, where appropriate, filtered to prevent particulate release. The exhaust for the pumps must be vented into an exhaust hood.

Waste Disposal

- All materials contaminated with oxidizing chemicals pose a fire hazard and should be disposed of as hazardous waste. Pure oxidizing chemicals that can readily form peroxides should never be disposed of directly but must be diluted before disposal.

Decontamination Procedure.

- Wash hands and arms with soap and water immediately after handling oxidizing chemicals.
- Carefully clean work area after use. Paper towels or similar materials contaminated with strong oxidizing chemicals may pose a fire risk and should be disposed of as a hazardous waste.
ETHERS AND PEROXIDES

Ethers can act as severe irritants to the eyes and mucous membranes. In high concentrations ethers (like ethyl ether) can cause central nerve system depression and sometimes deep anesthesia. Acute exposure can result in symptoms that include eyes irritation, dizziness, drowsiness, vomiting, muscle relaxation.

![Ether Structure]

Ethers are very unstable and dangerous due to formation of organic peroxides and increasingly high potential for explosion. Organic peroxides are among the most hazardous chemicals handled in the laboratory. They are generally low-power explosives that are sensitive to shock, sparks, or other accidental ignition. They are far more shock-sensitive that most primary explosives such as TNT. These chemicals are also highly sensitive to heat, friction, impact, light, reducing and oxidizing agents, they can cause violent explosion.

Classes of Chemicals that can form Peroxides upon Aging (list is illustrative but not exhaustive)

**CLASS I**: Unsaturated materials, especially those of low molecular weight, may polymerize violently and hazardoously due to peroxide initiation.

- Acrylic acid
- Acrylonitrile
- Butadiene
- Chlorobutadiene (chloroprene)
- Chlorotrifluoroethylene
- Methyl methacrylate
- Styrene
- Tetrafluoroethylene
- Vinyl acetate
- Vinyl acetylene
- Vinyl chloride
- Vinyl pyridine
- Vinyldene chloride

**CLASS II**: The following chemicals are a peroxide hazard upon concentration (distillation/evaporation). A test for peroxide should be performed if concentration is intended or suspected.

- Acetal
- Cumene
- Cyclohexene
- Cyclooctene
- Cyclopentene
- Diacetylene
- Dicyclopentadiene
- Diethylene glycol dimethyl ether (diglime)
- Diethyl ether
- Dioxane (p-dioxane)
- Ethylene glycol dimethyl ether (glyme)
- Furan
- Methyl acetylene
- Methyl cyclopentane
- Methyl-i-butyl ketone
- Tetrahydrofuran
- Tetrahydronaphthalene
- Vinyl ethers
CLASS III: Peroxides derived from the following compounds may explode without concentration.

**Organic:**
- Divinyl ether
- Divinyl acetylene
- Isopropyl ether
- Vinylidene chloride

**Inorganic:**
- Potassium metal
- Potassium amide
- Sodium amide (sodamide)

The following should be considered when working with ethers.

**Working with Ethers and Other Peroxides**

- Buy only the quantities you expect to use in 6 month period
- Write opening date on the container.
- Do not open a container that is more than two years old and unless it has been tested for peroxides.
- Use appropriate PPE when handling peroxides (eye goggles, nitrile or neoprene gloves and lab coat)
- Use peroxides in a fume hood with the face velocity at least 100 fpm, with the lowest sash position possible.
- Use only minimum amount necessary and never return excess chemical in the original container.
- Reduce the sensitivity of peroxides to impact and heat by using them in inert solvents such as aliphatic hydrocarbons.
- Never use a metal spatula to handle peroxides because contamination by metals can lead to the formation of explosive compounds. Use wood, ceramic, or plastic spatulas.
- If a volatile solvent must be used, avoid losses due to evaporation which could increase the peroxide concentration, eventually causing the formation of dangerously explosive crystals upon complete evaporation of the solvent.
- Avoid flames, sources of heat and direct sunlight.
- Avoid friction or impact with solid peroxides. Never use glass containers with ground glass or metal tops. Use only polyethylene bottles with screw tops.
- Do not cool liquid peroxides or its solutions to temperatures where they could solidify or precipitate because in this form they are extremely sensitive to impact and to heat.
- Note that alkali metals and their amides may form peroxides on their surface. **DO NOT** apply standard peroxide tests to such materials because they are both water and oxygen reactive!
- Immediately clean up spilled peroxide.

**Storage of Ethers and Peroxides**

- Store ethers in a cool, dry, well-ventilated area in tightly sealed containers.
- Flammable liquids cabinet should be used for storage.
- Store peroxides at lowest temperature possible above the freezing point, to minimize the rate of decomposition.
- Store away from direct sunlight and ignition sources.
Segregate peroxides from strong oxidizing agents, halogens, interhalogens, sulfur and its compounds.

**Testing for Peroxides**

Examples of chemicals that can form peroxides include aldehydes, ethers, and numerous unsaturated hydrocarbon compounds (i.e. hydrocarbon compounds having double or triple bonds). This group includes allyl compounds, haloalkenes, dienes, monomeric vinyl compounds, vinylacetylenes, unsaturated cyclic hydrocarbons like tetrahydronaphthalene or dicyclopentadiene. Please refer to the MSDS for specific details on peroxide formation.

- Keep current inventory of peroxidizable materials
- Test open containers every 3-6 month
- Use Quantofix peroxide test strips or other recommended test strips.
- Record test results and date tested on the container.
- If the peroxide concentration is greater than 100 ppm it should be treated as a potential explosive. DO NOT USE this chemical. Contact EH&S for special waste disposal.
REACTIVE CHEMICALS

**Unstable (reactive)** means a chemical which is the pure state, or as produced or transported, will vigorously polymerize, decompose, condense, or will become self-reactive under conditions of shocks, pressure or temperature.

**Signs and Labels**

- The NFPA diamond at the laboratory entrance should be appropriately marked and “reactive materials” sticker should be posted.
- All containers with reactive chemicals must be clearly labeled with the correct chemical name. Handwritten labels are acceptable; chemical formulas and structural formulas are not acceptable.

**Personal Protective Equipment**

- Eye protection in the form of safety glasses must be worn at all times when handling reactive chemicals. Adequate safety glasses must meet the requirements of the Practice for Occupational and Educational Eye and Face Protection (ANSI Z.87. 1 1989) and must be equipped with side shields.
- Gloves must be worn when handling reactive chemicals. Please refer to the MSDS for advice on glove selection.
- Lab coats closed toed shoes and long sleeved clothing should be worn when handling reactive chemicals.
- Safety shielding is required any time there is a risk of explosion, splash hazard or a highly exothermic reaction. All manipulations with reactive chemicals may pose this risk and should occur in a fume hood with the sash in the lowest feasible position and equipment must be shielded.

**Storage**

- Store reactive chemicals segregated from all incompatible chemicals, free from shock, vibration in a cool and dry location. Minimize the quantity of reactive chemicals stored in the laboratory.
- Date all containers upon receipt. Examine storage containers frequently. Dispose of any container that exhibits salt build up around the cap. Dispose of all reactive liquids whenever they are no longer required for current research.
- Never return excess chemicals to the original container. Small amounts of impurities may be introduced into the container that may cause a fire or explosion.

**Hazard Assessment**

- Carefully review MSDS to determine reactivity and compatibility of materials being used.
- Hazard assessment of work involving reactive chemicals should address proper use and handling techniques, fire safety (including the need for Class D fire extinguishers), storage, the specific reactive nature of the material (such as water and air reactivity), and waste disposal issues.
Vacuum Protection

- Vacuum pumps used in experiments with reactive materials should have tags indicating the date of the most recent oil change.
- Oil should be changed once a month or sooner if it is known that the oil has been exposed to reactive gases in the course of the experiment.

Waste Disposal

- All materials contaminated with reactive liquids should be disposed of as hazardous waste.
- Large quantities of waste may pose a flammability risk and should not remain in the laboratory overnight. Contact EH&S for waste pick up.

Decontamination

- Wash hands thoroughly after handling reactive materials. Work clothing should be changed at once if it is possible that clothing is contaminated.
- All surfaces should be wiped with appropriate cleaning material following reactive material handling.
Materials that may cause long term and immediate health effects such as cancer, allergic reactions, diseases of organs, neurological problems, reproductive problems, sensitization, and eye, skin, and respiratory system irritation, if personnel are repeatedly exposed to them in small amounts. Examples of toxic chemicals are sodium cyanide and hydrogen sulfide.

Toxic substances include a group chemicals that calls reproductive toxins which means chemicals that affect reproductive capability including chromosomal; damage (mutations) and effect on fetus (teratogenic effect).

### Reproductive Toxins

<table>
<thead>
<tr>
<th>Chemical</th>
<th>Chemical</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acrylonitrile</td>
<td>Formamides</td>
</tr>
<tr>
<td>Aniline</td>
<td>Lead (Organic)</td>
</tr>
<tr>
<td>Arsenic and its compounds</td>
<td>Manganese and its compounds</td>
</tr>
<tr>
<td>Benzene</td>
<td>Mercury and its compounds (Inorganic)</td>
</tr>
<tr>
<td>Benzo(a)pyrene</td>
<td>Methyl n-butyl ketone</td>
</tr>
<tr>
<td>Beryllium</td>
<td>Methyl chloroform</td>
</tr>
<tr>
<td>Boric acid (Boron)</td>
<td>Methyl ethyl ketone (MEK)</td>
</tr>
<tr>
<td>Cadmium and its compounds</td>
<td>Nitrogen Dioxide</td>
</tr>
<tr>
<td>Carbon monoxide</td>
<td>Ozone</td>
</tr>
<tr>
<td>Chlordecone (Kepone)</td>
<td>Platinum and its compounds</td>
</tr>
<tr>
<td>Chloroform</td>
<td>Polychlorinated biphenyls (PCB)</td>
</tr>
<tr>
<td>Chloroprene</td>
<td>Polybrominated biphenyls (PBB)</td>
</tr>
<tr>
<td>Dibromochloropropane (DBCP)</td>
<td>Selenium and its compounds</td>
</tr>
<tr>
<td>Dichlorobenzene</td>
<td>Styrene</td>
</tr>
<tr>
<td>1,1-Dichloroethane</td>
<td>Tellurium and its compounds</td>
</tr>
<tr>
<td>Dichloromethane</td>
<td>Tetrachloroethylene</td>
</tr>
<tr>
<td>Dioxane</td>
<td>Thallium and its compounds</td>
</tr>
<tr>
<td>Epichlorohydrin</td>
<td>Toluene</td>
</tr>
<tr>
<td>Ethylene Dibromide</td>
<td>Toluene-2,4-diisocyanate</td>
</tr>
<tr>
<td>Ethylene Dichloride</td>
<td>o-Toluidine</td>
</tr>
<tr>
<td>Ethylene Oxide</td>
<td>Trichloroethylene</td>
</tr>
<tr>
<td>Fluorocarbons</td>
<td>Vinyl chloride</td>
</tr>
<tr>
<td>Formaldehyde</td>
<td>Vinylidene chloride</td>
</tr>
<tr>
<td></td>
<td>Xylene</td>
</tr>
</tbody>
</table>

The effects of toxic materials are related to route of entry, dose and duration of exposure and can result in chronic or acute health effects.
A highly toxic chemical is a chemical falling under one of the following categories:

- A chemical with a median lethal dose (LD50) of 50 mg or less per Kg of body weight when administered orally to albino rats weighing between 200 and 300 gm each.
- A chemical with a median lethal dose (LD50) of 200 mg or less per Kg of body weight when administered by continuous contact for 24 hours (or less if death occurs within 24 hours) with the bare skin of albino rabbits weighing between 2 and 3 Kg each.
- A chemical that has a median lethal concentration (LC50) in air of 5000 ppm by volume or less of gas or vapor, or 50 mg per liter or less of mist, fume, or dust, when administered by continuous inhalation for 1 hour (or less if death occurs within 1 hour) to albino rats weighing between 200 and 300 gm each.

Many of these chemicals may also be characterized as a toxic gas, CDC Select Agent toxin, corrosive, irritant or sensitizer.

Examples of Compounds with a High Level of Acute Toxicity

- Acrolein
- Nickel carbonyl
- Arsin
- Nitrogen dioxide
- Chlorine
- Osmium tetroxide
- Diazomethane
- Ozone
- Diborane (gas)
- Phosgene
- Hydrogen cyanide
- Sodium azide
- Hydrogen Fluoride
- Sodium cyanide
- Methyl Fluorosulfonate
- (other cyanide salts)

Signs and Labels

- The NFPA diamond at the laboratory entrance should be appropriately marked and “acutely toxic” chemical sticker should be posted.
- A designated area should be clearly marked where acutely toxic chemicals are stored or used.
- A designated area may be the entire laboratory, an area of a laboratory or a devise such as fume hood.
- All containers with acutely toxic chemicals must be clearly labeled with the correct chemical name.
- Hand written labels are acceptable; chemical formulas and structural formulas are not acceptable.

Personal Protective Equipment

- Eye protection in the form of safety glasses must be worn at all times when handling acutely toxic chemicals. Adequate safety glasses must meet the requirements of the Practice for Occupational and Educational Eye and Face Protection (ANSI Z.87.1 1989) and must be equipped with side shields.
- Gloves should be worn when handling acutely toxic chemicals. Lab workers should review the MSDS for advice on glove selection.
• Safety shielding is required any time there is a risk of explosion, splash hazard or a highly exothermic reaction.
• All manipulations of acutely toxic chemicals which pose this risk should occur in a fume hood with the sash in the lowest feasible position.

Vacuum Protection

• Vacuum work involving acutely toxic chemicals must be conducted in a fume hood, glove box or isolated in an acceptable manner.
• Mechanical vacuum pumps must be protected using cold traps and, where appropriate, filtered to prevent particulate release.
• Vent apparatus which may discharge toxic chemicals (vacuum pumps, distillation columns, etc.) into local exhaust devices.

Hazard Assessment

In assessing the risks associated with acutely toxic chemicals, it is useful to classify a substance according to the acute toxicity level with respect to their LD50 values (see Table below)

<table>
<thead>
<tr>
<th>Hazard Level</th>
<th>Toxicity Rating</th>
<th>Oral LD50 (Rats, per kg)</th>
<th>Skin Contact LD50 (rabbits, per kg)</th>
<th>Inhalation LC50 (Rats, ppm for 1h)</th>
<th>Inhalation LC50 (Rats, mg/m3 for 1h)</th>
</tr>
</thead>
<tbody>
<tr>
<td>High</td>
<td>Highly toxic</td>
<td>&lt;50mg</td>
<td>&lt;200mg</td>
<td>&lt;200</td>
<td>&lt;2,000</td>
</tr>
<tr>
<td>Medium</td>
<td>Moderately toxic</td>
<td>50 to 500 mg</td>
<td>200mg to 1g</td>
<td>200 to 2,000</td>
<td>2,000 to 20,000</td>
</tr>
<tr>
<td>Low</td>
<td>Slightly toxic</td>
<td>500mg to 5 g</td>
<td>1 to 5 g</td>
<td>2,000 to 20,000</td>
<td>20,000 to 200,000</td>
</tr>
</tbody>
</table>

LD<sub>50</sub> values can be found for any given substance in such references like MSDS, Sigma-Aldrich Library of Chemical Safety Date and A Comprehensive Guide to the Hazardous Properties of Chemical Substances, etc.

Special attention should be given when working with any substance classified as having a high level of acute toxicity hazard. Please refer to the MSDS for particular advice on safe handling of these substances.

Storage

• Store chemicals known to be highly toxic in ventilated storage in unbreakable chemically resistant secondary containers.
• Keep quantity at a minimum possible level. Label storage area with appropriate warning sign. Maintain an inventory of all highly toxic chemicals.
Waste Disposal

- All materials contaminated with acutely toxic chemicals should be disposed of as a hazardous waste.

Decontamination

- Wash hands and arms with soap and water immediately after handling acutely toxic chemicals.
- Decontamination procedures vary depending on the material being handled. Wherever possible, acutely toxic chemicals should be handled over disposable paper covered work surfaces to minimize decontamination process.
- All surfaces should be wiped with the appropriate cleaning agent following dispensing or handling.
- All glassware should be decontaminated before removing it from the designated area.
WATER SENSITIVE CHEMICALS

Water sensitive materials are those that react violently with water. Alkali metals (e.g. lithium, sodium and potassium), many organometallic compounds and some hydrides react with water to produce heat and flammable hydrogen gas, which can ignite or combine explosively with atmospheric oxygen. Some anhydrous metal halides (e.g. aluminum bromide), oxides (e.g. calcium oxide), and nonmetal oxides (e.g. sulfur trioxide) and halides (e.g. phosphorous pentachloride) react exothermically with water, and the reaction can be violent if there is insufficient coolant water to dissipate the heat produced.

Signs and Labels

- The NFPA diamond at the laboratory entrance should be appropriately marked.
- All containers with water sensitive chemicals must be clearly labeled with the correct chemical name.
- Handwritten labels are acceptable; chemical formulas and structural formulas are not acceptable. Date containers upon receiving.

Personal Protective Equipment

- Eye protection in the form of safety glasses must be worn at all times when handling reactive chemicals. Adequate safety glasses must meet the requirements of the Practice for Occupational and Educational Eye and Face Protection (ANSI Z.87. 1 1989) and must be equipped with side shields.
- Gloves must be worn when handling reactive chemicals. Please refer to the MSDS for advice on glove selection.
- Lab coats, closed toed shoes, and long sleeved clothing should be worn.
- Safety shielding is required any time there is a risk of explosion, splash hazard or a highly exothermic reaction.

Storage

- Store water-sensitive chemicals in a cool, dry location.
- Segregate these chemicals from all other chemicals in the laboratory.
- Minimize quantity of the water sensitive chemicals in the laboratory.
- Be aware that potassium, when stored under oil at room temperature, will form peroxides and super-peroxides.
- Containers that have signs of salt build up on its exterior must be disposed of.

Hazard Assessment

Before assuming work with water sensitive chemicals the following should be noted.

- Alkali metals may ignite quickly on exposure to humid air and, therefore, should be handled under the surface of a hydrocarbon solvent such as mineral oil or toluene. Some of them can form explosive peroxides on contact with air.
- Using larger particles is preferable than using “sand” for drying solvents.
- Scraps of alkali metals should be destroyed by reaction with \( n \)-butyl alcohol.
Decontamination

- Wash hands and arms with soap and water immediately after handling water sensitive chemicals.
- All surfaces should be wiped with the appropriate cleaning agent following dispensing or handling.

Waste Disposal

- All water sensitive materials should be segregated from incompatible chemicals when disposing.
- Some water sensitive materials can be neutralized before disposal, consult MSDS.
- Alkali metals react violently with water, common hydroxylic solvents and halogenated hydrocarbons. The metals are usually destroyed by controlled reaction with an alcohol. The final aqueous alcoholic material can usually be disposed of in the sanitary sewer.
COMPRRESSED GASES

Gases may present a hazard because they are: flammable, an asphyxiant, an oxidizer, corrosive, toxic, cryogenic and/or under pressure.

Users of compressed gas should be familiar with procedures for the safe operation of cylinders and the properties and inherent hazards of the products they contain. Information concerning specific gases can be found on the product label and in the MSDS.

Responsibilities

- Compressed gases must be handled only by properly trained personnel in accordance with applicable regulations and the guidelines.
- The end user (Principal Investigator or Laboratory Supervisor) is responsible for the safe handling and use of compressed gas cylinders and their contents, and for placing and securing the cylinder in the lab.

General guidelines

- Cylinders must be secured in an upright position at all times during storage, transport and use.
- A cylinder’s contents must be identified at all times. Cylinder status (empty, full, in service, etc.) should also be specified.
- The prescribed markings on the cylinders shall be made and kept in a legible condition. The user must not remove or alter any of these markings. If these markings become illegible, the user must provide adequate labeling to identify the contents.
- The labels applied by the gas manufacturer to identify the cylinder contents must not be defaced or removed.
- The user must not modify, tamper with, obstruct, remove, or repair any part of the cylinder, including the pressure relief device and the cylinder valve or the valve protection device.
- Compressed gas streams must not be directed toward any person as this may cause serious injury to the eyes or body.
- Cylinder valve connections must have threads on the regulator connections or other equipment to match those on the cylinder valve.
- The cylinder valve must be kept closed at all times (charged or empty) except when the cylinder is in use. Valve outlets should be pointed away from all personnel when the valve is being opened.
Piping, regulators, and other apparatus must be kept gas tight to prevent leakage, and this must be confirmed using compatible leak test solution or an appropriate leak-detection instrument. A leak test must be conducted every time the cylinder is reconnected such as during cylinder replacement.

Before a regulator is removed from a cylinder, the cylinder valve should be closed and the regulator relieved of gas pressure.

Regulators, gauges, hoses and other apparatus provided for use with a particular gas, or group of gases, must not be used on gas cylinders having different chemical properties unless information obtained from the gas manufacturer indicates that this can be done safely.

Maintenance of cylinders and their valves or relief devices shall be performed only by trained personnel. This activity is best handled by the original manufacturer.

An emergency response plan shall be implemented wherever compressed gas cylinders and products are used, handled or stored.

Storage

- Containers must not be placed where they might become part of an electrical circuit or arc.
- Compressed gas cylinders must not be exposed to temperature extremes. Storage area temperatures should not exceed 125 degrees F.
- The user must keep valve protection caps on cylinders at all times except when cylinders are secured and connected to dispensing equipment.
- Where valve outlet caps and/or plugs are provided, the user should keep the device on the valve outlet at all times except when the cylinders are secured and connected to dispensing equipment.
- Vented storage areas should be designed to accommodate the various gases required by the user. Adequate spacing, or segregation by partitioning must be provided so that cylinders can be grouped together according to hazard class (flammable gasses should be separated from oxidizing gases (acetylene and propane cylinders should be separated from oxygen cylinders))
- Incompatible gases must be separated by a minimum distance of twenty feet, or by a wall with a thirty minute fire rating. Additional consideration should be given to separate storage of full and empty containers.
- Containers are not to be stored near readily ignitable substances or be exposed to corrosive chemicals or fumes.
- Containers must not be stored near elevators, walkways, building egresses, unprotected platform edges, or in locations where heavy moving objects may strike or fall on them. Cylinders are not to be stored in mechanical rooms, custodial closets, or utility spaces.
- All compressed gas cylinders in service or in storage at user locations must be secured to prevent falling/tipping/rolling and shall be stored and used valve end up. They can be secured with straps or chains connected to a wall bracket or other fixed surface, or by use of a cylinder stand.
- Compressed gas cylinders which contain acutely toxic gases must be stored in a designated area.
Transport

- Users of compressed gas cylinders must ensure that the cylinders are not rolled in the horizontal position or dragged. A suitable hand truck, forklift truck, or similar material handling device designed for cylinder transport should be used with the container properly secured to the device. Extreme caution should be used when handling cylinders to guard against dropping or permitting cylinders to violently strike against each other or other surfaces.
- It is necessary to take precautions so that gas cylinders are not dropped or allowed to strike each other or other objects. Dropping or striking may damage the cylinder valve, which could turn the cylinder into a dangerous torpedo with the potential to destroy property and/or injure personnel.
- Personnel who handle cylinders must be trained and instructed NEVER to lift cylinders by using the cylinder cap.

Hazard Assessment

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

Personal Protective Equipment

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

Waste Disposal

- All empty or partially filled compressed gas cylinders should be returned to the supplier.
NANOMATERIALS

Standard Operating Procedures for the Handling of Nanoparticles

Definition: Nanoparticles are particles that range in size <100 nm.

Solution vs. Dry Powder: In general the use of nanoparticles in the form of dry powders should be avoided.

Working with Solutions or Suspension of Particles

Routine laboratory safety procedures must be followed including:

- Wear safety glasses
- Wear gloves (nitrile gloves are recommended for most materials) when handling the material and then dispose of the gloves. Wearing gloves outside of the laboratory is not appropriate and can lead to contamination of the laboratory, hallway and lab personnel.
- Wear lab coat while in the laboratory. Wearing a lab coat outside of the laboratory is not appropriate and can lead to contamination of the laboratory, hallway and lab personnel.
- Work in hood whenever possible
- Labs must be under negative pressure with respect to the hallways and must have a non-recirculation ventilation system
- Cadmium containing materials are considered carcinogenic and use of these (as well as others) must be indicated on the safety placards.
- Dispose of nanoparticle containing waste, gloves, wipes, pipettes and other contaminated material as hazardous waste.

In addition the following specific procedures must be followed:

- Designate specific areas for the use of nanoparticles and provide signs indicating the designation
- Wipe down all areas where nanoparticles are used at least weekly (“bapy wipes” are useful for this application and should be disposed of as hazardous waste). Drops of solution lose solvent and become dry powders which are significantly more hazardous than the solutions.
- Activities which may lead to the production of an aerosol, such as sonication or vortexing, must be performed in a hood.
- Transportation of nanoparticles in any form should involve the use of secondary containers and the outsides of the secondary should be wiped clean before transportation outside of the laboratory.
- Tube furnaces used to produce or alter nanoparticles must be used in a hood or exhausted into the hood ducting. The same applies to pumps attached to glove boxes.

Working with dry powders – not recommended

In addition to the above procedures use of dry powders require the following:

- All work must be performed in a properly functioning hood. Determining mass of a sample (difficult in a hood because of drafts) can best be accomplished by the methods of difference using a balance outside of the hood and transferring the sample in closed containers. All
operations with the exposed sample are then confined to the hood. *Be aware that static electricity can cause dry powders to actually “jump” out of a container or off a spatula.*

- Work area and container must be cleaned and wiped down after the each time the particles are dispensed.

**Work Involving Animals**

- Applications of nanoparticles involving the use of animals require the approval of the Institutional Animal Care and Use Committee and appropriate SOP’s must be developed and approved prior to the start of experimentation.
- Applications of nanoparticles containing genetic material require the approval of the Biosafety Committee and appropriate SOP’s must be developed and approved prior to the start of experimentation.
Perchloric acid is a very strong mineral acid that can cause severe burns to the skin, eyes, and respiratory tract. Perchloric acid is also a strong oxidizing agent and will react violently with reducing agents or organic substances. It can form explosive mixture with organic materials such as wood, paper, cardboard and many organic solvents. Aqueous perchloric acid can cause violent explosions if not handled properly. Clothing and rubber materials become highly flammable if contaminated with perchloric acid.

Cold Perchloric Acid (Less than 72% concentrated at room temperature)

At normal room temperatures perchloric acid acts as a strong non-oxidizing acid. It is highly corrosive and will cause severe burns on contact with skin, eyes and mucous membranes. The following should be considered when working with it:

- Substitute with less hazardous substance when possible
- Dilute solution to less than 60% pure acid
- Use only in the properly functioning fume hood
- Handle perchloric acid over chemically resistant surface or suitable containment to minimize spill and decontamination clean up.
- Always wear appropriate personal protective equipment.

Heated Perchloric Acid (less than 72% concentrated)

When heated perchloric acid becomes strong oxidizer and eventually becomes unstable. It will react violently with most of the oxidizing substances; vapors may contaminate ventilation equipment with residues and form highly unstable metallic perchlorites. The following must be taken into consideration when working with heated perchloric acid:

- All handling of the heated perchloric acid should be done in specially design perchloric acid fume hood with the face velocity at least 100 fpm.
- A notice posted on the fume hood must identify it as being used for perchloric acid and prohibit the use or storage of combustibles in the fume hood.
- Exhaust duct must be as short as possible. The fume hood and duct work are usually made of stainless steel and must have water wash down facilities.
- The ducting and fume hood must be washed down at least once a day when in use.
- For use of appropriate personal protection refer to MSDS. Polyvinyl chloride (PVC) gloves would provide better protection than nitril.
- When handling beakers of hot acid use properly designed tongs.
- Lower fume hood sash as much as possible or use a safety shield to provide splash protection.
- Before setting your experiment be sure to understand the reactions that can occur and possible end products of it.
- Never mix perchloric acid with sulfuric acid because through dehydration, anhydrous perchloric acid is obtained, which is even more unstable.
- If the end product of the reaction involves formation of perchlorate esters be advised that, when exposed to impact, they will behave in the same manner as nitroglycerine.
- Always destroy any organic material with nitric acid before adding perchloric acid.
- All apparatus should have glass-to-glass joints and use silicon based lubricants. Never use rubber stoppers or tubes.
- Never use direct flame or oil baths for heating perchloric acid. Use electric hot plates, steam heated sand baths or steam baths to heat perchloric acid.
- Inspect all bottles of perchloric acid once a month, keep inspection records. If you notice any color change, dispose the bottle immediately.
- Spill of perchloric acid is a fire and explosion hazard. In case of a spill, dilute the spill to prevent the formation of anhydrous perchloric acid. Use inert, inorganic absorbent to soak up spill. In case of a large spill isolate and evacuate the area contact EH&S for assistance at 575-5448.

Anhydrous Perchloric Acid (more than 85% concentrated)

Anhydrous perchloric acid is unstable even at room temperature, decomposing spontaneously and exploding violently. In addition to the above steps, the following should be considered:
- Only experienced researchers can handle anhydrous perchloric acid. They should be well familiar with the literature on the acid.
- When handling anhydrous acid the body system should be used to monitor reaction progress.
- Safety shields must be used to protect against possible explosion.
- Use only freshly prepared acid.

Storage

- Keep quantity of the perchloric acid in the lab to a minimum.
- Perchloric acid should be stored in its original container and in compatible secondary container (glass or porcelain)
- It may be stored with other inorganic acids in the corrosive storage cabinet. Small quantities of the acid can be stored in the perchloric acid fume hood.
- Perchloric acid must be stored away from any organic, flammables or combustible chemicals and strong dehydrating agents like sulfuric acid.

If a bottle of perchloric acid has turned dark and has crystals forming around the bottom or the cap, there is a potential for explosion hazard. DO NOT MOVE THE BOTTLE. Immediately contact EH&S at 575-5448.
Picric acid is a strong irritant and sensitizer to eyes and skin. It is corrosive to the eyes and skin on contact. Inhalation of dust will produce irritation of the respiratory system and gastrointestinal problems. Severity of the damages will depend on the length of the contact. Medical surveillance should be focus on hypersensitivity, atopic dermatitis and liver and kidney function.

Dry picric acid is an explosive compound. It easily forms picrate salts that are heat, friction and impact-sensitive and more unstable and explosive than pure picric acid. These unstable picrate salts are formed when in contact with amines, bases, concrete and metals like copper, lead, mercury and zinc. Mixtures with aluminum and water may also ignite.

The following should be considered when working with picric acid:

- Dry picric acid is highly explosive material
- Order minimum amounts
- Wear appropriate personal protective equipment (splash goggles, lab coat, synthetic apron, and vapor or dust respirator if applicable). Refer to MSDS for more information.
- Never shake a bottle of picric acid
- Inspect container before opening, it must not be allowed to accumulate and dry (form crystals) around the container cap.
- After opening of the container, inspect it monthly to ensure moisture level is contained (more than 10%) and material had not dried out.
- Dehydrate the content of the container every 6 month with deionized water to maintain a wet paste. Document this dehydration process in the lab’s log book.
- When practical handle picric acid in the fume hood to minimize airborne contamination below the exposure limit (TWA: 0.1 mg/m3) or use enclosure or local exhaust ventilation.
- Ground all equipment containing picric acid
- Use explosion proof electrical equipment (ventilation, lightning, material handling)
- Empty containers may contain hazardous residue and pose a risk of fire
- Take precautionary measures against electrostatic discharge.
- Keep away from sources of ignition
- Keep away from direct sun light
- Dispose of old stock (after two years of initial receipt) as a hazardous waste.

Storage Picric Acid

- Store with at least 10% moisture content
- Store away from direct sun light and ignition sources
  - Picric acid must be stored in original container in cool, dry, well ventilated cabinet
  - Store separately from incompatibles like oxidizing agents, reducing agents, metals alkalis.
MATERIAL SAFETY DATA SHEETS

MSDS are required for each and every chemical in the laboratory and must be readily accessible on site for all employees at all times. The PI is responsible for maintaining accessibility to current MSDS. Electronic MSDS are permissible as long as they are readily accessible to all employees at any time, without restriction. However, merely referring personnel to the internet for obtaining MSDS is insufficient and is not an acceptable alternative. A specific web address must be provided. EH&S also has an extensive hard copy file of MSDS in its reference library.
Controls to Minimize Hazardous Material Exposure
ENGINEERING CONTROLS

The laboratory facility must have an appropriate general ventilation system with air intakes and exhausts located so as to avoid intake of contaminated air. Stockrooms and storerooms, in particular, must be well-ventilated. The general laboratory ventilation system must provide a source of air for breathing and for input to local ventilation devices. However, the general ventilation system, or building ventilation, should not be relied upon for protection from toxic substances released into the laboratory. The ventilations system should be balanced so that the laboratory air is continually replaced, preventing increase of air concentrations of toxic substances during the working day. The laboratories should be under negative pressure with respect to hallways and other non-laboratory areas; that is, there must be direct air flow into the laboratory from non-laboratory areas and out to the exterior of the building.

The laboratory must be equipped with appropriate laboratory hoods and sinks, and with safety equipment that includes plumbed in eyewash fountains and drench showers. A laboratory hood with 2.5 linear feet of hood space per person should be provided for every 2 workers if they spend most of their time working with chemicals. Each hood should have a continuous monitoring device for confirmation of adequate hood performance before use. If this is not possible, work with substances of unknown toxicity should be avoided or other types of local ventilation devices should be used, such ventilated storage cabinets, canopy hoods, snorkels, or glove boxes.

For maximum protection of the user and other laboratory occupants, fume hoods and other local ventilation devices must be appropriate to the work being performed and must be used according to design specifications. Fume hoods should be operated with the sash in the lowest position possible. Do not remove sashes or make other modifications to the hood.

Alterations to the ventilation system in a laboratory should be made only by trained personnel from Facilities Management. Alterations of the ventilation system should be made only if thorough testing indicates that worker protection from airborne toxic substances will continue to be adequate. Four to twelve room air changes/hour is normally adequate general ventilation if local exhaust systems such as hoods are used as the primary method of control. General air flow should not be turbulent and should be relatively uniform throughout the laboratory, with no high velocity or static areas. Ventilation should be evaluated, qualitatively and quantitatively, upon installation, regularly monitored and maintained, and reevaluated whenever a change in local ventilation devices is made.

All new and modified fume hood(s) shall be ASHRAE Tested and/or other forms of recognized standardized evaluation test approved by EH&S office. Results of the test should be sent to EH&S office. A sticker containing the flow rate, date of test, and contact information of the person conducted and certified the fume hood should be place in right hand corner above the sash of the fume hood.
A chemical fume hood can provide adequate protection for most laboratory processes if they are used correctly. Here are some important points to remember:

**Work with the hood sash partially or completely closed.** If this is not possible, additional Personal Protective Equipment (PPE) should be used to ensure adequate protection.

**Move work at least six inches inside the face of the fume hood.** This minimizes the effect of cross-drafts and eddies created by the hood operator or by occupants walking by the hood. Also, keeping windows and doors closed will control cross-drafts.
Avoid overcrowding the fume hood work areas.

- Chemicals and equipment not in use should be removed from the hood to a proper storage cabinet.
- Large bulky equipment used in the hood will cause eddies that can be reduced by making sure there is a 1-2 inch air space on all sides including the bottom.
- Avoid using equipment that blocks the hood sash from closing. A safer ventilation method may exist and should be pursued.

Control reaction rates and observe process until completion.

- Controlling the rate of vapor and particle formation can minimize the risk of exposure.
- Never leave a reaction unobserved for an extended period of time, due to possible hood failure or unexpected accidents/spills.

Minimize fire hazard within the hood.

- Do not place electrical spark producing equipment in a hood containing flammable chemicals.
- Never leave a flame or heating apparatus unattended.
- No permanent electrical receptacles are permitted inside the hood.

Do not attach or insert exhaust ducts or snorkels to the hood without checking with EH&S.

- Drilling holes into the side of a hood increases the risk of fume exposure if not done properly.

Do not, under any circumstances, remove the sash from the hood!

- The sash was designed to be a safety barrier for the user. Call 575-5050 for maintenance related issues.

Lockout/Tagout

- It will occasionally be necessary for EH&S to take a fume hood or other piece of equipment out of service for maintenance or safety reasons. When this happens, a tag will be placed on the equipment advising users that the equipment is out of service.
  - DO NOT REMOVE THESE TAGS.
  - DO NOT USE EQUIPMENT THAT HAS BEEN TAGGED OUT.
- EH&S will remove the tags when the equipment is ready for use,
WORK PRACTICE CONTROLS

Substituting Less Hazardous Chemicals – Replace or reduce hazardous substances in products and processes by less hazardous or non-hazardous substances that will achieve an equivalent functionality. Below is list of considerations OSHA has recommended when determining the suitability of potential substitutes.

1. **Effectiveness.** Will the material meet the technical requirements (e.g., solubility, drying time) for the job or process?
2. **Compatibility.** The substitute must not interfere or react with the process, the other materials or the equipment.
3. **Existing Control Measures.** Existing control methods may not adequately control the substitute (e.g., a less toxic substitute may evaporate more rapidly and the existing ventilation system may not adequately capture the vapors).
4. **Waste Disposal.** Will the current waste disposal system meet technical and regulatory requirements when dealing with any new waste created by using the substitute?
5. **Hazard Assessment.** A hazard assessment should be done to decide whether to substitute a different chemical or material.

See below suggested examples of substitution by University of Minnesota.

**Product Substitution:** Examples of substitution of nonhazardous or less toxic materials in chemical processes and experiments.

<table>
<thead>
<tr>
<th>Currently Use:</th>
<th>Substitute:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Xylene, benzene and toluene containing reagents in histology laboratories</td>
<td>Citric acid based reagents (e.g. AmeriClear)</td>
</tr>
<tr>
<td>Standard xylene or toluene based cocktails in radioactive tracer studies</td>
<td>Nonhazardous proprietary liquid scintillation cocktails; call the Radiation Protection Division at (612) 626-6764 for information.</td>
</tr>
<tr>
<td>Solvent based inks in printing operations</td>
<td>Soy based inks</td>
</tr>
<tr>
<td>Formaldehyde in cleaning hospital kidney dialysis machines</td>
<td>Peracetic acid</td>
</tr>
<tr>
<td>Mercury thermometers</td>
<td>Non-mercury thermometers</td>
</tr>
<tr>
<td>Solvent extraction</td>
<td>Solid phase or supercritical fluid extraction</td>
</tr>
<tr>
<td>Sulfuric acid/ potassium dichromate (chromerge) cleaning solutions</td>
<td>Detergents and enzymatic cleaners</td>
</tr>
<tr>
<td>Ethidium bromide</td>
<td>New filtration product to concentrate solvent waste 10 times</td>
</tr>
<tr>
<td>Phosphate chloride detergents for lab glass washing</td>
<td>Non-phosphate, non-chloride detergents</td>
</tr>
</tbody>
</table>
Design Changes

Isolate or enclose an experiment within a closed system to reduce exposure to hazardous chemicals. Another procedure change is when possible to micro-scale the size of the experiment to reduce the amount of chemical used.

Hazard Posting

Each laboratory should have the standardized yellow CAUTION placard (available from EH&S) permanently displayed on the door. Information displayed on this placard is essential for emergency responders. The placard should display decals appropriate to the hazard(s) in the laboratory. Emergency contact information should be on the placard, as well.

Access Control

The PI or laboratory supervisor is responsible for controlling access to the laboratory. Access should be limited to only those persons working or having business in the laboratory. Laboratories containing hazardous materials of any sort should be secured when unattended.

Equipment

Chemical-hygiene-related equipment, such as hoods, eyewashes, safety showers, should be continually appraised and should be serviced or modified if inadequate. These items of equipment undergo scheduled maintenance by Facilities Management personnel, but there may be routine maintenance tasks that must be performed by the laboratory staff. For example, for sanitation reasons, the eyewashes must be flushed weekly by laboratory personnel. Work spaces must be kept clean and uncluttered. For any equipment failure please contact Facilities Management at 575-5050 or EH&S at 575-5448.

Laboratory operations

Laboratory operations that have the potential to create fires or explosions require special procedures and safety equipment. Such operations must have prior approval of the laboratory supervisor. Safety equipment such as fire extinguishers, shields and safety showers must be checked prior to such operations.
Pressurized or vacuum operations

Such operations require prior approval of PI or laboratory supervisor, and may require special protective equipment or shielding. Glass vessels under vacuum or pressure can implode or explode, and without the proper protection there is always the risk of being cut from projectiles or splashed by the contents of the flask on the skin or eyes.

- Inspect glassware for flaws such as cracks, scratches, deep scoring and etching marks before using vacuum apparatus
- Make sure the vessels are specifically designed for vacuum work.
- Tape the glass vacuum apparatus to minimize projectiles due to implosion.
- Use adequate shielding when conducting pressure and vacuum operations
- Anchor the vacuum flask in place with a ring stand and clamp.
- Before taking any actions with the flask (removing funnel/stopper, adjusting hoses), release the vacuum by disconnecting the hose from the vacuum pump.
- Always wear eye and face protection when handling vacuum or pressure apparatus.

Low temperature Operations - such as procedures using dry ice or liquid gas require special care to avoid frostbite, container rupture, or condensation of liquid oxygen. Glass Dewar flasks should be taped to avoid flying glass resulting from failure. Such operations require prior approval of the PI or laboratory supervisor.

Chemicals with Limited Shelf life – may require special handling or storage procedures. Examples include solvents that form peroxides, such as diethyl ether; chemicals that decompose upon storage to form potentially dangerous pressures, such as formic acid; and chemicals that become unstable upon storage, such as picric acid.
PERSONAL PROTECTIVE EQUIPMENT (PPE)

“OSHA requires employers to ensure that employees have appropriate eye or face protection if they are exposed to eye or face hazards from flying particles, molten metal, liquid chemicals, acids or caustic liquids, chemical gases or vapors, potentially infected material or potentially harmful light radiation.”  

Appropriate eye protection should be worn when using:

- caustics, corrosives, or irritants
- glassware under vacuum or pressure (reduced or elevated)
- cryogenic materials
- flammable materials
- radioactive materials
- explosives
- lasers (special lens protection required)
- UV light (special lens protection required)
- Biohazards

Eye protection should also be worn when performing these machine shop operations:

- welding
- drilling
- sanding
- sawing
- grinding

Contact lenses should not be routinely worn in the laboratory. Laboratory personnel who must wear contact lenses while performing laboratory work should be aware of the following potential hazards:

- It may be impossible to remove contacts from the eyes following entry of some chemicals into the eye area.
- Contact lenses will interfere with emergency flushing procedures.
- Contacts may trap solid materials in the eyes.

“Employers must ensure that their employees wear head protection if any of the following apply:

- Objects might fall from above and strike them on the head;
- They might bump their heads against fixed objects, such as exposed pipes or beams; or
- There is a possibility of accidental head contact with electrical hazards.”

Unrestrained long hair can be hazardous. The use of caps, elastic bands or hair nets will prevent the hair from coming in contact with instrument/machinery parts, chemicals or flame-producing sources.

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1 OSHA 3151-12R
“When employees are subjected to sound exceeding those listed in Table G-16, feasible administrative or engineering controls shall be utilized. If such controls fail to reduce sound levels within the levels of Table G-16, personal protective equipment shall be provided and used to reduce sound levels within the levels of the table.

If the variations in noise level involve maxima at intervals of 1 second or less, it is to be considered continuous.

TABLE G-16 - PERMISSIBLE NOISE EXPOSURES (1)

<table>
<thead>
<tr>
<th>Duration per day, hours</th>
<th>Sound level dBA slow response</th>
</tr>
</thead>
<tbody>
<tr>
<td>8...........................</td>
<td>90</td>
</tr>
<tr>
<td>6...........................</td>
<td>92</td>
</tr>
<tr>
<td>4...........................</td>
<td>95</td>
</tr>
<tr>
<td>3...........................</td>
<td>97</td>
</tr>
<tr>
<td>2...........................</td>
<td>100</td>
</tr>
<tr>
<td>1 1/2 ......................</td>
<td>102</td>
</tr>
<tr>
<td>1...........................</td>
<td>105</td>
</tr>
<tr>
<td>1/2 ........................</td>
<td>110</td>
</tr>
<tr>
<td>1/4 or less................</td>
<td>115</td>
</tr>
</tbody>
</table>

Footnote(1) When the daily noise exposure is composed of two or more periods of noise exposure of different levels, their combined effect should be considered, rather than the individual effect of each. If the sum of the following fractions: C(1)/T(1) + C(2)/T(2) C(n)/T(n) exceeds unity, then, the mixed exposure should be considered to exceed the limit value. Cn indicates the total time of exposure at a specified noise level, and Tn indicates the total time of exposure permitted at that level. Exposure to impulsive or impact noise should not exceed 140 dB peak sound pressure level.”

The lab coat or apron is designed to protect the clothing and skin from chemicals that may be spilled or splashed. It should always be properly fitted to the wearer and is best if it is knee length. There are several different types of lab coats for different types of protection.

“Employees who face possible bodily injury of any kind that cannot be eliminated through engineering, work practice or administrative controls, must wear appropriate body protection while performing their jobs. In addition to cuts and radiation, the following are examples of workplace hazards that could cause bodily injury:

- Temperature extremes;
- Hot splashes from molten metals and other hot liquids;
- Potential impacts from tools, machinery and materials;
- Hazardous chemicals.”

2 OSHA 1910.95
3 OSHA 3151-12R
Appropriate **gloves** should be worn as needed.

“If a workplace hazard assessment reveals that employees face potential injury to hands and arms that cannot be eliminated through engineering and work practice controls, employers must ensure that employees wear appropriate protection. Potential hazards include skin absorption of harmful substances, chemical or thermal burns, electrical dangers, bruises, abrasions, cuts, punctures, fractures and amputations. Protective equipment includes gloves, finger guards and arm coverings or elbow-length gloves.”

Remove gloves before exiting the laboratory, recording data in a notebook, or working with a computer.

Care should be taken when removing gloves. Peel the glove off the hand, starting at the wrist and working toward the fingers. Keep the working surface of the glove from contacting skin during removal. Contaminated disposable gloves should be discarded in designated containers (e.g., radioactive or biohazardous waste containers).

Wash hands as soon as possible after removing protective gloves.

**Foot protection** is designed to prevent injury from corrosive chemicals, heavy objects, electrical shock, as well as giving traction on wet floors. Appropriate closed-toed shoes should be worn in the laboratory.

“Examples of situations in which an employee should wear foot and/or leg protection include:
- When heavy objects such as barrels or tools might roll onto or fall on the employee’s feet;
- Working with sharp objects such as nails or spikes that could pierce the soles or uppers of ordinary shoes;
- Exposure to molten metal that might splash on feet or legs;
- Working on or around hot, wet or slippery surfaces; and
- Working when electrical hazards are present.”
GENERAL STANDARD OPERATING PROCEDURES

The PI or Laboratory Manager is responsible for providing written SOPs relevant to health and safety for laboratory activities. Copy of SOP should be provided to EH&S office involving restricted chemicals, extremely hazardous chemicals (pyrophoric, highly reactive, etc), and high risk research procedures. Enforcement of these procedures is the responsibility of the PI or his or her designated laboratory supervisor. The PI is also responsible for ensuring that the work conducted and its scale must be appropriate to the physical facilities available, particularly with respect to the quality of ventilation.
EMERGENCY PROCEDURES
EMERGENCY PROCEDURES

Reporting Accidents
Accidents with personal injury must be reported to the laboratory supervisor on the day in which the injury occurred.

Response to Chemical Spills
All labs shall contain a chemical spill kit. See below for suggested list. Spill kits should be modified for specific needs of the lab. All personal shall be familiar with the lab chemical spill response procedures. Safely handling chemical spills in the lab requires first having a plan in place, second evaluating the severity of the spill, and finally cleaning of the spill by trained personal.

Be prepared, accidents happen:
1. Post emergency numbers by phone and lab door.
2. Establish standard operating procedures for special conditions in your lab.
3. Everyone working in the lab should read and understand the procedures.
4. Assemble a spill kit, tailored to clean up small spills of chemicals commonly used in your lab. See Appendix B for recommended spill kit.
5. Keep spill kit fully stocked and easily accessible at all time.
6. Train personnel how to use the contents of the spill kit and when it is safe to clean up a spill.
7. All personnel in lab should know:
   - Locations of fire extinguishers and manual pull stations, eye washes, emergency showers, and telephones
   - How to operate the fire extinguisher and when it's safe to do so. Training is available through the EH&S Office. For more information call EH&S Office at 575-5448.
   - How to use the eye wash and emergency shower.

Evaluate, can the spill be handled in house:
1. Small, incidental spills include spills that can be cleaned up by lab personnel without putting themselves or others in danger. If the spill presents no fire hazard and the material is not particularly volatile or toxic, cleanup is directed by the volume and state of material.
2. Large, incidental spills include:
   - Spills that present an immediate hazard (fire, explosion, chemical exposure, etc.)
   - Any spill of highly dangerous chemicals
   - Moderate or large-scale chemical spill
   - There is a fire, or the threat of fire, outside of a controlled space (fume hood).
   - There is a personnel injury or exposure likely to require medical assistance.
o The spill involves unknown or highly reactive material.
o There is a release of a toxic or flammable gas outside of a controlled space.

3. In both cases the MSDS for the chemical should be provided to the personal who will handle the cleanup of the spill.
4. U of A Police Department should be contacted (575-2222) to report all small spills. The Fayetteville Police Department should be contacted (911) for large spills.

**Small Spill, cleanup procedure:**
1. Alert people in the area. Avoid breathing vapors and try to determine what spilled.
2. If someone has been splashed with chemicals, immediately flush the affected area with water for at least 15 minutes. Call U of A Police, 575-2222, for advice and seek medical attention as recommended.
3. Wear personal protective equipment including safety goggles, gloves, and a long-sleeved lab coat during cleanup.
4. Confine the spill to a small area. Use a commercial kit or absorbent material from your spill kit to absorb spilled materials.
   o Using a plastic dustpan to scoop the saturated absorbent in a plastic bag or plastic bucket.
   o Re-cover the affected area with more absorbent to ensure all of spilt chemical has been absorbed, and scoop the material in the same bag or bucket with saturated absorbent.
   o Label the bag with a hazardous waste tag and include it in the next hazardous waste collection.
5. Clean the spill area with water. Detergent may be used if appropriate.
6. Clean up and leave area dry.
7. Report to supervisor and EH&S Office.
8. Replenish your spill kit supplies, so the kit is ready when you need it.

**Large Spill, cleanup procedure:**
1. Call EH&S Hazardous Materials Response:
   o Call 911. Police and Fire Department as well as EH&S officers will be dispatched as needed.
   o Provide as much of the following as possible to dispatch.
   - What chemical(s) are involved.
   - How much was spilled.
   - Where the spill is located.
   - Nature of any injuries.
   - What control measures have been taken.
▪ Your name and phone number.
▪ How officers can identify you. Include what you are wearing and where you will be located.

2. Emergency Guide's instructions for major chemical spills:

   o Avoid breathing vapors.
   o Alert people in the area and evacuate, closing all doors.
   o If someone has been splashed with chemicals, flush the affected area with water for at least 15 minutes.
   o Quickly identify the spilled material if you can do so safely.
   o If the spill involves a flammable liquid, turn off all ignition sources if you can do so safely.
   o Keep people away from the spill area until responders arrive. Lock doors and post warning signs.
   o Stay in safe and accessible location and identify yourself when officer come on scene.
## QUICK REFERENCE FOR SPILL CLEANUPS

Type of Material/Clean-Up Procedure: The table below provides a synopsis of type chemicals that may be spilled and recommended clean-up materials. This list should be amended to add any chemicals requiring special procedures. As always, the MSDS on the particular chemical is a preferable reference.

<table>
<thead>
<tr>
<th>Chemical Spilled</th>
<th>Clean-Up Procedures</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acids, organic</td>
<td>Apply sodium bicarbonate. Adsorb with spill pillow or vermiculite.</td>
</tr>
<tr>
<td>Acids, inorganic</td>
<td>Apply sodium bicarbonate/Calcium Oxide or sodium carbonate/calcium oxide. Adsorb with spill pillow or vermiculite. NOTE: Hydrofluoric acid is an exception to the general practice, see below.</td>
</tr>
<tr>
<td>Acid Chlorides</td>
<td>Do not use water. Absorb with sand or sodium bicarbonate.</td>
</tr>
<tr>
<td>Aldehydes</td>
<td>Absorb with spill pillow or vermiculite.</td>
</tr>
<tr>
<td>Aliphatic Amines</td>
<td>Apply sodium bisulfite. Adsorb with spill pillow or vermiculite.</td>
</tr>
<tr>
<td>Aromatic Amines</td>
<td>Absorb with spill pillow or vermiculite. Avoid skin contact or inhalation.</td>
</tr>
<tr>
<td>Aromatic Halogenated</td>
<td>Absorb with spill pillow or vermiculite. Avoid skin contact or inhalation.</td>
</tr>
<tr>
<td>Amines</td>
<td></td>
</tr>
<tr>
<td>Azides</td>
<td>Absorb with spill pillow or vermiculite. Neutralize with 10% ceric ammonium nitrate solution.</td>
</tr>
<tr>
<td>Bases (caustic alkalis)</td>
<td>Neutralize with acid, citric acid, or commercial chemical neutralizers. Absorb with spill pillow or vermiculite.</td>
</tr>
<tr>
<td>Carbon Disulfide</td>
<td>Adsorb with spill pillow or vermiculite.</td>
</tr>
<tr>
<td>Chlorohydrins</td>
<td>Absorb with spill pillow or vermiculite. Avoid skin contact or inhalation.</td>
</tr>
<tr>
<td>Cyanides</td>
<td>Cover solids with damp paper towel and push onto dust pan or use a HEPA filter vacuum to collect the solids. Absorb liquids with spill pillow or vermiculite.</td>
</tr>
<tr>
<td>Halides, organic or inorganic</td>
<td>Apply sodium bicarbonate.</td>
</tr>
<tr>
<td>Halogenated Hydrocarbons</td>
<td>Absorb with spill pillows or vermiculite.</td>
</tr>
<tr>
<td>Hydrazine</td>
<td>Avoid organic matter. Apply &quot;slaked lime&quot;. Adsorb with spill pillow or vermiculite.</td>
</tr>
<tr>
<td>Hydrofluoric Acid</td>
<td>Adsorb with calcium carbonate (limestone) or lime (calcium oxide) rather than sodium bicarbonate. The use of sodium bicarbonate will lead to the formation of sodium fluoride, which is considerably more toxic than calcium fluoride. Be careful in the use of spill pillows used to adsorb the acid. Some pillows contain silicates which are incompatible with hydrofluoric acid.</td>
</tr>
<tr>
<td>Chemical Spilled</td>
<td>Clean-Up Procedures</td>
</tr>
<tr>
<td>----------------------------------</td>
<td>----------------------------------------------------------</td>
</tr>
<tr>
<td>Inorganic Salt Solutions</td>
<td>Apply soda ash</td>
</tr>
<tr>
<td>Mercaptans/Organic Sulfides</td>
<td>Neutralize with calcium hypochlorite solution. Absorb with spill pillow or vermiculite.</td>
</tr>
<tr>
<td>Nitriles</td>
<td>Sweep up solids. Absorb liquids with spill pillows or vermiculite.</td>
</tr>
<tr>
<td>Nanoparticles</td>
<td>Pick up particles with a HEPA or ULPA filtered vacuum.</td>
</tr>
<tr>
<td>Nitro compounds/Organic Nitriles</td>
<td>Absorb with spill pillow or vermiculite. Avoid skin contact or inhalation.</td>
</tr>
<tr>
<td>Oxidizing Agents</td>
<td>Apply sodium bisulfite.</td>
</tr>
<tr>
<td>Peroxides</td>
<td>Absorb with spill pillow or vermiculite.</td>
</tr>
<tr>
<td>Phosphates, organic and related</td>
<td>Absorb with spill pillow or vermiculite.</td>
</tr>
<tr>
<td>Reducing Substances</td>
<td>Apply soda ash or sodium bicarbonate.</td>
</tr>
</tbody>
</table>

**Emergency Response**

A written, laboratory-specific emergency plan must be established and communicated to all personnel. The plan should include procedures for ventilation failure, evacuation of the laboratory, first aid and securing medical care, and reporting. Regular laboratory safety meetings and drills are recommended. There must be a written procedure for alerting all personnel in the laboratory, including areas such as growth chambers and cold rooms. Contact EH&S professionals at 575-5448 for assistance in developing such a plan.
CHEMICAL EXPOSURE ASSESSMENT
CHEMICAL EXPOSURE ASSESSMENT

In 1983, the National Academy of Sciences (NAS) published consensus-based terminology and concepts for risk assessments.

<table>
<thead>
<tr>
<th>Hazard</th>
<th>capability of a substance to cause an adverse effect</th>
</tr>
</thead>
<tbody>
<tr>
<td>Risk</td>
<td>probability that the hazard will occur under specific exposure conditions</td>
</tr>
<tr>
<td>Risk assessment</td>
<td>the process by which hazard, exposure, and risk are determined</td>
</tr>
<tr>
<td>Risk management</td>
<td>the process of weighing policy alternatives and selecting the most appropriate regulatory action based on the results of risk assessment and social, economic, and political concerns</td>
</tr>
</tbody>
</table>

Four fundamental steps in the risk assessment process as defined by the NAS are:

<table>
<thead>
<tr>
<th>Hazard identification</th>
<th>characterization of innate adverse toxic effects of agents</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dose-response assessment</td>
<td>characterization of the relation between doses and incidences of adverse effects in exposed populations</td>
</tr>
<tr>
<td>Exposure assessment</td>
<td>measurement or estimation of the intensity, frequency, and duration of human exposures to agents</td>
</tr>
<tr>
<td>Risk characterization</td>
<td>estimation of the incidence of health effects under the various conditions of human exposure</td>
</tr>
</tbody>
</table>

All PIs and lab supervisors are responsible for identifying hazards, critical exposure points, how to measure for exposure and risk associated with the exposure, and how to respond to the critical points. Standard operating procedures for each response must be created and all lab personal trained to assess the risk and response to exposure. Each PI should create methods (SOPs) not only to handle when critical exposure levels are reached, but how to minimize exposure.
Minimize Exposure

Minimize exposure by careful use of chemicals and by good housekeeping. Key provisions should include a prompt cleanup of equipment and work area, as well as the washing of hands prior to leaving the laboratory. Almost all laboratory chemicals involve some degree of hazard. Do not underestimate risk. Exposure should be minimized, even for substances not known to be hazardous. Some chemicals involve particular hazards, and for these, special precautions may be necessary. Always assume that any mixture of chemicals is more toxic than its most toxic component. The Permissible Exposure Limits (PEL) of OSHA and the Threshold Limit Values (TLV) of the American Conference of Governmental Industrial Hygienists should not be exceeded.

Avoid acute and chronic exposure by developing and encouraging safe habits; avoid unnecessary exposure to chemicals by any route. Do not smell or taste chemicals. Vent any apparatus that may discharge toxic chemicals (vacuum pumps, distillation columns, etc.) into local exhaust devices. Inspect gloves and test glove boxes or other containment equipment before use. Be especially careful of releasing toxic substances in cold rooms and warm rooms, since these have contained, recirculated atmospheres.

Knowledge of the Chemicals Used

Before a substance is received, information on proper handling, storage, and disposal should be made known to those who will be involved. No container should be accepted without an adequate identifying label. Chemical names and labels on each container should be carefully checked and double-checked prior to use. All chemical use should be preceded by knowledge of the chemical characteristics and its potential hazards.

Containment

When chemicals are hand carried from one location to another, the container should be placed in a secondary container or bucket. Freight-only elevators should be used if possible. Provisions also must be made for secondary containment in the event of spills or container breakage.
CHEMICAL LABELING, STORAGE, AND INVENTORY
CHEMICAL LABELING

Working Reagents Properly Labeled.

All reagents in the laboratory or storage area must be clearly labeled with the full chemical name and indication of the hazard (toxic, corrosive, flammable, etc), NFPA diamond is preferred. Chemical names or standard abbreviations are required. Chemical formulas or in-house abbreviations or acronyms are not acceptable, with the exception new products. In case of “new” product, label must contain the chemical structure, initials of the person created the chemical and page reference to lab notebook use to detail process. Labels must be applied to all temporary containers if the laboratory personnel are not in immediate control of the container. Transferring contents into a beaker for easy pouring does not require a label on the beaker. However, if the contents are transferred to a flask (with a lid) and left unattended overnight, then a label is required. Never leave a chemical containers open.

Peroxides Must be Labeled with Received and Open Date.

Each container of peroxide chemical shall be labeled with the date received by the user and the date opened. For organic peroxides requiring temperature control, it is recommended that the storage temperature range be marked on the container. The end user is responsible for labeling the containers. Store organic peroxides in areas which are:

- Well ventilated.
- Out of direct sunlight and away from steam pipes, boilers or other heat sources.
- At temperature as recommended by manufacturer/supplier. Always keep the storage area within the recommended temperature range.
- Supplied with suitable spill clean-up equipment and materials.
- Free of ignition sources such as open flames, hot surfaces, and spark-producing tools and devices.
- Accessible at all times.
- Labeled with suitable warning signs.

Hazardous Waste Properly Labeled

All hazardous waste in the laboratory or storage area must be clearly labeled with the contents, the date the contents were placed in the container, the date the container was filled and closed, some indication of the hazard (toxic, corrosive, flammable, stench) and a generator’s name, phone number, dept, building and room number. The container must also be labeled with the words “Hazardous Waste”. Chemical names are required. Formulas or in-house abbreviations or acronyms are not acceptable. Use only the labels provided by EHS. Substitute labels may not be used unless approved by EHS. If the contents are a mixture then reasonable estimates of the percentages of each component must be included. The material should be disposed within three days of the end fill date. To dispose, FAX EHS appropriate form as described on EHS web site http://ehs.uark.edu.
CHEMICAL STORAGE

Toxic substances must be segregated in a well-identified area with local exhaust ventilation. Chemicals that are highly toxic or reactive, or chemicals in containers that have been opened, should be in unbreakable secondary containers. Stored chemicals should be examined at least once a semester for expiration date, deterioration, and container integrity. Stockrooms and storerooms should not be used as preparation or repackaging areas. They should be open only during normal working hours, and should be controlled by one responsible individual. Amounts kept in inventory should be as small as practical. Storage on bench tops and in hoods is inadvisable. Exposure to heat or direct sunlight should be avoided. Periodic inventories should be conducted, with unneeded items being discarded or returned to the storeroom/stockroom.

Explosions, fires, toxic fumes, and other hazards can arise if incompatible chemicals are accidentally mixed. To minimize the possibility of such hazards:

1. The fronts of all chemical storage shelves should be equipped with horizontal bars so chemicals will not fall.
2. Chemicals should be stored with other compatible chemicals and separated by appropriate distances from incompatible chemicals.

**Metals:** All metals, except mercury, can be stored together. Metals should be stored separate from all oxidizers, halogens, organic compounds and moisture.

**Oxidizers** (except ammonium nitrate): Oxidizers include such chemicals as: nitrates, nitrites, permanganates, chromates, dichromates, chlorates, perchlorates, and peroxides. They should be separated from metals, acids, organic materials, and ammonium nitrate. They should be separated from flammable liquids by a one-hour fire wall or a distance of 8 meters.

**Ammonium nitrate:** Ammonium nitrate should be stored in isolation from all other chemicals.

**Bases:** All strong bases, such as sodium hydroxide or potassium hydroxide should be stored in a dedicated corrosive chemicals cabinet that is coated with corrosion-resistant material.

**Acids:** All inorganic acids (except nitric acid), and all regulated organic acids should be stored in a cabinet constructed of corrosion resistant material. Acids may be stored with bases, but fumes from acids and bases may produce an annoying coating of salt crystals on the outside of reagent containers. Nitric acid should be stored separately from acetic acid. Fuming nitric acid should never be used in the school laboratory.

**Flammables:** Flammables should be stored in a dedicated flammability cabinet, away from all oxidizers. Wood cabinets should be coated with flame retardant paint, and should be appropriately labeled with the notice: FLAMMABLE LIQUID STORAGE.

A maximum of 180 gallons of flammable and combustible liquids with a flash point of < 140 oF can be stored in a fire area (room with one-hour fire rated walls and self closing 20-minute fire rated door). This amount must be stored in the following manner:

- Not more than 10 gallons in containers or 25 gallons in safety cans shall be located outside a flammable storage cabinet.
- Not more than 60 gallons in a flammable storage cabinet.
- Not more than 3 flammable storage cabinets per fire area.
Poisons: Highly toxic substances such as cyanides should never be used in a school laboratory. Poisons approved by state and district education boards should be stored in a locked cabinet away from the acids cabinet.

Low Hazard Chemicals: Many weak bases, oxides, sulfides, indicators, amino acids, sugars, stains and carbonates are classified as low-hazard chemicals. These chemicals may be stored on open shelves with bars to prevent accidental spillage.

3. Gas cylinders must be secured. Compressed gas cylinders should be strapped to the wall. Oxidizing gases such as oxygen should be stored far away from flammable liquids, gases, and metals. Flammable gases should be separated from oxidizers and oxidizing gases by a one-hour fire wall or a distance of 8 meters.

4. All chemicals must be labeled with the chemical name and immediate hazard. The hazard may be noted by use of the NFPA diamond or hazard words such as flammable, oxidizer, irritant, poisonous if inhaled, etc. If there is no hazard note with a zeroed NFPA diamond, the diamond may be drawn on the label.

5. In addition to chemical name and hazard description, oxidizers must be labeled with the open and received date.
CHEMICAL INVENTORY

Online Chemical Inventory Available and Up to Date

Laboratories using hazardous chemicals must maintain a current and accurate inventory. The inventory shall list the name, and the approximate amount on hand. The inventory shall be treated as a living document and updated as frequently as needed. Electronic inventories are adequate. All laboratories, studios, and shops must maintain an inventory of hazardous substances present in their respective areas. Inventories must be maintained using OPUS, the on-line inventory system provided by EH&S. OPUS is designed to help PIs manage their data accurately, efficiently and effectively, allowing them to use that information to make faster and better-informed decisions when ordering chemicals and to reduce overhead. The program will increase safety on campus and will help to ensure compliance with Homeland Security, EPA, and other regulations that require tracking chemical inventories in laboratories across the campus. Contact the EHS office (575-5448) to receive more information.

Hazardous Chemical List Posted

A list of materials contained in the laboratory that are particularly hazardous must also be provided outside the door to each laboratory. This list should be written to aid fire department personnel. This list should not contain an exhaustive inventory. It should contain all hazardous chemicals in the room in quantities totaling 1 liter or 1 kg or greater and any quantity of explosives, highly reactive or highly toxic substances and all other extremely hazardous materials. For example a 5 lb bottle of sodium chloride is not of interest to the fire department personnel but a 1 lb container of sodium metal is of very significant interest. Gas cylinders in general should be listed. Approved forms may be requested through EHS office or found on EHS website.
LABORATORY AUDITS, SIGNAGE, AND TRAINING
LABORATORY AUDITS

Laboratory audits are preemptive measure to minimize risks, chemical exposure, and promote safe practices. Inspections are essential in identifying and addressing potential health and safety deficiencies in addition to fulfilling regulatory compliance requirements. The laboratory audits target compliance with all regulatory agencies not just the issues raised by ADEQ. The Arkansas Department of Labor (DOL) also visits the campus on a regular basis and their focus is “Right to Know” related problems and other problems usually attributed to Occupational Safety and Health Administration (OSHA) compliance. Failure to meet these audit requirements may result in initial and daily monetary fines for the University.

The Compliance group at EH&S conducts all laboratory audits. Although EH&S encourages Laboratory Supervisors to conduct self-audits to ensure all lab personal fully understand the protocol and regulation of the laboratory.

Audit results can be viewed online. Log in to the Environmental Health and Safety website (http://ehs.uark.edu/) by clicking the "LOGIN" button located at the bottom of the left hand menu on the home page. Use your university id and password to log in. After logging in the laboratory supervisors will be presented with the "Logged In Menu". Click the "Access Laboratory Records" button, navigate to the building and room of the laboratory desired, and click the "Lab Audits" button located in the row of buttons across the bottom of the laboratory page.

Call EH&S office at 575-5448, if you have any questions or comments.
SIGNAGE

**Arkansas Department of Labor Poster** should be posted in each lab where all lab occupants have an opportunity to read the poster. All individual working in the lab should be familiar with the Chemical Right to Know Act.

**Emergency Phone Number** should be posted on the outside door and by each phone. An example of the emergency phone number poster to place by phones is located on EH&S website. Fill the contact information on yellow caution sign place on door by EH&S personal. If you need a caution sign or need a new contact information sticker, please contact the EH&S office at 575-5448.

**Caution Sign** should be posted on outside of the door. The yellow caution sign and the appropriate hazard stickers can be obtained in the EH&S Office. Call EH&S 8 to get more information. Below are example stickers available. If addition hazard stickers are need, contact EH&S.
TRAINING

Documentation of all employee and student training sessions must be forwarded to EH&S at 521 South Razorback Road.

Each employee covered under this Chemical Hygiene Plan must be provided with information and training concerning the hazards of the chemicals present in his or her work areas. Each employee of the University who participates in the required New Employee Orientation receives the basic Hazard Communication Training (HAZCOM or “Right to Know” Training) mandated by OSHA. The training must be provided at the time of initial assignment and prior to any new assignments involving different exposure situations. Additional, job-specific training may be required for persons whose duties involve particular hazards, such as those associated with laboratories. Providing and documenting this training is the responsibility of the laboratory supervisor. Documentation of the training, which must include the employee’s start date, must be kept in the laboratory and a copy must be provided to EH&S.

Refresher training is required and is usually performed annually. The responsibility for providing and documenting the refresher training is the responsibility of the Principal Investigator. Occupational Safety Coordinators from EH&S are available upon request to provide information and assistance. Copies of the training materials and also copies of the documentation (sign-in sheets, etc.) must be forwarded to EH&S.

Student laboratory assistants will be provided training prior to their supervision of other students. This training must be provided and documented at the beginning of their employment by their laboratory supervisor (course instructor).

Custodians and other Facilities Management personnel who work in laboratory areas must be provided site-specific training under the Hazardous Communication Standard. This training is available from EH&S, but arranging for and documenting the training is the responsibility of the Supervisor.

Outside contractors, or university workers from such areas as Facilities Management must be informed of the hazards to which they might be exposed while working in the laboratory environment. The department that contracts for the work has the responsibility for informing workers of these hazards and for providing any associated training that will be site-and job-specific.

Site-specific training must include, at a minimum, the following information:

- contents and availability of the Chemical Hygiene Plan
- Permissible Exposure Limits (PEL) for OSHA regulated substances and recommended exposure limits for other hazardous chemicals where PEL do not exist.
- symptoms associated with exposure to the hazardous chemicals used in the laboratory
• physical properties and health hazards of chemicals in the work area
• location and availability of Material Safety Data Sheets (MSDS)
• methods and observations that may be used to detect the presence or release of a hazardous chemical
• measures that employees and students can take to protect themselves from these hazards, including specifics such as appropriate work practices, emergency procedures, and personal protective equipment to be used.

In addition to the hazard communication training, all faculty, staff, and students who manage or handle hazardous waste must have documented Hazardous Waste Generators’ Training. The laboratory supervisor is responsible for providing this training to employees and students. The training must be provided and documented at the time of initial employment and annually thereafter. At a minimum, the training must include basic RCRA requirements for:
• Storage requirements for hazardous waste; e.g. closing containers, head space, etc.
• Labeling of waste containers
• Choosing appropriate containers
• Compatibility of wastes
• Holding time
• Classification and sorting
• Appropriate disposal procedures

Assistance with this training is available from EH&S.
HAZARDOUS WASTE MANAGEMENT
HAZARDOUS WASTE MANAGEMENT

Waste Accumulation Site – Waste accumulation areas in laboratories are considered to be satellite accumulation areas of the University’s 90-day hazardous waste accumulation and storage area, and are strictly regulated by the Arkansas Department of Environmental Quality (ADEQ). Each laboratory generating hazardous waste must designate an appropriate area as a satellite accumulation area and must label the area as such (labels available from EH&S). Waste accumulation must be restricted and limited to these areas, and not stored in any other area in the laboratory. The location of satellite accumulation area must not be changed without prior notification to EH&S and approval of the Chemical Hygiene Officer.

Waste Accumulation Containers - All hazardous waste accumulation containers must be specifically labeled with the words “HAZARDOUS WASTE” and with the identity of the contents. The names of the chemicals must be spelled out. Chemical symbols or abbreviations are not acceptable. When the container is full, it must be labeled with the final fill date. EH&S must be notified, so that the container is picked up and placed in the 90-day accumulation facility within three days of being full. It is important to remember to leave sufficient head-space in filled waste containers to avoid breakage due to excess pressure.

Dealing correctly with laboratory wastes is an important issue for all who manage or are employed in chemical laboratories. To minimize the hazards:

1. Contact the U of A Chemical Hygiene Officer to determine the best location for satellite accumulation site. Place signage to indicate the location of the approved satellite waste accumulation site.

2. Store all waste in containers made of a compatible material. The container should be inspected frequently and not used repeatedly to store hazardous waste.

3. All waste containers must have tightly fitting caps and be kept closed. Do NOT leave funnel in bottle mouth.

4. Place approved waste disposable label on waste container. Stickers may be requested through the Environmental Health and Safety office. Note chemical waste will not be picked up unless the waste container is labeled appropriately.

5. Leave head space for the expansion of gas in bottle, approximately 20% of the container should be empty.

6. Be familiar with the waste request website. The hazard waste pickup shall be requested through the Environmental Health and Safety website (refer to Online Waste Pickup Request Form Guide on the next page for instructions). Hazardous waste must be disposed within 3 working days of when the container is declared full, pending weather conditions, and dated as full.
7. Dispose empty chemical bottle appropriately by:

1. Use the MSDS to determine whether the hazardous material container(s) once held has any restrictions for disposal of empty container.
2. Insure the container is empty.
3. Deface or remove the label of the empty container.
4. Remove any cap that may cause the container to become pressurized when compacting.
5. Dispose of the container in the dumpster. Do not dispose of the container(s) in regular trash bins.

The improper disposal of empty chemical containers may result in bodily injury as well as trash fires. Please remember that although chemical residues may be non-hazardous by themselves, they may mix with incompatible residues in a trash can or dumpster causing fire. In addition, sealed containers may become pressurized during compaction, which may result in residues spraying from the truck onto workers.

Online Waste Pickup Request Form Guide

Contact person for web related issues: Lew (lmeyers@uark.edu – 575-3537)
Contact person for hazardous-waste questions: Rick (raw002@uark.edu – 575-4079)

- EH&S Homepage (http://ehs.uark.edu) -> click on Login button in far left column below the Other Services button.
- Enter university email username and password
  - If this is your first time using the system the program will request that you enter your profile including a on campus phone that you may be reached.
- Once you log in, you will be presented with the “Logged In Menu”.
- Under Hazardous Waste Pickup
  - Select Request Hazardous Waste Pickup link to place a request
  - OR
  - Select Open Hazard Pickup List link to view the items on queue to be picked up

Request Hazardous Waste Pickup:
- Enter location of the pickup in the Building (use drop down list) and Room Number field
- Select the pickup type: chemical waste; biomedical waste; radiological waste
- Click the Continue button to enter the detailed page.
  
  Chemical Waste
  - Enter chemical name by using the Assistant button
    - Enter beginning/ part of the chemical description and click on the assist button
    - Scroll down and click on the chemical name requested for pickup and
    - click on select button and then OK button
  - If the item is a solution
    - Click on the % button to state percentage by weight or concentration
    - Click on the & button to added the additional product
    - Click on the % button to enter remaining percentage
  - Enter chemical state, container type, units of measure, quantity, and if special handling is required please indicate in comment field
Click on Submit button will take you to the Edit page. You have the option of editing, removing current request, or add another product to be picked up. Each request page can store up to 20 separate items to be picked up. If you have more than 20 items, you will need to start new pickup request form.

**Bio-Medical Waste**
- Enter bio-waste description
- Enter chemical state, container type, units of measure, quantity, and if special handling is required note in the in special handling field
- Click on submit button

**Radiological Waste**
- Enter rad-waste description by clicking on Assistant button
- Enter chemical state, container type, units of measure, quantity, and if special handling is required note in the in special handling field
- Click on submit button

**Open Hazard Pickup List:**
- From this page you may edit, delete, or view the manifest for your pickup request.
- Edit button – will allow you to edit the entry
- Delete button – will remove the entry from request queue

Manifest button – will give report you may print out for your records by using the Export to PDF/Print button. The exact manifest will be used to pick up the chemicals you request for disposal.
MEDICAL SURVEILLANCE
MEDICAL SURVEILLANCE

The OSHA Laboratory Standard [29CFR 1910.1450 (g)] mandates that employers provide employees an opportunity for necessary medical attention, examinations, and follow-up examinations at the physician's discretion in the event that:

- An employee develops symptoms associated with a hazardous chemical to which they may have been exposed
- Exposure monitoring reveals a persistent exposure level above the OSHA action level, or PEL for OSHA regulated substances
- An event takes place in the work area (such as a spill, leak, explosion or other occurrence) that results in the likelihood of a hazardous exposure.

The laboratory supervisor must provide the examining physician the following:

- Identity of the hazardous chemical to which employee may have been exposed
- Description of conditions of exposure, including exposure date, if available
- Description of the symptoms of exposure, if any, that the employee is experiencing
- A copy of the relevant MSDS

The laboratory supervisor should request and obtain a written opinion from the examining physician including:

- Results of examination and associated tests
- Recommendations for further medical follow-up
- Any medical condition revealed that may place the employee at increased risk as the result of a chemical exposure
- A statement that the employee has been informed by the physician of the results of the examination or consultation and told of any medical conditions that may require additional examination or treatment

The physician’s statement will not include specific findings and/or diagnoses that are unrelated to occupational exposure. Copies of all documentation surrounding the event should be provided to EH&S.
RECORD KEEPING
**RECORD KEEPING**

Accident records must be written and retained. All accidents are to be promptly reported to the laboratory supervisor. The supervisor will document the incident and forward a copy to EH&S.

All health and safety training records are to be maintained by the PI/Laboratory Supervisor.

Chemical Hygiene Plan records should document that the facilities and precautions were compatible with current knowledge and regulations. Inventory and usage records for must be kept for high-risk substances. Medical records will be retained by the institution in accordance with the requirements of state and federal regulations.
APPENDIX I

Chemical Hygiene at the 90-day Accumulation Facility
The University has a state-of-the-art facility (EHSS) for holding hazardous wastes picked up from the satellite accumulation areas, pending shipping for disposal at an appropriate facility. The Office of Environmental Health and Safety has Standard Operating Procedures (SOP) for managing hazardous wastes.

For the Generator and Satellite Accumulation Areas:

1. Ensure controlled access to the hazardous waste accumulation area. The area should be locked when there is no one in the laboratory or work area.

2. All hazardous waste accumulation areas must be identified as such with a sign stating that the area is for the accumulation of hazardous waste materials, and containers must be correctly labeled and kept closed. These signs are available from the Office of Environmental Health and Safety (EH&S).

3. All hazardous waste containers must be labeled with the words “Hazardous Waste” with the chemical(s) in the container listed on the label.

4. The amount of hazardous waste permitted to be stored in the satellite accumulation areas is limited to 55 gallons. (Amount of Extremely Hazardous Waste is limited to one quart.) Operations expected to generate more than these amounts must be reported to EH&S immediately and the date the waste exceeded these amounts must be recorded. Such excess amounts of waste must be removed to the 90-day storage facility within three days.

5. When the container is full, a hazardous waste pickup request must be promptly filled out and sent to the EH&S office. Request forms are available on the EH&S website.

6. All chemicals shall be separated with respect to compatibility.
   a. Acids and bases should not be stored together.
   b. Flammables and oxidizers should not be stored together.

7. All flammable materials must be stored in a “FLAMMABLES” cabinet.

8. All containers of chemicals must be labeled with the name of the chemical in the containers. (This means even water bottles containing water.) Products with trade names must be kept in the original labeled container.

9. All containers of chemicals must be kept closed at all times, except when removing materials or (in the case of hazardous waste containers) adding waste. Be sure to leave adequate head space in the container (a minimum of 2-3 inches is recommended for most containers).

10. Emergency phone numbers must be posted by the telephone and at the door. If there is not a phone in the area where hazardous materials are used or stored, the emergency phone numbers must be posted at the door.
11. In areas that contain more than one hazardous chemical, a chemical list must be available at all times. Material Safety Data Sheets (MSDS) must be kept on site and available upon request. The areas that contain hazardous chemicals must have a hazardous chemical list posted on or near the outside door of the area that the chemicals are stored.

12. All personnel working in an area that could generate hazardous waste must take the “Hazardous Waste Generators Training”. The training and the test are on the EH&S website. The training must be updated annually.

13. All personnel handling hazardous materials must wear the appropriate personnel protective equipment; e.g., closed-toed shoes, lab coats, gloves, eye protection, etc.

14. Spills should be avoided, but if they do occur, every effort should be made to contain them. A spill kit must be readily available in each area. Small spills may be cleaned up by the generator; larger spills should be reported to EH&S. In the event of a catastrophic release posing an immediate threat to human health or the environment, call 911.

To dispose of hazardous waste:

15. Go to the Environmental Health and Safety Website, hazardous waste disposal page:
   and follow the instructions on the page.

16. All hazardous waste containers must be appropriately labeled as the their contents and starting date of accumulation. For your convenience, EH&S is providing adhesive labels. ALL waste containers must be labeled and must be kept completely closed (no open containers; no funnels left in containers) at all times, except when adding waste. All items for disposal MUST be listed on the Hazardous Materials Disposal Form.

17. For additional information, consult the Chemical Hygiene Plan or call EH&S at 5-5448.

For EH&S and the 90-day Facility:
1. The request for hazardous waste pickup has been moved on-line. To schedule hazardous waste pickup please log in using your University ID and password at the following website:
   http://ehs.uark.edu/HazWasteDisposal.aspx
   EH&S staff will come to collect hazardous waste within 3 days of the request. Please DO NOT leave hazardous waste outside of the laboratory for pickup. Keep the waste in the designated satellite accumulation area inside your laboratory.

2. EH&S personnel then pick up the waste from the satellite accumulation site, making sure that all items are appropriately labeled and in suitable, securely closed containers.

3. EH&S personnel record the 90-day accumulation start date on each container label and sign or initial in the space provided.
4. Hazardous waste in amounts exceeding the 55-gallon limit (one quart for Extremely Hazardous Waste) must be removed from the satellite accumulation areas within three days of exceeding the limit. The date was exceeded must be recorded on the container, along with the 90-day accumulation start date.

5. The request form is checked for completeness and accuracy, and the items are checked make sure that all items to be picked up are listed on the request form and that all items listed are, in fact, ready for pick up. This information on the form must be correct, as this request form now becomes the inventory for the 90-day storage facility.

6. Items are placed in secondary containment and transported to the EH&S 90-day storage facility (EHSS). After unlocking and logging in, EH&S personnel unload the items and sort them by type into the appropriate storage locker. Any unknown items are characterized at this time, using the HAZCAT kit, after which they are labeled.

7. The request/inventory form is placed in a three-ring binder kept in a locked metal cabinet on the EHSS dock.

8. At the end of every quarter (more often, if necessary), the items are picked up by a contractor for transport and disposal at an approved facility. A record of the shipment is placed in the three-ring binder with the inventory sheets. The shipping manifests are sent to the EH&S office where they are place in the files.

9. For each quarter, there is a cumulative set of inventory sheets, accompanied by a shipping record. Periodically, the Records Manager for EH&S removes the inventory sheets from the binder and places them in the files in the EH&S office.

10. At any given time, it is possible to look in the binder and tell exactly what is in currently in the storage facility, where it came from, when it was picked up, when the last off-site shipment occurred, and what was shipped.

11. EHSS is inspected weekly by an EH&S staff member, using a checklist form, and the inspections are documented in a log kept on site at EHSS. Copies of the inspection forms are filed in EH&S.

12. Safety and security are to be maintained at EHSS at all times. Only EH&S personnel are authorized to enter the locked facility. Personnel must log in when entering the facility and must wear safety goggles.

13. All chemical storage rooms are equipped with vapor monitors and ventilation fans that are programmed to activate when the lights in the room are turned on. Personnel must not enter a room without first turning on the light.

14. Safety equipment (shower and eyewash) must be inspected and tested weekly. These inspections are likewise documented.
15. EHSS is equipped with an alarm system that reports to University Police (UAPD). UAPD dispatch maintains a contact list for EH&S that includes the contact information for the Emergency Coordinator and the Chemical Hygiene Officer.

16. All spills resulting in release of hazardous materials must immediately be reported to the Emergency Coordinator and to the Chemical Hygiene Officer.

**SOP for Weekly Inspection of the EHS Storage Facility (EHSS)**

EHSS is inspected *weekly* according to the following SOP:

1. Unlock the gate.
2. Go to the Records Cabinet, unlock it and get a copy of the Weekly Compliance Inspection Form.
3. Review the Log Book, to ensure that everyone entering the building has logged in.
4. Log in your Visit to the Hazardous Waste Storage Building, with your name, date and time of your visit, and the reason for the visit.
5. Check each of the doors to ensure that they are all locked, and secure.
6. Check the Fire Extinguishers to see that they are being inspected monthly, and that they are properly serviced. Take each extinguisher off of their hook, check the pressure, and do a quick check of the extinguisher as a whole. Then turn the extinguisher over a couple of times to break up the dry chemical. Then date and sign the inspection tag, with any comments necessary. Place the extinguisher back on its proper hook.
7. Take a look at the dock, looking at the overall neatness, and storage. Is it cluttered, or have a lot of trash?
8. Unlock the Supply Cabinet, and check to see if all of the PPE is available, and in good condition.
9. Unlock each of the storage rooms, and check each of the rooms. Check the containers to ensure that there is no leakage, and in good condition. Be certain that all of the containers are properly stored and closed. Check to see if any of the containers are overfilled. Check to see that all of the waste containers are properly labeled.
10. Make sure that each container is labeled with the 90-day accumulation start date and that the 90-day storage limit has not been exceeded. (Any item found to have been in storage for more than 80 days is to be immediately reported to the Chemical Hygiene Officer to assure timely disposal.)
11. Relock all of the storage room doors.
12. Note any violations on the Inspection Sheet, and add any necessary additional comments.
13. Sign the Weekly Inspection Form, and put it in the 3 Ring Binder labeled, Weekly Inspections.
15. Check the Waste Log Book to ensure that all of the Waste has been properly logged into the Storage Facility.
17. Double Check to make certain that all of the Storage Room Doors are Locked and Secure.
18. Relock the Gate as you leave the Building.
Universal Waste – There are also SOP for the handling and disposal of fluorescent lamps as Universal Waste

Preparation

- Wear appropriate gloves (e.g., leather) and approved eye protection when handling used lamps.
- Use the boxes provided for the collection of used lamps. Additional boxes are available from Razorback Recycling. Boxes the new lamps were shipped in can also be used as long as the flaps can be folded shut and the packing material (“egg crate”) has been removed.

Packaging and Storing Lamps

- Sort the lamps by the size and type. Incandescent bulbs are mercury-free and should be placed in the trash.
- Do not tape bulbs together, or they will be rejected.
- The box containing used lamps must be folded or taped shut except when bulbs are being added to it.
- Affix a “Universal Waste” label on the box/ fiber drum before placing the first lamp in it. This label must be readily visible (e.g., to inspectors) without moving the box/drum.
- Where ever possible, place the empty/filling lamp box at a 30-45 degree angle – this allows the maximum number of bulbs to be layered in the box.
- Use a safety chain or other restraint so boxes don’t fall.
- Store boxes in a dry, secured area.
- When the lamp container is full, inventory the contents and write this information on the “Universal Waste” label.

Packaging Broken Lamps

- Broken lamps are not Universal Wastes and require alternate labeling and packaging. EHS will provide a metal drum with a plastic liner for broken lamps. Broken lamps are Hazardous Wastes. Do not throw them into the trash.
- Place a Hazardous Materials Label (HML) on the drum before placing the first broken lamp in it. The label must read: HAZARDOUS WASTE – CONTAINS MERCURY.
- This drum must be kept closed and latched at all times except when broken lamps are being added to it.
- When the drum is full, submit a properly completed Hazardous Waste Pick-up Request Form (available on the EH&S web site).
- Because broken lamps are hazardous waste, personnel who handle or dispose of fluorescent lamps are required to take and document the basic Hazardous Waste Generator’s training, available on-line from the EH&S web site. A passing grade of 100% is required on the quiz.
Cleaning up Broken Lamps

Try and avoid breaking bulbs as mercury will be released into the atmosphere. But, if a bulb does break, follow this procedure:

- Mercury may be bound to the broken glass and powder. Keep people away from breakage area so that the mercury-containing powder is not tracked into other areas.
- Ventilate the area for 15 minutes, and keep the area well ventilated. This allows mercury vapors to dissipate.
- Assemble necessary supplies: latex gloves, tweezers, tape and a puncture resistant (e.g., plastic), sealable container.
- Wearing the gloves, carefully pick up any broken glass and place in puncture resistant container. Tweezers can be used to safely pick up broken glass. Tape can be used to pick up small pieces of glass and powder residue left on spill surface.
- Use two pieces of cardboard to push together remaining powder and fragments of glass. Finish clean up by sweeping if necessary.
- Important: Do Not Vacuum!! Dust will be dispersed into the air and mercury residue in the vacuum will be heated and vaporized when the vacuum is used again.
- After clean up is complete, placed contaminated clean-up materials, along with any other materials that came in contact with the mercury powder into the puncture resistant container and seal it shut with tape.
- Dispose of container in drum as described above.
- FOR QUESTIONS OR ASSISTANCE, PLEASE CALL EH&S AT 575-5448.

Spills and Releases of Hazardous Materials at EHSS

The University of Arkansas 90-day hazardous materials accumulation facility (ENSS) was designed and built to contain spills and prevent releases. There are four levels of spill containment for items placed in the facility:

- Primary containers of materials that are subject to spilling are placed within some kind of secondary container when they are checked into the facility. The secondary container may consist of a polypropylene tray or pan, or for larger items, a drum pallet.

- Tertiary containment is provided by the storage rooms themselves. Special containment features include Neoprene dams inside all walls and partitions to prevent spills from spreading from one room to another, and an impervious, chemically resistant epoxy coating on the floors, extending to a height of six inches up the walls of the storage rooms.

- The fourth level of containment consists of a concrete curb running the length of the dock area to help confine spills and releases to ENSS, should they occur.

The building is climate controlled and equipped with a sprinkler system. All electrical devices are explosion proof. The chemical storage rooms are equipped with ventilation fans that come on when the
lights in the rooms are turned on. The rooms are also equipped with chemical sensors that activate the ventilating fans when vapors begin to accumulate in the rooms. The fans in the rooms containing volatile chemicals are activated at the 25% of the lower explosion limits. The room containing corrosive chemicals has a hydrogen chloride receptor that activates a fan when air concentrations reach 10 parts per million (ppm). If levels of volatile chemicals reach 50% of the lower explosion limits, there is an alarm system that is activated, with both an audible alarm and strobe lights. Likewise the alarm is activated if hydrogen chloride concentrations in the corrosives storage area reach 25 ppm.

The alarm system is hard-wired to the sensors and continually reports to the University Police Department (UAPD) via a telephone line. If the alarm is activated, the UAPD dispatcher immediately notifies the University’s Hazardous Materials Emergency Coordinator, Wayne Brashear at 479-263-1622 and/or the Alternate Emergency Coordinator Rick Williams 479-879-2161. Other personnel are notified as appropriate, according to a contact list provided to dispatch. This list is updated twice a year, in January and July, or as appropriate.

Many spills and releases can be prevented through careful handling, the use of secondary containers, and ensuring adequate head space in containers of volatile materials. Minor spills and releases that do not extend beyond the confines of the facility may be contained and cleaned up by appropriately trained EH&S personnel, provided it can be done safely and without excessive risk to the personnel. EH&S personnel are charged with making that assessment and responding appropriately. Liquids are absorbed as quickly as possible. A supply of spill response materials is maintained on site, including booms, pillows, clay absorbent, and other materials that may be used for containment and absorption. Solid or particulate materials, including broken glass, are carefully picked up or swept into appropriate containers. Shovels, brooms, and drums for containing contaminated cleanup materials are all stored on site and readily available. EH&S personnel have been issued individual HAZMAT response bags containing full-face respirators, gloves, shoe covers, and other personal protective equipment and clothing, and are able and equipped to respond to a Level C or Level D incident. EH&S also maintains the necessary instrumentation for detecting and quantifying hazardous atmospheres. Contaminated spill materials are put into appropriate containers for disposal as hazardous waste. EH&S personnel who may be called to respond to spills have received RCRA and/or HAZWOPER training.

In the event of a spill or release of any hazardous material that may result in an immediate danger to life or health, all personnel at the facility, whether in a room or on the loading dock shall immediately leave the area and notify University Police by activating the red fire alarm pull station or by dialing 911.

University of Arkansas Police Department (UAPD) and Fayetteville Fire Department will respond to all emergencies at EHSS. (Both agencies receive annual training from EH&S regarding the potential chemical, radiological, and biological hazards associated with the University.) Additionally, the Northwest Hazardous Materials Response Team will respond, if needed. The spill or release will be handled as per protocol established by the Fayetteville Fire Department and/or Northwest Arkansas Regional Hazardous Materials Response Team according to standards and reasonable practices. A windsock is mounted on the south end of the building to aid responders in setting up a perimeter sufficient to protect response personnel and the general public. Washington Regional Medical Center has the equipment, personnel, and facilities necessary to decontaminate and care for personnel who may be injured as a result of a spill or release of hazardous materials.
All University, City, and County response agencies have received a copy of the University of Arkansas Hazardous Materials Emergency Response Plan. The Emergency Coordinator or Alternate Emergency Coordinator will be liaison between responding emergency agencies and the University of Arkansas, and has full authority from the Chancellor to make whatever decisions needed to mitigate the incident, preserve life and property, and to restore all buildings, staff, faculty, and students to normal daily operating conditions. The Emergency Response Coordinator(s) has the authority to request advice and or assistance from other professional and technical personnel from EH&S, and, if necessary, from knowledgeable University faculty. Upon receiving a call from UAPD dispatch the Coordinator or Alternate Coordinator will:

1. Ascertain the nature and extent of the spill or release.

2. Confer with EH&S Manager or Professional Staff to determine whether cleanup can and should be accomplished by EH&S personnel, i.e. Level C or Level D. If EH&S cleans up the spill, the Coordinator or Alternate Coordinator may assist with cleanup and decontamination of the area.

3. If it is determined that the spill or release requires a Level A or Level B response, a call will be placed to the Regional Hazmat Team. Every attempt will be made to give the responders as much information about the spilled material and the situation as possible.

4. In the event of a major spill or release, the University’s Emergency Operations Center (EOC) may be activated and the Emergency Operations Plan (EOP) may go into effect. (Please refer to the University’s EOP. Copies may be found at UAPD and in the library of EH&S in the Facilities Management Building.)

5. Media inquiries regarding the spill or release will be handled by University Relations or by the Manager of EH&S.

6. After the spill or release has been contained and or cleaned up, the Coordinator or Alternate Coordinator will make a full report of the incident to the Manager of EH&S.

Hazardous Materials Emergency Response Plan — The University of Arkansas has a Hazardous Materials Emergency Response Plan, the text of which is included here. A complete plan with maps of the campus and floor plans of all the buildings having satellite accumulation sites is on file in the EH&S library, at the Facilities Management Service Center, UAPD, and with all local and regional response authorities.
APPENDIX II

List of Chemicals Approved for Disposal into Sanitary Sewer
The City of Fayetteville waste-water treatment plant (OMI) furnishes a list of chemicals that may be disposed of into the sewer system. This list will be reviewed annually by the Office of Environmental Health and Safety Office and by OMI. As of January 2007, the following chemicals may be safely disposed of into the sanitary sewer following dissolution and dilution to 20% in water. Solid materials may not be sewered. Chemicals not appearing on this list may not be sewered.

- Ascorbic Acid
- Benzoic Acid
- Boric Acid
- Casamind Acid
- Citric Acid
- Lactic Acid
- Oleic Acid
- Phosphotungstic Acid
- Phthalic Acid
- Salicylic Acid
- Silic Acid
- Stearic Acid
- Succinic Acid
- Tartaric Acid Agar
- Albumen
- Aluminum
- Hydroxide
- Aluminum Metal
- Aluminum Oxide
- Amino Acids
- Alpha Salts (naturally occurring)
- Ammonium Bicarbonate
- Ammonium Carbonate
- Ammonium Chloride
- Ammonium Citrate
- Ammonium Lactate
- Ammonium Sulfamate
- Ammonium Phosphate
- Ammonium Sulfate
- Barium Carbonate
- Barium Sulfate
- Beef Extract
- Buffer Solution
- Calcium Borate
- Calcium Carbonate
- Calcium Chloride
- Calcium Citrate
- Calcium Fluoride
- Calcium Lactate
- Calcium Oxide
- Calcium Phosphate
- Calcium Sulfate
- Dextrose
- Cerelose
- Cobalt Oxide
- Copper Oxide
- Dextrose
- Malt Extract
- Yeast Extract
- Ferrous Ammonium Sulfate
- Ferrous Sulfate
- Gelatin
- Galactose
- Glycerine
- Hematoxylin
- Iron Oxide
- Kaolin,
- Mild Litmus
- Lactose
- Lithium Carbonate
- Lithium Chloride
- Lithium Sulfate
- Magnesium Borate
- Magnesium Carbonate
- Magnesium Citrate
- Magnesium Chloride
- Magnesium Lactate
- Magnesium Oxide
- Magnesium Phosphate
- Magnesium Sulfate
- Maltose
- Manganese Acetate
- Manganese Dioxide
- Manganese Chloride
- Manganese Oxide
- Manganese Sulfate
Methyl Salicylate
Pepsin
Peptone
Potassium Acetate
Potassium Bicarbonate
Potassium Bisulfate
Potassium Bitartrate
Potassium Borate
Potassium Bromate
Potassium Bromide
Potassium Chlorate
Potassium Chloride
Potassium Carbonate
Potassium Citrate
Potassium Iodide
Potassium Lactate
Potassium Sodium Tartrate
Potassium Sulfate
Potassium Sulfocyanate
Sodium Dodecyl Sulfate
Sodium Acetate
Sodium Ammonium Phosphate
Sodium Benzoate
Sodium Bicarbonate
Sodium Bisulfate Sodium Borate
Sodium Bromide