Laboratory Standard/

Chemical Hygiene Plan

University of New Orleans
Lakefront Campus
New Orleans, Louisiana
The Environmental Health and Safety Office (EHSO) has overall responsibility for coordinating safety and health programs for the University of New Orleans. The Directors / Department Chair persons have overall responsibility for the Laboratory Programs within their departments. They will review and update this program as necessary. Copies of the written program may be obtained from the EHSO, which is located in the Computer Center Building and in the participating departmental offices. The plan is also online in the SharePoint site of the EHSO.

The Occupational Exposure to Hazardous Chemicals in Laboratories Standard (often known as the Laboratory Right to Know Standard or simply the Laboratory Standard) is found at 1910.1450 in the OSHA regulations and requires a written Chemical Hygiene Plan. This document will serve as the Chemical Hygiene Plan for the university. The Chemical Hygiene Plan consists of the following:

- Purpose
- Summary of regulations
- Standard Operating Procedures
- Employer criteria for control measures
- Employee information and training
- Medical consultation and medical examinations
- Design of responsible personnel
- Employee protection provisions for particularly hazardous substances

**Purpose**

The implementation of this Chemical Hygiene Plan provides students and employees with the information and training necessary to improve workplace safety and health and to prevent chemical-related injuries and illnesses in our laboratories. It provides greater worker protection to protect our employees, faculty, staff and students. The Chemical Hygiene Plan is a complete and thorough documentation of our laboratory right to know program and of the methods, practices, and information necessary to protect individuals from the hazards of the chemicals in use on our campus.
Summary of Regulations

Scope and Application

This regulation applies to “all employees engaged in the laboratory use of hazardous materials.” The definitions discussed below of “laboratory use” and “laboratory scale” are of paramount importance in determining the applicability of the laboratory standard. The laboratory standard was developed to provide a standard appropriate for situations in which small quantities of multiple chemicals are used, each usually for a relatively brief time. Many facilities commonly referred to, as laboratories are not intended to be covered under this standard, such as quality control laboratories connected with production processes that perform repetitive tasks. If a facility does not meet the definitions of laboratory use and scale, it must comply with the general industry standard found in 29 CFR 1910 Subpart Z rather than the lab standard. The standard also does not apply to uses of hazardous chemicals, which provide no potential for employee exposure, such as medical labs, which only use prepackaged test kits. Most labs at higher education institutions will meet the criteria for coverage under the lab standard.

When the laboratory standard does apply, it supersedes the requirements of all other health standards in 29 CFR 1910 Subpart Z, with three (3) exceptions:

- Only the requirement to limit employee exposure to the permissible exposure limit (PEL) specified in any OSHA health standard applied to laboratories, unless the particular standard states otherwise.

- Prohibition of eye and skin contact specified by a substance-specific OSHA health standard must be observed.

- If the action level (or PEL if no action level is specified) is routinely exceeded for an OSHA-regulated substance with exposure monitoring and medical surveillance requirements, paragraphs (d) and (g) (1) (ii) of the lab standard apply. Paragraph (d) requires employee exposure monitoring according to the relevant substance-specific standard. Paragraph (g) (1) (ii) requires medical surveillance as specified in the relevant standard.

Definitions

Several terms defined in the regulation are key to understanding its scope, applicability, and requirements. Most important are the definitions of “laboratory,” “laboratory use,” and “laboratory scale” which are the criteria used to determine if the lab standard applies to a given facility.
A laboratory is defined as “a facility where laboratory use of hazardous chemicals occurs. It is a workplace where relatively small quantities of hazardous chemicals are used and a nonproduction basis.

Laboratory use has four components:

- **Laboratory scale** means that containers used for reactions, transfers, and other handling of substances are designed to be manipulated by one person.
- Multiple chemicals or multiple procedures are used.
- Procedures are not part of the production process.
- Protective laboratory practices and equipment are available and in use.

The component of laboratory use concerning protective laboratory practices and equipment is intended to mean that a body of knowledge is available, not to imply that such practices are implemented in a particular laboratory, according to OSHA.

Other definitions that are important to understanding the laboratory standard include:

- **Hazardous Chemical.** This is a chemical for which there is statistical evidence (based on at least one study) that acute or chronic health effects may occur to exposed employees. Appendices A and B of the Hazard Communications Standard (HCS) (29 CFR 1910.1200) provide further guidance on defining the scope of health hazards.

- **Chemical hygiene plan.** The cornerstone of the lab standard, the chemical hygiene plan, is a written program developed and implemented by the employer that sets forth procedures, equipment, personal protective equipment (PPE), and work practices capable of protecting employees from health hazards presented by the hazardous chemicals used in a particular work place. A chemical hygiene plan must meet the requirements specified in paragraph (e) of the standard. (see below)

- **Chemical Hygiene Officer.** The employer must designate a chemical hygiene officer as part of the chemical hygiene plan. This individual must be an employee who is qualified by training or experience to provide technical guidance in the development and implementation of the plan. There are no restrictions on the position description or job classification of the chemical hygiene officer.

- **Employee.** An individual employed in a laboratory workplace who may be exposed to hazardous chemicals in the course of his or her assignment is considered an employee for the purpose of the standard. This includes employees who may not actually work in a laboratory, but may be required to enter a laboratory where potential exposures could occur. Maintenance and custodial personnel are considered by OSHA to meet the definition of employee. Students are not covered unless they are paid by the institution for duties performed. The
definition of employee is important to keep in mind when a chemical hygiene plan and employee training programs are developed.

- **Designated area.** OSHA decided to use the term “designated area” rather than “regulated area,” which was used in the proposed regulation. Regulated area is used in the general industry standards area under the lab standard. A designated area is an area that may be used for work with “select carcinogens,” reproductive toxins, or substances with a high degree of acute toxicity. The purpose is to focus attention on the use of particularly hazardous substances to ensure that appropriate measures are taken by employees in or near the vicinity. A designated area may be an entire laboratory, an area of a laboratory, or a device such as a fume hood.

### Permissible Exposure Limits and Employee Exposure Determination

Employers must assure that employee exposures to OSHA-regulated substances do not exceed the PEL’s specified in 29 CFR Subpart Z. Exposure must be measured if there is reason to believe that exposures routinely exceed the action level (or PEL if no action level is established for the substance) for a substance regulated by a standard, which requires monitoring. If the initial monitoring shows exposure above the action level or PEL for the substance, the employer must immediately comply with the monitoring provisions of the relevant standard. The employer must notify the employee in writing of monitoring results within 15 days of receipt of those results, either individually or by posting a notice.

### Chemical Hygiene Plan

The development and implementation of a written chemical hygiene plan is the focus of the laboratory standard. The plan must be capable of protecting employees from health hazards associated with hazardous chemicals in a particular laboratory and of keeping exposures below the applicable PEL’s. The chemical hygiene plan must be readily available to employees, employee representatives, and, if requested, OSHA, Office of Risk Management. The chemical hygiene plan must be reviewed and its effectiveness evaluated by the employer annually. It should be updated as necessary.
Standard Operating Procedures

Uniformity of practice in the laboratory ensures safety and efficiency. These Standard Operating Procedures (SOP’s) create a standard of practice that is to be followed by all employees, faculty, staff, and students working in laboratories at this university, to ensure the safety of all individuals. The intent of the SOP’s is to assure that work practices and procedures are in place that protects employees from chemical hazards. SOP’s, for example, may specify general safety precautions (i.e. safety glasses, eating and drinking area restrictions, general housekeeping practices), accident response, disposal procedures, and spill clean-up procedures. The standard operating procedures in effect at this university include the following:

Accidents and Spills:

- **Eye contact:** Promptly flush eyes with copious amounts of water for a prolonged period (15 minutes) and have someone call University Police at X6666 immediately.

- **Ingestion:** Encourage the victim to drink large amounts of water and call University Police at X6666.

- **Skin contact:** Promptly flush the affected area with copious amounts of water and remove any contaminated clothing. Use a safety shower if necessary. Have someone call the University Police at X6666.

- **Spills:** For small spills, promptly clean up spills using appropriate protective apparel and equipment. Follow guidelines for proper disposal of material. Immediately call the Safety Office at X6670 or the Chemistry Stock Room at X6324 to collect the container. If you are unsure how to clean up the spill, call the Safety Office and they will try to assist you. For larger spills, evacuate the area, closing doors behind you, and contact University Police at X6666 and the Safety Office at X6670.

In the event that any personal injury occurs, an accident report must be filed by the employee’s supervisor.

Avoidance of “Routine” Exposure:

- Develop and encourage safe habits.
- Avoid unnecessary exposure to chemicals by any route (ingestion, inhalation, injection, and/or skin absorption).
• Do not smell or taste chemicals.
• Vent apparatus which may discharge toxic chemicals or chemical fumes (vacuum pumps, distillation columns, etc.) into local exhaust devices.
• Inspect gloves and test gloves before use.
• Do not allow release of toxic substances in cold rooms and warm rooms, since these have contained recirculated atmospheres.

Choice of Chemicals:

• Use only those chemicals for which the quality of the available ventilation system is appropriate.
• Please refer to “Specific Chemicals” section.

Eating, Drinking, Smoking, etc.:

• Avoid eating, drinking, smoking, gum chewing, or application of cosmetics in areas where laboratory chemicals are present.
• Wash hands after exiting the lab and again before conducting these activities.
• Avoid storage, handling or consumption of food or beverages in storage areas, refrigerators, glassware or utensils which are also used for laboratory operations.

Equipment and Glassware:

• Handle and store laboratory glassware with care to avoid damage.
• Immediately discard damaged glassware.
• Place all broken or damaged glassware in the proper disposal container.
• Use extra care with Dewar flasks and other evacuated glass apparatus (shield or wrap them to contain chemicals and fragments should implosion occur).
• Use equipment only for its designed purpose.

Horseplay:

• Practical jokes or other behavior which might confuse, startle or distract another worker will not be tolerated. These types of issues will be addressed by the appropriate disciplinary authority.

Pipetting/Siphoning:

• Never use mouth suction for pipetting or starting a siphon.
• Use squeeze bulbs and/or pressure variances.

Personal Apparel:
• Confine long hair and loose clothing.
• Wear shoes at all times in the laboratory.

• Never wear sandals, perforated shoes or any other type of open toe shoe.
• Laboratory Coats must be worn when working in the laboratory.

Personal Housekeeping:

• Keep the work area clean and uncluttered at all times.
• Always properly label and store chemicals and equipment.
• Clean the work area immediately following the completion of an operation or at the end of each day.

Personal Protection:

• Assure that appropriate eye protection is worn by all persons, including visitors, where chemicals, lasers or equipment under pressure are stored or handled.
• Wear appropriate gloves when the potential for contact with corrosive and/or toxic materials and/or machinery exists.
• Inspect the gloves before each use, wash them before removal, and replace them periodically. Always wash your hands thoroughly after removing gloves.
• UNO has a respiratory program. If you are working in an area where a respirator may be needed call the EHSO immediately at X6670. Several issues must be addressed such as medical surveillance before a respirator can be issued.
• Use any other protective and emergency apparel and equipment as appropriate.
• Avoid use of contact lenses in the laboratory unless necessary and if they are used, inform supervisor so special precautions can be taken.
• Remove laboratory coats immediately upon significant contamination.

Exiting:

• Wash areas of exposed skin well before leaving the laboratory.
• Make sure that laboratory is clean and that all equipment, burners, lights, etc. have been turned off. Please unplug any heat generating devices (i.e. warmers) if they are not going to be used for an extended period of time.

Planning:

• Seek information and advice about hazards, plan appropriate protective procedures, and plan positioning of equipment before beginning any new operation.
• Identify the chemicals that you will be dealing with and obtain appropriate Material Safety Data Sheet (MSDS) for each chemical. MSDS’s are located in the Chemistry Stockroom, in the lab, and also in the UNO Police Department
main Office. These MSDS’s are for your information and a copy will be made for you at your request.

- Become familiar with the equipment and the type of operation that you will be performing and take appropriate protective measures.
- Always be fully informed about all of the dangers related to equipment and chemicals **BEFORE** you start an experiment.

**Unattended Operations:**

- Leave the lights on, place an appropriate sign on the door, and provide for the containment of hazardous substances in the event of some sort of utility failure (i.e. cooling water).
- Make sure that all containers are properly labeled so that proper precautions can be taken in the event of an accident or a spill in your absence.

**Use of Hood:**

- Use the hood for operations which might result in release of toxic chemical vapors or dust.
- Use of the hood is also recommended for operations in which an implosion or explosion hazard exists.
- As a rule of thumb, use a hood or other local ventilation device when working with any appreciably volatile substance with a TLV of less than 50 ppm.
- Confirm adequate hood performance before use. The ventilation of a lab hood shall be rated a minimum of 70 feet per minute. There will be a sash level mark on the hood.
- Keep hood closed at all times except when adjustments within the hood are being made.
- Hoods shall not be used to store chemicals, broken glassware, etc. Storage in a hood impedes air flow.
- Leave hood “on” when it is not in active use if it is uncertain whether adequate general laboratory ventilation will be maintained when it is “off”.

**Working Alone:**

Avoid working alone in a lab and/or building, especially if the conditions are potentially hazardous.

**Hazardous Waste Disposal Procedures:**

- A plan for the collection of hazardous waste is needed for each lab.
- Waste containers must always be properly labeled. Label must include the name or type of waste and date collected.
- Waste should be properly stored and should be discarded in a timely fashion. It is not wise to accumulate large amounts of waste at any given time.
• Never unnecessarily mix waste. This can cause proper disposal to become more difficult, and in some cases, more expensive.

**Lab Safety:**

• Unscheduled inspections will be made in the laboratories.
• Results of inspections will be made available and every effort will be made to correct any and all deficiencies
• If any lab personnel notices any unsafe condition, please cease all operations and notify the lab supervisor and the Safety Office at X6670.

**Employer Criteria for Control Measures**

As part of the Chemical Hygiene Plan, we have developed criteria for determining and implementing control measures to reduce employee exposure to hazardous chemicals in the laboratory. OSHA policy dictates that engineering and work practice controls be used to reduce employee exposure below the PEL. The criteria we use include the following:

• The degree of toxicity of the substances to be used.
• The exposure potential of the chemical procedures to be performed.
• The capacity of the engineering controls, administrative/work practices and/or protective equipment to control employee exposure effectively.

**Engineering Controls (Design and Maintenance)**

**Design**

Each laboratory facility will be equipped with:

• A general ventilation system with air intakes and exhausts located so the intake of contaminated air will be avoided.
• Laboratory sinks and hoods.
• Safety equipment such as eyewashes, showers, fire detection devices and extinguishers.
• Hazardous waste collection procedures.

**Maintenance**

• Equipment such as hoods, sterilizers, glove boxes, etc. should be under continuous monitoring and any decline in performance should be reported to your supervisor and Facility Services (FS) at X6675 immediately. A safety trouble call can be taken over the phone, and a paper copy should be faxed (X5582) or mailed immediately. This sequence of events will allow FS to get the equipment up and running in a relatively short period of time.
• Hoods will be monitored and tested yearly by the Safety Office.

• Eyewashes and safety showers should be tested at least monthly.
• Fire extinguishers are inspected monthly and replaced as necessary through an outside contractor. If an extinguisher is used, you should notify the Safety Office so that it can be immediately recharged or replaced.

Work Practice Controls

Cleaning

Each laboratory supervisor should clean up all material when experiment(s) is completed or at the end of each day.

Spills

Spills should be cleaned up immediately and then reported to the Safety Office. Note the amount and the material that was spilled and the exact location of the spill. The Crisis Manual in the back of the UNO phone book has further information on this and other related Emergency topics.

Corridors

Stairways, hallways, and other corridor inside and outside of the lab area must remain free of clutter and disturbance. These corridors are very important during evacuation and in gaining access to vital areas. Door should never be blocked.

Personal Protective Equipment

Eye Wear

• Safety goggles or face shields are mandatory in Labs where chemicals are used.
• UV goggles and shields should be available and used in situations where lasers are in use.

Gloves

• When working with corrosive, toxic, reactive, cryogenic and/or flammable chemicals, gloves are recommended and should be worn.
• Gloves charts are available from the Safety Office and one is attached to the end of this document to help you pick out the appropriate glove type for the chemicals that will be used.
• Appropriate gloves should be chosen to maximize protection from exposure to chemicals.
Respirators

- Use of respiratory equipment must comply with the requirements of Title 29 CFR 1910.134, which specifies factors such as selection, fit, use, and maintenance.
- Respirators may be worn by lab personnel, however, they must follow the UNO respiratory guidelines which state that an initial medical evaluation and yearly pulmonary function tests be taken.
- UNO has an agreement with a local occupational health clinic for such medical evaluation and tests.
- The Safety Officer is authorized to set up an appointment for these medical tests.
- The lab supervisor must give their approval and an account number to the Safety Office for the tests to be performed.

Safety Shower

- Each lab should have easy access to a safety shower.
- These showers should be tested at least on a monthly basis.

Eyewash

- Each lab should have an eyewash station.
- These eyewash stations should be tested at least on a monthly basis.
- The replaceable bottle eyewashes must be maintained by the person in charge of the lab.

Inspections

Unannounced laboratory inspections will be held to evaluate proper use of the protective equipment listed above.

Other

Fire extinguishers, fire alarms, telephones, and other emergency equipment are in or near each and every lab should their use be necessary.

Employee Information and Training

Certain information and training is provided to all students, faculty and staff, and employees affected by the standard regarding how to work with hazardous chemicals and how to protect themselves. This section outlines the training and information in place at UNO.
Faculty/Staff

- Departments will provide training to their Faculty and Staff.
- The Safety Office will provide training to Faculty and Staff at their request and convenience.
- This document will be covered during the training session as well as special topics which may arise.

TA’s/GA’s

- Teaching Assistants and Graduate Assistants will be trained prior to the beginning of their first semester by the department or by the Safety Office.
- There is a comprehensive training seminar that covers lab safety and other topics at the beginning of each semester for all new TA’s and GA’s.
- It is the responsibility of the lab supervisor to train any new TA’s and/or GA’s prior to the start of each semester.
- The Safety Office will assist in this training if requested to do so.

Students

- It is the responsibility of the Professor to train all of the students who will be using the lab.
- The Safety Office is available to assist in any way - handouts, videotapes, etc.

Right to Know

- UNO has a Hazard Communication (Right to Know) Program.
- Material Safety Data Sheets are available in the UNO Police Department, in the Chemistry Stock Room, and in the individual labs.
- MSDS sheets are available online. The Safety Office website (www.uno.edu/~ehso/links) provides various links to websites where this information is available.

Information

Other related chemical and safety information such as chemical dictionaries and films are available in the Safety Office. Please feel free to check out this information on an as-needed basis.
Medical Consultation and Medical Examinations

Medical consultations and medical examinations are the employees’ right in certain circumstances, and we are committed to providing for such medical care for all employees affected by this standard. We provide the following types of care in the following circumstances:

Accidents

Skin and/or eye contact

- Flush the affected part(s) with copious amounts of water for at least 15 minutes.
- Do NOT remove contact lenses.
- Contact University Police at X6666.

Fire/Explosion

- Without endangering yourself, attempt to remove the injured person(s) from the affected area if they are in eminent danger. If this is not possible then leave the area. (Follow proper evacuation procedures for your area).
- Pull the fire alarm.
- Contact University Police at X6666.
- Do not re-enter the area.
- Remain in the vicinity to assist response personnel.

Reporting

After the accident is taken care of and order is restored, the supervisor must fill out the proper accident reporting forms and send them to the Human Resources Office.

First Aid

Our current policy is to send all persons involved in any type of accident to Health Services, located in UC244, for medical attention. If it is impossible for the person to go to Health Services, call University Police at X6666 and they will bring someone from Health Services to your location.

Medical Surveillance

- Where exposure monitoring reveals an exposure level above the OSHA Permissible Exposure Limit (PEL), respiratory protection must be used and medical surveillance must take place.
• Whenever a person experiences signs or symptoms associated with a hazardous chemical to which the employee may have been exposed to in the laboratory, the employee must notify their supervisor and make an appointment with Health Services.
• When the employee goes to Health Services, they must tell the medical staff which chemical(s) they were exposed to and they should also bring a Material Safety Data Sheet with them at the time of the appointment.

The physician doing the medical evaluation or consultation must be provided with the following required information:

• The identity of the hazardous chemical(s) involved.
• The conditions under which exposure occurred.
• A description of the signs and symptoms experienced by the worker.

After medical evaluation or consultation, the physician provides us with the following information:

• Results of medical exam as well as any test results.
• Any written opinion for a recommended follow-up examination.
• Any detected medical condition(s) of the employee that might pose increased risk.
• A written statement that the employee was informed of the medical examination/consultation results.

The university establishes and maintains for each employee an accurate record of exposure monitoring results and any medical consultations and examinations, including tests or physician medical opinions, in accordance with OSHA’s rule governing access to employee exposure and medical records, 29 CFR 1910.20.

**Designation of Responsible Personnel**

The University of New Orleans provides qualified and experienced personnel to provide technical guidance in the development and implementation of the provisions of the Chemical Hygiene Plan required by the Laboratory Standard. David Richardson, Safety Officer, is the designated Chemical Hygiene Officer for the University and may be reached at X6670.
Employee Protection and Provisions for Particularly Hazardous Substances

University laboratories may conduct work involving select carcinogens, reproductive toxins, and/or substances having a high degree of acute toxicity. To protect employees, faculty, staff, and students when working in these especially hazardous situations, there are special provisions in place for these situations, including designated work areas, special containment devices in those work areas, decontamination procedures, waste removal and operating procedures. The following lists provisions for special situations as well as special circumstances for use of specific chemicals.

Special Situations -- Physical Limitations

Disabled Persons

- Every effort will be made to assist you in your research and/or studies.
- UNO has a comprehensive plan to remain in compliance with the Americans with Disabilities Act (ADA).
- We have Disabled Student Services Office on campus and they can be reached at X6222.

Pregnant Women

- All pregnant women should consult with their physician before they work with any type of chemicals.
- Even if they are given approval by their physician, they must also receive approval from their supervisor and/or professor.
- Under NO circumstances will a pregnant woman be allowed to work with any type of embryotoxin, teratogen and/or mutagen.
- Pregnant women will not be allowed to work with any chemical without personal protective equipment and ALL work must be performed under a hood.

Specific Chemicals

EMBRYOTOXINS (i.e. lead compounds, formamide)

- There are special provisions for pregnant women, please read above.
- If you are a woman of child-bearing age, you should only handle these substances while wearing appropriate gloves and while working under a hood.

ALLERGENS (i.e. diazomethane, bichromates, dichromates, isocyanates)

- Gloves should be worn to prevent hand contact.
ETHYL ETHER

- Ether is a very volatile liquid, which requires special handling and usage procedures.
- This substance deteriorates with age and can become very explosive.
- Each can of ether must be dated when opened.
- Any unused portion of ether should be discarded after 6 months through the Safety Office.
- Ether should be purchased in small amounts, which will be used in a relatively short period of time to prevent the accumulation of “old” ether and to help avoid exposure to “old” ether.
- Never discard this chemical in any way other than the way specified above.

FLAMMABLE MATERIALS

The main concern of flammable materials is their ability to cause a fire. A material is considered flammable if the flash point is below 100 degrees F. The flash point is the temperature at which a mixture of that material and air will ignite if an ignition source is present. UNO uses mostly flammable liquids, however, flammable solids and gases are also sometimes used. There are three classes of flammable liquids:

- **Class I (Flammable Liquids)** – Have a flash point below 100 degrees F, or 37.8 degrees C.
- **Class II (Combustible Liquids)** – Have a flash point from 100 – 140 degrees F, or 37.8 – 60 degrees C.
- **Class III (no specific name)** – These are combustible liquids with a flash point over 140 degrees F, or 60 degrees C.

Storage of Flammable Materials – Flammable material storage requirements are regulated by the National Fire Protection Agency (NFPA), which the State of Louisiana has adopted.

- Class I and/or Class II liquids must be in a container no larger than 1 gallon, unless it is approved. The largest approved container for these liquids is 2.5 gallons.
- There is a 10-gallon maximum storage limit of Class I and/or Class II liquids in any one room, which can be outside an approved safety cabinet.
- Approved safety cabinets can store up to 60 gallons of Class I liquids in any one area.
Examples:

Class I
- Acetone
- Acetonitrile
- Benzene
- n-Butyl Acetate
- Collodion
- 1,4-Dioxane
- Ethanol
- Ethyl Acetate

Class II
- Acetic Acid
- Dibutylamine
- Diesel Fuel
- Isopentyl Alcohol

SOLVENTS

- One of the most highly visible potential hazards in many labs is the use of solvents, in particular, organic solvents.
- Solvents are for the most part very flammable and create noxious vapors.
- Chlorinated solvents are not flammable, but can emit toxic vapors, especially when heated.
- All solvents, especially volatile and/or flammable solvents, should be used in a functioning fume hood.
- Solvents should never be used when any type of open flame and/or major heat source such as a Bunsen burner, a torch, or a kiln is present in the laboratory.

Exposure Hazards – Solvents

Absorption/Skin Contact

- Solvents can readily be absorbed into the body via skin abrasion or cut, eye tissue, etc.
- Skin contact may produce a drying effect as well.
- Saturated hydrocarbons and paraffin solvents are stronger than their aromatic counterparts.

Inhalation

- Inhalation of solvents can cause bronchial irritation, nausea, dizziness, headaches, watery eyes, and coma.
- Liver and kidney damage may result from overexposure.
Ingestion

- Ingestion of a solvent can cause many internal effects on the body. Many result in very severe cases.
- Consult with the available MSDS on the type of solvent(s).

Personal Protective Equipment

- Gloves should be worn at all times when handling solvents.
- Respirators should be worn when dealing with Carbon Tetrachloride, Benzene, and Chloroform.
- The odor threshold is very high for these chemicals.
- A rule of thumb is that if you can smell it you may already be overexposed.
- The three solvents mentioned above are considered to be suspect carcinogens.

Substitution

- Where possible, potentially dangerous solvents can be substituted for a less hazardous material.
- If two solvents have the same amount of toxicity and one is odorless, chose the one with the odor as the substitute for the more hazardous material.

Substitution examples:
- Cyclohexane, toluene, or xylene for benzene
- Pentane for n-hexane
- Methylene chloride or 1,1,1-trichloroethane for chloroform and carbon tetrachloride
- Petroleum ether for diethyl ether

TOXICS

Toxic materials, or poisons, are broken down into two different categories: Acute and Chronic.

- Acute toxicity refers to the toxic effects of the material causing damage to the metabolism of a living tissue in a short amount of time (seconds to days).
- Chronic toxicity refers to the toxic effects of the material causing damage to the metabolism of a living tissue in a prolonged amount of time (months to years).

Toxic materials are also categorized by the type of damage they can cause on a body system. An example of this is a reproductive toxin which can cause damage to the
unborn fetus, as stated above, they are called teratogens, embryotoxins, and mutagens. Neurotoxin is another example where a material will damage the central nervous system, CNS. Examples of neurotoxins are formaldehyde and mercury.

Toxicity level is recorded on Material Safety Data Sheets (MSDS’s) by LC50 and/or LD50. LC50 is the lethal concentration in air that causes death in 50% of the test animals. LD50 is the lethal dose that is either injected, ingested, or applied to the skin that causes death in 50% of the test animals.

Remember that most chemicals can become toxic depending on the amount of material that is used. Chemicals can enter the body in several ways:

- **Ingestion** – residue on your hands
- **Injection** – from broken glass, pipette, or needle
- **Absorption** – through skin, eyes, etc.
- **Inhalation** – simply breathing

As you can see, these four methods of exposure can be controlled by either personal protective equipment, good lab practices, organization (sharps boxes, broken glass containers), and good hygiene.

The MSDS on each chemical should be examined before the chemical is used. The characteristics should be studied as well as the protective equipment that is recommended and the first aid techniques that are required.

**CORROSIVE CHEMICALS**

Corrosives are split up into strong acids, strong bases, dehydrating agents and oxidizing agents. Inhalation of vapors and / or mists can cause severe bronchial irritation. Other damages occur to the eyes, skin, and the respiratory system.

**Acids**

- Acids are very damaging to the skin and eyes.
- All exposed areas should be flushed with copious amount of water.
- Strong acids can cause severe burns and are very dangerous.

Examples: Hydrochloric, Hydrofluoric, Nitric, Sulfuric and Acetic Acid

**Bases**

- Bases also cause damage to the skin and eyes.
- Ammonia is a severe bronchial irritant and should be handled only in a well-ventilated area.
- Metal hydroxides are very damaging to the eyes and if an accident were to occur, the eyes should be washed with copious amounts of water for at least 15 minutes and the University Police (x6666) and Health Services (x6387) should be contacted immediately.
Examples: Potassium Hydroxide, Sodium Hydroxide, and Ammonia

**Dehydrating Agents**

- Dehydrating agents can cause severe burns on contact with the skin and eyes.
- These agents should be handled as stated on the MSDS’s.
- In case of contact with eyes or skin, the affected area should be flushed with copious amounts of water for 10 – 15 minutes and the University Police (x6666) and Health Services (x6387) should be contacted immediately.

Example: Concentrated Sulfuric Acid, Sodium Hydroxide, Phosphorus Pentoxide and Calcium Oxide.

**Oxidizing Agents**

- Oxidizing agents feed fires. These types of chemicals can also be corrosive.
- Oxidizing agents should never be stored next to FLAMMABLE materials.
- These agents should be handled only after thorough familiarization with the procedure stated in the MSDS’s.
- If skin contact occurs, flush affected area with copious amounts of water for 10 – 15 minutes and the University Police (x6666) and Health Services (x6387) should be contacted immediately.

Examples: Nitrates, Nitrites, Picric and Perchloric Acid, Peroxides.

**REACTIVE CHEMICALS**

Reactive chemicals have the potential to change dramatically under very little changes. Violent reactions such as fire, explosions, high pressure gas and heat releases can occur spontaneously with no warning.

Reactive compounds may have one or more of the following characteristics:

- Normally unstable and can undergo violent change and possibly explode (TNT).
- Highly reactive and can explode and/or emit vapors and/or gases when mixed with water (Sodium Metal).
- Highly reactive and can explode and/or emit vapors and/or gases when mixed with air.
- Strong Oxidizers (Hydrogen Peroxide).
- Shock Sensitive Compounds (Picric Acid).
- Organic Peroxides (Benzoyl Peroxide).

Reactive compounds must be treated and handled individually and cautiously. The MSDS should be consulted first before these types of materials are handled. Always use these compounds under a fume hood and refer to the MSDS for further handling and personal protective equipment instructions.

Examples: TNT, Sodium Metal, Hydrogen Peroxide, Picric Acid, Benzoyl Peroxide.