

## SCOPE OF CHP

### 1. Purpose

The Laboratory Standard is to protect laboratory employees from harm due to chemicals while they are working in a laboratory. In addition to academic and administrative employees who spend a significant amount of time working or teaching in a laboratory, the Laboratory Standard also includes as “laboratory employees” those office, faculty and staff persons who, as part of their duties, regularly spend a significant amount of time working within a laboratory environment. Students, as laboratory assistants, stockroom assistants and other positions that put them directly into the laboratory environment, and are paid by the College of Wooster, are also covered by the Laboratory Standard.

### 1.2 Scope

This document does not pre-empt the College of Wooster’s Chemical Hygiene Plan, but serves as a written guide for The College of Wooster, Department of Biology’s compliance to the Laboratory Standard and the Chemical Hygiene Plan (CHP) requirements contained therein.

The primary objective of this document is to provide a general guide for handling hazardous chemicals in laboratories. The Chemical Hygiene Plan establishes the basic safety principles for laboratory procedures, equipment, and work practices that are capable of protecting employees from physical and health hazards of hazardous chemicals in laboratories.

This document is intended only to highlight those safety measures necessary for achieving a safe and healthy work environment. Where the scope of hazards are not adequately addressed by this general document, a specific Standard Operating Procedure must be developed by the project director. This CHP does not, however, apply to:

1. Work involving chemicals that do not meet the conditions of the definition of laboratory use of hazardous chemicals. In such cases, the employer shall comply with all relevant specific substance standards even if such use occurs in a laboratory type setting.
2. Work involving the laboratory use of hazardous chemicals that does not have the potential for employee exposure.

### 1.3 Hazardous Chemical Definitions

A hazardous chemical is defined by OSHA as any chemical, chemical compound, or mixture of compounds which is a physical and/or health hazard.

A Chemical is a **physical hazard** by OSHA definition if there is scientifically valid evidence that it is:

- a flammable or combustible liquid
- a compressed gas
- an organic peroxide
- an explosive
- an oxidizer
- a pyrophoric
- an unstable material (reactive)
- a water reactive material

A chemical is a **health hazard** by OSHA definition if there is statistically significant evidence based on at least on study conducted in accordance with established scientific principles that acute or chronic health effects may occur in exposed employees. Included are:

- allergens
- embryotoxicants
- carcinogens
- toxic or highly toxic agents
- reproductive toxicants
- irritants
- corrosives
- sensitizers
- hepatotoxins (liver)
- nephrotoxins (kidneys)
- neurotoxins (nervous system)
- hematopoietic systems agents (blood)
- agents which damage the lungs, skin, eyes, or mucous membranes

**Particular hazardous substances**, by OSHA definition, are carcinogens, reproductive toxicants and chemicals with a high degree of acute toxicity.

**Select carcinogens** are chemicals listed by OSHA as carcinogens by the National Toxicology Program (NTP) as “known to be carcinogens” or “reasonably anticipated to be carcinogens” and by the International Agency for Research on Cancer (IARC) as Group 1, Group 2a, or Group 2B carcinogens are listed in Appendix 1.

**Reproductive toxicants** are defined by OSHA as any chemical which affects the reproductive capabilities of males or females, including chromosomal damage (metagenesis) and effects on fetuses (teratogenesis). Information on reproductive effects will be listed on the Material Safety and Data Sheet (MSDS).

**Chemicals with a high degree of acute toxicity** are not defined in the Laboratory Standard. The following standard will be used. Chemicals with a high degree of acute toxicity are chemicals that have a median lethal dose (LD50) of 50 milligrams or less per kilogram of body weight when administered orally to albino rabbits weighing 200 and 300 grams each. The LD50 is that dose at which a lethal response is observed in 50% of the test animals.

The following two courses have established lists of hazardous chemicals based on substantial tests:

1. OSHA, 29 CFR 1910.1200 Subpart Z, Toxic and Hazardous Substances and Appendices A and B of OSHA 29 CFR 1910.1200.
2. American Conference of Governmental Industrial Hygienists (ACGIH), "Threshold Limit Values for Chemical Substances and Physical Agents in the Work Environment," (latest edition).

The hazard(s) of a chemical may also be listed on its container label. Additionally, if the hazard of a chemical is not evident from the container label, the MSDS for the chemical will list the specific hazards.

### **1.4 Responsibility**

The project director is responsible for:

1. Ensuring all employees under his/her supervision have received general chemical training.
2. Providing all employees under his/her supervision with site-specific training and documenting such training. (See Appendix A for Awareness Certificate.)
3. Following appropriate guidelines prescribed in this document.

**Employee.** Individual laboratory employees are responsible for their own safety. All individuals performing work with hazardous substances must accept a shared responsibility for operating in a safe manner once they have been informed about the extent of risk and safe procedures for their activities. They also have the responsibility to inform their supervisors of accidents and work practices or working conditions they believe hazardous to their health or to the health of others.

**Student.** While students are not covered under the provisions of the OSHA Laboratory Standard, students should be made aware of chemical health and safety hazards in the classroom situations and should also be provided with information and equipment to protect themselves from those hazards. Individual laboratories should provide student training at the beginning of each course in which hazardous chemicals are used. Specific safety instructions should be provided at the beginning of each class period.

### **1.5 Employee Information and Training**

Employees must have access to information and training to ensure that they are apprised of the hazards of chemicals present in the work area. Such information must be provided at the time of an employee's initial assignment to a work area where hazardous chemicals are present and prior to assignment involving new exposure situations. Employees should receive periodic refresher

information and training to ensure that they are aware of the risks of exposure to hazardous chemicals.

### **1.6 General Principles:**

1. Workers should be informed of the hazards associated with chemicals used at their workplace.
2. Workers should be instructed about how to obtain and use the information provided on labels and chemical safety data sheets.
3. Workers should be trained in the correct and effective use of the control measure, in particular the engineering control measures and measure for personal protection provided, and should be made aware of their significance.
4. Employers should use chemical safety data sheets, along with information specific to the workplace, as a basis for the preparation of instructions to workers, which should be in writing if appropriate.
5. Workers should be trained on a continuing basis in the working systems and practices to be followed and their significance for the safety in the use of chemicals at work, and in how to deal with emergencies.

### **1.7 Information provided to employees should include:**

1. The contents of the OSHA Hazardous Work in Laboratories Standard (Located at [www.osha-slc.gov/OshStd\\_data/1910\\_1450\\_APP\\_A.html](http://www.osha-slc.gov/OshStd_data/1910_1450_APP_A.html)).
2. The location and availability of the College of Wooster, Biology Department CHP. (Located in room 104.)
3. The permissible exposure limits for OSHA regulated substances or published exposure limits for other hazardous chemical where there is no applicable OSHA standard. (See individual MSDS sheets-located in Room 104 & 214) (Also See Appendix P).
4. Signs and symptoms associated with exposures to hazardous chemicals used in the laboratory (available on Material Safety Data Sheets).
5. The location and availability of known reference materials on the hazards, safe handling, storage and disposal of hazardous chemicals found in the laboratory, including, but not limited to, Material Safety and Data Sheets received from the supplier.

## **1.8 Method of Training**

General training will be provided by the Biology Department Safety Officer at annual seminar. Individual instruction, group seminars, handout material, or any combination of the above may be used to reinforce the training seminar.

**General awareness training** provided to employees will include:

1. Methods and observations that may be used to detect the presence or release of a hazardous chemical (such as monitoring conducted by continuous monitoring devices, visual appearance or odor of hazardous chemicals when being released, etc.).
2. General physical and health hazards of chemicals in the work area. This must include an awareness that many factors influence whether a given chemical might constitute a hazard (e.g. Dose, exposure time, genetic background, developmental state, mixtures of interactions of chemicals, etc.).
3. The measures employees can take to protect themselves from these hazards, including specific procedures the department has implemented to protect employees from exposure to hazardous chemicals, such as appropriate work practices, emergency procedures, and personal protective equipment to be used.

## **Site-specific training**

Provided by supervisors to employees will include:

1. Site-specific standard operation procedures.
2. Specific physical and health hazards of chemicals in the work area (available on MSDS sheets).

## **1.9 Documentation**

The training certification form in Appendix A will be filled out by employees at the time of training. The Biology Department will maintain these training forms. Site-specific training must be documented and maintained by the supervisor and be available to regulatory officials upon request.

The Biology Department will retain records of all employees who attend the general Chemical Safety Seminar and the Laboratory Standard/Chemical Hygiene Plan seminar given by the Department Safety Officer and Laboratory Technician.

Accident records for employees should be written and retained within the department.

The amount of time a unit chooses to retain training records is not specified in the Laboratory Standard. It is recommended that such records be retained for at least one year after an employee leaves a position. Ideally training records should be retained indefinitely.

## 1.10 Review

The extent of the training and instruction received and required should be reviewed and include the examination of:

1. Whether workers understand when protective equipment is required, and its limitations;
2. Whether workers understand the most effective use of the engineering control measure provided;
3. Whether workers are familiar with procedures in the event of an emergency involving a hazardous chemical

## 2.0 Standard Operating Guidelines

**The College of Wooster, Chemical Hygiene Committee**, has developed generic operation procedures relevant to safety and health consideration when laboratory work involves the use of hazardous chemicals. This document is a supplement to those procedures. Where the scope of hazards are not adequately addressed by the General Chemical Hygiene Plan or by the Biology Department Chemical Hygiene plan, project directors must develop written standard operation procedures for work area specific operations. Standard operation procedures must be provided to all affected laboratory employees. The Standard Operation Guidelines in this document specify minimum regulations and recommendations.

Note: *Prudent Practices for Handling Hazardous Chemicals in Laboratories* (National Research Council, 1981). The Indiana University Chemical Hygiene Plan, and the Michigan State University Chemical Hygiene Plan were used as the basis for these following guidelines.

### 2.1 General Safety Guidelines

The following guidelines have been established to minimize hazards and to maintain basic safety in the laboratory.

- A. Examine the know hazards associated with the materials being used. Never assume all hazards have been identified. Carefully read the lable before using an unfamiliar chemical. When appropriate, review the MSDS for special handling information. Determine the potential hazards and use appropriate safety precautions before beginning any new operation.
- B. Be familiar with the location of emergency equipment-fire alarms, fire extinguishers, fire blankets, emergency eyewash, and shower stations and know the appropriate emergency response procedures.
- C. Avoid distracting or startling other workers when they are handling hazardous chemicals.
- D. Use equipment and hazardous chemicals only for their intended purposes.

- E. Always be alert to unsafe conditions and actions and call attention to them so that corrective action can be taken as quickly as possible.
- F. Wear eye and face protection when appropriate.
- G. Always inspect equipment for leaks, tears, and other damage before handling a hazardous chemical. This includes fume hoods, gloves, goggles, etc.
- H. Avoid tasting or smelling hazardous chemicals.

## **2.2 Health and Hygiene**

The following practices have been established to protect laboratory employees from health risks associated with the use of hazardous chemicals:

- A. Avoid direct contact with any hazardous chemical. Know the types of protective equipment available and use the proper type for each job.
- B. Confine long hair and loose clothing and always wear footwear which fully covers the feet.
- C. Do not mouth pipette.
- D. Use appropriate safety equipment whenever exposure to gases, vapors, or aerosols is suspected and ensure exhaust facilities are working properly.
- E. Wash thoroughly with soap and water after handling chemicals, before leaving the laboratory and before eating or drinking.
- F. Replace personal protective equipment as appropriate.
- G. Laboratory employees shall be familiar with the symptoms of exposure for the chemicals with which they work and the precautions necessary to prevent exposure. (**Check MSDS Sheets**).

## **2.3 Food and Drink in the Laboratory**

The following statement is the accepted practice on food and drink in laboratories and should be followed at all times; There shall be no food, drink, smoking or applying cosmetics in laboratories which have radioactive materials, biohazardous materials or hazardous chemicals present. There shall be no storage, use or disposal of these 'consumable' items in laboratories (including refrigerators within laboratories). Rooms which are adjacent, but separated by floor to ceiling walls, and do not have any chemical, radioactive, or biohazardous agents, present, may be used for food consumption, preparation, or applying cosmetics at the discretion of the project director responsible for the areas.

## 2.4 Housekeeping

Safety follows from good housekeeping practices. Use the following guidelines to maintain an orderly laboratory:

- A. Keep work areas clean and uncluttered with chemicals and equipment. Clean up work areas upon completion of an operation or at the end of each workday.
- B. Dispose of waste as per the College of Wooster Waste Management Plan (Available in main office, Room 104).
- C. A separate waste receptacle must be designated for non-contaminated glass. Follow guidelines established in the College of Wooster Hazardous Waste Management Plan for disposal of contaminated glass.
- D. Clean spills immediately and thoroughly, as per the guidelines established in section 4.0 of this document. Ensure a chemical spill kit is available and that employees know how to use it. (Second Floor, janitor's closet).
- E. Do not block exits, emergency equipment or controls or use hallways and stairways as storage areas.
- F. Assure hazardous chemicals are properly segregated into compatible categories (see section 5.1.4 and Appendix E of this document).

## 2.5 Chemical Handling and Storage

The decision to use a hazardous chemical should be a commitment to handle and use the chemical properly from initial receipt to disposal:

- A. Information on proper handling, storage, and disposal of hazardous chemicals and access to related MSDS should be made available to all laboratory employees prior to the use of the chemical.
- B. Always purchase the minimum amount necessary to maintain operations.
- C. Chemical containers with missing or defaced labels or that violate appropriate packaging regulations should not be accepted.
- D. Chemicals utilized in the laboratory must be appropriate for the laboratory's ventilation system.
- E. Chemicals should not be stored on high shelves and large bottles should be stored no more than two feet from floor level.
- F. Chemicals shall be segregated by compatibility.

- G. Chemical storage areas must be labeled as to their contents (see section 5.1.4.)
- H. Storage of chemicals at the lab bench or other work areas should be kept to a minimum.
- I. Any chemical mixture shall be assumed to be as toxic as its most toxic component.
- J. Substances of unknown toxicity shall be assumed toxic.

## 2.6 Transferring of Chemicals

When transferring chemicals outside the laboratory, precautions should be taken to avoid dropping or spilling chemicals:

- A. Carry glass containers in specially designed bottle carriers or a leak resistant, unbreakable secondary container.
- B. When transporting chemicals on a cart, use a cart that is suitable for the load and one that has high edges to contain leaks or spills.

## 2.7 Compressed Gases

Special systems are needed for handling materials under pressure. Cylinders pose mechanical, physical and/or health hazards, depending on the compressed gas in the cylinder.

- A. **Cylinders with regulators must be individually secured.** Only cylinders with valve protection caps securely in place may be safely gang-chained (chained in groups).
- B. When sorting or moving a cylinder, have the valve protection cap securely in place to protect the stem.
- C. Cylinders must be secured in an upright position at all times. Use suitable racks, straps, chains, or stands to support cylinders against an immovable objects, such as a bench or a wall, during use and storage. Do not allow cylinders to fall or lean against one another.
- D. Use an appropriate cart to move cylinders.
- E. Never bleed a cylinder completely empty. Leave a slight pressure to keep contaminants out.
- F. Oil or grease in the high-pressure side of an oxygen cylinder can cause an explosion. Do not lubricate an oxygen regulator or use a fuel gas regulator on an oxygen cylinder. Use an oxygen approved regulator.
- G. Always wear goggles or safety glasses with side shields when handling compressed gases.

- H. Always use appropriate gauges, fittings, and materials compatible with the particular gas being handled.
- I. When work with a toxic, corrosive, or reactive gas is planned, the Department Safety Officer should be contacted for information concerning specific handling requirements. Generally, these gases will need to be used and stored with local exhaust ventilation such as a lab hood or a gas cabinet designed for that purpose.

## **2.8 Unattended Operations**

At times, it may be necessary to leave a laboratory operation unattended. Follow these basic guidelines in the design of an experiment to be left unattended.

- A. Always check with your laboratory supervisor to determine if it is necessary to leave a laboratory operation unattended. If necessary, develop a protocol with your laboratory supervisor for the unattended operation of potential dangerous equipment or methods. Develop a protocol for potential interruptions in electric, water, inert gas and other services, and provide containment for toxic substances as part of the protocol/
- B. A warning notice must be posted in the vicinity of the experiment if hazardous conditions are present.

## **2.9 Working Alone**

Avoid working alone whenever possible. Students working after hours are not permitted to conduct research alone. Another student **MUST BE** available in the building.

## **2.10 Storage and Disposal of Hazardous Waste**

For guidelines on the storage and disposal of hazardous wastes from laboratory operations at The College of Wooster, Biology Department, refer to the College Environmental Safety Coordinator, ext. 2282.

## **3.10 Standard Laboratory Safe Handling / Storage Requirements**

The objective is to identify the hazardous properties of chemicals which may constitute a risk during normal handling or use, risks to health, property of the environment. For classification purposes the degree of hazard depends not only on the properties of a dangerous substance but also on the level of exposure. This refers to the concentration of hazardous components in the mixtures. In order to assess a preparation is essential to know also the quantities of its hazardous minor components.

### **3.1 Hazard Identification**

The following properties contribute to risk to health resulting from acute, repeated or prolonged exposure:

very toxic or toxic  
harmful  
corrosive  
irritant  
cancer causing (carcinogen)  
hazards to reproduction (teratogenic or mutagenic)  
can cause non-heritable birth defects  
sensitizing

Identify the specific hazard associated with a chemical greatly reduces chances of misuse by regular laboratory employees, new users, or visitors to the laboratory. At the very minimum, hazardous chemical containers must have the chemical name(s) and hazard identification (s). With respect to identifying containers, storage areas and laboratory entranceways, the following conditions entail hazard identification:

1. Project directors must ensure that labels on incoming containers of chemicals for laboratory use are not removed or defaced
2. Supervisors must ensure the laboratory containers (those containers filled from the original shipping container) of chemicals are properly labeled.
3. Supervisors must ensure that hazardous chemical storage areas are labeled per the guidelines established in sections 5.1.4.
4. Supervisors must ensure that entranceways to laboratory facilities are labeled with the appropriate warning signs per the guidelines established in section 5.1.2.

### **3.2 Hazards Subject to Review or Prior Approval**

The Laboratory Standard requires that project directors identify those activities that the project directors believe to be of a sufficiently hazardous nature to warrant prior to approval before implementation by an employee.

### **3.3 Chemicals Developed in the Laboratory**

The following requirements apply to chemical substances developed in the laboratory:

1. If the composition of the chemical substance which is produced exclusively for the laboratory's use is known, the supervisor must determine if it is a hazardous chemical. This can be done by a literature search for similar substances. If the chemical is determined to be hazardous, the supervisor must provide appropriate training to protect employees.
2. If the chemical produced is a product or a by-product whose composition is not known, the supervisor must assume that the substance is hazardous and must comply with the requirements of the CHP.

## 3.4 Labeling

### 3.4.1 Container Labels

All containers of chemicals must be labeled with:

**name of the chemical**

**hazard(s).** (Flammable, poison, corrosive, etc.) If a chemical has more than one hazard, it must be labeled with both hazards. For example, acetaldehyde is both a flammable and a carcinogen.

**fire class** if applicable

**storage code**

green- nonintrusive chemicals

blue- health risk

white- corrosive

red- flammable

yellow- reactive

**assigned identification number** (available from the laboratory technician or secretary)

Additionally, the following guidelines will be followed:

1. All peroxide forming chemicals must be labeled with the date the container was opened. After the recommended disposal date, test chemical for peroxides or dispose of properly (see Appendix F for a list of peroxide forming chemicals and peroxide testing protocols).
2. Anything available over the counter to the general public is exempt from labeling requirements if it has already been labeled by the manufacturer. This includes consumer products such as cans of spray paint or turpentine.
3. Portable containers into which hazardous chemicals are transferred from labeled containers and which are intended to be under the use and control of the person who transferred it, within the work shift in which it was transferred, are exempt for labels. However, it is recommended that a temporary label identifying the chemical and its primary hazard be affixed to the container.
4. All sample containers or prepared solutions must be labeled. If there is a large quantity of container with the same chemical, labeling of the container, tray, cupboard or refrigerator will suffice.

### 3.4.2 Waste Containers.

All hazardous chemical waste should be segregated and labeled according to the College of Wooster Waste Management Plan. Special attention should be given to the following areas:

1. Waste containers for non-contaminated glass must be labeled “**Broken Glass**” and kept separate from other non-contaminated waste.
2. Upon initial waste collection, attach a dated Materials Pick Up tag and label containers with the words “Hazardous Waste.”
3. Store in the Stock Room on the 2<sup>nd</sup> floor in designated area until pickup.

### **3.5 Special Considerations**

The OSHA Laboratory Standard requires that special precautions for additional employee protection be followed for the laboratory use of select carcinogens, reproductive toxicants and chemicals with a high degree of acute toxicity (defined in section 1.3).

Protection from these hazards is provided by assuring exposure to such hazards is minimized, i.e. kept under the PEL, TLB, or STEL, or eliminated. To minimize exposure, it is necessary to determine the route by which exposure may occur, whether by inhalation, absorption, injection, ingestion, or a combination of exposure routes. To ensure employees do not receive exposures in excess of the PEL or TLV, hygienic standards have been established for many toxic materials. The following general hygiene standards should be observed when using select carcinogens, reproductive toxicants and chemicals with a high degree of acute toxicity.

#### **Establish a designated area.**

- A. Use and store materials only in designated areas: a restricted access hood, glove box, or portion of a lab, designated for use of highly toxic substances. Assure that all personnel with access are aware of necessary safety precautions.
- B. Label all containers, storage, and use areas appropriately. Follow the guidelines established in sections 3.4.1, 5.1.3, and 5.1.4 of this document.

#### **Use proper containment devices for the protocol and chemical(s) being used.**

- A. Use a hood or other containment device for procedures which may result in the generation of aerosols or vapor; trap released vapors to prevent their discharge with fume hood exhaust.
- B. It is recommended that breakable containers be stored in chemical-resistant trays. Work and mount apparatus above such trays or cover work and storage surfaces with removable, absorbent, plastic backed paper.

#### **Removal of Contaminate Waste**

Follow the guidelines established by the College of Wooster, Waste Management Plan.

**Always take extra precautions when working with particularly hazardous chemicals.**

Guard against spills and splashes. Appropriate safety apparel, especially gloves, should be worn. All hoods, glove boxes, or other essential engineering controls should be operation properly before work is started.

Notify the College Environmental Safety Coordinator of all incidents of exposure or spills.

### **3.6 Physical Hazards**

Materials which present a physical hazard (see section 1.3) can be safely used if the specific hazard(s) are understood. If appropriate precautions are not taken, personal injury or property damage may occur. Additionally, certain chemicals cannot be safely mixed or stored with other chemicals because of the danger of a severe or extremely toxic reaction. See Appendix E for a table of incompatible chemicals.

#### **3.6.1 Flammable/Combustible Material:**

Fire and explosion hazards may be classified as follows:

- explosive
- oxidizing
- extremely flammable
- highly flammable
- flammable

The following chart is helpful in determining the fire class of a flammable:

#### **Flammable Flash Point Boiling Point**

- Class IA <73oF (22.8oC) <100oF (37.8oC)
- Class IB <73oF (22.8oC) >=100oF (37.8oC)
- Class IC >=73oF (22.8oC)

#### **Combustible**

- Class II >=100oF (37.8oC) & 140oF (60oC)
- Class IIA >=140oF (60oC) & < 200oF (93oC)
- Class IIIB >=200oF (93oC)

These classes give measure of the fire risk. Appendix G lists some common flammable and combustible chemicals.

Note: the flash point is defined as the minimum temperature at which a liquid or solid gives off vapor in sufficient concentration to form an ignitable mixture with air near the surface of the liquid or solid. For handling Flammable/Combustible materials, observe the following guidelines.

- A. Eliminate ignition sources such as open flames, hot surfaces, sparks from welding or cutting, operation of electrical equipment, and static electricity.
- B. Store in NFPA approved flammable liquid containers or storage cabinets, in an area isolated from ignition sources. (A Flammable cabinet is available in rooms 107, 212, 301, and 308.)
- C. Ensure there is proper bonding and grounding when it is required, such as when transferring or dispensing a flammable liquid from a large container or drum. Assure bonding and grounding is checked periodically.
- D. Assure appropriate fire extinguishers are in the area. And know the location of these extinguishers

### **3.6.2 Corrosives:**

Are materials which can react with the skin causing burns similar to thermal burns, and/or which can react with metal causing deterioration of the metal surface. See Appendix I.

- A. Containers and equipment used from storage and processing of corrosive materials.

### **3.6.3 Oxidizers:**

**Are** materials which react with other substances by giving off electrons and undergoing reduction. This reaction may result in fire or explosion. The intensity of the reaction depends on the oxidizing-reducing potential of the materials involved. See Appendix J.

- A. Known the reactivity of the materials involved in the experiment or process. Ensure there are no extraneous materials in the area which could become involved in a reaction.
- B. If the reaction is anticipated to be violent or explosive, use shield or other methods for isolating the materials or the process.

### **3.6.4 Water Reactive Materials:**

**Are** materials which react with water to produce a flammable or toxic gas or other hazardous condition. Often a fire or explosion may results. Safe handling of water reactive materials will depend on the specific material and the conditions of use and storage. Examples of water reactive chemicals include alkali metals such as lithium, sodium, and potassium; acid anhydrides, and acid chlorides.

**3.6.5 Pyrophoric Materials:** Materials which ignite spontaneously upon contact with air. Often the flame is invisible. Examples of pyrophoric materials are silan, silicon tetrachloride, and white or yellow phosphorous. Pyrophoric chemicals should be used and stored in inert environments.

**3.6.6. Peroxidizable Chemicals (Organic Peroxides):** Materials which undergo auto-oxidation (a reaction with oxygen in the air) to form peroxides (an O<sub>2</sub> group) which can explode with

impact, heat, or friction. Since these chemicals may be packaged in an air atmosphere, peroxides can form even though the container has not been opened, necessitating careful handling. See Appendix F for a list of materials which may form peroxides.

- A. Date all peroxidizable upon receipt and upon opening. Dispose of or check for peroxide information after one year.
- B. Do not open any container which has obvious solid formation around the lid.
- C. Addition of an appropriate inhibitor to quench the formation of peroxides is recommended.
- D. It is recommended to chemically test for peroxides periodically.
- E. Follow the same basic handling procedures as for flammable materials.

### **3.6.7 Light-Sensitive Materials:**

Are materials which degrade in the presence of light, forming new compounds that can be hazardous or resulting in conditions such as pressure build-up inside a container which may be hazardous. Examples of light sensitive materials include chloroform, tetrahydrofuran, ketones, and anhydrides. Store light-sensitive materials in a cool, dark place in amber colored bottles or other containers which reduce or eliminate penetration of light.

### **3.6.8 Unstable Materials:**

Are compounds which can spontaneously release large amounts of energy under normal conditions, or when struck, vibrated, or otherwise agitated. Some chemicals become increasingly shock-sensitive with age. Of great concern in the laboratory is the inadvertent formation of explosive or shock-sensitive materials such as peroxides, perchlorates (from perchloric acid), picric acid and azides. A list of shock sensitive and explosive materials is provided in Appendix K.

- A. Contact the College of Wooster Environmental Safety Coordinator when it is suspected that the inadvertent formation of shock-sensitive materials in ductwork, piping, or chemical being stored has occurred
- B. Date all containers of explosives or shock-sensitive materials upon receipt and when opened.
- C. If there is a chance of explosion, use barriers or other methods of isolating the materials or the process.

### 3.6.9 Radioactive Material

#### General Instructions of researchers and Students Using Radioactive Materials

NRC License 313 Radiation Safety Officer: Dean Fraga  
License Renewal 34-11812-01 X2556

- A. **Acquiring radioactive materials:** All radioactive materials included in this license shall be dispensed by the Radiation Safety Officer (RSO) who will give them only to personnel who are known to have received training appropriate for use of that material. The amounts of radioactivity dispensed will be limited to the smallest quantity required for the purposes needed. Instructional use will normally not exceed 50  $\mu\text{Ci}$ . Research use will normally not exceed 0.5  $\mu\text{Ci}$  per experiment.
- B. **Handling of radioactive materials:** Users will routinely be required to wear disposable gloves, a lab coat, and remote manipulation of liquids using a pipeting bulb with disposable pipets or micropipetor with disposable tips. Other disposable items such as centrifuge tubes will be used when possible. Special care will be exercised to see that larger quantities of radioactivity (0.5-2.5  $\mu\text{Ci}$ , the maximum licensed limit) are handled by trained professionals, not by students. Avoid personal contamination by not eating, drinking or smoking in a control area. Non-essential items for the work in progress such as outerwear and book bags will be kept out of the control area.
- C. **Volatile radioactive materials:** These will be used in a designated fume hood with the fan on. When possible, these materials will remain in the hood throughout the procedure in which they are used. In no case should they be exposed to the atmosphere when outside of the hood. Hoods in use will be checked initially and at six-month intervals for operability and expected face velocities. The RSO will maintain a log of inspections.
- D. **Shielding:** One  $\mu\text{Ci}$  or more of hard beta or gamma emitting isotopes ( $^{32}\text{P}$ ,  $^{86}\text{Rb}$ ,  $^{22}\text{Na}$ ) will be manipulated behind low density shielding (e.g., Plexiglas). A mandatory survey and wipe test will be carried out after each use. A ring film badge will be worn. A dry run will be completed when a new procedure is put in place in the presence of the RSO to avoid unexpected complications.
- E. **Contamination survey:** At the end of each day's work with radioactive isotopes, the surfaces which potentially could have become contaminated will be surveyed with a survey meter (hard beta or gamma emitters) or a wipe test (soft beta emitters). Contaminated surfaces will be identified, isolated, and decontaminated according to spill procedures (page) Wipe tests with more than 220 d/m per 100  $\text{cm}^2$  or survey meter readings more than 2X background will require decontamination. Record these tests on the Survey Meter/Wipe Test Report Form.

#### **F. Transporting radioactive materials:**

Radioactive materials transported outside of control areas will be in shatterproof containers with adequate shielding to reduce incident radiation to acceptable levels (10 CFR 20, paragraphs 20.101 and 20.103) Shielding will be measured by a survey meter. Materials will be confined to Matter hall and Severance Hall which are connected by a hallway so that movement of materials will not be outside these premises.

#### **G. Labeling radioactive materials:**

All radioactive materials will be identified on their containers by labels with standard symbols identifying contents by isotope, form, radioactivity, date, and specific activity. Rooms containing radioactive materials will be placarded at their entrance. The placard will include phone numbers of the RSO for emergency use.

#### **3.6.10 Doing a Radiation Survey**

- A. Prepare a 70% ETOH solution and place in beaker.
- B. Cut filter paper into small squares and soak in ETOH solution.
- C. Prepare scintillation vials by adding 25 mLs of scintillation cocktail to each.
- D. Clearly identify each vial as to room and location (an identification key is acceptable, just be sure to include it with the results).
- E. Use the soaked filter paper as swabs for collecting samples from various surfaces. These should be rubbed on the surface vigorously for a few seconds and then placed into a scintillation vial.
- F. Be sure to take swipes from areas that you are sure are not radioactive (to be used as controls).
- G. Collect all vials and use the scintillation counter to obtain readings.

#### **3.6.11 Emergency Procedure**

##### **Minor Spills:**

- A. Notify persons in the area that a spill has occurred.
- B. PREVENT THE SPREAD: Cover the spill with absorbent paper.
- C. CLEAN UP: Use disposable gloves and remote handling tongs. Carefully fold the absorbent paper and pad. Insert into a plastic bag and dispose of in the radioactive waste container. Include all other contaminated materials such as disposable gloves.

- D. Survey: For hard beta and gamma emitters use the G.M. Survey Meter, check the area around the spill, your hands and clothing for contamination. Make a wipe test for soft beta contamination.
- E. Report: Report incident to the Radiation Safety Officer on the Survey Meter/Wipe Test Form.

## **Major Spills**

- A. CLEAN THE AREA: Notify all persons not involved in the spill to vacate the room.
- B. PREVENT THE SPREAD: Cover the spill with absorbent pads, but do not attempt to clean it up. Confine the movement of all personnel potentially contaminated to prevent the spread.
- C. SHIELD THE SOURCE. If possible, the spill should be shielded, but only if it can be done without further contamination or without significantly increasing your radiation exposures.
- D. CLOSE THE ROOM. Leave the room and lock the door(s) to prevent entry.
- E. CALL FOR HELP. Notify the Radiation Safety Officer (Dean Fraga, 262-6110) immediately.
- F. PERSONAL DECONTAMINATION. Contaminated clothing should be removed and stored for further evaluation by the Radiation Safety Officer. If the spill is on the skin, flush thoroughly and then wash with mild soap and lukewarm water.

Wipe surveys in areas where work has been performed, where radioactive materials are stored, and in the area of a spill, will be used when low energy Beta emitters are involved. The survey will consist of wiping the containers, bench top, or other possible contaminated surfaces, with moistened filter paper disc two inches in diameter and recording the activity in liquid scintillation counter. Results exceeding 22 d/m per 100 cm<sup>2</sup> required decontamination.

## **4.0 Waste Management**

### **4.1 Effluent waste:**

Liquid and soluble radioactive waste will be diluted to the standards Appendix B, Table 2 column 2 or 10x Appendix C, 10 CFR Part 20 prior to discharge in designated drains (sinks). They will be ca. pH 7. These combine with the wastes from the total three story building before being discharged into the city sewer.

## **4.2 Solid wastes:**

Items such as scintillation vials, liquid column chromatographic packing, and disposable plastic ware will be stored in a location so that it does not create a hazard until there is no incident radiation above background. Contaminated materials will be segregated by isotope and date of receipt so that those with short half-lives can be decontaminated by decay more easily.

## **4.3 Carcasses of animals exposed to radioactive tracers:**

These will be stored at -20oC in freezer that also provides adequate shielding against emission of radiation until they are no longer radioactive. Animal wastes will be stored until they have no radiation above background.

## **4.4 Environmental monitoring:**

This will not be required for unrestricted areas because radiation will no exceed background.

**Wastes may be transferred to a waste disposal vendor**

## **5.0 Emergency/Medical Procedures**

### **5.1 Basic steps for Emergency and Spill Response**

Release of hazardous substances that pose a significant threat to health and safety or that, by their very nature, require an emergency response regardless of the circumstances surrounding the release or the mitigating factors are emergency situations. The following definitions designate an emergency situation:

1. The particulars of the situation are unclear to the person causing or discovering the spill.
2. The release requires evacuation of persons.
3. The release involves or poses a threat of
  - Fire, suspected fire, explosion or other imminent danger
  - Conditions that are Immediately Dangerous to Life and Health (IDLH)
  - High levels of exposure to toxic substances.
4. The person(s) in the work area is uncertain they can handle the severity of the hazard with the personal protective equipment (PPE) and response equipment that has been provided and/or the exposure limit could easily be exceeded

Conversely, releases that do not pose significant safety or health hazards to person(s) in the immediate vicinity or to the persons cleaning releases, do not have the potential to become

emergencies within a short time frame are not emergency situations. The following situations **ARE NOT emergency situations:**

1. The person causing or discovering the release understand the properties and can make an informed decision as to the exposure level.
2. The release can be appropriately cleaned up by the lab personnel using authorized (certified) spill kits (available in the 2<sup>nd</sup> floor janitor's closet).
3. The materials are limited in quantity, exposure potential, or toxicity and present minor safety or health hazards to persons in the immediate work area or those assigned to clean up the activity.
4. Incidental releases of hazardous substances that are routinely cleaned up by trained custodians from outside the immediate release area need not be considered an emergency.

### **5.2 Emergency Situation- Fire:**

All employees should be trained in the proper use of handling a fire extinguisher. Each employee should make themselves familiar with the locations of fire extinguishers, fire blankets, and fire alarms.

**NEVER place yourself at risk to extinguish a fire.** The following are basic protocol for handling a fire or fire-related emergency situation in the laboratory.

1. Pull the fire alarm
2. Notify security x2590 or x8888
3. Evacuate

**5.3 Emergency situation- Spill.** If the spill is of high toxicity of flammability, or you are unsure of how to proceed, or is greater than one liter, execute the following.

1. Notify security x2590 or x8888
2. Evacuate personnel from the spill area and alert surrounding areas to the spill.
3. Isolate the spill area and close doors to the room where the spill occurred.
4. Remove ignition sources and shut down equipment.
5. Establish exhaust ventilation to the outside of the building only.
6. Open windows.

**Evacuation of the building is mandatory if chemicals or contaminants could enter the air circulation system of the building or in the case of fire.**

**Attend to victim for body splash:**

1. Remove person(s) from spill area to fresh air only if this attempt to receive victim(s) does not present a danger to the rescuer(s).
2. Remove contaminated clothing while under an emergency shower (located on each in the hallway and between rooms 102 and 103)
3. Flood affected area with cool water for at least 15 minutes or longer if pain persists.
4. Wash skin with mild soap and water- do not use neutralizing chemicals, unguents, creams, or lotions..
5. Contact security x2590 or x8888 and then dial 9-911 for transport to emergency facility.
6. Contact the College Environmental Safety Coordinator and inform what chemical(s) is involved.

**Attend to victim for an eye splash:**

1. Remove victim(s) from spill area to fresh air only if this attempt to rescue victim(s) does not present a danger to the rescuer(s).
2. Lead the victim(s) immediately to an emergency eye wash facility (one is located in each laboratory)
3. Hold eyelids open.
4. Flush eyes for at least 15 minutes or longer if pain persists.
5. Contact security x2590 or x8888 and dial 9-911 for transport to emergency facility.
6. Contact College Environmental Safety Coordinator and inform what chemical(s) is involved.

**5.4 Mercury Spills.**

For very small spills, less than 1 cc, such as a broken thermometer, use a mercury sponge.

1. Do not use a domestic or commercial vacuum cleaner
2. Cover small droplets in accessible areas with one of the following:
  - mercury absorb sponge
  - mercury absorb powder

3. Place residue in special labeled Ziploc bag
4. Place bag in hood.
5. Call the College Environmental Safety Coordinator to request mercury vapor monitoring.

**For large spills, i.e. greater than 1 cc, contact the College Environmental Safety Coordinator for spill cleanup, instructions or assistance.**

### **5.5 Spill kits:**

Ready access to a chemical spill kit is required in laboratories that work with hazardous chemicals. Minimally, such a kit should contain

- a flashlight
- splash resistant goggles
- chemical resistant gloves
- plastic bags
- multi-chemical sorbent (enough for a two gallon spill)
- scooper

**Most spills greater than 1 liter in volume require assistance from a trained personnel from the College Environmental Safety Coordinator.**

Some sorbents are chemically specific. The best sorbents are those which can be used to clean up all types of chemical spills. Check absorbents in spill kits for their absorbency range.

Each laboratory's spill kit should be kept in a readily accessible location and each employee should be trained on how to use the spill kit.

### **5.6 Non-Emergency Situation-Spill:**

If the spill is less than one liter and the chemical involved is of low toxicity and low flammable hazard, handle it in the following manner:

**If there are any questions about proper spill response techniques, call the College Environmental Safety Coordinator at 2282.**

1. Locate the spill kit.
2. Choose the proper protective equipment:
  - Always wear gloves and protective eyewear
  - Use additional protective equipment such as an apron, coveralls, or boots.
  - Use a fitted respirator if there is an inhalation hazard above the permissible exposure limit.
3. Confine or contain the spill.

### **For non-reactive spills**

- A. Cover liquids spills with a spill kit absorbent and scoop into a plastic disposal bag.
- B. Sweep solid material into a dustpan and place in a sealed container.
- C. Dispose of waste as normal trash as long as substance is non-volatile, non-hazardous.

### **For reactive or potentially reactive spills:**

- A. Cover liquid spill with spill kit absorbent and scoop into an appropriate disposal container.
- B. Wet mop dry substances to avoid spreading hazardous dust, provided it is non-water reactive.
- C. If spilled chemical is a volatile solvent, transfer disposal bag to a hood for evaporation of a solvent.

### **5.7 Power Outages.**

The following steps should be taken:

- Place lids on all open containers of volatile chemicals
- Lower the sash on chemical fume hoods
- Shut down all equipment (leaving cooling water and purge gases on as necessary)
- Turn off ignition sources
- Secure or isolate reactions that are underway (boiling liquid on a hot plate, distillations\_)
- Close fire doors

In anticipation of possible power outages, do the following:

Have a flashlight conveniently located or other emergency lighting

Make sure that all emergency contact numbers on the door are accurate and updated

### **5.8 Injury and illness**

For medical treatment, under current College of Wooster policies and procedures, affected employees must seek care from The Center for OCC Med between 8 a.m. to 5 p.m. Monday through Friday or Wooster Community Hospital, Emergency Department.

The supervisor or instructor must ensure that the appropriate injury forms are completed. The forms are available from the Human resource Department. If you have any questions regarding injury and illness procedures, contact your supervisor, instructor, of the **College Environmental Safety Coordinator**.

## **First Aid Kits:**

First aid kits are accessible in each laboratory. These kits are for use on minor injuries only, cuts, scrapes, etc. **Do not** put any ointments or cream on wounds or burns. Use cool water. The MSDS contains specific first aid information for a given chemical, but emergency room treatment is best.

## **5.9 Medical Consultations and Examinations:**

The laboratory will provide the following information to a physician treating an employee.

1. The identity of the hazardous chemical(s) to which the employee may have been exposed.
2. A description of the conditions surrounding the exposure, including available quantitative exposure data.
3. A description of the signs and symptoms of exposure that the employee is experiencing, if any.

## **6.0 Laboratory Facility Requirements**

### **6.1 Signs and Information**

Labels and warning signs should alert employees to potentially hazardous material and allow those unfamiliar with the laboratory surrounding to identify hazardous chemical use and storage areas, safety facilities, emergency equipment and exits to aid emergency response personnel. Signs and labels are generally available from the stock room.

### **6.2 Material Safety Data Sheets (MSDS)**

A material Safety Data Sheet (MSDS) is a document containing chemical hazard identification and safe handling information and is prepared in accordance with the OSHA Hazard Communication Standard and the Right-to-Know law.

Chemical manufacturers and distributors must provide the purchasers of hazardous chemicals an appropriate MSDS for each hazardous chemical/product purchased.

The original MSDS's received are stored in 105 which is open 24/7/365.

### **6.3 Generic Signs**

Every laboratory shall have the following signs visibly posted:

1. Emergency contact number (two names, preferably the Ph.D., technician or appropriate individual) shall be posted on the external doorway to the lab. The names and numbers

shall be updated with personal changes. In case of an emergency, responders need this information to contact knowledgeable personnel about specific laboratory hazards.

2. If a laboratory has 10 gallons or more of a flammable liquid, the main doorway to the lab shall have a flammable sticker visibly posted on it. This is an aid to fire response personnel.

#### **6.4 Restricted Access and Designated Areas.**

Facilities containing certain hazards must have warning signs posted at the designated area of the laboratory where the hazard exists, and at the entranceway to the laboratory. Any areas placarded as such are restricted access, designated areas and have certain standards regarding training and use by employees. Such hazards include”

- OSHA Class A carcinogens
- Radioisotopes
- Other chemical hazards will be dealt with on a case-by-case basis, with consultation from the Safety Committee

\*Please contact the Department Safety Officer or the Radiation Safety Officer for requirements on these items.

#### **6.5 Storage Areas.**

Chemicals should be stored according to compatibility (see Appendix E), as designated by hazard classes. Particularly hazardous chemicals should be stored and handled with extreme care. When ordering chemicals that are unfamiliar, review the MSDS before purchase so that use and storage guidelines are understood. Assure that the following areas are labeled and chemicals are stored appropriately:

- Carcinogens
- Corrosives
- Flammable Liquids
- Flammable Solids
- Oxidizers
- Perchloric acid

Additionally, storage areas for biohazardous agents and radioisotopes should be appropriately labeled. Please contact the Department Safety Officer or the Radiation Safety Officer for information.

#### **6.6 CONTROL MEASURES:**

1. The Project Director must implement control measure to reduce employee exposure to hazardous chemicals. The three types of control measures are:

- A. Administrative Control: methods of controlling employee exposures to contaminants by job rotation, work assignment or time periods away from contaminant. Examples include Standard Operating Procedures, Chemical Hygiene Plans and Safety Manuals.
  - B. Engineering Controls: methods of controlling employee exposures by modifying the source or reducing the quantity of contaminant released into the work environment. Examples include fume hoods and biosafety cabinets.
  - C. Personal Protection Equipment: personal safety equipment designed for secondary employee protection from hazardous chemicals. Examples include gloves, lab coats, and safety goggles.
2. Control measures are required when the following circumstances are met:
- A. Whenever employees use hazardous materials.
  - B. Whenever employee exposure exceed the action level (or, in the absence of action level, the Permissible Exposure Limit (PEL) the published exposure limit or the Threshold Limit Value (TLV)).
  - C. Upon addition of new chemicals or changes in procedures.
3. The following general control measures are recommended for use in most situations requiring the use of hazardous chemicals:
- A. Use the following primary methods for detecting exposures.
    - i. Determine the source of exposure
    - ii. Determine the path the contaminant follows to reach the employee.
    - iii. Determine the employee's work pattern and use of personal protective equipment.
    - iv. Change one or more of the above pathways to reduce or eliminate exposure.
  - B. Substitute less harmful chemicals for more harmful chemicals whenever possible.
  - C. Change or alter processes to minimize exposure
  - D. Isolate or enclose a process or work operation to reduce the number of employees exposed (for example, use a fume hood)
  - E. Use wet methods to reduce the generation of dust.
  - F. Use local exhaust ventilation (hoods) at point of generation or dispersion of contaminants and use dilution (general) ventilation to reduce air contaminants.
  - G. Practice good housekeeping procedures to reduce unnecessary exposures.
  - H. Use training and education as primary administrative controls for reducing exposures.
  - I. Use special control methods such as shielding and continuous monitoring devices to control exposures in special situations.

## **6.7 PERSONAL PROTECTION AND SAFETY EQUIPMENT:**

Maintaining a safe laboratory environment is the responsibility of the Project Director, but **all employees play a role in observing safety guidelines**. Personal Protective devices and safety equipment must be provided to all employees under the appropriate circumstances and employees have the responsibility of properly using such equipment.

The MSDS will provide some information of the personal protective equipment and safety procedures recommended for a given chemical, through the MSDS may not provide sufficient information concerning the specific type of safety equipment required (for example, it may say “use gloves” but not list the best glove to use.

### **6.7.1 Personal Protective Eye Protection:**

Eye protection must be made available to all employees or visitors to laboratories where chemicals are used and stored. Protective eye and face equipment must be used where there is a reasonable probability of injury from hazardous chemicals that can be prevented by such equipment. The minimum acceptable requirements are for hardened glass or plastic safety spectacles. The Project Director should establish the level of eye protection needed per laboratory activity. Specialized types of eye protection, such as ultraviolet light restricting safety glasses, are available. The following types of eye protection are recommended for use in the laboratory by ANSI:

All eye protective devices must be stamped with “Z87” by the manufacturer if they meet ANSI standards. If the eye protection is not marked, it may not be the most effective protection available.

1. Safety glasses with side shields offer minimal protection against flying fragments, chips, particles, sand and dirt. When a splash hazard exists, other protective eye equipment should be worn.
2. Safety goggles (impact goggles) offer adequate protection against flying particles. These should be worn when working with glassware under reduced or elevated pressure.
3. Chemical splash goggles (acid goggles) have indirect venting for splash proof sides, which provide adequate protection against splashes. Chemical splash goggle offer the best eye protection from chemical splashes. Impact goggles should not be worn when danger of a splash exist.
4. Face shields protect the face and neck from flying particles and splashes. Always wear additional eye protection under face shields. Ultra-violet light face shields should be worn when working under UV light sources.

### **6.7.2 Protection of Skin and Body:**

Skin and body protection involves the use of protective clothing to protect individuals from chemical exposure. Determine clothing needed for the chemical being used, as protective garments are not equally effective for every hazardous chemical. Some chemicals will permeate a garment in a very short time, whereas others will not.

The basic and most effective forms of protection are gloves and lab coats.

Protect exposed skin surfaces when there is a reasonable anticipation of a splash. Avoid wearing open-toed shoes, sandals, shorts, etc. when working with injurious or corrosive chemicals.

Even when there is minimal danger of skin contact with an extremely hazardous substance, lab coats, coveralls, aprons, or protective suits should be utilized. **These garments should not leave the work site.**

Exposure to strong acids and acid gases, organic chemicals and strong oxidizing agents, carcinogens, and mutagens require the use of specialized protective equipment that prevents skin contamination. Impervious protective equipment must be utilized. Examples include: rubber gloves, aprons, boots, and protective suits.

### **6.7.3 Respirators:**

Prior to using a respirator for the first time or for a new activity, employees must have received instruction, undergo a fit test and answer a physical questionnaire. Please contact the College Environmental Safety Coordinator for proper instruction.

## **6.8 Safety Equipment**

### **6.8.1 Safety Showers.**

Safety showers provide an immediate water drench of an affected person.

1. The location of showers should be clearly marked, well lighted and free from obstacles. (See Appendix R for location of showers).
2. Safety showers should be checked and flushed periodically.

### **6.8.2 Eye Wash Facilities:**

Eye wash facilities are required in all laboratories where injurious or corrosive chemicals are used or stored.

1. Optimally, those affected must have both hands free to hold open the eye to ensure an effective wash behind the shields. This means providing eye wash facilities that are operated by a quick release system and simultaneously drench both eyes.

2. Eye wash facilities must provide the minimum of a 15-minute water supply at no less than 0.4 gallons per minute.
3. Eye wash facilities must not exceed 25 PSI.
4. Eye wash facilities should be flushed out for five minutes at a time, once per week. A log documenting flushes is recommended.

## **6.9 Ventilation Controls:**

Ventilation controls are those controls intended to minimize employee exposure to hazardous chemicals by removing air contaminants from the work site. There are two main types of ventilation controls:

1. General (Dilution) Exhaust: a room or building-wide system which brings in air from outside and ventilates within. Laboratory air must be continually replaced, preventing the increase of air concentration of toxic substances during the workday. General exhaust systems are not recommended for the use of most hazardous chemicals.
2. Local Exhaust: a ventilated, enclosed workspace intended to capture, contain and exhaust harmful or dangerous fumes, vapors and particulate matter generated by procedures conducted with hazardous chemicals.

To determine ventilation requirements, assess the MSDS. Some MSDS terminology, as listed below, may indicate a need for special ventilation considerations beyond general exhaust ventilation.

- Use with adequate ventilation
- Avoid vapor inhalation
- Use in a fume hood
- Provide local exhaust ventilation

Proper Use of Local Ventilation Systems: Once a local ventilation system is installed in a work area, it must be used properly to be effective. For use of hazardous chemicals warranting local ventilation controls, the following guidelines should be observed:

1. Conduct all operations which may generate air contaminants at or above the appropriate PEL or TLV inside a fume hood.
2. Keep all apparatus at least 6 inches back from the face of the hood and keep the slots in the hood baffle free of obstruction by apparatus or containers. Large equipment should be elevated at least two inches off the base of the fume hood, to allow for the passage of air underneath the apparatus.
3. Do not use the hood as a waste disposal mechanism except for very small quantities of volatile materials.

4. Minimize foot traffic and other forms of potential air disturbances past the face of the hood.
5. Keep the hood sash closed at all times except when hood is in use.
6. Minimize storage of chemicals or apparatus in the hood.
7. Do not have sources of ignition inside the hood when flammable liquids or gases are present.
8. Use a sash as a safety shield when boiling liquids or conducting an experiment with reactive chemicals.
9. Periodically check the airflow in the hood using a continuous monitoring device or another source of visible airflow indicator. If airflow has changed, contact College Environmental Safety Coordinator or Physical Plant for repair.

The system must be checked prior to each use to assure it is operation. Never work with hazardous chemicals if the required ventilation system is not working.

Hood inspections should be performed annually. After an inspection, hoods are passed or failed for use based on the following criteria:

1. The face velocity of air being drawn into the hood at maximum sash height is measured quantitatively in feet per minute (fpm) by a thermoAnemometer (a hot wire). One measurement is taken per square foot of face space and averaged. Hoods must have an average face velocity of 60-150 fpm, depending on their design, with 100 fpm being the ideal average face velocity.
2. The turbulence of the air is measured qualitatively by releasing smoke from a smoke tube. The smoke must be captured by the hood, with a minimum of turbulence.

If the exhaust system does not pass the face velocity test and/or has excessive turbulence, it will be posted as “failed” by the inspector. The lab instructor must contact Physical Plant to have the system repaired before hazardous chemicals can be used in the hood.

If the exhaust system does pass, the inspector will post the date of inspection and will mark the hood to indicate proper sash position for optimum hood performance. The hood sash should be set at this point for procedure which could generate toxic aerosols, gases, or vapors. In general, the sash height should be set at a level where the operator is shielded to some degree from any explosions or violent reaction which could occur and where optimum airflow dynamics are achieved. If a fume hood has no markings regarding sash height or inspection dates, please contact the Department Safety Officer to arrange for an inspection.

Certain types of local exhaust systems are not designed for the use of hazardous chemicals. If a local exhaust system’s capabilities are not fully understood, check the manufacturers’ specification before using hazardous chemicals in the system.

Proper use of Ductless Ventilation Systems: Ductless, or portable fume hoods, which employ filtration media, may be an option to conventional local exhaust hoods.

Standard Repair/Close-out/Decommissioning Procedures

### **6.10 Decontamination of Equipment:**

When a request for equipment repair or transfer to another location is initiated, the following steps must be taken to ensure the safety of the employees responsible for repair or transfer if the equipment has been contaminated by hazardous chemicals:

- A. Remove chemical contaminants with an appropriate solvent or cleaning solution.
- B. Once contaminants have been eliminated, fill out an “Equipment Release Form” (located in the main Biology Office) and place in a prominent position on the equipment to be repaired or transferred. The equipment must have the Equipment Release Form affixed for initiation of repair or transfer.

**Appendix A- Awareness Certification**

The Occupational Safety and Health Administration (OSHA) requires that all laboratory employees be made aware of the Chemical Hygiene Plan (CHP) at their place of employment.

By signing the certification form, you acknowledge that you are aware of the Biology Department's CHP and the policies and procedures applicable to the OSHA Laboratory Standard and have read the Safety Manual.

NAME (Please Print)

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SIGNATURE

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**Appendix B  
Laboratory Checklist**

**GENERAL**

Y N NA

1	Emergency phone numbers posted on the laboratory door			
2	Warning signs posted on doors			
3	All personnel know how to obtain MSDS sheets			
4	All personnel have received Lab Specific Training			
5	Lab coats are available			
6	Chemical protective gloves are available			
7	Safety glasses/goggles are available			
8	An eyewash fountain/bottle is present			
9	An emergency shower is available			
10	Food and beverages are not stored or used in lab			
11	Aisles are uncluttered and without a tripping hazard			
12	Chemical spill kits are available			
13	Non-contaminated sharp objects in labeled puncture-proof containers			
14	Fume hoods are routinely inspected			
15	All exit ways are free and unobstructed			
16	Fire extinguishers are free and unobstructed			
17	Fire extinguishers are inspected and sealed			
18	Current inventory of chemicals is available			

**CHEMICAL STORAGE & HANDLING**

1	Gas cylinders are properly secured			
2	All chemical containers are properly labeled			
3	Chemicals are stored according to compatibility			
4	Peroxide forming reagents are dated when opened			
5	Peroxide forming reagents are disposed of or tested after expiration date			
6	Flammable storage area is labeled			
7	Flammables are kept away from sources of heat, ignition, flames, etc.			
8	Corrosive chemical storage area is labeled			
9	Carcinogen storage is labeled			
10	Chemicals in the open are kept to a minimum			
11	Flammable/Combustible liquids do not exceed NFPA storage limits			
12	Flammable/Combustible liquid total volume is not greater than 10gal			
13	Flammable gasses are not present			
14	Poisonous gasses are not present			

**CHEMICAL WASTE**

1	Hazardous waste container are labeled and have closed lids			
2	Hazardous waste tags are complete			
3	Hazardous wastes are not stored beyond 90 days			

**COMMENTS:**

## Appendix C- Fume Hood Safety

- Make sure that the exhaust blower is operating and air is entering the hood, prior to starting any experiment.
- Do not place your face inside the hood. Keep hands out as much as possible.
- Keep sources of emission 6" (6 inches) inside the fume hood. Minimize storage of chemicals in the hood.
- Clean up spills immediately
- Periodically clean hood interior, including fluorescent bulb panel. If volatile or corrosive materials are stored in the hood, **it should be in operation**. Avoid blocking off baffel exhausts slots in any manner.
- Elevate large equipment 2" (2 inches) off the base of the fume hood.
- Be aware of other room ventilation factors that may interfere with our fume hood operation, such as open doors to labs, open windows, blocked exhaust ports or heating and air conditioning vents.
- Avoid cross drafts and disruptive air currents in front of the fume hood.
- Use the sash as a safety shield when boiling materials or conducting an experiment with reactive chemicals. Prepare a plan of action in case of an emergency, such as power failure, especially when using extremely hazardous chemicals or acids.
- Periodically check airflow through the hood using a source of visible smoke or other airflow indicator, such as Kim wipe. If airflow has changed, check ductwork, blower, etc. to determine cause.
- Work with the sash at the proper operation level as indicated by the arrows.

## Appendix D- Gas Cylinder Safety

- Do not drop cylinders or permit them to strike anything violently.

Cylinders transported by truck must be fastened securely in upright position so that they will not fall or strike each other.

- Always chain gas cylinders upright to a wall, cylinder truck, cylinder rack or post.
- Caps used for valve protection should be kept on the cylinders at all times except when the cylinder is actually being used or charged. Cylinders cannot be transported without safety caps. A cylinder's cap should be screwed all the way down on the cylinder's neck ring and should fit securely. Do not lift cylinders by the cap. The cap is for valve protection only.
- Open cylinder valves SLOWLY. Do not use a wrench to open or close a hand wheel type cylinder valve. If it cannot be operated by hand, the valve should be repaired.
- Do not attempt to repair cylinder valves or their relief devices while a cylinder contains gas pressure.
- Before attaching cylinders to a connection, be sure that the threads on the cylinder and the connection mate are of a type intended for gas service.
- Do not permit oil or grease to come in contact with cylinders or their valves.
- Do not charge, ship, or use any cylinder which is not provided with a legible decal that identifies its contents.
- Cylinders should be stored in a well-ventilated area away from flames, sparks, or any source of heat or ignition. Keep cylinders away from electrical circuits.
- Do not expose cylinders to any open flame or to any temperatures above 130° F.

- Oxygen cylinders (empty or full) in storage should be separated from fuel-gas cylinders and combustible material by a minimum distance of 20 feet or by a barrier at least 5 feet high having a fire-resistance rating of at least one-half hour.
- Do not store flammable gas cylinders with oxygen or nitrous oxide cylinders adjacent to oxygen charging facilities.
- Full and empty cylinders of all gases should be stored separately and identified by signs to prevent confusion.
- Cylinders may be stored outdoors but should be protected from the ground to prevent bottom corrosion. Where extreme temperatures prevail, cylinders should be stored so they are protected from the direct rays of the sun.
- Cylinders should not be exposed to continuous dampness, stored near slat or other corrosive chemicals or fumes. Corrosion may damage cylinders and cause their valve protection caps to stick.
- Always use the proper regulator for the gas cylinder.
- Always check the regulator before attaching it to a cylinder. If the connections do not fit together readily, the wrong regulator is being used.
- Always “crack” the cylinder valve (open it slightly and close it immediately) before attaching a gas regulator to any cylinder-except hydrogen or fuel gas cylinder.
- Always use a cylinder wrench or another tightly fitting wrench to tighten the regulator nut or hose connections.
- Wipe out the outlet with a clean, dry, lint-free cloth once the cylinder valve has been cracked. The threads and mating surfaces of the regulator and hose connections should be cleaned before the regulator is attached.

- Do not crack hydrogen and fuel-gas cylinder valves-merely wipe out the outlet connections with a clean, dry, lint-free cloth.
- Attach the regulator securely before opening the valve wide.
- Tag leaking cylinders or cylinders with stuck valve and move to a safe, secure outdoor location.

## Appendix E – Incompatible Chemicals

When certain hazardous chemicals are stored or mixed together, violent reactions may occur because the chemicals are unsuitable for mixing, or are incompatible. Classes of incompatible chemicals should be segregated from each other during storage, according to hazard class. Use the following general guidelines for hazard class storage.

Flammable/Combustible Liquids and Organic Acids  
 Flammable Solids  
 Mineral Acids  
 Caustics  
 Perchloric Acid  
 Compressed Gases

Before mixing any chemicals, refer to this partial list of the chemicals MSDS's to verify compatibility:

<b>CHEMICAL</b>	<b>INCOMPATIBLE CHEMICAL(S)</b>
<b>Acetic acid</b>	Aldehyde, bases, carbonates, hydroxides, metals oxidizers, peroxides, phosphates, xylene
<b>Acetylene</b>	Halogens (chlorine, fluorine, etc.), mercury, potassium, oxidizers, silver
<b>Acetone</b>	Acids, amine, oxidizers, plastics
<b>Alkali &amp; alkaline earth metals</b>	Acids, chromium, ethylene, halogen, mercury, nitrogen, oxidizers, plastics, sodium chloride, sulfur
<b>Ammonia</b>	Acids, aldehydes, amides, halogens, heavy metals, oxidizers, plastics, sulfur
<b>Ammonium nitrate</b>	Acids, alkalis, chloride salts, combustible materials, metals, organic materials, phosphorus, reducing agents, urea
<b>Aniline</b>	Acids, aluminum, dibenzoyl peroxide, oxidizers, plastics
<b>Bromine</b>	Acetaldehyde, alcohols, alkalis, amines, combustible materials, ethylene, fluorine, hydrogen, ketones (acetone, carbonyls, etc.), metals, sulfur
<b>Calcium oxide</b>	Acids, ethanol, fluorine, metals, oxygen, plastics, silanes
<b>Carbon (activated)</b>	Alkali metals, calcium, hypochlorite, halogens, oxidizers
<b>Carbon tetrachloride</b>	Benzoyl peroxide, ethylene, fluorine, metals, oxygen, plastics, silanes

<b>Chlorates</b>	Powdered metals, sulfur, finely divided organic or combustible materials
<b>Chromic acid</b>	Acetone, alcohol, alkalis, ammonia, bases
<b>Chromium trioxide</b>	Benzene, combustible materials, hydrocarbons, metals, organic materials, phosphorous, plastics
<b>Chlorine</b>	Alcohol's, ammonia, benzene, combustible materials, flammable compounds (hydrazine), hydrocarbons, (acetylene, ethylene, etc.), hydrogen peroxide, iodine, metals, nitrogen, oxygen, sodium hydroxide.
<b>Chlorine dioxide</b>	Hydrogen, mercury, organic materials, phosphorous, potassium hydroxide, sulfur
<b>Copper</b>	Calcium, hydrocarbons, oxidizers
<b>Hydro peroxide</b>	Reducing agents
<b>Hydrogen sulfate</b>	Acetylaldehyde, metals, oxidizers, sodium
<b>Hypochlorites</b>	Acids, activated carbon
<b>Iodine</b>	Acetylaldehyde, acetylene, ammonia, metals, sodium
<b>Mercury</b>	Acetylene, aluminum, amines, ammonia, calcium, fluminic acid, lithium, oxidizers, sodium
<b>Nitrate</b>	Acids, nitrites, metals, sulfur, sulfuric acid
<b>Nitric acid</b>	Acetic acid, acetonitrile, alcohol's, amines, (concentrated) ammonia, aniline, bases, benzene, cumene, formic acid, ketones, metals, organic materials, plastics, sodium, toluene
<b>Oxalic acid</b>	Oxidizers, silver, sodium chlorite
<b>Oxygen</b>	Acetaldehyde, secondary alcohol's, alkalis and alkalines, ammonia, carbon monoxide, combustible materials, ethers, flammable materials, hydrocarbons, metals, phosphorus, polymers
<b>Perchloric acid</b>	Acetic acid, acetonitrile, alcohol's, amines, (concentrated) ammonia, aniline, bases, benzene, cumene, formic acid, ketones, metals, organic materials, plastics, sodium, toluene
<b>Peroxides, organic</b>	Acids (organic or mineral)
<b>Phosphorus (white)</b>	Oxygen (pure and in air), alkalis
<b>Potassium</b>	Acetylene, acids, alcohols, halogens, hydrazine, mercury, oxidizer, selenium, sulfur
<b>Potassium Chlorate</b>	Acids, ammonia, combustible materials, fluorine, hydrocarbons, metals, organic materials, sugars

<b>Potassium perchlorate (also see chlorates)</b>	Alcohols, combustible materials, fluorine, hydrazine, metals, organic matter, reducing agents, sulfuric acid
<b>Potassium permanganate</b>	Benzaldehyde, ethylene glycol, glycerol, sulfuric acid
<b>Silver</b>	Acetylene, ammonia, oxidizers, ozonides, peroxyformic acid
<b>Sodium</b>	Acids, hydrazines, metals, oxidizers, water
<b>Sodium nitrate</b>	Acetic anhydride, acids, metals, organic matter, peroxyformic acid, phosphorous, reducers, sugars, waters
<b>Sodium peroxide</b>	Acetic acid, benzene, hydrogen sulfide metals, oxidizers, peroxyformic acid, phosphorous, reducers, sugars, waters
<b>Sulfides</b>	Acids
<b>Sulfuric acid</b>	Potassium chlorates, potassium perchlorate, potassium permanganate.

From the Michigan U Chemical Hygiene Plan

Referenced from Material Safety Data Sheets, various chemical companies

## Appendix F –Common Peroxide Forming Chemicals

It is recommended that peroxide-forming chemicals be checked for the formation of peroxides or disposed of one year after opening. If peroxides are present, remove the peroxides or dispose of the chemical.

**These recommendations** are from Stephen R. Rayburn, *The Foundations of Laboratory Safety*, 1990 and Jay A. Young, *Improving Safety in the Chemical Laboratory*, 1991.

### DETECTION AND INHIBITION OF PEROXIDES

#### BASIC PROTOCOLS

##### Ferrous Thiocyanate Detection Method

Ferrous thiocyanate will detect hydroperoxides with the following test:

1. Mix a solution of 5 mL of 1%, ferrous ammonium sulfate, 0.5 mL of 1 N sulfuric acid and 0.5 mL of 0.1 N ammonium thiocyanate (if necessary decolorize with a trace of zinc dust).
2. Shake with an equal quantity of the solvent to be tested
3. If peroxides are present, a red color will develop

##### Potassium Iodide Detection Method

1. Add 1 mL of a freshly prepared 10% solution of potassium iodide to 10 mL of ethyl ether in a 25 mL glass-stoppered cylinder of colorless glass protected from light (both components are clear)
2. A resulting yellow color indicates the presence of 0.005% peroxides

##### Inhibition of Peroxides

1. Storage and handling under an inert atmosphere is a useful precaution
2. Addition of 0.001 X, hydroquinone, diphenylamine, polyhydroxyphenols, aminophenols or arylamines, may stabilize ethers and inhibit formation of peroxides.
3. Dowex- 1 g has been reported effective for inhibiting peroxide formation in ethyl ether.
4. 100 ppm of 1-naphthol effective for peroxide inhibition in isopropyl ether.
5. Hydroquinone effective for peroxide inhibition in isopropyl ether.
6. Stannous chloride or ferrous sulfate effective for peroxide inhibition in dioxane.

**Please note that these methods are BASIC protocols. Should a researcher perform one of these methods, all safety precautions should be thoroughly researched.**

Copied from Norman V. Seere in *Handbook of Lab Safety*

### COMMON PEROXIDE FORMING CHEMICALS

Acetal	2-ethoxyethyl ether
Acetaldehyde	Ethyl diglyme
Allyl ethyl ether	Ethyl ether
Bis (2-ethoxyethyl) ether	Ethylene glycol monoethers
Butadiene	Ethylene glycol dimethyl ether
2-Butanol	Fluroplast
Buten-3-yne	Furan
2-(2-Butoxyethoxy) ethanol	Hexone
Butyl dioxitol	Isopropyl alcohol
Butyl ether	Isopropyl ether
Crotonaldehyde	Methyl isobutylketone
Cyclohecane	4-Methyl-2-pentanone
1,3,5,7-Cyclooctatetraene	Oxitol acetate
Cyclooctene	1-Pentene
Cyclopentene	Perfluorethene
Decalin (decahydroaphthalene)	2-Propanol
Dibutyl ether	Styrene
Diethyl ether	Tetrahydrofuran
Diethylene glycol dimethyl ether	Tetrahydrophthaline
Diisopropyl ether	Vinyl acetate
1,2-dimethoxyethane	Vinyl chloride
Dimethyl ether	Vinyl ethers
Dioxane	Vinylindene chloride
Ether	
Ethoxy acetate	

## Appendix G – Common Laboratory Flammable and Combustible Chemicals

Flammable and combustible chemicals are the most commonly used hazardous chemicals. The hazard of a flammable or combustible chemical is based on its flash point, and in the case of a flammable chemical, its boiling point as well. The National Fire Protection Association (NFPA) has identified flammability classes from the flash point and boiling point data of chemical. The following table lists some common flammable and combustible chemicals, their flash point and boiling points, and associated NFPA flammability classes:

Chemical	Flash Point	Flash Pt. °C	Flash Pt. °F	Boiling Pt. °C	NFPA
Acetaldehyde	-38	-39	69	21	IA
Acetic Acid, Glacial	103	39	244	48	II
Benzaldehyde	145	63	352	178	IIIA
Benzene	12	-11	176	46	IB
Benzyl Alcohol	213	101	410	205	IIIB
Bromobenzene	118	48	306-316	153-158	II
Caproic Acid	215	102	400	204	IIIB
Carbon Disulfide	-22	-30	115	46	IB
Cyclohexanol	154	68	322	161	IIIA
Chlorobenzene	82	28	270	132	IC
Dimethyl sulfide	-36	-38	99	37	IA
Epichlorohydrin	88	31	239-243	115-117	IC
Ethyl ether	-49	-45	95	35	IA
Ethyl alcohol	55	13	173	78	IA
Ethylene oxide	-20	-29	55	13	IA
Ethylene glycol	232	111	388	198	IIIB
Formic acid	156	69	213	101	II
Isopropyl alcohol	53	12	180	82	IB
Metacrylic acid	170	77	316	158	IIIA

From Michigan U Chemical Hygiene Plan, Material Safety Data Sheets and National Fire Protection Agency document “NFPA 321: Classification of Flammable and Combustible Liquids, 1991 Edition.”

### Flammable and Combustible Liquid Containment Storage Requirements

Only approved containers and metal portable tanks authorized by NFPA 30 (National Fire Protection Association) shall be used to store flammable liquids.

Container	Flammable Class			Combustible Class	
	IA	IB	IC	II	III
Glass	1 pt*	1 qt*	1 gal	1 gal	5 gal
Metal or Approved Plastic	1 gal	5 gal	5 gal	5 gal	5 gal
Safety Cans	2 gal	5 gal	5 gal	5 gal	5 gal
Metal Drums	60 gal	60 gal	60 gal	60 gal	60 gal
Approved Metal Portable Tanks	660 gal	660 gal	660 gal	660 gal	660 gal
Polyethylene	1 gal	5 gal	5 gal	60 gal	60 gal

\* Class IA and IB liquids may be stored up to one gallon in glass containers if liquid purity would be affected by storage in metal containers or if metal containers could undergo excessive corrosion by the contained liquid.

Only NFPA 45 approved amounts of flammable liquids shall be stored in laboratory units outside of flammable liquid storage rooms.

Flammable/Combustible Class	Maximum Quantity per 100 ft <sup>2</sup> of Laboratory Unit	Maximum Quantity per Laboratory Unit	
		Unsprinklered	Sprinklered
List as Class A Lab			
I	20 gallons	600 gallons	1200 gallons
I, II, and IIIA	40 gallons	800 gallons	1600 gallons
List as Class B Lab			
I	10 gallons	300 gallons	600 gallons
I, II, and IIIA	20 gallons	400 gallons	800 gallons
List as Class C Lab			
I	4 gallons	150 gallons	300 gallons
I, II, and IIIA	8 gallons	200 gallons	400 gallons

The amounts listed in Table 2 include quantities stored in approved storage cabinets and safety cans. Allowable quantities stored outside of approved storage cabinets and safety cans 50% of equation listed above.

Laboratories or rooms listed as Class A shall be considered high hazard laboratories and shall not be used as instructional laboratories.

Laboratories listed as Class B shall be considered intermediate hazard laboratories.

Laboratories listed as Class C shall be considered low hazard laboratories.

Should Class B or C laboratories be used for instructional purposes, quantities of flammable and combustible liquids shall be 50% of those listed in the above table.

### NFPA Classification of Some Common Liquids Used in the Laboratory

The list below contains commonly used liquids in research settings. This list is not exhaustive. The chemical classification system of the National Fire Protection Association (NFPA) is used to classify laboratory fire hazards based on types and quantities present. Use this table in conjunction with a chemical inventory and MSDS sheets to classify the fire hazards of a particular laboratory.

#### Fire Hazard Symbols: Source

**F**-Flammable Hazardous Chemicals Data Book

**FB**- Flash back can occur G. Weiss, Noyes Data

**E**- explosion of closed containers Corporation, Park Ridge, NJ.

**C**-combustible 1986.

**P**- poisonous fumes from fire ISBN 0-8155-1072-1

Liquid	Chemical Class NFPA	Flash Point °F	Boiling Point	Fire Hazard
Acetaldehyde	IA	-36	68.7F (20.4C)	F, FB, E
Diethyl Ether		-40	94.3F (34.6 C)	F, FB, E
Ethyl Chloride		-58	54F (12.2 C)	F, FB, E
Isopentane		-70	82.2F (27.9 C)	F, FB, E
Pentane		-57	97F (36.1 C)	F, FB, E
Acetone	IB	4	133F (56.1 C)	F, FB, E
Acetonitrile		42	179F (81.6 C)	F, P, FB, E
Acrylonitrile		30	171F (77.4 C)	F, P, FB, E
Ally alcohol		72	203F (96.9 C)	F, P, FB, E
Benzene		12	176F (80.1 C)	F, FB, E
Carbon Disulfide		-22	115F (46.3 C)	F, FB, E
Crotonaldehyde		59	216 F (102.2 C)	F, FB, E
Cyclohexane		-4	177.3F (80.7 C)	F, FB, E
Ethyl acetate		24	171F (77 C)	F, FB, E
Ethyl alcohol		55	172.9 F (78.3 C)	F, FB, E
Gasoline		-36	140-390 F	F, FB, E
Heptane		25	209.1 F (98.4 C)	F, FB, E
Hexane		-7	155.7 F (68.7 C)	F, FB, E
Isobutyl acetate		62	243.1 F (117.3 C)	F, FB, E

Isopropyl alcohol		65	180.1 F (82.3 C)	F, FB, E
Methyl alcohol		54	148.1 F (64.5 C)	F, FB, E
Methyl ethyl ketone		20	175.3 F (79.6 C)	F, FB, E
N-propyl acetate		58	214.9 F (101.6 C)	F, FB, E
o-Xylene		63	291.9 F (144.4 C)	F, FB, E
Propionaldehyde		-22	118.4 F (48 C)	F, FB, E
Pyridine		68	239.5 F (115.3 C)	F, FB, E
Tert-Butyl		52	181 F (82.6 C)	F, FB, E
Tetrahydrofuran		6	151 F (66 C)	F, FB, E
Toluene		40	231 F (110.6 C)	F, FB, E
Trimethylchlorosilane		0	135 F (57 C)	F, FB, E, P
Chlorobenzene	IC	84	270 F (122 C)	F, FB, E
Ethylene glycol diethyl ether		90	252 F (112 C)	C
Isoamyl acetate		77	287.6 F (142 C)	F, FB, E
Isobutyl alcohol		82	226.2 F (107.9 C)	F, FB, E
m-Xylene		84	269.4 F (131.9 C)	F, FB, E
n-butyl acetate		99	259 F (126 C)	F, FB, E
n-butyl alcohol		84	243.9 F (117.7 C)	F, FB, E
n-dubutyl ether		92	280.9 F (138.3 C)	F, FB, E
n-propyl alcohol		81	250 F (121 C)	F, FB, E
p-xylene		81	280.9 F (138.3 C)	F, FB, E
Propylene glycol methyl ether		97	250 F (121 C)	F, FB, E
Sec-butyl alcohol		75	211 F (99.5 C)	F, FB, E
Turpentine		95	302-320 F	F, FB, E
Acetic acid		112	244 F (117.9 C)	C, E
Acetic anhydride		136	282 F (139 C)	C, E
Amyl alcohol		118	280.2 F (137.9 C)	F, FB, E
Bromobenzene		124	313 F (156 C)	C
Cyclohexanone		129	312.4 F (155.8 C)	C
Formic acid		138	214 F (101 C)	C

Isoamoyl alcohol		114	270 F (132 C)	C
Mineral spirits		105	310-395 F	C
Naptha		107	200-500 F	C
No. 2 fuel oil		136	540-640 F	C
Propionic acid		134	285.4 F (140.8 C)	C
Aniline	IIIA	168	363.6 F (184.2 C)	C, P, E
Benzaldehyde		148	354 F (179 C)	C
Benzyl chloride		165	354.9 F (179.4 C)	C
Cyclohexanol		160	322 F (161 C)	C, P
o-Cresol		178	376 F (191 C)	C, P
o-Toluidine		167	392 F (200 C)	C, P
p-Cresol		187	395.5 F (201.9 C)	C, P
Phenol		185	359.2 F (181.8 C)	C, P
Benzyl alcohol	IIIB	220	401 F (205 C)	C
Diethylene glycol monobutyl ether		230	438 F (231 C)	C
Diethylene glycol monoethyl ether		201	396 F (202 C)	C
Ethylene glycol		240	387 F (197.6 C)	C
Glycerine		350	554 F (290 C)	C
m-Cresol		202	397 F (203 C)	C, P
Mineral oils		380		C
Motor oils		300		C
Propylene glycol		210	369.1 F (187.3 C)	C

## Appendix H – Common Laboratory Corrosives

### Organic Acids:

Acetic anhydride, Acetyl bromide, Acetyl chloride, Benzoyl chloride, Benzyl bromide, Benzyl chloride, Butyric acid, Chloroacetic acid, Chloroacetyl chloride, Chlorotrimethylsilane, Dichloromethylsilane, Dimethyl sulfate, Formic acid, Methyl chloroformate, Oxalic acid, Phenol, Sodium hydride, Sodium hydroxide.

Bromine pentafluoride, Chlorosulfonic acid, Chromerge (a), Hydrobromic acid, Hydrochloric acid, Hydrofluoric Acid, Hydroiodic acid, Nitric acid, No-Chromix (a), Perchloric acid, Phosphorus pentachloride, Phosphorus tribromide.

### Elements:

Bromine (g), Chlorine (g), Fluorine (g), Iodine (g), Phosphorus

### Acid Salts:

Aluminum trichloride, Ammonium bifluoride, Antimony trichloride, Calcium fluoride, Ferric chloride, Sodium chloride, Sodium fluoride, Phosphorus trichloride, Sulfuric acid, Sulfuryl chloride, Thionyl chloride, Tin bromide, Tin chloride, Titanium tetrachloride

### Organic Bases:

Ethylenediamine, Ethylimine, Hexamethylenediamine, Hydroxylamine, Phenylhydrazine, Poperazine, Tetramethylammonium hydroxide, Tetramethylethylenediamine, Trimethylamine (aa), Propionyl bromide, Propionyl chloride, Salicylic acid, Trichloroacetic acid

### Inorganic Bases:

Ammonium hydroxide, Ammonium sulfide, Calcium hydride, Calcium hydroxide, Calcium oxide, Hydrazine, Potassium hydroxide

### Inorganic Acids:

### References:

The Foundations of Laboratory Safety, S.R. Rayburn. 1990. *Prudent Practices for Handling Hazardous Chemicals in Laboratories*, National Research Council, 1981. *Improving Safety in the Chemical Laboratory*, 2<sup>nd</sup> Ed. J.A. Young, 1991. Material Safety Data Sheets, various chemical companies.

## Appendix I – Select Carcinogens

The Laboratory Standard has established criteria for the classified as carcinogens by the following agencies: OSHA, the International Agency for Research on Carcinogens, and the national Toxicology Program. The following list is a compilation of the chemicals falling into the “select carcinogens” category.

Chemical Name	OSHA	IARC	NTP
Acetaldehyde		2B	2
Acetamide		2B	
Acetic acid, cobalt (2+) salt		2B	
Acetylaminofluorene 2-	X		2
Acrylamide		2A	2
Acrylonitril, inhibited	X	2A	2
Adriamycin		2A	2
AF-2[2-(2-Furyl)-3-(5-nitro-2-furyl)acrylamide]		2B	
Aflatoxin M1		2B	
Aflatoxin B1		1	
Aflatoxins		1	1
Aluminum production		1	
Anisidine Hydrochloride O-		2B	
Amino-2-methylantraquinone (1-)			2
Amino-5-(5-nitro-2furyl)-1,3,4-thiadiazole 2-		2B	
Amino-a-C (2-Amino-9H-pyrido [2,3-b]indole)		2B	
Aminoanthraquinone 2-		2B	2
Aminobiphenyl 4-	X	1	1
Amitrole		2B	2
Ammonium dichromate (VI)		1	
Androgenic (anabolic) steroid		2A	
Analgesic mixtures containing phenacetin		1	1
Antimony trioxide production		2B	
Arsenic and compounds	X	1	1
Arsenic acid, disodium salt, heptahydrate			1
Arsenic acid, sodium salt			1
Arsenic acid, calcium salt			1
Arsenic trioxide		1	
Arsenic pentoxide			1
Arsenic Acid, lead (2+) salt (1:1)			1
Arsenic Acid, monopotassium salt		1	1

Arsenic acid, monosodium salt		1	1
Arsonic acid, calcium salt (1:1)		1	1
Asbestos, Actinolite	X	1	1
Asbestos, Crocidolite		1	1
Asbestos, Chrysotile	X	1	1
Asbestos		1	1
Asbestos, Amosite	X	1	1
Aramite		2B	
Atrazine		2B	
Arsenenous acid, potassium salt			
Arsenenous acid, calcium salt (2:1)			1
Arsenenous acid, calcium salt			1
Arsenenous acid, calcium salt (2:3)		1	1
Auramine, manufacture of		1	
Auramine (technical-grade)		2B	
Azacitidine		2A	
Azaserine		2B	
Azathioprine		1	1
Azallen asbestos			1
Barium chromate (IV)		1	1
Benzene	X	1	1
Benzidine	X	1	1
Benzidine-based dyes		2A	
Benzofuran		2A	
Benzotrichloride			2
Benzo[a]pyrene		2B	2
Benzo[b]fluoranthene		2B	2
Benzo[k]fluoranthene		2A	2
Benzyl violet 4B		2B	
Benz[a]anthracene		2A	2
Beryllium oxide		1	2
Beryllium oxide carbonate		1	2
Beryllium oxide carbonate		1	2
Beryllium hydroxide		1	2
Beryllium aluminum silicate		1	2
Beryllium aluminum alloy		1	2
Beryllium and beryllium compounds		1	2
Beryllium hydrogen phosphate		1	2
Beryllium chloride		1	2
Beryllium fluoride		1	2
Beryllium sulfate		1	2
Beryllium sulfate tetrahydrate		1	2

(1:1:4)			
Beryllium compounds, n.o.s.		1	2
Beryllium zinc silicate		1	2
Betel quid with tobacco		1	
Bis (chloromethyl)ether (technical grade)		1	1
Bis (2-chloroethyl)- 2naphthylamine (chlornaphazine) N,N-	X	1	
Bischloroethyl nitrosourea (BCNU)		1	2
Bitumens, extracts of steam- refined and are refined.		1	
Bleomycin, chlorohydrate		1	
Boot and Shoe manufacture and repair		1	
Braken fern		2B	
Bromodichloromethane		2B	2
Butadiene 1,3-		2A	2
Butanediol dimethanesulfonate 1,4-(busulphane; myleran)		1	1
Butylated hydroxyanisole (BHS)		2B	2
Butyrolactone B-		2B	
C.I. Acid Red 114		2B	
C.I. Basic Red 9		2B	2
C.I. Direct blue 15		2B	
Cadmium fume (as Cd)		1	2
Cadmium sulfide		1	2
Cadmium nitrate			2
Cadmium sulfate (1:1)		1	2
Cadmium	X	1	2
Cadmium carbonate			2
Cadmium fluborate		1	2
Caffeic acid		2B	
Calcium chromate (VI)		1	1
Capatfol		2A	
Carbon tetrachloride		2B	2
Carbon-black extracts		2B	
Carpentry and joinery		2B	
Carrageenan, degraded		2B	
Chlorambucil		1	1
Chloramphenicol		2B	
Chlordane b-		2B	
Chlordane, technical		2B	
Chlordane		2B	

Chlordane (kepone)		2B	2
Chlorendic acid		2B	2
Chlorinated paraffin (C12 60% chlorine)		2B	2
Chlorinated paraffins (C23, 43% chlorine)			2
Chlorinated toluene a-		2B	
Chloro 2-methylpropene 3-			2
Chloro-o-toluidine hydrochloride 4-		2A	
Chloro-ortho-phenylenediamine 4-		2A	
Chloroethyl(2)-3-(4-methylcyclohexyl)-1-nitrosourea (1-) (methyl-CCNU;semustine)		1	1
Chloroethyl(2)-3-cyclohexyl-1-nitrosourea (CCNU) (1-)		2B	2
Chloroform	X	1	1
Chloromethyl methyl ether (technical-grade)		2B	1
Chlorophenols		2B	
Chlorophenoxy herbicides		2B	
Chlorophenyl-o-)-2-(p-chlorophenyl)-1,1,1-trichloroethane		2B	
Chlorozotocin		2A	
Chromate (1-) Hydroxyoctaoxidizincatedi-, potassium		1	
Chromic acid, disodium salt		1	1
Chromic acid, lead (2+) salt (1:1)		1	1
Chromite (mineral)			1
Chromium (VI) chloride		1	
Chromium triacetate			1
Chromium (VI) compounds		1	1
Chromium phosphate			1
Chromium (III) oxide (2:3)			1
Chromium carbamate (6Cl)		1	
Chromium (VI) oxide (1:3)		1	1
Ciclosporin		1	
Cisplatin		2A	2
Citrus Red no. 2		2B	
Coal tar distillate			1
Coal tar dye			1
Coal tar			1

Coal gasification		1	
Coal tar pitches		1	
Coal-tars		1	1
Cobalt triacetate		2B	
Cobalt alloy, Co, Cr		2B	1
Cobalt carbonyl (co <sub>4</sub> (CO) <sub>12</sub> )		2B	
Cobalt (II) hydroxide		2B	
Cobalt, Di-mu-carbonylhexacarbonyl-di-1(Co-Co)		2B	
Cobalt, (mu-carbonato(2-)-O;O') Dihydroxide		2B	
Cobalt (2+) Sulfide		2B	
Cobalt (II) carbonate hydroxide (2:3) monohydroxide		2B	
Cobalt (II) sulfate (1:1)		2B	
Cobalt (III) oxide		2B	
Cobalt oxide		2B	
Cobalt carbonate, cobalt dihydroxide (2:3)		2B	
Cobalt (II) Chloride		2B	
Cobalt (II) nitrate (1:2)		2B	
Cobalt hydroxide oxide		2B	
Cobalt hydroxide		2B	
Cobalt dinitrate hexahydrate		2B	
Cobalt molybdate (VI)		2B	
Cobalt (2+) Oxide		2B	
Cobalt naphthanate		2B	
Cobalt and cobalt compounds		2B	
Cobalt-aluminium-chromium spinel		2B	
Cobalt0chromium nickel-tungsten alloy		2B	
Cobalt-chromium-molybdenum- alloy		2B	
Coffee		2B	
Coke production	X	1	1
Coke oven emissions	X		1
Conestroal			1
Conjugated estrogens		2A	1
Cresoate, wood			1
Cupferron			2
Cycasin		2B	
Cyclophosphamide		1	1
Cyclosporin A		1	
Dacarbazine		2B	2

Dantron (chryszin; 1,8-dihydroxyanthraquinone)		2B	
Daunomycin		2B	
DDT		2B	2
Di(2-ethylhexyl) phthalate		2B	2
Diacetylbenzidine N,N'-		2B	
Diaminoanisole sulfate 1,4-			2
Diaminoanisole 2,4- (and its salts)		2B	
Dminodiphenyl ether 4,4' -		2B	2
Diaminotoluene 2,4-		2B	2
Dibenzo [c,g] carbazole 7H-		2B	2
Dibenzo [a,h] pyrene		2B	2
Dibenzo [a, i] pyrene		2B	2
Dibenzo [a, e] pyrene		2B	2
Dibenzo [a, h] pyrene		2B	2
Dibenzo [a, l] pyrene		2B	2
Dibenzo [a,h] acridine		2A	2
Dibromo-3-chloropropane 1,2- (DBCP)	X	2B	2
Dichloro-4-4'-diaminodiphenyl ether 3,3' -			
Dichlorobenzidine dihydrochloride 3,3' -			2
Dichlorobenzidine and 3,3-dichlorobenzidine dihydrochloride 3-3'			2
Dichlorodiphenyldichloroethane (DDD)		2B	
Dichlorodiphenyldichloroethylene (DDE)		2B	
Dichloroethane 1,2-		2B	2
Dichloromethane		2B	
Dichlorophenoxy, 2-4-) propionic acid (2)		2B	
Dichloropropene 1,3- (technical grade)		2B	2
Dichlrovos		1	
Dichromic acid, diammonium salt		2B	2
Dimethylbenzidine 3,3' (o-tolidine)		2B	2
Diepoxybutane (+-) -1,2:3,4-		2B	
Diepoxybutane		2A	
Diesel exhaust		2A	2
Diethyl sulfate		2B	2
Diethylhydrazine 1,2-			

Diethylstilbestrol (DES)		1	1
Diglycidyl resorcinol ether		2B	2
Dihydrosafrol		2B	
Dimethoxybenzidine 3,3'- (ortho-Dianisidine)		2B	2
Dimethoxybenzidine dihydrochloride 3,3'-			2
Dimethyl sulfate		2A	2
Dimethylcarbamoyl chloride		2A	2
Dimethylformamide		2B	
Dimethylhydrazine 1,2-		2B	
Dimethylhydrazine		2B	2
Dinitropyrene 1,6-		2B	
Dinitropyrene 1,8-		2B	
Dioxane 1,4-		2B	2
Direct black 38			2
Direct blue 6			2
Disperse blue 1		2B	
Epichlorhydrin		2A	2
Erionite		1	1
Estra-1,2,4 (10, 7-tetraen-17-one,3-(sulfoxy)-, sodium salt			1
Estrogens (not conjugated) estrone			2
Estrogens (not conjugated) Estradiol-17			2
Estrogens (not conjugated) ethinylestradiol			2
Ethyl acrylate		2B	2
Ethyl methanesulfonate		2B	2
Ethyl-N-nitrosourea N-		2A	2
Ethylene thiourea		2B	2
Ethylene oxide	X	2A	2
Ethylene dibromide		2A	2
Ethyleneimine, inhibited	X		
Formaldehyde (gas)	X	2A	2
Formylhydrazino (2)-4(5-(5-nitro-2-furyl) thiazole, (2-)		2B	
Fowler's solution		1	
Fuel oil, residual		2B	
Furan		2B	
Furniture and cabinet making		1	
Gamma-chlordane		2B	2
Gamma-hexachlorobenzene			
Gasoline, unleaded		2B	

Gasoline engine exhaust fumes		2B	
Gasoline		2B	
Glass wool		2B	
Glu-P-1 (2-amino-6-methyldipyrido[1,2-a:3',2'-d]imidazole)		2B	
Glu-P-2 (2-aminodipyrido[1,2-a:3'2-d]imidazole)		2B	
Glycidaldehyde		2B	
Glycidol			2
Griseofulvin		2B	
Haematite mining, underground, with exposure to radon		1	
HC blue 1		2B	
Heptachlor		2B	
Heptachlor epoxide		2B	
Hexachlorobenzene			2
Hexachloroethane			2
Hexamethylphosphoramide		2B	2
Hydrazine, sulfate (1:1)			2
Hydrazine (anhydrous)		2B	2
Hydrazine and hydrazine sulfate			2
Hydrabenzene			2
Indeno[1,2,3-cd] pyrene		2B	
Inorganice-acid mists containing sulfuric acid		1	
IQ (2-amino-3-methylimidazo[4,5-f]quinoline)		2A	
Iron and steel founding		1	
Iron-dextran complex		2B	2
Isoproprene		2B	2
Isopropyl alcohol manufacture, strong-acid process		1	
L-1,2: 3 4 –diepoxybutane		2B	
Lasciocarpine		2B	
Lead and lead compounds, inorganic		2B	
Lead acetate			2
Lead acetate (II), trihydrate			2
Lead acetate and lead phosphate			2
Lead chromate (VI) ocide		1	1
Lead (II) phosphate (3:2)		2B	2
Lindane b-			2
Lindane a-			2
Magentsa, manufacture of			1

Magenta (containing CI basic red 9)		2B	
MeA-alpha-C (2-Amino-3-methyl-pH-pyridol [2,3] indole)		2B	
Medroxyprogesterone acetate		2B	
Melphalan		1	1
MelQ (2-amino-3,4-dimethylimidazol [4,5f] quinoline)		2B	
MelQx (2-amino-3,8-dimethylimidzao [4,5-f] quinoxaline)		2B	
Merphalan		2B	
Meso-1,2,3,4-diepoxybutane		2A	
Methoxysoralen (methoxsalen) 8-plus UV radiation		1	
Methoxysoralen (methoxsalen) 8-plus UV A radiation		1	1
Methyl methanesulfonate		2B	2
Methyl-1-nitroanthraquinone 2-(uncertain purity)		2B	
Methyl-N-nitrosourethane N-		2B	
Methyl-N-nitro-N-nitrosourethane N-		2B	
Methylaziridine 3 (propylenimine)		2B	2
Methylazoxymethanol acetate		2B	
Methylazoxymethanol and its acetate		2B	
Methylchrysens 5-		2B	2
Methylene bis (2-methylaniline) 4,4'-		2A	
Methylene bis (2-chloroaniline) 4,4'			2
Methylene bis (n,N-dimethylbenzeamine) 4,4'-			2
Methylenedianiline dihydrochloride 4,4'			2
Methylenedianiline 4,4	X	2B	2
Methylthiouracil		2B	
Mineral oil, petroleum nephthenic oils, catalytic dewaxed heavy (mild or no solvent refining or hydrotreatment)		1	
Mineral oil, petroleum distillates, acid-treated light paraffinic (mild		1	

or no solvent refining or hydrotreatment)			
Mineral oil, petroleum distillates, solvent-dewaxed heavy paraffinic (mild or no solvent refining or hydrotreatment)		1	
Mineral oil, petroleum distillates, heavy paraffinic		1	
Mineral oil, petroleum paraffin oils, catalytic dewaxed heavy (mild or no solvent or hydrotreatment)		1	
Mineral oil, petroleum distillates, light naphthenic		1	
Mineral oil, petroleum distillates, hydrotreated (mild), heavy paraffinic		1	
Mineral oil, petroleum distillates, acid-treated heavy paraffinic (mild or no solvent refining or hydrotreatment)		1	
Mineral oil, petroleum distillate, hydrotreated (mild) light naphthenic		1	
Mineral oil, petroleum distillates, acid-treated light naphthenic (mild or not solvent refining or hydrotreatment)		1	
Mineral oil, petroleum residual oils, acid-treated			2
Mineral oil, petroleum distillates, heavy naphthenic distillate solvent		1	
Mineral oil, petroleum extracts, residual oil solvent		1	
Mineral oil, petroleum distillates, solvent-refined (mild) heavy naphthenic		1	
Mineral oil, petroleum distillates, solvent-dewaxed light paraffinic (mild or no solvent refining or hydrotreatment)		1	
Mineral oil, petroleum distillates, light paraffinic		1	
Mirex		1	
Mitomycin C		1	2

Molybdate orange		1	
Monocrotaline		1	
MOPP and other combined chemotherapy including alkylating agents		1	
Morpholinomethyl (5-)3-[(5-nitrofurfurylidene)amino]-2-oxazolidinone		2B	
Mustard gas		1	1
Nafenopi		2B	
Naphthylamine a-	X		1
Naphthylamine 2-	X	1	2
Nickel sulfide (3:2)			2
Nickel (II) carbonate (1:1)			2
Nickel (II) acetate (1:2)			2
Nickel, metallic		2B	2
Nickel compounds		1	
Nickel biscyclopentadiene			2
Nickel (II) hydroxide			2
Nickel alloy, Ni47-59, Co 17-20, cr 13-17, mo4.5-5.7, al 3.7-4.7, fe 0-1, c 0-0.1 (ALSL 678)		2B	
Nickel carbonyl			2
Nickel (II) oxide (1:1)			2
Nickel, compound with pi-cyclopentadienyl (1:2)			2
Nickel (II) hydroxide			2
Niridazole		2B	
Nitrilotriacetic acid, trisodium salt monohydrate		2B	
Nitrilotriacetic acid, disodium salt		2B	
Nitrilotriacetic acid sodium salt		2B	
Nitrilotriacetic acid monosodium salt		2B	
Nitrilotriacetic acid and its salts		2B	2
Nitrilotriacetic acid, trisodium salt		2B	2
Nitro-2-furyl)-2-thioxolyl-acetamide N-[4-(5-		2B	
Nitroacenaphthene 5-			
Nitrobiphenyl 4-	X		
Nitrochrysene 6		2B	
Nitrofen, technical grade		2A	2
Nitrofluorene 2-		2B	

Nitrofurfurylidene -5)amino]2-imidazolidinone (1-)		2B	
Nitrogen mustard n-oxide			
Nitrogen mustard hydrochloride			2
Nitrogen mustard		2A	2
Nitrogen mustard n-oxide hydrochloride		2B	
Nitropropane 2-		2B	
Nitropyrene (1-)		2B	
Nitropyrene 4-			
Nitrosobutylbutanolamine N-			2
Nitrosodi-n-butylamine N-		2B	2
Nitrosodiethanolamine N-		2B	2
Nitrosomethylamino, N) propionitrile 3-		2B	2
Nitrosomethylethylamine N-		2B	
Nitrosomethylvinylamine N-		2B	2
Nitrosodimethylamine N-	X	2B	2
NitrosomorpholineN-		2B	2
Nitrosornicotine N' -		2B	
Nitrosornicotine N' (+-)		2B	2
Nitrosopiperidine N-		2B	2
Nitrososarcosine N-		2B	2
Norethisterone		2B	
Ochratozxn A		1	
Oestrogen, steroidal		1	
Oestrogen replacement therapy		1	
Oestrogen, nonsteroidal		1	
Oil orane SS		2B	
Oral contraceptives, combined		1	
Oral contraceptives, sequential		1	
Ortho-aminozaaotoulene		2B	2
Ortho-toludine		2B	2
Oxymetholone			2
Panfurna S (containing dihydorxymethylfuratrizine)		2B	2
Para-chloro-ortho-toludine and its strong acid salts		2A	
Para-credidine		2B	2
Para-dichlorobenzene		2B	2
Para-dimethylaminoazobenzene	X	2B	2
Pentachlorobiphenyl			2
Pentachlorophenol		2B	
Phenacetic		2A	2
Phenobarbital		2B	

Phenoxybenzamine hydrochloride		2B	2
Phenozopyridine hydrochloride		2B	
Phenyl glycidyl ether		2B	2
Phenytoin		2B	
Phlp (2-amino-1-methy-6-phenyl-imidazo [4,5-b] pyridine)		2B	
Polybrominated biphenyl (FF-1)		2B	2
Polybrominated biphenyl (pbbs)		2B	2
Polychlorinated biphenyl (aroclor 1254)		2A	2

## Appendix J- Common Laboratory Oxidizers

Oxidizers react with other chemicals by giving off electrons and undergoing reduction. Uncontrolled reaction of oxidizers may result in a fire or an explosion, causing severe property damage or personal injury. Use oxidizers with extreme care and caution and follow all safe-handling guidelines specified in MSDS.

		<b>Oxidizers</b>
Bleach	Guanyl	Trimethylolethane
Bromates	Fulminate of silver	Trimonite
Nitrites	Ozonides	Trinitroanisole
Nitrous Oxides	Pentolite	Trinitrobenzoic acid
Ednatol	Perchlorates of heavy	Trinitrocresol
Erythritol tetranitrate	metals	Trinitroresorcinol
Fulminating silver	Peroxides	Trional
Ethyl-tetryl	Picramic acid	Urea nitrate
Ethylene oxide	Picramide	
Galatinized	Picratol	
nitrocellulose	Picric acid	

Shock sensitive refers to the susceptibility of a chemical to rapidly decompose or explode when struck, vibrated or otherwise agitated. Explosive chemicals are those chemicals which have a higher propensity to explode under a given set of circumstances than other chemicals (extreme heat, pressure, mixture with an incompatible chemical, etc.). The label and MSDS will indicate if a chemical is shock sensitive or explosive. The chemicals listed below may be shock sensitive or explode under a given number of circumstances and are listed only as a guide to some shock sensitive or explosive chemicals.

Follow these guidelines:

Write the date received and date opened on all containers of shock sensitive chemicals. Some chemicals become increasingly shock sensitive with age.

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

Wear appropriate personal protective equipment when handling shock sensitive chemicals.

## Appendix L- Chemicals that can be combined for disposal

<b>Halogenated</b>	Butanol (1-)	Methyl alcohol;
Butyl chloride (n-)	Butanol (iso-)	methanol
Chlorobenzene	Butanone (2-)	Methyl acetate
Chlorotoluene (o-)	Butyl alcohol(sec-)	Methyl benzoate
	Butyl benzene	Methyl cyclohexane
	Butyl "cellosolve"	Methyl salicylate
	Cycododecanecyclohexane	Methyl-2-pentanol (4-)
Cyclohexane		Methyl -2,4-pentanediol (2-)
Dichlorobutanone (1,4)	Diethylene glycol	Nitrobenzene
Ethylene dichloride	Ethyl acetate	Octane (iso-)
Methylene chloride	Ethyl alcohol	Octanol (2-)
Dichloromethane	Ethyl benzene	Pentanol
Tetrachloroethane (1,1,2,2-)	Ethyl formate	Pentanone (2-)
Trichloroethane (1,1,1-)	Ethyl hexanol (2-)	Pentanone (3-)
	Formamide	Petroleum ether; ligroin
	Heptane	Propyl alcohol
<b>Non-halogenated</b>	Heptanone (2-)	Propylene oxide
Acetone	Heptanone (3-)	Pyridine
Acetonitrile	Heptanone (5-)	Tetrahydrofuran
Amyl acetate	Heptyl alcohol	Toluene
Amyl acetate (iso-)	Hexane	Xylene
Amyl alcohol	Hexyl alcohol (n-)	
Amyl alcohol (n-)	Karl Fischer Reagent	
Aniline	Methoxy-methoxy	
Anisole	ethanol	
Benzene	Methoxyethanol (2-)	

Information received from Chemical Analytics, chemical disposal company for COW  
11/5/97

## Appendix M – Glossary of Terms

**ACGIH-** The American Conference of Governmental Industrial Hygienists is a voluntary membership organization of professional industrial hygiene personnel in governmental or educational institutions. The CCGIH develops and publishes recommended occupational exposure limits each year called Threshold Limit Values (TLV's) for hundreds of chemicals, physical agents, and includes Biological Exposure Indices (BEI)

**Action Level-** A concentration designated in 29 CFR part 1910 for a specific substance, calculated as an eight hour time-weighted average, which initiates certain required activities such as exposure monitoring and medical surveillance.

**Acute-** Severe, often dangerous, exposure conditions in which relatively rapid changes occur.

**Acute exposure-** An intense exposure over a relatively short period of time

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

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

**Autoclave-** A device to expose items to steam at a high pressure in order to decontaminate the materials or render them sterile.

**Biohazard-** Infections agents that present a risk or potential risk to the health of humans or other animals, either directly through infection or indirectly through damage to the environment.

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

**“C” or ceiling-** A description usually seen in connection with a published exposure limit. It refers to the concentration that should not be exceeded, even for an instant. It may be written as TLV-C or Threshold Limit Value–Ceiling (See also Threshold Limit Value)

**Carcinogen-** A substance that may cause cancer in animals or humans.

**C.A.S. Number**—Identifies a particular chemical by the Chemical Abstracts Service, a service of the American Chemical Society that indexes and compiles abstracts of worldwide chemical literature called “Chemical Abstracts.”

**Chemical Hygiene Officer**—An employee who is designated by the employer and who is qualified by training and experience, to provide technical guidance in the development and implementation of the provisions of the Chemical Hygiene Plan. This definition is not intended to place limitations on the position description or job classification that the designated individual shall hold within the employer’s organizational structure.

**Chemical Hygiene Plan**—A written program developed and implemented by the department which sets forth procedures, equipment, personal protective equipment and work practices that are capable of protecting students, instructors and other personnel from the health hazards presented by the hazardous chemicals used in that particular workplace.

**Chronic Exposure**— A prolonged exposure occurring over a period of days, weeks, or years.

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

**Compressed Gas**— A gas or mixture of gases that, in a container, will have an absolute pressure exceeding 40 psi at 70°F or 21.1°C. A gas or mixture of gases having, in a container, an absolute pressure exceeding 104 psi at 130°F or 54.4°C, regardless of the pressure at 70° F. A liquid having vapor pressure exceeding 40 psi at 100° F or 37.8°C.

**Concentration**— the relative amount of material in combination with another material. For example, 5 parts (of acetone) per million (parts of air).

**Corrosive**—A substance that, according to the DOT, causes visible destruction or permanent changes in human skin tissue at site of contact or is highly corrosive to steel.

**Cutaneous/Dermal**— Pertaining to or affecting the skin.

**Cytotoxin**— A Substance toxic to cells in culture, or to cells in an organism.

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

**Designated area**— An area which may be used for work with “select carcinogens” reproductive toxins or substances which have a high degree of acute toxicity. This area may be the entire laboratory or an area under a device such as a laboratory hood.

**Dermatitis**– An inflammation of the skin.

**Dilution ventilation**–See GENERAL VENTILATION

**DOT**– the United States Department of Transportation is the Federal agency that regulates the labeling and transportation of hazardous materials.

**Dyspnea**–Shortness of breath, difficult, or labored breathing.

**EPA**– The Environmental Protection Agency is the governmental agency responsible for administration of laws to control and/or reduce pollution of air, water, and land systems.

**EPA Number**–The number assigned to chemicals regulated by the Environmental Protection Agency (EPA).

**Epidemiology**–The study of disease in human populations.

**Erythema**– The reddening of the skin.

**Evaporation Rate**–The rate at which a material is converted to vapor (evaporates) at a given temperature and pressure when compared to the evaporation rate of a given substance. Health and fire hazard evaluations of materials involve consideration of evaporation rates as one aspect of the evaluation .

**Explosive**– A chemical that causes a sudden, almost instantaneous release of pressure, gas, and heat when subjected to sudden shock, pressure or high temperature.

**Flammable Gas**– A gas that, at an ambient temperature and pressure, forms a flammable mixture with air at a concentration of 13 percent by volume or less; or, a gas that, at an ambient temperature and pressure forms a range of flammable mixtures with air wider than 12% by volume, regardless of the lower limit.

**Flammable Liquid**–According to the DOT and NFPA a flammable liquid is one that has a flash point below 100°F (See FLASH POINT).

**Flammable Solid**– A solid, other than a blasting agent or explosive, that is liable to cause fire through friction, absorption of moisture, spontaneous chemical change or retained heat from manufacturing or processing, or which can be ignited readily and when ignited burns so vigorously and persistently it creates a serious hazard.

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

**Fume**–A solid particle that has condensed from the vapor state.

**Gas**—Chemical substance that exist in the gaseous state at room temperature.

**General Ventilation**—Also known as general exhaust ventilation, this is a system of ventilation consisting of either natural or mechanically induced fresh air movements to mix with and dilute contaminants in the workroom air. This is not the recommended type of ventilation to control contaminants that are highly toxic, when there may be corrosion problems from the contaminant, when the worker is close to where the contaminant is being generated, and where fire or explosion hazards are generated close to sources of ignition (see LOCAL EXHAUST VENTILATION).

**Grams per Kilogram (g/Kg)**— This indicates the does of a substance given to test animals in toxicity studies. For example, a does may be two grams (of substance) per kilogram of body weight (of the experimental animal).

**Hazardous Chemicals**—Any chemical for which there is significant evidence, that acute or chronic health effects may occur in exposed personnel. The term “health hazard” includes chemicals that are carcinogens, toxins, irritants, corrosives, sensitizers or ther agents that can damage the lungs, skin, eyes, or mucous membranes.

**Ignitable**—A solid, liquid, or compressed gas waster that has a flash point of less than 140°F. Ignitable material may be regulated by the EPA as a hazardous waste, as well.

**Inhalation**—The breathing in of an airborne substances that may be in the form of gas, fumes, mists, vapors, dusts, or aerosols.

**Inhibitor**—A substance that is added to another to prevent or slow down an unwanted reaction or change.

**Irritant**—A substance that produces an irritation effect when it contacts skin, eyes, nose, or respiratory system.

**Laboratory**—A facility where relatively small quantities of hazardous materials are used on a non production basis.

**Laboratory Scale**—Work with substances in which the containers used for reactions, transfers, and other handling of substances are designed to be easily and safely manipulated by one person.

**Laboratory-type Hood**—A device constructed and maintained to draw air from the laboratory and to prevent or minimize the escape of air contaminants into the laboratory.

**Laboratory Use of Hazardous Materials**— The handling or use of chemicals in which the following conditions are met: (1) Chemical manipulations are carried out on a laboratory scale. (2) Multiple chemical procedures or chemicals are used. (3) The procedure involved are not part of a production process. (4) Protective laboratory

practices and equipment are available and in common use to minimize the potential for personnel exposure to hazardous chemicals.

**Laminar Air Flow**–Air flow in which the entire mass of air within a designated space move with uniform velocity in a single direction along parallel flow lines with a minimum of mixing.

**Lethal Concentrations 50**–The concentration of an air contaminant (LD50) that will kill 50% of the test animals in a group during a single exposure.

**Lethal Dose 50**–The dose of a substance or chemical that will (LD50) kill 50% of the test animals in a group within the first 30 days following exposure.

**Local Exhaust Limit (LEL)** (also known as exhaust ventilation) – A ventilation system that captures and removes air contaminants at the point they are being produced before they escape into the workroom air. The system consists of hoods, ductwork, a fan and possibly an air cleaning device. Advantages of local exhaust ventilation over general ventilation include: removing the contaminant rather than diluting it; less airflow making it a more economical system over the long run; and conservation or reclamation of valuable materials. However, the system must be properly designed with the correctly shaped and placed hoods, correctly sized fans and correctly connected ductwork.

**Lower Explosive Limit (LEL)** (also known as exhaust ventilation)–The lowest concentration of a substance that will produce a fire or flash when an ignition source (flame, spark, etc.) is present. It is expressed in percent of vapor or gas in the air by volume. Below the LEL or LFL, the air/contaminant mixture is theoretically too “lean” to burn (see also UEL).

**Melting Point**–The temperature at which a solid changes to a liquid. A melting range may be given for mixtures.

**MSHA**–The Mine Safety and Health Administration; a Federal agency that regulates the mining industry in the safety and health are.

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

**Narcosis**–Stupor or unconsciousness caused by exposure to a chemical

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

**NIOSH**–The National Institute for Occupational Safety and Health is a Federal Agency that among its various responsibilities trains occupational health and safety professionals, conducts research on health and safety concerns, and tests and certifies respirators for workplace use.

**Occupational Safety and Health Administration (OSHA)**–A Federal agency under the Department of Labor that publishes and enforces safety and health regulations for most businesses and industries in the United States.

**Odor Threshold**–The minimum concentration of a substance at which a majority of test subjects can detect and identify the substance’s characteristic odor.

**Oxidation**–The process of combining oxygen with some other substance or chemical change in which the atom loses electrons.

**Oxidizer**–Is a substance that gives up oxygen easily to stimulate combustion of organic material.

**Oxygen Deficiency**– An atmosphere having less than the normal percentage of oxygen found in normal air. Normal air contains 21% oxygen at sea level.

**Permissible Exposure Limit (PEL)**–An exposure limit that is published and enforced by OSHA as a legal standard. PEL may be either a time-weighted average (TWA) exposure limit (8 hour), a 15-minute short term exposure limit (STEL), or a ceiling. The PELs are found in Tables Z-1, Z-2, or Z-3 of OSHA regulations 1910.1000. (See also TLV).

**Personal Protective Equipment** –Any devices or clothing worn by the worker to protect against hazards in the environment. Examples are respirators, gloves, and chemical splash goggles.

**Physical Hazard**–A chemical that has scientifically valid evidence proving it to be a combustible liquid, a compressed gas, explosive, flammable, an organic peroxide, an oxidizer, pyrophoric, unstable (reactive) or water-reactive.

**Polymerization**–A chemical reaction in which two or more small molecules combine to form larger molecules that contain repeating structural units of the original molecules. A hazardous polymerization is the above reaction with an uncontrolled release of energy.

**RAD**–The unit of absorbed dose equal to 100 ergs per gram or 0.01 joules per kilogram of absorbing material.

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

**Reproductive Toxins**—Chemicals which affect the reproductive capabilities including chromosomal damage (mutations) and effects on fetuses.

**Respirator**—A device which is designed to protect the wearer from inhaling harmful contaminants.

**Respiratory Hazard**—A particular concentration of an airborne contaminant that, when it enters the body by way of the respiratory system or being breathed into the lungs, results in some bodily function impairment.

**Select Carcinogen**—Any substance which is regulated by OSHA as a carcinogen, or is recognized as a carcinogen by the National Toxicology or the International Agency for Research on Cancer Monographs.

**Sensitizer**—A substance that may cause no reaction in a person during initial exposures, but afterwards, further exposures will cause an allergic response to the substance.

**Short Term Exposure Limit**—Represented as STEL or TLV-STEL, this is the maximum concentration to which workers can be exposed for a short period of time (15 minutes) for only four times throughout the day with at least one hour between exposures. Also, the daily TLV-TWA must not be exceeded.

**Skin**—This designation sometimes appears alongside a TLV or PEL. It refers to the possibility of absorption of the particular chemical through the skin and eyes. Thus, protection of large surface areas of skin should be considered to prevent skin absorption so that the TLV is not invalidated.

**Systemic**—Spread throughout the body; affecting many or all body systems or organs; not localized in one spot or area.

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

**Threshold Limit Value**— Airborne concentrations of substances devised by the ACGIH that represents conditions under which it is believed that nearly all workers may be exposed day after day with no adverse effect. TLV's are advisory exposure guidelines, not legal standards, that are based on evidence from industrial experience, animal studies, or human studies when they exist. There are three different types of TLV's: Time Weighted Average (TLV-TWA), Short Term Exposure Limit (TLV-STEL), and Ceiling (TLV-C). (See also PEL).

**Time Weighted Average**— The average time, over a given work period (e.g. 8-Hour workday), of a person's exposure to a chemical or an agent. The average is determined by sampling for the contaminant throughout the time period. Represented as TLV-TWA.

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

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

**Unstable (reactive)**– A chemical that, in its pure state or as commercially produced, will react vigorously in some hazardous way under shock conditions (i.e. dropping), certain temperature, or pressures.

**Upper Exposure Limit**– Also known as Upper Flammable Limit, is the highest concentration (expressed in percent of vapor or gas in the air by volume) of a substance that will burn or explode when an ignition source is present. Theoretically, above this limit the mixture is said to be too “rich” to support combustion. The difference between the LEL and the UEL constitutes the flammable range or explosive range of a substance. That is, if the LEL is 1 ppm and the UEL is 5 ppm, then the explosive range of the chemical is 1 ppm to 5 ppm . (See also LEL)

**Vapor**–The gaseous state of substance which are normally in the liquid or solid state (at normal room temperature and pressure). Vapors evaporate into the air from liquids such as solvents. Solvents with low boiling points will evaporate.

**Vapor Pressure**– The pressure that a solid or liquid exerts when it is in equilibrium with its vapor at a given temperature.

**Water Reactive**– A chemical that reacts with water to release a gas that is either flammable or presents a health hazard.

## Appendix N– Ohio Safety Agencies

### Directory of State Environmental, Health and Safety Agencies:

#### **Aboveground Storage Tanks**

State Fire Marshal  
8895 East Main St.  
Reynoldsburg, OH, 43068  
614-752-8200

#### **Air Quality**

Environmental Protection Agency

#### **OSHA Office**

Federal Office Building, Room 734  
234 North Summit St.  
Toledo, OH, 43064  
419-259-7542

#### **Recycling**

Department of Natural Resources

#### **Air Pollution/ Solid Waste**

P.O. Box 1049  
Columbus, OH, 43266-1049  
614-644-2270

#### **Community Right-to-Know**

Environmental Protection Agency  
Office of emergency Response  
P.O. Box 1049  
Columbus, OH, 43266-0149  
614-644-2260

#### **OSHA Office**

36 Triangle Park  
Cincinnati, OH, 45246  
513-841-4132

#### **OSHA Office**

Federal Office Building  
1240 East Ninth St.

Cleveland, OH, 44199  
216-522-3818

#### **OSHA Office**

Federal Office Building, Room 620  
200 North High St.  
Columbus, OH, 43215  
614-469-5582

#### **Litter Prevention/Recycling**

Fountain Square Building, F-2  
Columbus, OH, 43266-1049  
614-265-6333

#### **Solid Waste Management**

Environmental Protection Agency  
Solid/Hazardous Waste Management  
P.O. Box 1049  
Columbus, OH, 43266-1049  
614-644-2621

#### **Used Oil Recycling**

Environmental Protection Agency  
P.O. Box 1049  
Columbus, OH, 43266-1049  
614-644-2621

#### **UST/LUST**

Dept. of Commerce  
8895 East Main St.  
Reynoldsburg, OH, 43068  
614-752-7938

#### **Water Quality**

Water Quality Modeling Section  
Water Quality Planning  
P.O. Box 1049  
Columbus, OH, 43266-1049  
614-644-2856

## **Appendix Q– Protective Equipment**

**Spill Cart–2<sup>nd</sup> floor Janitor Closet to the right of elevator:** Blank labels, Bouffant cap, Broom, Bucket, Cartridges (respirator), Ammonia and methylamine-green, Formaldehyde and acid gas-white, Organic vapors and acid gas-yellow, Citric acid, Cleanup boots, Full face shield, Goggles, Solusorb, Solvent spill cleanup kit, and Vinyl coveralls.

**Stockroom–2<sup>nd</sup> Floor and 108 left of sink:** Gloves

**2<sup>nd</sup> floor Janitor Closet, shelves on back wall (stock supply)–** Hg absorbent sponges, Dusk masks, Absorbent blankets, Absorbent pads, Respirator, Respirator cartridges (green, white, yellow), Litmus paper, Mercury Sponge, Nitrile rubber gloves (3 pairs), Plastic scoop, Polysorb pads (3 sm., 1 lg.), Safety aprons (2), Sodium Sesquicarbonate, Solusorb, and Citric acid.

## Appendix R– “How to” Order Chemicals

### I. Check computer database

A computerized chemical inventory is located on the open computer in the **main office (Room 104)** and the computer in the **stockroom (Room 213)**.

Before ordering a chemical you **MUST** check this database-located in the electronic folder “Chemical Inventory”-a file “Data Inventory”. Instructions for using the database are on a **READ ME** file in the folder **CHEMICAL INVENTORY**. If the chemical you wish to order is on the database, check the inventory date. If it was inventoried within the last year, check the location listed for stock of that chemical. If it is located in any room other than the stockroom, you must check with the professor using that room for permission to use the chemical.

If the chemical is located in the **STOCKROOM**, you may as the Lab Technician (available in the building from 9am-2pm) or Stockroom Attendant available in the main office from 4-5pm daily to get the chemical for you, **THE STOCKROOM WILL NOT BE OPEN AFTER 5pm** and the Night Guard does not have the key.

### II. Ordering a Chemical

If the chemical you require is not available in the department, you may obtain an order form from the Secretary (room 104). Catalogs are available in the Secretary’s office as well. Please check **Fisher, Mallinkrodt, Spectrum, or VWR** catalog first for the chemical you need. If it is **NOT** available from any of these suppliers, you may use the other suppliers (Aldrich, New England Nuclear, Sigma, USBiochemicals, etc.).

**Fill out the order form completely** and have your advisor sign the form. When you have completed the form, give it to the Secretary who will place the order.

### III. MSDS Sheets

After you have ordered the chemical, secure a copy of the MSDS sheet (Material Safety Data) from the Secretary’s office. You **MUST** store these in plastic protective sheets (also available from secretary) at the end of your IS carrel.

If you are conducting your research in a lab, check the MSDS sheets for that laboratory. Each laboratory has a grey letter box labeled MSDS Sheets, hanging either from a cabinet or on the wall. If a sheet for the chemical you ordered is not available in that MSDS storage location, make a copy from the original in the main office and put it in the letter box in alphabetical order **IN CASE OF AN EMERGENCY** or you need an MSDS sheet in the evening, they are available 24 hours in room 105 next door to the main office 104. If you remove an MSDS from this filing cabinet for an emergency, notify the Lab Technician, Stock Room Attendant, or Secretary and give them the name of the chemical and the name of the manufacturer so that the MSDS sheet might be replaced .

### IV. Empty Bottles

If you use the last of a chemical or there is only a small portion of the chemical remaining, do the following:

1. Report it to either the Lab Technician or the Secretary. They will place an order for replacement.
2. Give the empty bottle to either the Lab Technician or the Secretary for disposal. **THIS IS VERY IMPORTANT.** The item must be removed from the chemical inventory so that future users will not anticipate stock of the chemical when it is actually spent.

#### **V. When your chemical arrives**

You will be notified through e-mail when the chemical arrives and you may pick it up from the stockroom attendant, the lab technician, or the secretary in the main office in Mateer (104). You will be responsible to label the chemical with your name, storage code color stripe (information available on the data inventory) and any other pertinent information (poison, caustic, etc.) before it leaves the secretary's office. Sign a log for receipt of the chemical and assurance that you have properly labeled the bottle. You may obtain the proper labels from either the Lab Technician, Stock Room Attendant, or the Secretary.

If you are mixing solutions or storing any portion of a chemical in glassware, that glassware **must** be labeled with your name, name of the chemical, date, storage code (the most severe chemical is used for storage), and any appropriate hazard labels (carcinogen, poison, caustic, etc.).

#### **VI. At the end of your research**

Return all chemicals to the stock room. This may be done by locatin the lab technicia, the stock room attendant, or the secretary.

If you have waster chemicals that need disposal and they are not labeled grey (green), check with Dr. Fraga for proper disposal. Any waste that cannot be disposed of by you or the department should be given to the lab technician or the secretary in properly labeled containers (your name, date, chemical name, hazard) for waster disposal.