CHEMICAL HYGIENE PLAN

March 2008

My signature verifies I have read and understand the contents of the Northland Pioneer College Chemical Hygiene Plan March 2008.

Signature	Print Name	Date

Chemical Hygiene Officer Appointment

In compliance with the OSHA 29 CFR 1910.1450: " The Laboratory Standard ", Northland Pioneer College (aka Navajo County Community College District) realizes its responsibility for the protection of our personnel. We hereby institute the following Chemical Hygiene Plan.

Northland Pioneer College (NPC) hereby appoints, Ernie Cunningham., to be our Chemical Hygiene Officer. We acknowledge that the Chemical Hygiene Officer has the knowledge and authority to implement our Chemical Hygiene Plan.

Although NPC is designating Mr. Cunningham *as* the College's Chemical Hygiene Officer. The ultimate responsibility for the Chemical Hygiene Plan rests with the Chief Executive Officer and the Governing Board of the College.

____________________ __________________

Signature Date

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I. INTRODUCTION

A. Occupational Safety and Health Administration Requirements

On January 31, 1990, the Occupational Safety and Health Administration (OSHA) promulgated a final rule for occupational exposure to hazardous chemicals in laboratories. Included in the standard, which became effective on May 1, 1990, is a requirement for all employers covered by the standard to develop and implement the provisions of a Chemical Hygiene Plan (CHP).

A CHP is defined as a written program that specifies procedures, laboratory equipment, personal protective equipment and work practices that are capable of protecting employees from the health hazards associated with the use of hazardous chemicals in the workplace. Components of the CHP include the following:

1. Standard operating procedures for safety and health;
2. Criteria for the implementation of control measures;
3. Measures to ensure proper operation of engineering controls and personal protective equipment;
4. Provisions for information and training;
5. Laboratory activities requiring prior approval before implementation;
6. Provisions for medical consultation and examinations;
7. Designation of responsible personnel; and
8. Identification of particularly hazardous substances.

B. Objectives

The primary goal of this program is the well-being of the faculty, all laboratory instructors, staff, students, and the visiting public. To accomplish this, NPC is committed to achieving the following goals:

1. Maintain a safe environment for all faculty, staff, students, and the visiting public;
2. Provide the necessary facilities, staff and equipment for safety;
3. Minimize all chemical exposure;
4. Avoid underestimation of risk;
5. Provide adequate ventilation;

6. Institute a Chemical Hygiene Plan;

7. Observe the Permissible Exposure Limits (PELs) and when these are not available, to observe Threshold Limit Values (TLVs); and

8. Protect the environment from hazardous chemicals and wastes.

While the Chemical Hygiene Plan is an important part of laboratory safety, not all concerns deal with chemicals. Therefore, it is important to establish additional safety policies and practices regarding biological, physical and electrical considerations and incorporate them into the overall laboratory safety program.

C. Responsibility for safety

Responsibility for chemical hygiene in the laboratory rests with the Chemistry Department Chair, the Chemical Hygiene Officer (CHO), the Laboratory Supervisor or Principal Instructor, and the Laboratory Worker. A chemical safety committee has been appointed by the Provost to assist in the implementation of the CHP.

1. College President
   The College President has the ultimate responsibility for the chemical hygiene program within NPC. The President and the Department Chairs must provide continuing support for institutional chemical hygiene.

2. Department Chairs
   The responsibility for safety in a college (or other administrative unit) lies with the Department.

3. Chemical Hygiene Officer
   The Chemical Hygiene Officer (CHO) is a key component of the CHP. The CHO is a staff member within the Division of Environmental Health and Safety. The CHO monitors the CHP, advises laboratory supervisors on safety matters, and in general serves as a focus for the safety concerns of the laboratory staff. Duties of the CHO are as follows:

   a. Work with administrators and other employees to develop and implement appropriate chemical hygiene practices and policies;

   b. Monitor procurement, use, and disposal of chemicals used in the laboratories;

   c. Ensure that safety audits are performed periodically;

   d. Understand the current legal requirements concerning regulated substances; and

   e. Seek ways to improve the CHP.

4. Laboratory Supervisor or Principal Instructor

5. The Laboratory Supervisor or Principal Instructor has the overall responsibility of administering and enforcing the CHP in the laboratory. Duties are as follows:

    a. Ensure that the laboratory worker understands and follows the policies and practices provided in the Laboratory Safety Procedures and Chemical Hygiene Plan;

    b. Ensure that protective equipment is in working order and available to the laboratory worker;

    c. Conduct regular, formal chemical hygiene and housekeeping inspections, including routine inspections of emergency equipment.

    d. Maintain a proper inventory of the chemicals.

    e. Ensure that appropriate training is provided to the laboratory workers;

    f. Understand the current legal requirements concerning regulated substances;

    g. Determine the required level of protective apparel and equipment for a given procedure; and

    h. Ensure that facilities and training for use of any material being ordered are adequate.

6. Laboratory Worker
    The laboratory worker has the following responsibilities:

    a. Plan and conduct each operation in accordance with the College's Laboratory Safety Procedures and Chemical Hygiene Plan; and

    b. Develop good personal laboratory hygiene habits.

7. Laboratory Visitors
    It is the Laboratory Supervisor or Principal Instructor's responsibility to ensure the safety of all visitors in the laboratory. Any visit which involves children must be brought to the attention of the CHO or the College Chairperson.

II. CHEMICAL HYGIENE PLAN (CHP)

A. Scope

Addresses all laboratories and the laboratory employees at the College. The information provided in these procedures satisfies the CHP requirements in 29 Code of Federal Regulations (CFR) 1910.1450, "Occupational Exposure to Hazardous Chemicals in Laboratories". Further information can be found in more detail in the appropriate section of the Laboratory Safety Procedures and Chemical Hygiene.

The purpose of the CHP is to provide general rules and information for chemical safety and to educate each laboratory on the requirements of the CHP. It is necessary for each College and the individual laboratories to supplement this CHP with specific information in order to comply with the CHP. The success of the CHP will depend on the development and/or implementation of the following information:

1. Chemical inventories for each laboratory and storage area.
2. Material Safety Data Sheet (MSDS) files for each laboratory.
3. Standard Operating Procedures for specific hazardous chemicals used in the individual laboratories.
4. A floor plan for the location of fume hoods per college stating building, floor, and room numbers. The CHP should be maintained by the Building Supervisor.
5. Information and training programs to meet requirements of the CHP.
6. A written approval system must be maintained at each laboratory for off hours work, working alone, hazardous work, and unattended operations.
7. Provisions to meet the medical consultation and examination requirements of the CHP.
8. Accurate and up-to-date record keeping as designated by the CHP.
9. Designation of a safety committee or officer per college or department to develop and help implement safety procedures and meet requirements of the CHP.

   The Division of Environmental Health and Safety will be available to assist in the development and implementation of all aspects of the Chemical Hygiene Plan as listed above. All reference material is available through the Division of Environmental Health and Safety.

B. Standard Operating Procedures for Employees

1. Employee Information and Training

All employees should be apprised of the hazards presented by the chemicals in use in the laboratory. Each employee must receive training at the time of the initial assignment to the laboratory, prior to assignments involving new exposure situations, and/or at a regular frequency as determined by the CHO, and Laboratory Supervisor or Principal Instructor. The Laboratory Supervisor or Principal Instructor maintains documentation of training at the workplace.

This training should include methods of detecting the presence of a hazardous chemical, physical and health hazards of chemicals in the lab, and measures employees can take to protect themselves from these hazards. This training presents the details of the CHP, and includes:

a. The contents of the OSHA laboratory standard, and its appendices;

b. The location and availability of the Chemical Hygiene Plan;

c. The permissible exposure limits for OSHA regulated substances or recommended exposure values for other hazardous chemicals not regulated by OSHA which are present in the laboratory;

d. Signs and symptoms associated with exposure to the chemicals present in the laboratory; and

e. The location and availability of reference material on the Laboratory Safety Procedures and Chemical Hygiene Plan.

   Training must be conducted by the Laboratory Supervisor or Principal Instructor, or his/her designee.

2. Chemical Procurement

   It is the responsibility of departments and units within the College to establish guidelines for the procurement of chemicals. All employees involved in the receiving of chemicals should be informed about proper handling, storage, and disposal procedures. All chemicals should be dated upon receipt. Chemicals should not be accepted without accompanying labels, Material Safety Data Sheets, and proper packaging. Damaged or leaking containers should not be accepted. Employees should be informed about the proper handling of new chemicals that are known or suspected as hazardous; particularly those that are known, or suspected carcinogens, or those with special storage or handling requirements.

3. General Procedures

   The following set of general principles should be adhered to by all laboratory staff:

a. Know the safety policies and procedures that are applicable to the task at hand.

b. Determine the potential physical, chemical and biological hazards and appropriate safety precautions before beginning any new or modified procedure.

c. Know the location of all emergency equipment in the laboratory and the proper procedure for each.

d. Be familiar with all laboratory emergency procedures.

e. Be alert to unsafe conditions and actions, and alert the CHO, Laboratory Supervisor, or Principal Instructor.

f. Follow acceptable waste disposal procedures to avoid hazards to the environment.

g. Ensure that all chemicals are correctly and clearly labeled.

h. Post warnings when unusual hazards exist, such as flammable materials or biological hazards.

i. Avoid distracting or startling a coworker.

j. Use equipment only for its originally designed purpose.

k. Do not work alone in the laboratory if any hazardous procedures are being conducted.

l. Do not store, handle, or consume food in an area containing hazardous substances.

m. Never use glassware or utensils that have been used in the laboratory to prepare or consume food or beverages.

n. Report unusual odors as soon as they are detected to the Laboratory Supervisor or Principal Instructor.

o. Do not use odors as a means of determining that inhalation exposure are or are not exceeded. Whenever there is a reason to suspect that a toxic chemical inhalation limit might be exceeded, whether or not a suspicious odor is notified, notify the Laboratory Supervisor or Principal Instructor.

p. Use safety shields whenever a reaction is attempted for the first time.

q. Use careful handling and storage procedures to prevent damage to glassware.

r. Do not use damaged glassware items; either discard or repair.

s. Use hand protection when picking up broken glass. Small pieces should be swept up with a brush into a dust pan.

t. Report all accidents immediately to the Laboratory Supervisor or Principal Instructor.

4. Chemical Handling

a. Various standardized chemical safety procedures should be followed by laboratory workers:

1) Do not use an open flame to heat a flammable liquid or to carry out a distillation.
2) Use an open flame only when necessary and promptly extinguish it when it is no longer needed.
3) Before lighting a flame, remove all flammable substances from the immediate area. And check all containers of flammable materials in the area to ensure that they are tightly closed.
4) Notify other personnel in the laboratory before lighting a flame.
5) Store flammable materials in their proper storage area.
6) Use only non-sparking electrical equipment when volatile flammable materials are present in the laboratory.
7) An approved fume hood must be used when conducting the following procedures:

a) When adding water to inorganic acid (hydrochloric acid, nitric acid), always add water slowly with stirring.
b) Always add a strong dehydrating agent (sulfuric acid, sodium hydroxide, calcium oxide) to water slowly with stirring.
c) Flammable or toxic materials should be handled in a fume hood.
d) Perform any operation that generates vapors, dusts, or aerosols in a fume hood.

8) Never use improper reagents.
9) Keep all chemical containers closed unless in active use.
10) Exercise particular caution when handling carcinogenic, teratogenic, mutagenic, or highly toxic materials, and observe all necessary precautions.

b. When working with chemicals, all employees should know and constantly be aware of the following:

1) The hazards identified with the chemical(s) being used. This information is provided in the appropriate MSDS and other sources such as the Merck Index.
2) How and where to properly store the chemical(s) when not in use.
3) The proper methods for transporting chemicals within the laboratory facilities.
4) What safety precautions are needed when working with the

chemical(s), such as the appropriate personal protective equipment.
5) The location of, and the way to properly use, all emergency equipment.
6) The appropriate procedure for dealing with emergencies, including evacuation routes, procedures for spill cleanup, and proper waste disposal.

5. Personal Hygiene

   a. Whenever a chemical comes in contact with the skin, wash the area promptly.

   b. Avoid inhalation of chemical aerosols, dusts, fumes, mists, and vapors. Do not try to determine chemical properties by “sniffing” the chemical.

   c. Use pipette safety devices such as bulbs or pumps. Do not pipette by mouth suction.

   d. Wash hands well with soap and water before leaving the laboratory. Do not wash hands with solvents.

   e. Do not drink, eat, chew gum, smoke or apply cosmetics in the laboratory.

   f. Do not bring beverages, food, tobacco, or cosmetic products into chemical storage or use areas.

   g. Protective Clothing and Equipment

   All laboratory workers should observe the following practices:

   1) Eye protection should meet the requirements of the American National Standards Institute (ANSI) Z87-1. Safety goggles with side pieces are required when the potential for flying objects or chemical splashes exists.
   2) Wear appropriate protective clothing, such as a laboratory coat or apron at all times.
   3) Confine long hair and loose clothing when in the laboratory.
   4) When working with corrosive liquids, or with allergenic, sensitizing, or toxic chemicals, wear gloves made of a material known to be resistant to permeation by the chemical. Test gloves for the absence of pin-hole leak by air inflation; do not inflate by mouth.
   5) Do not wear shorts or short skirts when working in the laboratory.
   6) Wear low-heeled shoes with fully covered “uppers”. Do not wear sandals or open-toed shoes, shoes that do not cover metatarsal area, or shoes made of woven materials.
   7) Use a fume hood whenever inhalation exposure for a chemical is likely to exceed the permissible exposure limits specified in 29 CFR,

Part 1910, Subpart Z.
8) Before using any protective equipment, inspect for defects. Do not use defective protective equipment.

6. Housekeeping

Safety performance and good housekeeping practices in the laboratory are directly related to each other. The workplace should be kept clean and orderly, and chemicals and equipment should be stored in appropriate areas when not in use. The following general procedures should be followed by the laboratory staff.

a. Work areas should be kept clean and free of obstructions. Cleanup should follow the completion of any operation and/or at the end of each day.

b. Access to emergency equipment showers, eyewash fountains, and exits should never be blocked, even temporarily. Do not park chemical carts in front of any emergency equipment.

c. Wastes should be deposited in appropriate receptacles.

d. Place broken glass in a separate container.

e. Do not store chemicals in aisles, stairways and hallways, or on floors, desks, or laboratory bench tops.

f. Equipment and chemicals should be stored properly.

g. All chemical containers must be labeled with at least the identity of the contents, the associated hazards to the user, and the name and address of the chemical manufacturer, importer, or other responsible party.

h. Keep all work areas clear of clutter, especially bench tops and aisles.

i. At the end of each work day, place all chemicals in their assigned storage area.

j. Wastes should be labeled properly.

k. Clean all working surfaces and floors on a regular basis.

7. Prior Approval

Employees must obtain prior written approval from the Chemical Hygiene Officer before proceeding with a laboratory task whenever:

a. A new laboratory procedure or test is carried out.

b. A toxic limit concentration is likely to be exceeded, or other harm is likely.

c. There is a change in procedure or test, even if it is very similar to prior practices. “Change in a procedure or test” is defined as:

1) A ten percent or greater increase or decrease in the amount of one or more chemicals used.
2) A substitution or deletion of any of the chemicals in a procedure.
3) Any change in other conditions under which the procedure is to be conducted.

d. There is a failure of any equipment used in the process, especially any failure of safeguards such as fume hoods or clamped apparatus.

e. There are unexpected results.

f. Members of the laboratory staff become ill, suspect that they or others have been exposed, or otherwise suspect a failure of any safeguards.

g. First level beginning lab classes use the following chemicals:

Elemental potassium
Elemental iodine
Elemental mercury
Elemental bromine
Elemental chlorine phenol
Benzene
Diethyl ether
Methanol
Chloroform
Acetic anhydride
Hydrogen sulfide
Diphenyl hydroflouric acid formic acid
Perchloric acid
Picric acid
Cyanide compounds
Mercury compounds
Lead compounds
Barium compounds
Cadmium compounds
Perchlorate compounds
Chlorate compounds
Nickel compounds
Hexavalent chromium compounds
Mercury thermometers

As a general principle, a less toxic chemical shall be used whenever possible to substitute for a more toxic one.

8. Chemical Spills

   Spills of toxic of chemical substances should be resolved immediately according to the Emergency/Incident Procedures found in IX, Emergency/Incident Procedures.

C. Specific Safety Procedures

All laboratory procedures must contain a written description of specific safety practices incorporating the applicable precautions described in this section. Employees should read and understand these practices before commencing a procedure.

1. Procedures for Toxic Chemicals

   The MSDS sheets for many chemicals used in the laboratory will state recommended limits and/or OSHA-mandated limits as guidelines for exposure. Typical limits are Threshold Limit Values (TLVs), Permissible Exposure Limits (PELs), and action levels. When such limits are stated, they will be used to assist the CHO in determining the safety precautions, control measures, and safety apparel that apply when working with toxic chemicals.

   a. When a TLV or PEL value is less than 50 parts per million (ppm) or 100 mg/M3, the user of the chemical must use it in an operating fume hood or similar device. If none are available, no work should be performed using that chemical.

   b. If a TLV, PEL, or comparable value is not available for that substance, the animal or human median inhalation concentration of toxicity will be assessed. If that value is less than 200 ppm or 2000 mg/M3 when administered continuously for one hour or less, then the chemical must be used in an operating fume hood. If none are available, no work should be performed using that chemical.

   c. Whenever the handling of toxic substances with moderate or greater vapor levels will generate vapors likely to exceed air concentration limits, laboratory work with such liquids and solids will be conducted in a fume hood. If none are available, no work should be performed using that chemical.

2. Procedures for Flammable Chemicals

   In general, the flammability of a chemical is determined by its flash point, the lowest temperature at which an ignition source can cause the chemical to ignite momentarily under certain conditions.

   a. Chemicals with a flash point below 200 degrees Fahrenheit (93.3 degrees Celsius) will be considered “fire-hazard chemicals”.

b. Fire-hazard chemicals should be stored in a flammable-solvent storage area or in storage cabinets designated for flammable materials.

c. Fire-hazard chemicals, that are used in quantities that may present a fire hazard, must be used only in vented hoods and away from sources of ignition.

3. Procedures for Reactive Chemicals

Reactivity information for a chemical is sometimes supplied in the manufacturer's MSDS or on the label. Guidelines on which chemicals are reactive can be found in regulations promulgated by the Department of Transportation (DOT) in 49 CFR. Also see NFPA Manual 325, "Fire Hazards Properties of Flammable Liquids, Gases, Volatile Solids"; Manual 459, "Hazardous Chemical Data"; and Manual 491M, "Manual of Hazardous Chemical Reactions". Another complete and reliable references on chemical reactivity is found in the current edition of the "Handbook of Reactive Chemical Hazards," written by L. Bretherick, and published by Butterworths.

A reactive chemical is one that:

a. Is described as such in Bretherick or the MSDS;

b. Is ranked by the NFPA as 3 or 4 for reactivity;

c. Is identified by the DOT as:

1) an oxidizer;
2) an organic peroxide; or
3) an explosive, Class A, B, or C;

d. Fits the EPA definition of reactive in 40 CFR 261.23;

e. Fits the OSHA definition of unstable in 29 CFR 1910.1450;

f. Is known or found to be reactive with other substances.

Reactive chemicals should be handled with all proper safety precautions, including segregation in storage and prohibition on mixing even small quantities with other chemicals without prior approval and appropriate personal protection and precautions.

4. Procedures for Corrosive Chemicals and Contact-Hazard Chemicals

Corrosivity, allergenic, and sensitizer information is sometimes given in manufacturers' MSDSs and on labels. Also, guidelines on which chemicals are corrosive can be found in other OSHA standards and in regulations promulgated by DOT in 49 CFR and the EPA in 40 CFR.

A corrosive chemical is:

a. A chemical that causes visible destruction of, or irreversible alterations in, living tissue by chemical action at the site of contact. For example, a chemical is considered to be corrosive if, when tested on the intact skin of albino rabbits by the method described by the U.S. Department of Transportation in Appendix A to 49 CFR part 173, it destroys or changes irreversibly the structure of the tissue at the site of contact following an exposure period of four hours. This term should not refer to action on inanimate surfaces.

b. One that fits EPA definition of corrosive in 40 CFR 261.22 (has a pH greater than 12.5 or less than 2.0);

c. Known or found to be corrosive to living tissue.

5. Procedures for Carcinogens, Reproductive Toxins and Chemicals of Unknown Toxicity

The procedures described heretofore should be followed when performing laboratory work with any select carcinogen, reproductive toxin, substance that has a high degree of acute toxicity, or a chemical whose toxic properties are unknown.

a. The following definitions apply:

1) Select carcinogen
Any substance defined as such in 29 CFR 1920.1450 and any other substance described as such in the applicable MSDS.
2) Reproductive toxin
Any substance described as such in the applicable MSDS.
3) Substances with a high degree of acute toxicity
Any substance for which the LD50 data described in the applicable MSDS causes the substance to be classified as a “highly toxic chemical” as defined in ANSI Z129.1.
4) Chemical whose toxic properties are unknown
A chemical for which there is no known statistically significant study conducted in accordance with established scientific principles that establishes its toxicity.
5) Adverse chemical
For the purposes of this , the chemicals listed in the above four categories will be called adverse.
6) Designated area
A hood, portion of a laboratory, or an entire laboratory room designated as the only area where work with quantities of the adverse chemicals in excess of the specified limits must be conducted.

b. Designated areas must be posted and their boundaries clearly marked. Only those persons trained with the use of adverse chemicals will work with those chemicals in a designated area. All such persons will:

1) Use the smallest amount of chemical that is consistent with the requirements of the work to be done.
2) Use the high-efficiency particulate air (HEPA) filters or high-efficiency scrubber systems to protect vacuum lines and pumps.
3) Decontaminate a designated area when work is completed.
4) Prepare wastes from work with adverse chemicals for waste disposal in accordance with specific disposal procedures consistent with the Resource Conservation and Recovery Act (RCRA) and as designated by the Laboratory Supervisor.

c. Storage of all adverse chemicals in locked and enclosed spaces with a slight negative pressure compared to the rest of the building is preferred.

d. Do not wear jewelry when working in designated areas, because the decontamination of jewelry may be difficult or impossible.

e. Wear long-sleeved clothing and gloves known to be resistant to permeation by the chemicals to be used when working in designated areas.

6. Control Measures and Equipment

Chemical safety is achieved by continual awareness of chemical hazards and by keeping the chemical under control by using precautions, including engineering safeguards such as fume hoods. Laboratory personnel should be familiar with the precautions to be taken, including the use of engineering and other safeguards. The Laboratory Supervisor or Principal Instructor should be alerted to detect the malfunction of engineering controls and other safeguards and bring to the attention of appropriate personnel for corrections. All engineering safeguards and controls must be properly maintained, inspected on a regular basis and never overloaded beyond their design.

7. Ventilation

a. Laboratory ventilation should be not less than six calculated air changes per hour. This flow is not necessarily sufficient to prevent the accumulation of chemical vapors. Therefore, when working with toxic chemicals, fume hoods should always be utilized.

b. Fume hoods should provide 80-120 linear feet per minute of air flow.

c. Laboratory employees should understand and comply with the following:

1) Work should not be done if hood low flow alarm is on.
2) A fume hood is a safety backup for condensers, traps, or other devices that collect vapors and fumes. It is not used to “dispose” of chemicals by evaporation unless the vapors are trapped and recovered

for proper waste disposal.
3) The apparatus inside the fume hood should be placed on the floor of the hood at least six inches away from the front edge.
4) Fume hood windows should be lowered (closed) at all times except when necessary to raise (open) them to adjust the apparatus that is inside the hood.
5) The hood fan should be kept "ON" whenever a chemical is inside the hood, whether or not any work is being done inside the hood.
6) Personnel should be aware of the steps to be taken in the event of power failure or other hood failure.
7) Maintenance personnel should inspect hood vent ducts and fans, following the manufacturer procedures, at frequent intervals to ensure they are both clean and clear of obstructions.
8) Hoods should not be used as storage areas for chemicals, apparatus, or other materials.

8. Flammable-Liquid Storage

   a. "Fire-hazard chemicals" should be stored in approved containers as specified in 29 CFR 1910.106 (d) iii. Safety can should be used only as recommended by the manufacturer, including the following safety practices:

      1) Never disable the spring-loaded closure.
      2) Always keep the flame-arrester screen in place; replace if punctured or damaged.

   b. Cabinets designed for the storage of flammable materials should be properly used and maintained.

   c. Read and follow the manufacturer's information and also follow these safety practices:

      1) Store only compatible materials inside a cabinet.
      2) Do not store paper or cardboard or other combustible packaging material in a flammable liquid storage cabinet.
      3) Follow the manufacturer established quantity limits for various sizes of flammable-liquid storage cabinets; do not overload a cabinet.

9. Eyewash Fountains and Safety Showers

   Equip all laboratories with eyewashes and safety showers. These must be located so they can be reached from any point in the laboratory, as specified in the latest edition of ANSI Z358.1. Emergency eyewash fountains and emergency shower units must be in accessible locations requiring no more than 10 seconds to reach and should be within 100 feet (30.5 meters) of the hazard.

For strong acids or caustics, eyewash fountains should be directly adjacent to or within 10 feet (3 meters) of the hazard.

Check the functioning of eyewash fountains and safety showers on a weekly basis. Eyewash equipment must be capable of delivering to the eyes not less than 1.5 liters per minute for 15 minutes.
Be sure that access to eyewash fountains and safety showers is not restricted or blocked by temporary storage of objects or in any other way.

10. Respirators

    a. Respirators may not be used under any circumstances unless approved by EH&S.

    b. The requirements of 29 CFR 1920.134, and the College Respiratory Protection Program must be followed.

    c. For assistance in the Respiratory Protection Program, refer to Exhibit LBSF.4, Contact Person List, and contact the EH&S Coordinator.

D. Provisions For Medical Consultations

1. All employees who work with hazardous chemicals should have the opportunity to receive medical attention, including follow-up exams, under the following circumstances:

    a. When an employee develops signs or symptoms associated with a hazardous chemical they may have been exposed to, they should receive an appropriate medical exam.

    b. When exposure monitoring reveals exposure level to be above the action level or PEL for which there are exposure monitoring and medical surveillance requirements, medical surveillance should be established as prescribed by the standard.

    c. When an event such as a spill, leak, or explosion occurs resulting in the likelihood of a hazardous exposure, medical consultation should be provided to determine the need for a medical examination.

2. All medical exams and consultations must be performed by or under the direct supervision of a licensed physician and should be provided without cost to the employee, without loss of pay, and at a reasonable time and place. The employer should provide the following information to the physician:

    a. The identity of the hazardous chemical(s) to which the employee may have been exposed;

    b. A description of the conditions under which the exposure occurred including quantitative exposure, if available; and

c. A description of the signs and symptoms of exposure that the employee is experiencing, if any.

3. The employer must obtain a written opinion from the the physician performing the examination or consultation which must include the following:

    a. Any recommendation for further medical follow-up;

    b. The results of the medical examination and any associated tests;

    c. Any medical conditions which may be revealed in the course of examination which may place the employee at increased risk as a result of exposure to a hazardous chemical found in the workplace; and

    d. A statement that the employee has been informed by the physician of the results of the consultation or examination and any medical condition that may require further examination or treatment.

    The written opinion should not reveal specific findings of diagnoses unrelated to occupational exposure.

III. CHEMICAL HANDLING AND EXPOSURES

E. General Information About Chemicals

1. Chemical Grade

   There are several grades of chemicals which may be encountered in the laboratory. These are technical, practical or purified, pharmaceutical, reagent, ACS certified and primary standards.

2. NFPA Hazard Identification System

   The NFPA 704 Hazard Identification System provides:

   a. Planning guidance to the fire departments for safe tactical procedures in emergency operations.

   b. On-the-spot information to safeguard the lives of fire fighting personnel and others who may be exposed.

   c. A means of identifying hazardous materials and areas in which they are stored for plant engineers and safety personnel.

   It is important to realize that not all chemicals have been rated with the NFPA system. Additionally, the quantity of a chemical can influence the degree of hazard present.

   The diamond-shaped diagram gives a general idea of the inherent hazards of the chemical, as well as the order of these hazards under emergency conditions such as spills, leaks, and fires. The diamond is divided into four color-coded quadrants.

   The top three quadrants of the diamond are labeled with numbers to indicate the degree of hazard for each category: Emergency health hazard, fire hazard, and instability/reactivity hazard. The bottom quadrant is used to indicate water reactivity, radioactivity, biohazards, or other hazards. Generally, the higher the hazard rating, the higher the hazard. Table NFPA Flammability Hazard Rating for Flammables and Combustibles, NFPA 45, shows how the flammability hazard rating relates to flammables and combustibles. Refer to the Summary of NFPA Hazard Rating System, NFPA 704, for the rating system definitions.

F. Material Safety Data Sheets

The Hazard Communication Standard (HCS), 29 CFR 1910.1200, provisions have been incorporated into the Laboratory Standard, 29 CFR 1910.1450. The purpose of the HCS is to provide workers with information about potential risks due to chemical hazards in the workplace. The HCS created a “right to know” procedure for the worker who handles or is exposed to hazardous chemicals. The HCS is a critical, integral part of an overall approach to worker safety. Among the various topics covered by the HCS are the labeling of containers and availability of material safety data sheets (MSDSs), and the education and training of employees.

1. MSDS Format

   An MSDS should be obtained for each chemical used in the laboratory. Manufacturers and suppliers can be helpful in determining whether the material is hazardous and requires an MSDS. The HCS, however, does not specify any particular format for MSDSs.

2. Obtaining MSDSs

   When a chemical is ordered for the first time, Purchasing personnel will require an MSDS for the material as a condition of purchase. If an MSDS is not received with or prior to the shipment, the material should be secured until the MSDS is received. Additionally, each time a substance is reordered, Purchasing Agents will request an updated MSDS for the material, provided one is available.

3. Availability of MSDSs

   All employees should have access to the MSDSs at all times. MSDSs should be filed alphabetically in clearly labeled notebooks and updated as new sheets are received. The notebooks must be kept in an area easily accessible to all employees in the laboratory.

   Each MSDS is an excellent source of information, including, but not limited to, physical properties, fire and explosion hazards, chemical reactivity, recommended protective equipment, and spill and first aid procedures for a specific chemical. Because of this, each employee should be familiar with the location and types of information available in MSDSs. If there are any questions about the material presented in the MSDS, the laboratory worker should contact the Laboratory Supervisor or Principal Instructor for clarification.

G. Chemical Labeling

1. New Chemical Containers

   When a new chemical is received, the label on the hazardous material should be checked against the information provided in the MSDS for consistency. In general, labels should contain information about the identity of the material, appropriate hazard warnings, and the name and address of the chemical manufacturer, importer or other responsible party.

   OSHA has published standards for certain materials, including requirements for specific wording on labels. These substances are covered in 29 CFR 1910, and it should be consulted for the actual text of the required wording and for any other requirements. The American National Standards Institute (ANSI) has published a voluntary labeling standard, ANSI Z129.1-1982, which includes the following items:

a. The identity of the product or its hazardous components;

b. Signal words, such as CAUTION, WARNING, or DANGER;

c. A statement of actual hazards present;

d. Precautionary measures to prevent physical harm, such as the wearing of rubber gloves, goggles, or respirators;

e. Instructions in the case of contact or exposure, such as “wash with cold water” or “do not induce vomiting”;

f. Antidotes in case of poisoning;

g. Notes to physicians on recommended emergency treatment;

h. Instructions in case of fire, spill, or leak, such as type of fire extinguisher; and

i. Instructions for container storage and handling, such as “keep away from fire” or “store in a cool, dry place”.

2. Prepared Chemicals

Any container into which materials are transferred for in-house use, other than for immediate use by the employee filling the container, should be labeled consistent with the label on the original container. Labels for all hazardous substances should be checked monthly to ensure that labels are not defaced, and are intact and accurate. Immediate use is defined as the time during the employee’s work shift for a given day.

Pictorial symbols may be suitable for quick reference. Additionally, the National Fire Protection Agency (NFPA) has developed the 704M System, which rates risks from 0 (minimum) to 4 (maximum). The system is explained further in III.A.2., NFPA Hazard Identification System. Indications of the severity of risk in three categories: Flammability, dangerous reactivity or explosivity, and general health are shown on the multi-colored, diamond-shaped label, as well as any special hazard.

The National Paint and Coatings Association (NPCA) has developed the Hazardous Materials Information System (HMIS), which is similar to the NFPA 704M system. The HMIS involves the use of numerical values, which are virtually the same as the NFPA 704 system, but include a descriptive means of evaluation of the applicable hazards, and the use of a single letter symbol to denote the appropriate combination of personal protective equipment, e.g., “A” represents the use of rubber gloves.

H. Classification of Chemicals

There are many ways to classify chemicals. Potential physical and health hazards associated with the use of the chemical are in two classifications.

1. Hazard Classification

Chemicals can be further classified by the potential physical and health hazards that can be present in the laboratory . Understanding these classes can further aid in determining the safe handling, storage, and disposal techniques to employ for specific chemicals. Some chemicals may actually fall into more than one class.

a. Flammable and Combustible

Flammable substances are those which readily catch fire and burn in air. The vapors from a flammable liquid burn, not the liquid itself. Flammable liquids are those which have a flashpoint below 100 degrees F (37.8 degrees C) and a vapor pressure that does not exceed 40 pounds per square inch (psi) at 100 degrees F. Refer to NFPA Classification of Flammable and Combustible Liquids for Storage Purposes, NFPA 321, for the division of flammable and combustible liquids into several classes.

In addition to liquids, the Department of Transportation (DOT) also classifies flammable substances as solids and gases. Examples of flammable gases are acetylene, ethylene oxide, and hydrogen. Flammable solids are those which are capable of producing fires as a result of friction or heat retained from production or that, if ignited, produce a serious transportation hazard.

A combustible liquid is one which has a flash point at or above 100 degrees F (37.8 degrees C). Organic acids are combustible materials, with many being liquids.

1) Explosives

Explosive gases and solids are also part of the flammable and combustible group. Light, mechanical shock, heat and certain catalysts can act as initiators of explosive reactions. One example of an explosive mixture is a suspension of oxidizable particles, such as magnesium powder or zinc dust, in air.

There are three types of fast chemical decompositions which belong in this group: deflagrations, explosions, and detonations. A deflagration is a soft explosion when pressures are relatively low. An explosion involves pressures of several atmospheres, while a detonation is a severe form of explosion when pressures are much higher and are spread at a high rate, i.e., as much as several miles per second.

A compound is more likely to be explosive if its heat of formation is smaller by more than 100 calories per gram than the sum of the heats of formation of its products. Explosives include nitrates, chlorates, perchlorates, and picrates.

2) Pyrophorics

Pyrophoric chemicals are those substances that react so rapidly with air and its moisture that the ensuing oxidation and/or hydrolysis leads to ignition. Ignition may be instantaneous, delayed, or occur only if the material is finely divided or spread in a diffuse layer. Some examples are:

a) Finely divided metals, such as calcium, magnesium, and zirconium.
b) Metal or non-metal hydrides, such as germane and diborane.
c) Partially or fully alkylated derivatives of metal or non-metal hydrides, such as diethylaluminum hydride and trimethyphosphine.
d) Alkylated metal alkoxides or non-metal halides, such as diethylethoxyaluminum and dichloromethylsilane.
e) Carbonyl metals, such as pentacarbonyl iron and octacarbonyl dicobalt.
f) Used hydrogenation catalysts, which are especially hazardous due to the hydrogen present.

Spontaneous (instantaneous) ignition or combustion occurs when a substance reaches its ignition temperature without the application of external heat. Substances capable of spontaneous combustion include alkali metals such as sodium and potassium, finely divided pyrophoric metals, and phosphorus.

3) Water-Reactive Substances

Water-sensitive compounds react exothermically and violently with water, particularly if it is present in limited quantities, since no significant cooling effect will occur. The following are examples of water-reactive substances:

a) Alkali and alkaline earth metals, such as potassium and calcium;
b) Anhydrous metal halides, such as aluminum bromide and germanium chloride;
c) Non-metal halides, such as boron tribromide and phosphorus pentachloride;
d) Anhydrous metal oxides, such as calcium oxide and cesium trioxide;
e) Non-metal oxide, such as sulfur trioxide and hot boron trioxide; and
f) Non-metal halide oxides, such as phosphoryl chloride, sulfonyl chloride, and chlorosulfonic acid.

4) Peroxidizable Substances

Peroxidizable substances slowly react under ambient conditions with atmospheric oxygen to initially form peroxides. The shelf life varies among the various compounds in this group.

b. Corrosives

Corrosives include strong acids, strong bases, dehydrating agents, and oxidizing agents. These chemicals erode the skin and respiratory epithelium, damage the eye and cause severe bronchial irritation.

1) Strong Acids

All concentrated acids can damage the skin and eyes. Nitric, chromic, and hydrofluoric acids are particularly damaging because of the types of chemical burns they inflict.

2) Strong Bases

Common bases include sodium hydroxide, potassium hydroxide and ammonia. Metal hydroxides are extremely damaging to the eyes. Ammonia acts as a bronchial irritant.

3) Dehydrating Agents

Strong dehydrating agents include concentrated sulfuric acid, sodium hydroxide, phosphorus pentoxide, and calcium oxide. These substances can cause severe burns on contact with the skin because of their affinity for water.

4) Oxidizers

The NFPA Standard 1;27, Hazardous Materials and Chemicals, defines oxidizers as any material that readily yields oxygen or other oxidizing gas, or that readily reacts to promote or initiate combustion of combustible materials. The four class definitions of oxidizers are provided in NFPA Classification of Oxidizers for Storage Purposes, NFPA 1, as well as examples of other oxidizers. Examples of Commonly Occurring Oxidizing Agents, in Improving Safety in the Chemical Laboratory, provides examples of oxidizing agents which are gaseous, liquids, and solids.

2. Physiological Classification

Chemicals can be classified based on their physiological characteristics.

I. Storage Of Chemicals

1. Important Safety Rules for the Storage of Chemicals

Proper storage of chemicals is important for the health and safety of the entire laboratory staff. Improper storage can result in hazardous situations that can endanger laboratory workers and physical property. The following is a list of important safety rules for the storage of chemicals:

a. Never store incompatible chemicals together in alphabetical order.

b. Never store chemicals in a laboratory fume hood.

c. Return all chemicals to their appropriate storage areas at the end of a procedure or the end of the day.

d. Flammable chemicals that should be refrigerated must be stored in an approved explosion-proof refrigerator.

e. Chemicals should preferably not be stored on shelves above eye level.

f. Never stack bottles on top of each other.

g. Preferably store chemicals only on sturdy shelving, which has a raised lip edging, and has been secured to the wall, ceiling, or floor.

h. Bottles of flammable liquids should not be stored near materials in cardboard containers.

i. All chemical containers should be labeled with the date of receipt and the date opened.

Two principles are important for safe chemical storage: Inventory control and segregation.

2. Inventory Control

Proper inventory control is essential in the laboratory. The following principles are involved in this process:

a. Chemicals are purchased in limited amounts. A one-year supply or less is generally the amount preferred.

b. An expiration date should be assigned to each chemical container. This date should be no longer than one year from the date received. At the end of the period, a chemical may be marked for disposal, or assigned a new expiration date (except peroxide formers, e.g., diethyl ether).

c. Information about every chemical received, such as date received, manufacturer, and quantity, is recorded to ensure a “cradle-to-grave” record for that substance.

d. A first-in, first-out system should be used. This practice ensures less of a likelihood that chemicals will deteriorate beyond use or exceed their shelf life.

e. One person should be designated as the individual responsible for removal and return of chemicals to the storage area.

f. When chemicals are removed from the storage area, the appropriate information should be recorded by the laboratory worker on the chemical inventory log sheet. The amount used should be recorded at the time the chemical is returned.

Chemicals should be examined semi-annually. During the inspection, those chemicals, which have the following conditions should be disposed of by the proper procedures: kept beyond their appropriate shelf life; deterioration of the chemical; questionable labels or no labels; leaking containers; and corroded caps.

3. Segregation

Chemicals should be arranged in the storage area according to their reactivity. Various schemes have been proposed to segregate chemicals, many of which are too elaborate to encourage laboratory staff to utilize them. Compatible Chemical Groups, CRC Handbook of Laboratory Safety, shows some incompatibilities to be considered when planning a storage scheme.

Many times, chemicals fall into more than one hazard category. The chemical should be categorized according to the most severe hazard. Further information from MSDSs and other references concerning hazards and incompatibilities may be used to categorize the chemical differently from that of the manufacturer. In these instances, the container is then marked with the appropriate colored tape to indicate the proper storage area.

4. Special Considerations

In addition to the general requirements for storing chemicals, various groups of chemicals have special considerations.

a. Flammable and Combustible Liquids

Maximum Allowable Size of Containers and Portable Tanks, NFPA 30, sets the maximum allowable size of containers for the storage of flammable liquids and combustible liquids.

For exemptions to the maximum allowable size of containers and potable tanks, contact the Senior Environmental Health & Safety Specialist for Fire.

The presence of flammable liquids in glass containers presents substantial hazards from accidental breakage. Many suppliers furnish glass containers with “shatter-resistant coatings.” These “shatter-resistant” glass containers offer significant protection from accidental breakage and are recommended for use when hazardous chemicals must be kept in glass rather than plastic or metal containers. Maximum Quantities of Flammable and Combustible Liquids in Laboratory Units Outside of Flammable Liquid Storage Rooms, NFPA Standard 45, further limits the storage of chemicals for research laboratory work.

Flammable and combustible materials should be kept as far away from oxidizers as possible. Organic acids, which are combustibles, generally should not be stored with mineral acids, which are oxidizers.

When flammables must be stored in a refrigerator, an approved flammable material storage or explosion-proof unit should be used. Containers should never be placed in a refrigerator uncapped. Containers should be capped to ensure a seal that is both vapor tight and unlikely to permit a spill if the container is tipped over.

b. Oxidizers

Oxidizers should be stored to avoid contact with incompatible materials, such as combustible or flammable liquids. Solid oxidizers should not be stored directly beneath incompatible liquids. Oxidiizers should be stored on separate shelves with solid vertical and horizontal partitions isolating each shelf. Gaseous oxidizing materials are highly reactive, and can react vigorously with finely divided metals, organic liquids, and other materials that are readily oxidizable.

Spilled oxidizers should be placed in a clean, separate container, and disposed of in the proper manner. Oxidizer materials should not be placed in the trash. Spilled materials should never be returned to the original container.

c. Health Hazards

Chemicals that are considered to be health hazards include those which are highly toxic. They also include carcinogenic substances and those chemicals suspected of causing cancer. Storage areas should exhibit a warning sign and have limited access.

d. Compressed Gases

Cylinders of compressed gas should be securely strapped or chained to a wall or bench top. When a cylinder is not in use, it is a good practice to keep it capped. Cylinders should always be stored in an upright position.

e. Corrosives

Corrosives should be placed in storage cabinets or in polyethylene trays or containers large enough to contain the contents of the bottles. Care must be exercised by the laboratory worker to prevent mutually reactive substances from contacting one another. For example, sulfuric acid should not be stored in the same tray or cabinet as sodium hydroxide.

f. Water-Sensitive and Air-Sensitive Chemicals

Water-sensitive chemicals should be stored away from water sources. Air-sensitive chemicals should be stored under inert gas whenever possible. Containers should be water-proof and/or sealed against air exchange, and inspected frequently. Water-sensitive chemicals, as well as hygroscopic compounds, should be stored in desiccators.

g. Unstable Chemicals or Chemicals with a Short Shelf Life

Whenever possible, unstable chemicals, or those which have a short shelf life, should be purchased with inhibitors present. Consumption of the chemical should occur before the inhibitor is exhausted. These substances should be protected from heat, high temperature, rapid temperature changes, mechanical shock, and light.

h. Incompatible Chemicals

Chemicals that are incompatible should not be stored together. It is impossible to list all the chemical incompatibilities which can be potentially encountered in the storage area. When in doubt, the laboratory worker should consult the CHO or Laboratory Supervisor for proper storage instructions. MSDSs and references such as the NFPA 49, Hazardous Chemical Data and NFPA 491M, Manual of Hazardous Chemical Reactions, can provide useful information concerning potential storage problems. The following are examples of some incompatibilities that can be encountered when storing chemicals:

1) Acid-sensitive material such as cyanides and sulfides should be stored in a separate location from acids, or protected from contact with acids.

2) Potassium and sodium metals and many metal hydrides react on contact with water to produce hydrogen. In turn, these reactions produce sufficient heat to ignite the hydrogen with explosive violence.

3) Pyrophoric substances should not be stored near flammable gases or vapors.

4) Refer to Examples of Toxic Hazards from Contact of Chemicals, Improving Safety in the Chemical Laboratory: A Practical Guide, for further examples of incompatible chemicals that can produce toxic products when reacted together. Chemicals in Column A should be stored so that there is no possibility of accidental contact with

materials in Column B, which would cause the highly toxic products in the third column to be evolved.

i. Controlled Substances

Facilities will secure Controlled Substances in sufficiently strong storage to prevent forced entry for 10 minutes or more and must be bolted so the entire unit may not be carried away. A log of controlled substance will include the date the substance was placed in the storage cabinet and the dates and amounts disbursed from it.

J. Transferring And Transportation Of Chemicals

When reagents are transported or transferred between containers, the potential for an accident increases. The laboratory worker must exercise care when performing these procedures. Appropriate personal protective equipment and other safety equipment should be used during these operations.

1. Transferring Chemicals

When a laboratory worker is doubtful about the proper way to transfer a chemical, the Laboratory Supervisor can provide instruction. Chemicals should never be transferred from one container to another by pressurizing the original container with air via a compressed air line. Flammable or combustible liquids should never be transferred by air pressure.

When working with flammable and combustible materials, the laboratory worker should first ensure that no sources of ignition are present in the area. An exhaust hood should be used whenever flammables and combustibles are transferred from one container to another.

It is essential that there be sufficient expansion space within the container being filled. Overfilling a container can result in pressure great enough to cause leakage or rupture. The laboratory worker should be especially conscious of temperature changes that will affect the pressure. For example, a glass bottle with a screw cap lid can rupture if it is filled full to the top with a cold liquid and then stored in a warm or hot area.

Pipetting of liquids should never be done by mouth. Instead, use a laboratory safety pipet bulb or pump. Automatic burettes or pipets may also be used for the transfer and dispensing of some liquids.

2. Transportation of Chemicals

The transport of chemicals should always be handled in such a way to ensure the safety of all laboratory personnel. Carts used for transport should be sturdy and have a substantial rim around the edge. Carts should also have wheels large enough to negotiate uneven surfaces, such as expansion joints or floor drain depressions, without tipping or stopping.

a. Glass Containers

Glass bottles must be protected during transportation within the building. Various types of bottle carriers are available. The acid/solvent bottle carrier is a two-piece system that has a dome-lid that can be provided with several options for dispensing. The bottle tote is designed for transporting acids, alkalies and solvents. Rubber acid buckets may be used for a wide variety of corrosive chemicals.

Safety-coated glass bottles can be purchased from the manufacturer. During transportation, these bottles can provide separation for containers of incompatible chemicals that could react, if mixed. Although the coating provides some protection during transportation, a carrier should be used when moving a container any substantial distance. In the event of an accidental spill, even with protective film, the bottle and contents must be cleaned up immediately.

b. Other Containers

Beakers and flasks should be grasped by the body, not by the lid. When hand-carried, they should be placed in an acid bucket to protect against spillage or breakage. Jars of solids should be moved in plastic boxes.

c. Compressed Gases

Cylinders should never be dragged or rolled. To protect the valve during transportation, the cover cap should be left in place. Cylinder(s) must be transported using an appropriate carrier.

K. Compressed Gas Cylinders

Cylinders of compressed gas present special concerns in the laboratory. Cylinders should be stored and handled according to the procedures provided in the Compressed Gas Association Pamphlets P-1 and AV-1. Acetylene cylinders should be transferred, handled, and stored according to Pamphlet G-1, also provided by the Compressed Gas Association. Other applicable pamphlets are as follows:

1. C-7, Precautionary Labeling and Marking of Containers;
2. S.1.1, S.1.2 and S.1.3, Pressure Relief Device Standards;
3. C-2, Disposition of Unserviceable Cylinders; and
4. C-6 and C-6.1, Standards for Visual Inspection of Cylinders.

Oxidizing gases include chlorine and oxygen. Examples of flammable gases are acetylene, ethylene oxide, and hydrogen. Toxic gases include arsine, phosphine, and sulfur dioxide. Like chemicals, gases can present multiple hazards.

Cylinders are tested under hydrostatic water pressure every five years. The date of testing is the latest date stamped on the cylinder. Those cylinders to be used for liquified gases also have a tare weight stamped on them.

Frequent visual inspection of gas cylinders is important. Any observation of bulging, dented, or deteriorating cylinders should be reported to the Laboratory Supervisor immediately.

Cylinders should never be dropped or permitted to strike each other. They should be secured individually by a strap or chain to the wall or bench top. Cylinders should always be stored or used in an upright position. Generally, “empties” should be segregated from full cylinders.

When stored, cylinders should be segregated from other chemicals. Unless in use, cover caps on cylinders should be in place. Stored cylinders should be examined frequently.

During use, the pressure in a cylinder should never be allowed to drop below 25 psig (pounds per square inch of gas). When the gauge reaches 25 psig, the cylinder should be marked “empty” and moved to the appropriate storage area. For non-liquified gases, the pressure within the cylinder decreases in proportion to the amount of gas withdrawn. When liquified gases are used, the pressure remains equal to the vapor pressure at that temperature until all the liquid has evaporated and only the gas remains. Weighing the cylinder, is the best way to determine how much gas remains. This is why the tare weight is stamped on the cylinder.

Refer to Maximum Quantities and Size Limitations for Compressed or Liquified Gas Cylinders in Laboratory Work Areas, NFPA 45, for the quantity and size of cylinders in laboratory work areas.

IV. LABORATORY EQUIPMENT

L. Glassware Safety

A large percentage of laboratory accidents involve glass. Not only does glass cause cuts and lacerations, but burns may also result from handling hot glassware.

1. Types of Glass

   Nearly all glass used in the laboratory is based on silica. Silica glass may be classified according to its composition, i.e., silica glass, soda-lime glass, lead alkali glass, borosilicate glass, and aluminosilicate glass.

2. General Safety Considerations

   a. Laboratory glassware should generally be made of borosilicate glass, unless for unusual applications that require different characteristics.

   b. Laboratory glassware should never be used for beverages or food.

c. Broken, cracked, scratched, or chipped glassware should not be used in the laboratory.

d. Repair any sharp edges on glassware by fire polishing as soon as possible.

e. Broken glass should be discarded in separate containers designed for this purpose.

f. Plasticware can be substituted for glassware when appropriate.

g. When inserting glass tubing or a thermometer into a stopper, use the following technique and appropriate personal protective equipment:

1) Make sure that the hole is not too small. The hole should be just large enough to grip the tubing. The bore should be one size smaller than one that will just barely fit over the tubing.
2) The edges of the glass tubing should be fire polished.
3) Lubricate the glass tubing with water, glycerol, or other available lubricant.
4) Wrap a cloth or paper towel around the glass, or use a glass tubing manipulator. Wrap the stopper with another cloth or towel, or wear a leather work glove.
5) Grasp the tubing at a point within one to two inches of the end to be inserted into the hole.
6) Push the end of the glass into the hole, with a twisting motion, while exerting moderate pressure. Do not twist or push too vigorously.

h. When breaking a section of tubing, use the proper procedure and appropriate personal protective equipment.

1) Score a line about a third of the way around the circumference with a sharp file.
2) Wrap a cloth or paper towel around the tubing.
3) With thumbs placed against the sides opposite the score, apply pressure on the glass.

3. Cleaning Glassware

Generally a simple cleaning with soap and water is sufficient. In some cases more aggressive techniques may be necessary. For biologically contaminated glassware, the contaminated glassware should be autoclaved before cleaning. When using chemicals, such as an acid wash, to further clean glassware, the laboratory worker should be familiar with the proper techniques and appropriate personal protection equipment. The Laboratory Supervisor can provide information on the suitable cleaning agent to use for the specific cleaning situation.

M. Electrically-Powered Laboratory Apparatus

The utilization of electrically-powered equipment can pose hazards in the laboratory when not used properly. Problems that are encountered when using any laboratory equipment should be reported to the Laboratory Supervisor immediately.

1. General Concerns

When flammables are present, all motor-driven electrical equipment in the laboratory should be equipped with non-sparking induction motors rather than series wound motors that use carbon brushes. For this reason, kitchen appliances should generally not be used in the laboratory .

Electrical equipment should be located to minimize any potential contact with water or chemicals. If water or chemicals are spilled accidentally on the equipment, the unit should be unplugged immediately. The equipment should not be used again until it has been cleaned and inspected.

Power line cords should always be unplugged before any adjustments, modifications, or repairs are attempted, with the exception of some instrument adjustments. When it is necessary to handle equipment that is plugged in, the laboratory worker should be certain that his/her hands are dry prior to handling.

2. Refrigerators/Freezers

There should be no potential sources of electrical sparks on the inside of a laboratory refrigerator/freezer where chemicals are to be stored. Two types of chemical storage refrigerator/freezers exist--flammable materials storage and explosion-proof. The refrigerator/freezer should be labeled to indicate they are suitable for storing flammable materials.

The flammable material storage refrigerator/freezer has a spark-proof, corrosion-resistant interior. The electrical components are encased, and the door gaskets are non-sparking. In addition to meeting the requirement of the flammable material storage refrigerator/freezer, the explosion-proof variety is engineered for spark-proof operation externally. This type of refrigerator/freezer is hard-wired at installation to meet local electrical codes for maximum safety in hazardous areas, such as a chemical storage room.

3. Drying Ovens

Drying ovens are commonly used to remove water or other solvents from samples, and to dry laboratory glassware. Since these ovens do not have a provision for preventing the discharge of volatilized substances into the air, organic compounds should not be dried in these units. Conventional oven units should not be used to dry any chemical that is moderately volatile and might pose a health hazard of acute or chronic toxicity. Glassware rinsed in an organic solvent should not be dried in an oven.

Thermometers containing mercury should not be used in drying ovens. Instead, a bimetallic strip thermometer is recommended. If a mercury thermometer is used and does break, the oven should be turned off immediately, and all the mercury removed from the cold oven.

4. Magnetic Stirring/Hot Plates

   When working with flammables, it is imperative that magnetic stirring/hot plates not produce any sparks. These units are often used in laboratory fume hoods. These stirring/hot plates should have non-sparking induction motors.

   The actual heating element in any heating device should be enclosed in glass, ceramic, or an insulated metal case so that no conducting wires are exposed. If heating elements do become exposed, the unit should either be discarded or repaired immediately.

5. Water/Steam Baths

   The heating elements should be enclosed. The bath should be inspected and cleaned periodically.

6. Equipment

   Equipment should be fitted with a power cord that contains a separate grounding wire. The laboratory worker should exercise caution to ensure that chemicals and water are not spilled accidentally on equipment. If a spill occurs after the equipment is unplugged, the spill should be cleaned promptly. The unit should not be used until it is inspected.

   Further information on various units can be found in the manuals supplied by the manufacturer. The Laboratory Supervisor can answer any questions about the proper use of instruments.

V. PERSONAL PROTECTIVE EQUIPMENT

N. Regulations Pertaining To Individuals

The potential hazards in the laboratory are numerous. Personal protective equipment (PPE) plays a major role in reducing the direct effects of accidents. PPE consists of eye protection, face protection, safety shields, laboratory coats and aprons, shoes, gloves, and respirators.

PPE should always be used in conjunction with other means of control, such as engineering technology (i.e. fume hoods or auxiliary ventilation), and should never be the primary means of protection when working with chemicals. Because no personal protective equipment or clothing ever extends 100% protection, PPE should be considered secondary, yet still essential protection. PPE does not take the place of thoughtful and proper handling of chemicals and hazardous materials.

While the use of PPE can minimize exposures to the hazards encountered in the laboratory environment, the equipment must be used properly. When the laboratory worker is in doubt of proper usage procedures, the CHO or Laboratory Supervisor can provide appropriate instruction.

1. Eye Protection

Because of the vulnerability and fragility of the eye, laboratory workers, visitors and students should wear eye protection at all times when present in an area where chemicals are stored or handled. Eye protection should conform to the Standard for Occupational and Educational Eye and Face Protection, Z87.1, established by the American National Standards Institute (ANSI).

Since gases and vapors can cause permanent damage by concentrating under contact lenses, these lenses should not normally be worn in areas where chemicals are stored or handled.

In the event that an accident should occur, eyewash fountains are readily available; refer to VI.A.2, Eye Wash Fountains, for eye wash guidelines. These devices should be inspected regularly to maintain proper working order. Additionally, safety glasses and goggles should be cleaned and inspected frequently for scratches, fogging, and replaced if they are found to reduce visibility.

a. Safety Glasses

Safety glasses protect the eyes against flying objects and direct splashes. Safety glasses are the minimum acceptable eye protection, and should be made of impact-resistant hardened glass or plastic. Many safety glasses have side shields molded into or attached onto the ear pieces. Side shields on safety glasses provide some peripheral protection, but cannot provide adequate shielding from all flying debris and chemical splashes. Other eye protection should be worn when a significant hazard exists.

b. Safety Goggles

Safety goggles provide protection for the eye from flying objects or splashing chemicals. To prevent lenses from fogging, impact-protection goggles have screened areas on the sides to provide ventilation. However, these do not provide full shielding from chemical splashes. When full protection from harmful chemical splash is needed, splash goggles or “acid goggles” should be worn.

2. Face Protection

Face shields should also conform to the ANSI Standard, Z87.1, type N. While face shields protect the face, they are not a substitute for safety goggles. Face shields should be large enough to protect the face, ears, and neck of the user. When worn with safety goggles, this PPE device can provide maximum shielding from flying particles and harmful splashes. Like safety glasses and goggles, face shields should be cleaned and inspected frequently. A face shield should be replaced if it is damaged, or provides impaired vision.

3. Safety Shields

The most common example of a safety shield is the window of a laboratory fume hood. Portable safety shields can also be used on the laboratory counter top. Portable shields should be non-combustible. They can be made of laminated safety glass or polymeric materials such as polycarbonate or methacrylate. When used on the laboratory bench, safety shields should surround the hazard, with minimum openings to allow maneuvering of apparatus inside. Like safety glasses and goggles, safety shields should be cleaned and inspected frequently. Cracked or pitted safety shields should be replaced.

4. Laboratory Coats and Aprons

Laboratory coats or aprons should be worn when working with chemicals in the laboratory. These garments should be replaced if they become perforated or torn.

A laboratory coat can provide protection against contact with dirt and minor chemical splashes or spills. It also provides protection for the user’s clothing. The laboratory coat does not, however, significantly resist penetration by organic liquids or concentrated acids and bases. If the coat becomes contaminated, it should be removed immediately.

Laboratory coats should be made of cotton or synthetics such as Tyvek or Nomex. Garments should not be made of rayon and polyester due to their combustibility. Coats should be laundered frequently.

Aprons can provide better protection from corrosive and irritating liquids than laboratory coats. These are generally made of rubber or plastic and resist penetration better than woven fabric. However, since plastic aprons can be subject to static electricity and therefore may be a source of “sparks”, these aprons are not recommended when working with flammables or other materials that may ignite easily. Aprons should be cleaned periodically.

5. Shoes

Normally, special work shoes are not required. However, open or cloth shoes are unacceptable in the laboratory. While leather shoes offer protection in case of spills, leather readily absorbs organic liquids. If shoes become contaminated, they should be discarded. Disposable shoe covers may be needed when particularly hazardous materials are handled.

6. Gloves

Gloves are one of the most common forms of protective clothing. When properly selected, gloves can offer protection from exposure to a wide variety of hazardous and infectious substances. Gloves should be chosen on the basis of the materials being handled, the potential hazards involved, and the suitability of the glove to the particular operation being performed.

a. Thermally - Resistant Gloves

Thermally-resistant gloves are used when handling exceptionally hot or cold materials. Although asbestos gloves are no longer used because of the carcinogenic hazard they present, substitute materials exist. Before each use, gloves should be inspected for punctures and tears and replaced, if necessary.

b. Chemically Resistant Gloves

Chemically-resistant gloves should be worn whenever potential contact exists between the skin and corrosive or toxic materials. Neoprene, polyvinyl chloride, nitrile, and butyl or natural rubbers are the most common glove materials. Resistance to Chemicals of Common Glove Materials table, from Prudent Practices for Handling Hazardous Chemicals in Laboratories, can aid in choosing the proper composition. The table also demonstrates that no one glove material is right for every task. Information supplied by the various glove manufacturers can be helpful in proper glove selection.

Before each use, all gloves should be inspected for discoloration, punctures, and tears. Before removal of any gloves, the user should wash the gloves appropriately. Gloves should be removed before leaving the laboratory, and prior to touching doorknobs, telephones, pens or pencils, notebooks, etc. As gloves are eventually permeated by chemicals, they can only be used for limited time periods. Nondisposable gloves should be inspected carefully before each reuse. Gloves should be replaced periodically, depending on the frequency of use and the permeability to the hazardous materials handled. When possible, disposable gloves should be used.

If there are any questions concerning the proper type of glove materials or proper use of gloves, the CHO or Laboratory Supervisor should be contacted.

c. Gloves for Biological Work

Vinyl or latex gloves are marketed as sterile or non-sterile. There have been no reported differences in the barrier effect between vinyl or latex. Generally, the non-sterile type is suitable for most biological work. Sterile gloves can be used for microbiological work in which there is a chance the gloves may contribute to contamination. When working with human pathogens or blood, double-gloving is highly recommended. Single-use disposable gloves should be used for general biological work. Gloves should not be re-used or washed. Gloves contaminated with an infectious agent should be disposed of by appropriate procedures. General purpose utility gloves should be used for housekeeping chores. For individuals allergic to latex gloves, vinyl gloves are recommended.

7. Respirators and Face Masks

Under ordinary conditions, respirators should not be necessary in the laboratory. Respirators may not be used under any circumstances unless approved by EH&S and the wearer has been enrolled and completed the mandated physical exam, fit testing and training. If a respirator is thought to be needed, please call EH&S and request a hazard assessment to determine if one is required.

VI. MANDATORY SAFETY EQUIPMENT

a. General Safety Equipment

Safety and emergency equipment is an integral and important part of each laboratory. This equipment includes fire extinguishers, fire blankets, eyewash fountains, safety showers, laboratory hoods, laboratory sinks, and first-aid kits.

i. Eye Wash Fountains

An eyewash fountain should be capable of providing a gentle stream or spray of aerated water for an extended period of time, usually fifteen minutes, although 30 minutes may be required. The minimum flow rate should be at least 1.5 liters per minute for 15 minutes.

The eyewash should be located as close to the safety shower as possible, so that the eyes may be rinsed while the body is being showered. Plumbed eyewash units must be activated weekly to flush the line and to verify proper operations. Self-contained units must be inspected and maintained in accordance with the manufacturer's instructions.

ii. Safety Showers

Safety showers are for immediate first-aid treatment of personnel contaminated with hazardous materials and for extinguishing clothing fires. Every laboratory worker should be familiar with the location and proper operation of safety showers. Each shower must be activated weekly to flush the line and to verify proper operation.

The shower should be equipped with a quick-opening valve that can remain open without being held and requires manual closing. Since the minimum recommended time of operation is 15 minutes, the installation of a floor drain close to the shower is recommended to facilitate the removal of water.

iii. Laboratory Fume Hoods

When properly used, laboratory hoods can act as a barrier between the laboratory worker and potential hazards, such as chemical splashes, fires, and minor explosions. Hoods are further discussed in VII, Ventilation.

iv. Laboratory Sinks

The laboratory sink is essential for safety in the laboratory. Employees must wash their hands with soap and water after removal of gloves, before leaving the laboratory, or when skin comes in contact with hazardous substances. The sink is also used for washing equipment that comes in contact with hazardous materials.

v. First Aid Kits

A first aid kit should be clearly marked and available to all laboratory workers. The kit should be inspected periodically and the contents replenished as needed. An attached tag or sticker can serve as documentation of inspection. The first aid supplies should be approved by a consulting physician.

VII. VENTILATION

b. Heating, Ventilation, And Air Conditioning System

The laboratory Heating, Ventilation, and Air Conditioning system (HVAC), consisting of heating, ventilation and air-conditioning, is an important requirement for laboratory safety. The system provides sufficient input air to:

i. Permit proper movement of air, fumes and gases through hood exhausts;

ii. Prevent migration of noxious and hazardous vapors into other rooms; and

iii. Provide environmental comfort for personnel.

Ventilation in the laboratory can be divided into the following classes based on function: Comfort ventilation systems; supply air systems; and health and safety exhaust ventilation systems.

Fans, ducts, air cleaners, inlet and outlet grilles, sensors, and controllers are all components of a ventilation system. Exhaust ducts from hoods must not contain any fire dampers. All other ducts should be installed with fire/smoke dampers as per the applicable codes.

When a laboratory has a “negative” pressure, more air is exhausted from the room than is provided through the supply system. Negative pressure allows air to flow from the surrounding areas into the laboratory. This prevents odors and contaminants from exiting the laboratory. In some cases the reverse, “positive” pressure, is used to prevent contaminants from entering a laboratory, e.g., clean rooms and trace analysis laboratories.

Exhaust air from the laboratory should not be recycled, but rather discharged to the outside.

Prudent Practices for Handling Hazardous Chemicals in Laboratories recommends between four and twelve room air changes per hour.

Ventilation plays an important part in the proper performance of laboratory hoods. Conversely, hoods have the most significant impact of any equipment on the design and efficiency of laboratory air handling systems. Many types of local laboratory exhaust ventilation systems exist, including laboratory fume hoods and biological safety cabinets.

c. Laboratory Fume Hoods

Many types of laboratory fume hoods exist, including vertical sash, horizontal sash, auxiliary air, and variable air volume (VAV). To learn more about the various types of fume hoods, laboratory workers should consult the Scientific Apparatus Makers Association (SAMA) Standard LF 10-1980.

Hoods and their associated ducts should be constructed of nonflammable materials; corrosion resistance should be considered. Electrical outlets and utility controls should be located on the outside of the hood. Glass within the sash should be laminated safety glass at least 7/32 inches thick or equivalent.

With particularly hazardous chemicals or wastes, operations such as unpacking, diluting, packing, or reacting hazardous materials should be performed in the fume hood. Weighing operations involving particularly hazardous substances should be performed in a hood.

i. General Guidelines for Fume Hoods

The following general guidelines should be observed for safe and effective use of all fume hoods.

1. Hoods should be evaluated periodically to ensure adequate face velocities.

2. Chemicals should not be stored in hoods. Chemicals should be returned to their appropriate storage area. Chemical containers can block vents or alter airflow patterns.

3. The hood sash should be kept closed unless manipulations are being performed within the hood. This improves the overall performance of the hood.

4. Hoods should never be used as a means of disposal for chemicals. Wastes should be disposed of by established procedures.

5. Hoods may be turned off when not in use if adequate general laboratory ventilation can be maintained when they are not running. Hoods must be left on if any toxic material is present in the hood.

6. Materials such as paper should not be permitted to enter the exhaust ducts of the hood. They can adversely affect the performance of the system by lodging in ducts and fans.

7. Equipment, such as hot plates and heating mantles, should be placed at least 6 inches from the hood sash. Generally all equipment should be placed as far to the back of the hood as practical.

8. Only those items that are essential should be in the hood. Extraneous items may impair the effectiveness of the fume hood.

ii. Face Velocity Determination

In order for a hood to work properly, it must exhaust air properly. The simplest evaluation method is to determine the face velocity of the hood with a hot wire anemometer while the exhaust system is operating. When the hood has its own exhaust blower and is located in a room with additional hoods, all hoods should be turned on during testing. In a central exhaust system, all hoods should be in operation.

The evaluation is performed both with the hood sash wide open and partially closed. A 1.0 square feet imaginary grid pattern shall be formed by equally dividing the design hood opening into vertical and horizontal dimensions. Measurements should be performed with the hot wire anemometer in the middle of each section. With the hood sash wide open, an average reading is taken for each section, and recorded. The individual readings are then added, and divided by nine, the total number of readings, to obtain an average. The test is repeated with the hood sash one-third to one-half open. The same position should be used each time. The results are recorded and expressed in feet per minute.

The evaluation should be performed every three months, and the results should not vary more than + or - 10% from the previous testing. Face velocity should be typically between 80 and 120 linear feet per minute (lfpm). For special application hoods, e.g. nuclear, face velocity are different and applicable codes/standards should be referenced. If the face velocity is outside the accepted range, the laboratory worker should report this to the CHO or Laboratory Supervisor immediately.

The hot wire anemometer should be sent to the manufacturer for recalibration on an annual basis.

1. Hood Baffles

   The adjustable back baffle device in a hood gives more control of the exhaust system by more evenly distributing the air across the face of the hood. Baffles usually have movable slot openings at both the bottom and top, and sometimes in the center. The relationship of openings at the top and bottom has a major and deciding role on the manner in which the hood operates.

   When air enters the hood, it is divided into two segments: floor sweep and vortex (circular and turbulent air pattern). The floor, or work surface sweep, is the zone from the work surface to approximately 8 inches above the floor of the hood. The semi- neutral zone is from the 8 inch height to 20 inches above the work surface. The vortex is from 20 inches above the floor to the top of the chamber. If the baffle slots are not properly adjusted, the vortex can move the generated fumes from the back of the hood to the front.

   Except for heat induced density changes, almost all vapors generated from chemical and biochemical reactions have a heavier- than-air density. Therefore, the bottom baffle slot should usually be left wide open. The top slot should be adjusted to an opening of 0.5 inches unless there is a high heat loading, when the opening should be adjusted to 1.5 inches.

d. Biological Safety Cabinets

A biological safety cabinet is not a chemical fume hood and should not be used as such. However, the biological safety cabinet is the most effective primary containment device in the laboratory for infectious agents. There are three types: Class I, II, and III (NPC does not have Class II and Class III cabinets at this time).

i. Classes of Biological Safety Cabinets

A Class I biological safety cabinet is an open-fronted, negative pressure unit with a minimum inward velocity at the working opening of at least 75 fpm. There may be a full-width open front, an installed front closure panel not equipped with gloves, or an installed front closure panel equipped with arm-length rubber gloves.

While the Class II cabinet has the same minimum inward velocity as that of the Class I cabinet, the Class II unit has vertical laminar flow in addition to a HEPA (high efficiency particle arrestor) filter which provides recirculated air within the work space. The exhaust air is also cleaned by HEPA filters.

A Class III cabinet is a totally enclosed, ventilated cabinet of gas-tight construction in which manipulations are conducted through attached rubber gloves. In addition to a HEPA filter system for the supply air, there are two HEPA filters installed in series to cleanse the air prior to exhaustion.

ii. Class II Biological Safety Cabinets

The Class II biological safety cabinet is used for most microbiological work. The use of a Class II cabinet combined with good laboratory techniques not only protects the worker from infectious agents, but additionally protects the materials from airborne contaminants. Furthermore, this cabinet is the most suitable location for opening packages containing pathogenic microorganisms.

While Class II units produce a very high quality, low particulate environment, non-particulate toxic, flammable, or explosive materials are not removed by HEPA filters, and are sent back into the room. Chemical preparations and reactions should be carried out in a chemical fume hood.

The use of a cabinet alone may not be sufficient, especially when aerosols are produced. Other personal protective equipment may be needed.

The operational efficiency of the biological safety cabinet should be specially tested and the system recertified annually by a qualified, trained service professional. HEPA filters should be changed when they fail to meet testing requirements established by the National Sanitation Foundation (NSF) in NSF Standard 49.

VIII. LABORATORY WASTE

a. Disposal Of Chemical Wastes

Academic laboratories must meet disposal regulations set forth by Federal, State and local governments. Methods of disposing of laboratory wastes and unused chemicals must be safe and environmentally acceptable. The protocol established by the College is to handle all chemicals/materials that require MSDS under OSHA regulations as hazardous waste. This has been done to protect all workers, students or other individuals who may come in contact with wastes generated at the College. Planning for the disposal of substances should be as much a part of the experiment as the actual laboratory procedure. Disposal problems can be greatly reduced by planning procedures to reduce the amount of hazardous materials generated.

i. Hazardous Waste Disposal

All hazardous wastes must be properly identified, labeled and stored.

A waste is any material that is no longer used. A waste may be either recycled, or stored until it can be treated and/or properly disposed of. Many wastes can cause serious health or environmental problems if not handled and disposed of carefully. These wastes are considered hazardous, and they are currently regulated by federal and state laws. NPC has extremely low amounts of classified hazardous waste.

There are a number of ways that a waste can be hazardous:

1. An ignitable waste with a flash point less than 140 degrees F or is easily combustible. Examples are solvents or paint wastes.

2. A corrosive waste with a pH less than 2 or greater than 12.5 and can dissolve metals, other materials, or burn the skin. Examples are acids and bases.

3. A reactive waste that is unstable or undergoes rapid or violent chemical reaction with water or other materials. Examples are oxidizers and flammable solids.

4. A toxic waste with an oral LD50 of less than 50mg/kg of body weight, or an inhalation LD50 concentration less than 2mg/liter, or a skin adsorption LD50 of less than 200mg/kg of body weight, or listed constituents such as heavy metals, pesticides, or volatile organic compounds. Examples include mercury, lindane and 3,3 diaminobenzidine.

To determine if a material should be classified as a hazardous waste, review the information found on the material safety data sheet (MSDS) for the particular substance, and determine if the material meets the above definitions. When in doubt treat all wastes as if they are hazardous.

Unknown materials must be identified before they can be sent for treatment and disposal. This can become quite expensive. Good safety practices should be followed in this area. That is, all chemical containers should be properly labeled. Following this practice will eliminate unknowns.

If hazardous wastes are stored in the laboratory for over 90 days, this does not mean that a violation has occurred. The regulations pertaining to hazardous waste allow for satellite accumulation. This allows for the accumulation of hazardous wastes in containers at or near the point of generation where wastes initially accumulate and is under the control of the operator of the process generating the waste, without following the 90 day rule. The 90 day rule applies only after the waste has been taken to the hazardous waste site.

The College contracts with a company that specializes in hazardous waste management. This company removes the material from the hazardous waste site at least every 90 days. The material is transported to their permitted storage facility and then transported to one of their permitted treatment and disposal facilities. The type of treatment is dependent upon the composition of the material. Examples include recycling, fuel blending, incineration, neutralization, stabilization and landfill.

ii. Hazardous Waste Storage and Pick-up Procedures

1. Hazardous waste containers awaiting pickup must be stored in the immediate vicinity of the related work process. Hazardous material/waste may not be moved to a different room or work area for storage. The safe collection in proper containers and management of the waste is the responsibility of those department personnel who generate the material/waste. Procedures to package and pickup waste are available by contacting David Huish at 7691.

2. The volume of hazardous material/waste stored at any site must be kept to a minimum. The site is also limited to accumulation of less than 1 quart of pure, acutely toxic waste, as defined in EPA regulated "P" Waste list. This list is available from can be found in 40 CFR 261.33(e). Generators must monitor their rate of accumulation in order to avoid exceeding these limitations.

3. Wastes must be identified as such by having the words, "Hazardous Waste" clearly, visibly attached to the item.

4. Accumulated hazardous material/waste must be under the **control** of the generator(s). Control includes keeping containers closed and visual observation by the operator or appropriate security measures e.g., a locking mechanism.

5. Hazardous material/waste containers must be compatible with the material in them. They must be sturdy and able to be sealed. The containers must be able to withstand packaging and travel. Plastic milk containers and other beverage/food containers are not acceptable.

6. Hazardous material/waste containers must be segregated by chemical compatibility: oxidizers, flammables and combustibles, acids, bases and reactives. If space is limited, segregation can be accomplished by using secondary containment devices. Nalgene or HDPE plastic tubs or trays can be used to segregate incompatible chemical wastes. Secondary containment is recommended for all liquid chemical wastes. Secondary containment will minimize spill cleanup from leaking containers and prevent liquid wastes from going down sinks or floor drains.

7. Generators must document weekly inspections of their hazardous materials to insure collection containers are properly labeled, clean, closed, not leaking, and appropriately segregated.

8. Material/waste identified as Hazardous or THAT CANNOT BE IDENTIFIED AS NONHAZARDOUS must not be poured down drains. If you need help determining whether a waste is hazardous or not, please contact the CHO.

iii. Minimization of Wastes

Whenever possible, waste should be minimized. This is the least expensive approach to waste disposal. Control your inventory by only purchasing the amount of a chemical that you will be using. Special care should be taken when purchasing chemicals that can become highly dangerous with time. If you will no longer be using a chemical, others in your area might have a need for it. Where possible, substitute less hazardous or non-hazardous materials for the chemicals you are currently using. Practice good safety principles. All individuals working with chemicals and hazardous substances should know the hazards associated with the substance and what to do in the event of a spill or other emergency.

IX. EMERGENCY/INCIDENT PROCEDURES

All emergencies or incidents (fire, major chemical spill, explosive chemical) must be reported - DIAL 911 and reported to the Campus Manager.

a. Incident Response Procedures

Upon notification of an emergency or incident (fire, chemical spill, explosive chemical) CHO will be called. During off hours and weekends the Campus Manager and Monitors will be contacted with regard to any chemical spills, fire, or explosive chemicals.

i. Fire

1. Evacuation Procedures

When evidence of fire and/or smoke is detected, the College faculty/staff/students are instructed to use four basic guidelines in the following order of importance:

1) Activate the fire alarm pull box, or shout "FIRE" if there is no alarm.
2) Evacuate the area to assure personnel safety.
3) Call the Fire Department on a direct line. (DIAL 911.)
4) Close doors to help control spread of smoke and fire.

2. Evacuation Procedures For Persons With Disabilities:

1) Learn location of nearest exits.
2) Use buddy system; have designated/assigned individual assist disabled persons to exit.
3) Persons having difficulty utilizing the exit stairs should wait in corner of landing inside stairwell. The Fire Department will search stairs first. (Stairwells provide extra fire protection.)

3. Method of Reporting

1) Activate the nearest alarm pull-box. Know the location of the nearest pull-box.
2) Telephone Police. (DIAL 911.)
This is necessary even after the pull box has been activated. Use the telephone to give specific information, such as building name, floor, room number, and whether toxic chemicals are involved. Arrange for someone to meet the fire fighters outside the building.
3) Be sure that everyone in the building or area is aware of the fire alarm location and procedures. For a campus area without alarm pull-boxes: Telephone Police (DIAL 911), and proceed as above. Off

campus areas: Dial 911 for Police/Fire.
4) Campus Manager will follow up with notification to State Fire Marshal when required.

ii. Chemical Spills

Upon request for assistance in the handling of chemical spills, the Campus Manager or Monitor should take the following actions:

4. Determine who the caller is, the spill location, and the individual who is responsible for the material spilled.

5. Determine the nature of the material (flammable, corrosive, toxic, etc.) and the quantity involved.

6. An assessment of the situation must be made. If the situation is perceived as minor and can be handled safely by laboratory personnel, cleanup should begin immediately following MSDS guidelines. If notification of the Fire Department or Hazmat Team occurs, the Principal Instructor or CHO should coordinate the activity at the spill site.

   1) Minor incident: Determine if the laboratory has the proper material; e.g., absorbents and containers, to commence cleanup. If necessary, adequate material is available at the hazardous waste facility in the storage shed; assist as necessary.

   2) Major incident: If an evacuation is necessary, the Campus Manager or Monitor must be contacted to assist in the evacuation. Ensure that all personnel are cleared from the area and that all experiments and processes are safely shut down. No one should be admitted to the area until the problem has been alleviated.

7. During off-hours and weekends, the Campus Monitor is to be contacted concerning any chemical spill. They should contact the CHO.

iii. Explosive Chemicals

Upon receipt of request for assistance with, or notice of, potentially explosive chemicals, the following actions should be taken by laboratory personnel:

8. Seek available assistance from Primary Instructor involved and CHO. They will determine if the situation is safe and inspect suspect material to determine hazard potential.

9. If determined that explosive potential exists and the material must be removed:

1) Contact an independent contractor who is licensed to remove and dispose of hazardous materials. The company contracted by the College should be contacted first.
2) If immediate danger exists, notify Campus Manager who will make arrangements for pickup by the Arizona Department of Public Safety.
3) Contact Arizona Department of Environmental Protection (DEP). Arrange for necessary permits and notifications.
4) Inform person in charge of affected area of action taken, and the Arizona Department of Public Safety is in charge of Bomb Squad pickup and any necessary evacuation.
5) After material is removed, observe disposal and file necessary reports.

10. In all cases, be sure that the College President, Department Chairs, Building Supervisors and instructors in the affected building/area are notified. Try to provide notification 24- 48 hours before removal, but do not compromise the safety of the building occupants or facilities.