NMHU Chemical Hygiene Plan for Laboratories and Studios

Section 1: Chemical Hygiene Responsibilities and Program Coverage

1.1. Chemical Hygiene Responsibilities

Environmental Health and Safety responsibilities at NMHU, including Chemical Hygiene responsibilities, can be viewed in Section 3 of the EH&S Standard Operating Guidelines of NMHU.

A. Building Supervisor

The Building Supervisor has responsibility for the safety and upkeep of instructional and laboratory building spaces assigned to them. The building supervisor, in collaboration with laboratory and studio supervisors, ensures that all employees and students follow NMHU Environmental Health and Chemical Safety policies within the building; including the Chemical Hygiene practices and documentation for laboratories and studios where chemicals are used. Specifically, the building supervisor shall:

- Ensure that appropriate training is being provided to employees and students.
- Ensure that regulatory compliance practices are being adhered to in the building.
- Oversee that pertinent documentation on chemical hygiene is up-to-date and being followed.
- Perform periodic inspections.

B. Laboratory or Studio Supervisor

The Laboratory or Studio supervisor is the faculty member who is the sole or primary faculty member responsible for operations in the studio or laboratory space(s). The laboratory or studio supervisor has ultimate responsibility for upkeep of their workspaces, including chemical hygiene. The Laboratory or Studio supervisor supports the Chemical Hygiene efforts of laboratory or studio workers, with the assistance of the NMHU Environmental Health and Safety Committee.

Specifically, the lab or studio supervisor shall:

- Develop implement appropriate chemical hygiene policies and practices specific to the operations of the workspaces they are responsible for.
- Perform regular, formal chemical hygiene inspections, including inspections of emergency equipment. The lab or studio supervisor will set the frequency of these

with concurrence of the building supervisor. Weekly housekeeping and monthly equipment inspections are strongly urged, particularly where there is a lot of workspace use by undergraduate or graduate students.

- Develop Standard Operating Procedures specific to tasks in their lab or studio operations.
- Determine the proper level and type of personal protective equipment (PPE) for operations.
- Ensure that appropriate training has been provided to employees and students in the labs or studios, and, that the training has been documented.
- Maintain a current knowledge of the legal requirements of hazardous and regulated materials in their workspaces.
- Review and improve the laboratory's or studio's Chemical Hygiene Plan on an annual basis.

C. Environmental Health and Safety Program

The EHS committee at NMHU includes a Campus Safety Officer, and, a Campus Chemical Hygiene Officer. The EHS committee can direct laboratory or studio supervisors to information resources and provide direct services in assistance in meeting environmental and safety regulatory concerns. The EHS Committee provides technical and policy oversight of laboratory and studio activities that involve the use of hazardous chemicals

1.2. Scope and Application of this Plan

This standard applies where "laboratory or studio use" of hazardous chemicals occurs. Laboratory or studio use of hazardous chemicals means handling or use of such chemicals in which all of the following conditions are met:

- The handling or use of chemicals involves containers which can easily and safely manipulated by one person;
- Multiple chemical procedures or chemical substances are used; and
- Protective practices and equipment are available and in common use to minimize potential for employee or student exposures to hazardous chemicals.

This definition covers employees (including student employees, technicians, supervisors, researchers, and artists) who use chemicals in teaching and research or creative

endeavors at NMHU. Certain non-traditional laboratory or studio settings may be included under this standard at the option of individual departments within the university. Also, it is the policy of the University that laboratory or studio students, while not legally covered under this standard, will be given training commensurate with the level of hazard associated with their laboratory or studio work.

Where the use of hazardous chemicals provides no potential for employee exposure, such as in procedures utilizing chemically impregnated test media or commercially prepared test kits, a Chemical Hygiene Plan is not required.

1.3. Coordination with Other Standards and Guidelines

This standard deals only with the use of hazardous chemicals; however, employees may encounter potential physical, biological, or radioactive hazards in laboratories or studios. Other campus policies and procedures also affect the use of hazardous chemicals. For instance, the Appendix describes the proper procedures for the disposal of chemicals. In the event of conflict between various standards, the NMHU Environmental Health and Safety Committee should be contacted to assist in resolving the discrepancy.

Section 2: Information and Training

2.1. Information

It is essential that laboratory and studio employees have access to information on the hazards of chemicals and procedures for working safely. Supervisors must ensure that laboratory and studio employees are informed about, and have access to the following information sources:

- The contents of the OSHA laboratory standard, Occupational Exposure to Hazardous Chemicals in Laboratories, and its appendices (29 CFR 1910.1450).
- The NMHU Chemical Hygiene Plan (this document) and local laboratory or studio Standard Operating Procedures (SOPs)
- The Permissible Exposure Limits (PELs) for OSHA regulated substances.
- Safety Data Sheets (SDSs) for laboratory and studio chemicals. These are available on the World Wide Web (Internet), and in individual laboratories or studios. Departments that receive SDSs in shipments will make such information available to employees using the chemicals.

2.2. Training

Each laboratory supervisor is responsible for ensuring that laboratory employees are provided with training about the hazards of chemicals present in their laboratory work area, and methods to control exposure to those chemicals. Each employee shall receive training at the time of their initial assignment to the laboratory, prior to assignments involving new exposure situations, and at a regular frequency.

A. Availability

Training is available in the form of:

- Literature describing proper lab practices.
- Group and individual training, conducted by lab or studio personnel, or EHS Committee staff.

B. Content

Employee training programs shall include, at a minimum, the following subjects:

- Methods of detecting the presence of hazardous chemicals (observation, signage and labeling, odor, real-time monitoring, air sampling, etc.)
- Symptoms associated with exposure to hazardous chemicals

- Good laboratory or studio practice, including general techniques designed to reduce personal exposure and to control physical hazards, as well as specific protective mechanisms and warning systems used in individual laboratories or studios;
- Emergency response actions appropriate to individual laboratories or studios;
- Applicable details of the departmental Chemical Hygiene Plan, including general and laboratory- or studio-specific Standard Operating Procedures and
- An introduction to Hazardous Waste Management procedures at NMHU.

3.2. Criteria for Implementation of Specific Control Measures

Engineering controls, personal protective equipment (PPE), hygiene practices, and administrative controls each play a role in a comprehensive laboratory and studio safety program. Implementation of specific measures must be carried out on a case-bycase basis, using the following criteria for guidance in decision-making.

A. When to Use Fume Hoods

Fume hoods are a type of local area ventilation (LAV) used for small sources of chemical releases. A LAV system may be called something different in various units. Fume hoods are enclosed spaces that pull clean air past the user through the small workspace past the source. The contaminated exhaust is vented to the outside.

The fume hood is the major protective device available to laboratory and studio workers. Characteristics of substances to be considered in requiring fume hoods for an operation are: physical properties, namely volatility (vapor pressure), eye and skin irritation potential, toxicity, flammability, and odor. A fume hood also provides a degree of protection in case of explosion, violent chemical reaction, and aerosol generation (smoke, dust, sprays).

A fume hood should be used during a chemical procedure when:

- Airborne concentrations might approach the action level (PEL or TLV)
- Flammable vapors might approach 1/10th of the lower explosion limit (LEL)
- Substances with unknown toxicities are generated or used
- Odor is annoying to laboratory occupants or adjacent units

Procedures that can generally be carried out safely outside of a fume hood (depending on the capacity of the room ventilation system to remove airborne contaminants) including those involving:

- Water based solutions of salts, dilute acids, bases, or other reagents (dilution of concentrated acids/bases may require a fume hood because of reactivity)
- Liquids or solids with very low volatility
- Closed systems that do not allow significant escape of volatile substances to the workplace air
- Extremely small quantities of substances that otherwise would have to be handled in a fume hood

B. When to Use Safety Shields or Containment Devices

Safety shields, such as the sliding sash of a fume hood, are appropriate when working with highly concentrated acids, bases, oxidizers, or reducing agents, all of which have the potential to cause sudden spattering or explosive release of materials. Reactions carried out at non-ambient pressures (vacuum or high pressure) also require safety shields, as do reactions or processes that are carried out for the first time, or are significantly scaled up from previous attempts.

Other containment devices, such as glove boxes or vented gas cabinets, may be required when a process must be conducted in an inert atmosphere, when capture of any chemical, biological, or radiological emission is desirable, or when standard fume hoods do not provide adequate assurance that overexposure to a hazardous chemical or agent will not occur. The presence of biological or radioactive materials may also mandate certain special containment devices.

Local exhaust ventilation (LEV) may be required for equipment that exhausts toxic, small particulate, or irritating materials to the laboratory or studio environment (the dust of certain kinds of wood is listed as a known carcinogen!).

Ventilated chemical storage cabinets or rooms should be used for such chemicals that may generate toxic, flammable, or irritating levels of airborne contaminants.

C. When to Use Personal Protective Equipment

Laboratory supervisors or the Chemical Hygiene Officer shall designate areas, activities, and tasks which require specific types of personal protective equipment. **Protective equipment shall not be worn in public areas (e.g., hallways, restrooms, etc.), in order to prevent the spread of chemical or biological contamination.** Especially gloves must be removed outside the laboratory to prevent contamination of surfaces such as door handles.

<u>Eye Protection.</u> Eye protection is required for all personnel and any visitors when a laboratory is in active use or when chemical or physical hazards are present. Side shields on safety spectacles provide some protection against splashed chemicals or flying particles. Goggles and/or face shields are to be used when there is a greater than average danger of eye or face contact. A higher than average risk exists when

working with highly reactive chemicals, concentrated corrosives, or with vacuum or pressurized glassware systems.

Protective Clothing. Lab coats or similar protective clothing are mandatory for all lab or studio personnel. Protective clothing should be selected based upon resistance to specific types of substances. Bare feet are not permitted in any laboratory or studio. Sandals and open-toed shoes are prohibited. When boots are used, they must be slip-on.

Gloves. Gloves are required to protect the hands and arms from thermal burns, cuts, or chemical exposure that may result in absorption through the skin or cause skin irritation or injury. The type of glove used in any setting depends on the hazard encountered.

Respiratory Protection. Respiratory protection is generally not necessary in the laboratory or studio setting and must not be used as a substitute for adequate engineering controls. If a procedure requires exposure above the action level that cannot be reduced, respiratory protection will be required. All use of respiratory protective equipment is covered under the NMHU Respiratory Protection program.

4: Management of Engineering Controls

The engineering controls installed in the laboratory are intended to minimize employee exposure to chemical and physical hazards in the workplace. These controls must be maintained in proper working order for this goal to be realized. No modification of engineering controls will occur unless testing of the modification indicates that worker protection will continue to be adequate. Improper function of engineering controls must be reported to the laboratory or studio supervisor immediately. The defective system shall be taken out of service until proper repairs have been executed.

4.1. Local Exhaust Ventilation

The following procedures shall apply to the use of local exhaust ventilation:

- Intakes of local exhaust will be as close as possible to the source of contaminants
- Local exhaust fans shall be turned on when exhaust hoods are being used
- After using local exhaust equipment, operate the blower for an additional period of time sufficient to clear the ducts of residual contaminants;
- The ventilation system shall be inspected annually by the EHS Committee representative; and
- Prior to a change in chemicals or procedures, the adequacy of the ventilation systems shall be determined by the laboratory or studio supervisor.

4.2. Fume Hoods

Work practices shall follow established good practices. Prior to introduction of new chemicals, the adequacy of hood systems shall be determined by the lab supervisor.

Ductless hoods recirculate exhaust air through filters back into the room. Therefore, they cannot be used for volatile toxic materials and must be posted as “Not for use with toxic materials.

4.3. Chemical Storage Cabinets

Storage cabinets for flammable and hazardous chemicals will be ventilated as needed. They will be provided with a spill containment system appropriate to the chemicals stored within them.

4.4. Biosafety Cabinets, Glove Boxes and Isolation Rooms

The exhaust air from biosafety cabinets, glove boxes or isolation rooms will pass through scrubbers, HEPA filters, or other treatment prior to release to the regular exhaust system. Biosafety cabinets will be certified annually and each time they are moved. Certification can be obtained through the EHS Committee.

4.5. Cold Rooms, Warm Rooms and other enclosed spaces

Temperature-controlled rooms generally do not have fresh air ventilation. Do not use volatile chemicals in them! Gases from leaking or improperly shut off cylinders can displace oxygen from room air causing dangerous oxygen-deficient conditions. It is not recommended to transport Dewar vessels in elevators.

4.6. Emergency Equipment

Eye washes and safety showers are flushed monthy by Campus EH&S. Fire extinguishers are checked quarterly by the Campus Fire Safety Officer

Section 5: Standard Operating Procedures

Standard operating procedures (SOPs) are the generally accepted practices for use of chemicals in particular situations. The SOPs can be overridden in specific instances when appropriate. It is advisable to document the reasons for such modifications. When SOPs are not available for a specific laboratory or studio situation, the lab supervisor and Chemical/Biological Hygiene Officer will develop them, in consultation with the references cited below and the EHS Committee.

5.1. General Principles

A. Controlling Chemical Exposure
Each laboratory employee shall minimize exposure of occupants to the chemicals in the laboratory. General precautions, which shall be followed to achieve this goal during the handling and use of all chemicals, are:

- A chemical mixture shall be assumed to be as toxic as its most toxic component. Possibilities for substitution will be investigated (RCRA waste minimization, OSHA 29 CFR - 1910.1450)
- Laboratory employees shall be familiar with the symptoms of exposure for the chemicals with which the work and the precautions necessary to prevent exposure;
- Eating, drinking, and smoking are prohibited in areas where laboratory chemicals are present. Hands shall be thoroughly washed after working with chemicals. Storage, handling, and consumption of food or beverages shall not occur in chemical storage areas, refrigerators, with glassware or utensils also used for laboratory or studio operations;
- Mouth suction for pipetting or starting a siphon is prohibited
- Smelling vapors from solvents to determine composition of a liquid is strictly prohibited
- Skin contact with all chemicals shall be avoided. Employees shall wash exposed skin prior to leaving the laboratory or studio
- Additional specific precautions based on the toxicological characteristics of individual chemicals shall be implemented as deemed necessary by the lab or studio supervisor.

B. Laboratory Equipment

The following rules shall apply to the use of laboratory and studio equipment:

- All laboratory equipment shall be used only for its intended purpose
- All glassware will be handled and stored to minimize breakage; all broken glassware will be immediately disposed of in a broken glass container. Sharps are disposed of in a sharps container
- All evacuated glass apparatus shall be shielded to contain chemicals and glass fragments should implosion occur
- Waste receptacles shall be identified as such by signs attached to the receptacle. Signs shall include an indication of the type of waste that is accumulated in the container
- All laboratory and studio equipment shall be inspected on a periodic basis and replaced or repaired as necessary.

C. Planning for Emergencies

Before work with laboratory or studio chemicals begins, plans for various emergencies will be developed. The circumstances to be covered include fire, chemical spill, and personnel exposure. In addition, the following work practices will be observed:

- Spill containment will be established around areas in which more than one liter of liquid is used
- Workers manipulating chemicals will always be in easy communication distance of other people while handling chemicals. Working alone with hazardous materials or equipment is prohibited
- Emergency equipment shall be checked on a daily basis for unusual conditions.

5.2. General References

A useful source for Standard Operating Procedures is *Prudent Practices in the Laboratory: Handling and Disposal of Chemicals* (National Research Council, 1995 adopted for general use at NMHU. An excellent reference on chemical hazards is *Bretherick's Handbook of Reactive Chemical Hazards*.

A useful reference for art hazards and other studio related occupational health issues can be found at the *Center for Research on Occupational and Environmental Toxicology*.

5.3. Laboratory or Studio Specific SOPs

Laboratory or studio specific SOPs are available in each campus laboratory or studio where they are applicable. The SOPs developed for specific lab or studio should be listed in the lab's or studio's individual Chemical Hygiene Plan.

Section 6: Particularly Hazardous Procedures

The OSHA Laboratory Standard requires that special consideration be given to the use of chemicals or procedures with particular hazards. The definition of "particularly hazardous chemical" is given in the OSHA laboratory standard, and comprises "select carcinogens", reproductive toxins" and "substances with a high degree of acute toxicity". Examples of such chemicals are given in Chapter 3C of *Prudent Practices*. This consideration requires either the development of special operating procedures or prior approval of the laboratory supervisor as indicated by a written permit describing the conditions for the work to be done.

6.1. Work with Particularly Hazardous Substances

When laboratory procedures include the use of highly hazardous chemicals, special precautions shall be deemed necessary by the lab supervisor. These precautions will be developed for work with select carcinogens, reproductive toxins and substances which have a high degree of acute toxicity. Development of these precautions will consider including the following provisions in special procedures:

- Establishment of a designated area for the use of high-hazard chemicals
- Signage and access control to the work area where the chemical is used
- Special precautions such as use of containment devices such as glove boxes; isolation of contaminated equipment, and prudent transportation of very toxic chemicals
- Planning for incidents and spills
- Special storage and waste disposal practices.

Prudent Practices provides detailed recommendations for work with particularly hazardous substances.

6.2. Pre-approval of Particularly Hazardous Work

The responsibility for approval of the acquisition and use of hazardous chemical agents rests with the Chemical Hygiene Officer and with the Laboratory and Studio Supervisors for their laboratories and studios. Prior approval is required for substances listed in Appendix A of the Hazard Communication Plan. Certain materials including radioactive materials, explosives, recombinant DNA, and certain biohazards require prior internal (campus), or,

external approval at various levels. If there are questions concerning the need for approvals and permits, the Environmental Health and Safety Committee should be consulted.

A. Working Alone - Unattended Operations
   When working with hazardous materials, it is imperative to have a second person present. No dangerous experiments or studio processes will be run unattended unless they are fail-safe. A dangerous experiment or studio process is one that will constitute an immediate threat to life or property, if there is a loss of water pressure, electricity, or hood operation. Such experiments or processes as cannot be safely isolated shall not be performed unattended unless a suitable monitor is present and functioning. Standard Operating Procedures shall be developed that describe the safe operation of unattended processes

Section 7: Emergency Response

7.1. Emergency Response

Telephone numbers of emergency personnel, supervisors, and other workers as deemed appropriate are posted on the lab or studio entrance. These signs will be checked quarterly for accuracy.

7.2. In Case of Fire

NMHU's policy is that the first reaction to a fire is to evacuate the occupants of the building and then alert the Fire Department. Fire extinguishers are available in labs and studios. Extinguishers can be used by trained personnel to fight small fires (size of wastebasket or less). Fire extinguisher training is available from the Campus Safety Officer.

7.3. In Case of Spills

In the event of a chemical spill, release or other accident, lab or studio workers will respond as outlined in the NMHU Emergency Response Plan. The size of the spill and its hazards will guide the appropriate response. If there is any doubt about the lab worker's ability to safely clean up the spill, call EH&S. Note that proper emergency response depends upon knowledge of the hazards present in the lab. For this reason a campus-wide inventory of the hazardous chemicals in the labs and studios is conducted annually.

7.4. In Case of Personnel Exposure

All employees shall be instructed in the location and proper usage of emergency showers and eyewashes. In case of a medical emergency phone Campus Security at 555. A person can seek a medical consultation after an exposure at NMHU expense (See Section 8).

7.5. Emergency Phone Numbers

- NMHU Campus Security(24 hours): 5555 (on campus) or 454-3278
- Campus Safety Officer: 454-3392
- Chemical/Biological Hygiene Officer: 426-2035 or 426-5124
- Poison Control Center: 9-1-800-222-122

Section 8: Medical Consultations and Examinations

8.1. Availability

All employees who work with hazardous chemicals will have an opportunity to receive medical attention, including any follow-up examinations that the examining physician determines to be necessary under the following circumstances:

- Whenever an employee develops symptoms associated with a hazardous chemical to which the employee may have been exposed in the laboratory or studio
- Where exposure monitoring reveals an exposure level routinely above the action level, PEL, or TLV for an OSHA-regulated substance for which there are exposure monitoring and medical surveillance requirements;
- Whenever an event takes place in the work area, such as spill, leak, explosion, or other occurrence resulting in the likelihood of a hazardous exposure. The Campus Safety Officer will be contacted whenever the need for medical consultation or examination occurs, or when there is uncertainty as to whether any of the above criteria have been met.

8.2. Arranging for Medical Exams

All medical examinations and consultations will be performed by or under the direct supervision of a licensed physician and will be provided through the NMHU Environmental Health and Safety Program, without loss of pay, and at a reasonable time and place. In the event of a life-threatening illness or injury dial 9-911 and request an ambulance.

8.3. Information

NMHU will provide the examining physician with the following information:

- The identity of the hazardous chemical(s) to which the employee may have been exposed
- A description of the conditions under which exposure occurred including quantitative exposure data, if available;
- A description of the symptoms of exposure an employee is experiencing, if any.

The above information will be collected and transmitted by the lab or studio supervisor and will be submitted to the NMHU Environmental Health and Safety Program, as well as to the examining physician.

8.4. Report

The examining physician will provide to the lab or studio supervisor and NMHU Environmental Health and Safety Program a written report including the following:

- Any recommendation for further medical follow-up
- The results of the medical examination and any associated tests
- Any medical condition which may be revealed in the course of the examination which may place the employee at increased risk as a result of exposure to a hazardous chemical found in the workplace;
- A statement that the employee has been informed by the physician of the results of the consultation or medical examination and any medical condition that may require further examination or treatment. The written opinion will not reveal specific findings or diagnoses unrelated to occupational exposure.

8.5. Confidentiality

The Federal Health Insurance Portability and Accountability of 2002 requires that any medical information remain confidential. Information from medical examinations will not be released either in print or verbally to anyone other than NMHU employees that are authorized to review the information. An employee can file a written request to receive a copy of records of consultations or medical examinations from NMHU. Records will be held for periods described in Section 9

Section 9. Recordkeeping

NMHU policy is to maintain safety records as required by OSHA. Records shall be stored in fireproof lockable filing cabinets.

9.1 Accident Reports

Accident investigations will be conducted by the lab supervisor with assistance from the NMHU Environmental Health and Safety Program as deemed necessary. Accident reports will be written and retained for 5 years.

9.2. Exposure Evaluations

Any records of exposure evaluation carried out by NMHU Environmental Health and Safety Program will be filed. Raw data will be kept for one year. Summary data will be kept for the term of employment plus 30 years.

9.3. Medical Consultation and Examinations

The NMHU Environmental Health and Safety Program will keep results of medical consultation and examinations for a length of time specified for the appropriate medical records standard. This period will be at least the term of employment plus 30 years.

9.4. Training

Individual employee training will be recorded. The record will be kept in the individual's departmental file for 5 years.

9.5. Equipment Inspection

Records of inspections of equipment will be maintained for 5 years. NMHU Environmental Health and Safety Program will keep data on annual fume hood monitoring. Fume hood monitoring data are considered maintenance records; as such, raw data will be kept for one year, and summary data for 5 years

Section 10: Annual Chemical Hygiene Plan Review

The laboratory supervisor and Chemical Hygiene officer will review the laboratory's or studio's Chemical Hygiene Plan annually, every June. Results will be provided to the NMHU Environmental Health and Safety Program and the building supervisor. Laboratory supervisors are responsible for taking corrective action for any deficiency noted.

Appendix A: Chemical Hygiene Plans

The chemical hygiene plan shall include each of the following elements and shall also indicate the specific measures to be taken to ensure that University employees are protected.

1. Standard operating procedures relevant to all laboratory operations, to be followed by laboratory employees.
2. Statements of the criteria that will be used to determine and implement control measures to reduce employee exposure to hazardous chemicals. These measures include engineering controls, use of personal protective equipment, and personal hygiene practices. Criteria to reduce exposure to extremely hazardous chemicals used in the laboratory shall be specifically included.
3. A requirement that fume hoods and other protective equipment shall function properly and descriptions of the methods to be taken to make sure that such equipment is functioning properly.
4. Provisions for employee training and information.
5. Circumstances under which a laboratory practice requires prior approval from a supervisor before implementation.
6. Provisions for medical consultation and examination.
7. Designation of personnel responsible for implementation of the chemical hygiene plan.
8. Provisions for additional protection for employees when working with particularly hazardous substances, including:
    a. Select carcinogens.
    b. Reproductive toxins.
    c. Substances with a high degree of acute toxicity.
9. Specific mention of the following provisions, including when appropriate:
    a. Establishment of a designated area.
    b. Use of containment devices such as fume hoods or glove boxes.
    c. Procedures for safe removal and disposal of contaminated and hazardous waste
    d. Decontamination procedures

Two Examples of Chemical Hygiene Plans from the University of Illinois

EXAMPLE 1:

FELMLEY 444 CHEMICAL HYGIENE INFORMATION (as of 1/31/95)

LAB PURPOSE:

Undergraduate Teaching
Analytical Chemistry, Quant., Biochemistry.
Chem 315, 215, 343

FACULTY CONTACTS
Dr. John Baur: 438-2663 (w) 452-2065 (h)
Dr. James Webb: 438-2604 (w) 827-2192 (h)

Overview of Laboratory Operations
Chemistry 315 students perform chemical analysis using electroanalytical, spectroscopic, and chromatographic methods.

LABORATORY STAFF AND USERS
Dr. John Baur, FSA 331, 438-2663 (w), 452-2065 (h)
Dr. James Webb, FHS 207D, 438-2604 (w) 827-2192 (h)

Undergraduate students will use the lab under the supervision of one of the employees listed above.

Hazardous Material Use Some of the hazardous materials used in the lab include:
(Extremely hazardous materials are in **bold**.)

In Hood:

Hydrochloric Acid, conc. (1 L)
Sulfuric Acid, conc. (1 L)

Under Hood:

Chloroform (8 L)
Sodium Hydroxide, conc. (1 L)
Nitric Acid, conc. (4 L)
Hydrochloric Acid, conc. (4 L)
Carbon Tetrachloride (4 L)
n-Propyl Alcohol (4 L)

Under South Countertop:

Methanol (4 L)
Dilute acids and bases in 1 L to 4 L quantities

In Cabinets on South Wall:

Silver Nitrate (600 g)
Lead chloride (100 g)
Mercurous chloride (110 g)
Lead nitrate (450 g)

Caffeine (100 g)
Mercury (3 pounds)

Extremely Hazardous Materials

The most toxic substances used in this lab include the following:

Mercury: highly toxic

Special Equipment and Procedures

A. Atomic Absorption Spectrometer (AA)

The AA may be used only under supervision of a qualified employee.

- Students wishing to use the AA for research purposes must undergo instruction by Dr. Webb or Dr. Baur.
- The air and acetylene tanks may be changed only by an instructor or TA. T
- The hood above the AA must be on when the flame is burning.
- No flammable solvents may be brought near the AA when the flame is burning.

High Performance Liquid Chromatograph (HPLC)

The HPLC may be used only under supervision of a qualified employee.

- Students wishing to use the HPLC for research purposes must undergo instruction by Dr. Webb or Dr. Baur.
- The Nitrogen tank may be changed only by an instructor or TA.
- All safety shields must be in place when the system is pressurized.

Lab Safety Awareness Training -Specific Operations and Equipment - FHS 444

By our signatures below, we certify that we have been trained and agreed to be responsible for the following principles:

- The lab safety rules designated by the general section of the Chemical Hygiene Plan.
- The requirements and safety procedures described by Dr. Baur and Dr. Webb in
- The use and location of all safety equipment within the laboratory

Training Conducted by: Date: Name of Lab Worker

Appendix B: General Standard Operating Procedures

B1 Administrative Procedures

- a. Chemical Procurement
- b. Prior Approval
- c. Working Alone - Unattended Operations

B.2 General Chemical Safety

- a. Horseplay
- b. Personal Hygiene
- c. Housekeeping
- d. Material Transport
- e. Solvent Storage and Handling
- f. Glassware and Laboratory Equipment
- g. Vacuum and Pressure Operations
- h. Sinks and Refrigerators
- i. Compressed Gases
- j. Fume Hoods
- k. Cryogenic Liquids
- l. Laboratory Freeze Dryers (Lyophilizers)
- m. Autoclaves
- n. Warning Signs and Labels
- o. Centrifuges

B.3 Waste Disposal

- a. Labeling Waste Containers
- b. Storing Waste
- c. Having Waste Picked up for Disposal
- d. Radioactive Waste
- e. Potentially Infectious Material Waste
- f. Minimizing Waste
- g. Using Sink Drains and the Sewer

B.4 Special Chemical Safety

- a. Corrosive Substances
- b. Oxidizers
- c. Oxygen and Moisture Sensitive Compounds
- d. Pyrophoric Compounds
- e. Peroxide-Forming Compounds
- f. Explosive and Shock-Sensitive Compounds
- g. Incompatible Materials
- h. Laser Installations
- i. Formaldehyde
- j. Mercury
- k. Radioactive Materials

B.5 General Biological Safety

- a. Universal Precautions
- b. Containers for Contaminated Material
- c. Work Area Restrictions
- d. Biosafety Cabinet

B.1 Administrative Procedures

a. Chemical Procurement

Chemicals shall not be accepted by Receiving Staff without accompanying labels, and, packaging in accordance with all appropriate DOT regulations with little apparent damage. All chemical shipments should be dated and initialed by storeroom personnel when received and opened by user and noted in the user records. Receiving Staff should contact the Chemistry Stockroom manager with packages marked Perishable, such as chemicals shipped on dry ice or water ice. Deliveries of chemicals are to be made to the Stockroom Manager, not to individual faculty members.

b. Prior Approval

The responsibility for approval of the acquisition and use of hazardous chemical agents rests with the Chemical Hygiene Officer and with the Laboratory and Studio Supervisors for their laboratories and studios. Certain materials including radioactive materials, explosives, recombinant DNA, and certain biohazards require prior internal (campus) or external approval at various levels. If there are questions concerning the need for approvals, the Office of Environmental Health & Safety should be consulted.

c. Working Alone - Unattended Operations

When working with hazardous materials, it is required to have a second person present. Working without a second person in eyesight is prohibited.

No dangerous experiments or studio processes will be run unattended unless they are fail-safe. A dangerous experiment or studio process is one which will impose an immediate threat to life or property, if there is a loss of water pressure, electricity, or ventilation. Those experiments or processes which cannot be safely isolated shall not be performed unattended unless a suitable monitor is present and functioning.

B.2 General Chemical Safety

a. Horseplay

Horseplay of any kind and unauthorized experiments are strictly forbidden in the laboratories.

b. Personal Hygiene

- Wash promptly if skin contact is made with any chemical, regardless of corrosivity. Use emergency eyewash or shower when appropriate.
- Wear appropriate eye protection at all times.
- Mouth Pipetting is forbidden; use suction bulbs or other pipetting devices.
- Eating, drinking, and the application of cosmetics is forbidden in areas where hazardous chemicals are used. Food, drink and cosmetics are prohibited in the laboratory.

c. Housekeeping

- Access to emergency equipment, showers, eyewashes, and exits must NOT be blocked in any way with equipment, furniture, etc.
- Work areas and floors are not to be used for excessive storage. No unauthorized items shall be stored in the corridors. 18 inches distance must be kept to the ceiling.
- Promptly respond to all spills; properly dispose of the spilled chemical and cleanup materials.
- Out of date chemicals should be disposed of – hoarding and excessive accumulation of chemicals is not permitted.

d. Material Transport

Glass containers or containers holding hazardous materials shall be transported in 5 gallon buckets, or preferably in rubber buckets. These are available for transport from stockrooms. Elevators shall not be used to transport any hazardous material or cryogenic gases unless approved by a supervisor.

e. Solvent Storage and Handling

Flammable and combustible liquids in moderate amounts (less than 5 gallons) may be stored in the laboratory or studio . Larger quantities require a flammable liquid storage cabinet and cannot exceed 60 gallons of a class I flammable liquid or a class II combustible liquid (for definitions and allowable quantities consult the OSHA website).

f. Glassware and Laboratory Equipment

All broken glassware will be immediately disposed of in a rigid, puncture-resistant container, preferably a dedicated cardboard container with lid. The container must bear a legible sign that says “SHARPS”. Contaminated glassware should be decontaminated in an appropriate manner for the chemical or biohazard used, but in such a manner as to minimize harm from the glass to all present and future handlers.

All laboratory equipment shall be used only for its intended purpose, unless appropriately modified.

g. Vacuum and Pressure Operations

The hazards of high-pressure systems arise largely from failures caused by leaks, pulsation, vibration, and overpressure. Pressure gauges and burst disks should be checked and recalibrated on a regular basis.

Safety glasses are required at all times in laboratories and studios with pressure or vacuum equipment. Extra precautions are necessary when working with vacuum and high-pressure devices. If explosion or implosion appears possible, face shields should be worn to protect the face and neck of the user.

Inspect glassware for cracks before using.

If liquefied oxygen is suspected in a vacuum line, evacuate room and seek faculty assistance.

Note: Specific procedures should be developed for dealing with potential problems when using vacuum and pressure operations. The procedure must be described in the chemical hygiene plan.

h. Sinks and Refrigerators

Sinks:

- May only be used for aqueous/non-hazardous material, never for solvents
- Must have a screen or appropriate cover over the drain to prevent solid material from entering the drain.
- Should have water added periodically to prevent desiccation of the drain trap and exposure to sewer gases.
- Should be kept clean and free of debris.

Refrigerators:

- Explosion proof refrigerators are to be used for storage of flammable or unstable chemicals
- Stored chemicals and other materials must be tightly closed and labeled.

i. Compressed Gases

- Cylinders must be stored in well-ventilated areas with their protective caps screwed on and the cylinder secured (e.g., strapped or chained) to reduce the chance of the cylinder being knocked over.
- Do not store cylinders near heat or sunlight or in high traffic areas.
- Separate flammables and oxidizers, and store empty and full cylinders separately.
- Storage of large quantities of cylinders must be done in an approved gas cylinder storage area.
- Use appropriate hand carts to move cylinders. Cylinders must be secured to the cart during transport with protective caps in place.
- Always consider cylinders as full and handle them with corresponding care.
- Cylinders should be secured at all times, during transport, storage and use
- Do not keep unused cylinders in the laboratory, store them in the cylinder storage area

j. Fume Hoods

- Make sure hood has been maintained in accordance with the Fume Hood Manual.
- Make sure the exhaust blower is operating and air is entering the hood prior to starting an experiment.
- Keep the sash of the hood as low as possible to increase the inward velocity of the air at the opening of the hood.
- Do not place your face inside of the hood. Keep hands out as much as possible.
- Keep sources of emission six (6) inches inside the hood.
- Minimize the storage of chemicals in the hood and store chemicals near the back of the hood
- Periodically clean hood interior, including fluorescent bulb panel. If volatile or corrosive materials are stored in the hood, it should be in continuous operation.
- Do not use the hood for disposal
- Do not handle toxic materials in a hood filled with equipment or chemicals.

k. Cryogenic Liquids

- Loose-fitting heavy cloth or dry leather gloves should always be worn when handling anything that comes in contact with cold liquids, cold solids and/or cold vapor. Gloves should be loose fitting so that they can be removed quickly if liquids are spilled into them. A potholder or other insulation should be used between the gloves and container except when the material is in a dewar.
- Keep container (dewar) vertical at all times. Do not roll the container on its side. Secure dewars in restrainers to avoid spills.
- Relief valves on dewars shall not be tampered with under any circumstances!
- sources of ignition are prohibited where liquid hydrogen and oxygen are present. The use of smoking materials are prohibited anywhere in NMHU buildings by NM state law.
- Any frosting, ice formation, or excessive corrosion on safety valves may render the safety valves inoperative. In the event of any of these instances, the vessel should be taken out of service as these valves may not work, thus not allowing pressure release in the event of its buildup.
- Two individuals should be present when transferring cryogenic liquids.
- Store dewars and liquid gas cylinders in well-ventilated storage areas when not in use or connected to a closed system.

l. Laboratory Freeze Dryers (Lyophilizers)

- Sign log at time of use.
- In order to avoid implosion, use only appropriate lyophilizer flasks and inspect for cracks or scratches that may cause failure. Do not substitute regular laboratory glassware for vacuum use.
- Locate the unit out of the traffic flow.
- Empty the condensate trap regularly and change pump oil after large loads or at least every six months.

Autoclaves

- Sign log at time of use.
- Any time the door is closed on the unit, assume it is fully pressurized.
- Inspect the unit on a regular basis for closure alignment, cracks, damage or hot spots and clean once a month. Never leave flammable materials, debris, or plastics in or near the unit.
- Under no circumstances, should the door of the autoclave be opened until the interior or chamber pressure has been released

n. Warning Signs and Labels

- Warning Signs: Laboratory areas that have special or unusual hazards shall be posted with warning signs, such as carcinogenic hazards, biological hazards, fire hazards, laser operations, etc. Specific warning sign requirements can be found at the OSHA website. Other signs shall be posted to show the locations of safety showers, eyewash stations, exits, and fire extinguishers.
- Labels: Laboratory and studio supervisors must ensure conformance with the labeling policy. Waste containers should be labeled appropiately. Unlabeled bottles of chemicals should not be opened; such materials should be disposed of promptly and will require special handling procedures.

Disposal costs for containers with contents that are unknown are the responsibility of the source department or grant activity.

o. Centrifuges

- Sign log at time of use.
- Each operator should be instructed on proper operating procedures before being allowed to use the centrifuge. Instructions should include requirements for balancing loads, using the proper rotor, and using accessory equipment. Inspect rotor before use
- Each employee who uses a centrifuge is responsible for the condition of the machine and rotor at the end of the procedure

B.3 Waste Disposal

We should strive to minimize or prevent waste generation. Waste minimization is an action of both local and global significance. Faculty and staff are encouraged to share thoughts and ideas concerning waste minimization and prevention. Inevitably, some waste will be generated. NMHU is committed to managing its wastes in a safe and efficient manner. These procedures govern the management of RCRA hazardous wastes at the University.

Hazardous waste management is ruled by increasingly stringent and complex regulations. Management of chemical and hazardous wastes at the University is accomplished by the generator of the waste with the assistance of the Office of Environmental Health and Safety (OEHS). OEHS will assist generators on campus to help assure that wastes are managed in accordance with the regulations. However, It is the generator who is ultimately responsible for assuring that waste generated is managed in a safe and appropriate manner.

Any waste material that may, upon contact, present a hazard to one's health or surrounding environment should be treated as a potentially hazardous waste. This includes spent or unused chemicals, cleaning solutions, oils, etc.. If there is any doubt whether a material should be treated as hazardous, contact EH&S at 6-2035. Only aqueous/non-hazardous waste may be disposed in the sewer or trash.

EHS will pick up properly documented and packaged wastes and will store them prior to their final disposition. Waste is disposed of by contract and is picked up from the University usually twice a year. The hierarchy of disposal methods used for the University's waste is reclamation and residual destruction, high temperature incineration, chemical/physical treatment, and secure landfilling.

a. Labeling Waste Containers
   All containers should be labeled with contents including %, accumulation date, associated hazards, necessary precautions, and generator identification. When a material has not been spent or otherwise altered, and has the original label in good condition, the original label will be sufficient. Otherwise, when container size and configuration allow, the uniform waste label should be used. Labels are available from OEHS.
   If for some reason the uniform waste label can not be used, the generator shall be sure to label the waste container with all of the information included in the uniform label. A safety data sheet can often provide information necessary to label a container. SDS's should be obtained and kept on file for each potentially hazardous material brought on campus.

b. Storing Waste
   All waste shall be stored in a safe and secure area. Waste shall remain in such areas until picked up by OEHS. Never leave waste in a hallway or other unsecured area where it may be subject to public contact. Wastes should be properly segregated. Halogenated materials should be collected separate from non-halogenated and solids separated from liquids. Generators are responsible for obtaining necessary storage containers. Containers shall be structurally sound, in good condition, and have a tight fitting cap. Stoppered bottles, beakers covered with foil or food containers are not acceptable. A waste generator shall also assure that a container is compatible with the material to be stored. Materials that may generate vapor, such as solvents and other low boiling point materials, should be stored in a properly ventilated area. All waste containers should have at least 10 to 20% headspace left in them to avoid pressure build up that may occur with expansion.

c. Having Waste Picked Up for Disposal

Information must be provided to OEHS to adequately characterize and dispose of the waste, prior to having it picked up. A pickup will not be made until appropriate information is received. Certain wastes will require the generator to certify the presence or absence of constituents and concentrations. This certification can be based on the generators knowledge, analytic testing, or other scientific data. OEHS will notify generators when additional information or certification is necessary. The generator, defined as Laboratory Supervisor, in making the certification, accepts the associated liability and responsibility for possible misrepresentation of the waste. Penalties for misrepresentation, a violation of state and federal law, can include fines and/or imprisonment. When the generator does not have sufficient knowledge or information to make the certification, the wastes must be analyzed at the Department's (generator's) expense. The analysis must performed by a laboratory acceptable to EHS and be sufficient to provide necessary data for the generator to certify the waste. EHS can provide guidance on appropriate analyses. A comprehensive analysis of an unknown waste can cost well over $1,000. It is therefore in the generator's and Department's best interest to maintain meticulous data concerning the waste and strict control over its composition.

d. Potentially Infectious Material Waste

Potentially Infectious Material (PIM) refers to materials that can be infectious to humans and associated biologicals. The types of material are generated in connection with diagnosis, treatment (i.e., provision of medical services), or immunization of human beings or animals; medical research or the production or testing of biologicals. Examples of potentially infectious materials include:

- The following human body fluids: blood,semen, vaginal secretions, cerebrospinal fluid, synovial fluid, pleural fluid, pericardial fluid, peritoneal fluid, amniotic fluid, saliva in dental procedures, any body fluid that is visibly contaminated with blood, and all body fluids in situations where it is difficult or impossible to differentiate between body fluids.
- Any unfixed tissue, organ (other than intact skin), and body parts (except teeth and the contiguous structures of bone and gum) from a human (living or dead).
- HIV-containing cell or tissue cultures, organ cultures, and HIV or HBV containing culture medium or other solutions; and blood, organs, or other tissues from experimental animals infected with HIV or HBV.

- Cultures and stocks of agents infectious to humans, and associated biologicals; wastes from the production of biologicals; discarded live or attenuated vaccines; culture dishes and devices used to transfer, inoculate, or mix cultures.
- Waste materials originating from animals inoculated during research, production of biologicals, or pharmaceutical testing with agents infectious to humans; carcasses, body parts, blood, or bedding of animals known to have been in contact with agents infectious to humans.

Regulated Medical Waste means liquid or semi-liquid blood or other potentially infectious materials and includes the following:

- Contaminated items that would release blood or other potentially infectious material in a liquid or semi-liquid state if compressed.
- Items that are caked with dried blood or potentially infectious material and are capable of releasing these materials during handling.
- Contaminated sharps and Unused needles or syringes.
- Pathological and microbiological wastes containing blood or other potentially infectious material.

Non-Regulated Waste materials include:

- Waste generated as general household waste (
- Waste (except for sharps) for which the infectious potential has been eliminated by autoclaving. (
- Sharps that meet both of the following conditions: a. The infectious potential has been eliminated from the sharps by autoclaving. b. The sharps are placed in leak-proof, puncture-resistant containers.

Non-regulated waste that is contained in biohazard bags or biohazard sharps containers must first be marked "Treated" on the outside of the container, if the container does not already have an autoclave heat/pressure tape indicator affixed to it, prior to disposing into general trash receptacles.

Potentially infectious material can be disposed of in one of several manners. Rendering the material non-infectious by such means as autoclaving allows the material to be considered a non-regulated waste. Totally destroying the material through incineration requires that each department collect the PIM in appropriate containers, store the material, and contact OEHS to pickup the material for incineration in an EPA approved incinerator.

Under no circumstances are any sharps to be discarded into the general trash. Departments will utilize the following storage requirements for regulated waste prior to treatment or transport off-site.

Regulated waste must be collected or secured at the end of each day by the generators of the waste. If there is sufficient waste in the container at the end of the day, the container should be removed to the storage area. If the storage container is to be left in the use area, it must be secured so no other personnel can get into the material or any of the infectious material can contaminate any other material.

Store waste in a manner and location that provides protection from water, rain, and wind. Maintain PIM in a nonputrescent state, using refrigeration when necessary. Lock outdoor storage areas to prevent unauthorized access. Limit access to on-site storage areas to authorized employees. Store in a manner that affords protection from animals and does not provide a breeding place or a food source for insects and rodents.

If PIM is to be rendered non-infectious by means of autoclaving the following should be adhered to: All autoclaving of PIM must be documented. This documentation should include the date, the person conducting the autoclaving, the material autoclaved, and the verification that the material was rendered non-infectious. Verification that the autoclave reached the right temperature and pressure for the required amount of time is required. One way to do this is by autoclaving, along with the waste, a jar with spores in it. The jar is to be placed in the center of the waste bags, then if the spores are destroyed, it is feasible that the infectious material has been rendered non-infectious. Once a week a spore test will be required, all other times a heat/pressure tape is required to be placed on the bags.

All autoclaves that will be used for this type of work should also be inspected annually by a certified inspector. These inspections are to ensure that the autoclaves are capable of conducting the procedures they are being used for.

e. Minimizing Waste

Waste minimization or prevention can be accomplished many different ways. Generators are strongly encouraged to be alert for alternative procedures or products that will reduce or prevent waste generation.

Departments should be familiar with the nature of the waste they generate, including composition and quantity. In so doing, goals or benchmarks should be identified with efforts focused on reaching them.

Chemicals or other materials which have not been opened or are still in usable form can be saved from becoming waste by being offered for other University staff use. EHS will periodically distribute a list of "unwanted but still usable" materials. Staff wishing to obtain a material for use may contact EHS. EHS will pick up and deliver the material to the requester. Staff wishing to list materials should also contact EHS. Materials should continue to be stored by the listing Department until a user is found.

If this is not possible, or if an appreciable amount of time has expired with no result, EHS can pick up the material. Waste generated through scientific classroom instruction has additional reduction options available. These include converting to microscale experiments and incorporating material neutralization or inactivation into experiment procedures. This promotes environmental and product stewardship and could be a valuable theme in course curriculum.

f. Using Sink Drains and the Sewer

Sink drains or the sewer should never be used as a means to dispose of hazardous or other chemical waste unless it is known to environmentally compatible. Chemical and waste products should enter the sewer only through actions incident to the process or experiment, such as container washing and rinsing. Waste material should otherwise be collected for pickup and disposal.

Materials of questionable nature should not be put down the drain without first contacting EHS. Never allow flammable liquids, mercury, or toxic substances to enter the sewer.

3.4 Special Chemical Safety

a. Corrosive Substances

Biological corrosives attack human tissue and cause irritation, chemical burns, and in severe cases, tissue destruction. In case of skin or eye contact with corrosives, prompt treatment with a physiologically correct buffered saline is important. Consultation with a medical professional is required. Safety showers and eyewash fountains must be provided for this purpose and must be readily available to all lab occupants. In laboratories which do not have safety showers, the nearest location should be posted. All labs must have eyewash stations and laboratory personnel must be aware of their location.

Types of corrosives and examples of each are:

Acids:

Inorganic or mineral acids include sulfuric, nitric, hydrochloric, phosphoric and hydrofluoric. Organic acids contain a carboxylic group, (-COOH) and are generally less acidic and corrosive than the mineral acids. Common organic acids include acetic, benzoic, citric, and oxalic.

Usage of hydrofluoric acid requires special precautions and prior approval from EH&S.

Bases:

Bases are alkaline substances that have a pH above 7 when dissolved in water. Contact with the skin causes a "slippery" or "soapy" feeling. Examples of common bases include: Ammonium hydroxide, Calcium hydroxide, Potassium carbonate, Potassium hydroxide, Sodium carbonate, Sodium hydroxide and organic amines. The eye is especially susceptible to alkalies and splash goggles or face shields are required whenever there is a possibility of eye contact. Organic amines can cause blindness.

Halogens: The elemental halogens (bromine, chlorine, fluorine, and iodine) are all extremely corrosive, especially to the respiratory system. They are also capable of causing the deterioration of many materials of construction used for gaskets, piping and tubing. Usage of fluorine requires special precautions and prior approval from EH&S.

Organic Compounds: Can be as corrosive as the inorganic acids and bases. Examples include phenols, amines and some unsaturated ketones. In addition, many organics can be absorbed through the intact skin or diffuse through gloves and produce toxic effects.

b. Oxidizers

Oxidizers are compounds (solid, liquid, gas) that evolve oxygen or are electron acceptors either at room temperature or upon slight heating. This group includes peroxides, chlorates, perchlorates, nitrates, permanganates, and the elemental halogens. Oxidizers can react vigorously at ambient temperatures when they contact organic material or reducing substances.

c. Oxygen and Moisture Sensitive Compounds

Many chemical compounds deteriorate when exposed to air. For most of these, oxidation only causes a decrease in purity. But for a few, extreme reactivity with oxygen leads to other effects. Another group of compounds reacts with atmospheric moisture and causes the release of toxic or flammable gases or vapors or the generation of enough heat to cause fires and explosions. In the following information, the threshold limit value (TLV) is the safe amount to which a person can be exposed to without harm.

Examples of Air-Sensitive Compounds:

- Aluminum and Lithium Alkyls: React with moisture to generate extremely flammable hydrocarbon vapor. Some are pyrophoric
- Dichlorosilane: Forms silicon dioxide and hydrogen chloride on contact with air. Will detonate spontaneously under some conditions.
- Phosphides, sulfides and selenides: React with moisture to form highly toxic phosphine, hydrogen sulfide or hydrogen selenide
- Alkali metals: React with moisture to release hydrogen that may ignite when combined with oxygen. Potassium may form explosive peroxynitrites under prolonged storage
- Complex hydrides: Evolve hydrogen on contact with water or moist air. Most are violently reactive

d. Pyrophoric Compounds

Pyrophorics are a special subgroup of air-sensitive compounds. These substances are so reactive that they will ignite spontaneously when exposed to air. It is obvious that the handling requirements for pyrophorics are extremely restrictive.

Examples of Compound Effects:

- Lithium and Aluminum Alkyls: Ignite spontaneously in air. Also react violently with water and with oxygenated and halogenated solvents.
- Diborane May ignite spontaneously in air and may detonate under some conditions. Extremely toxic vapor (TLV=0.1 ppm)
- Phosphine and silane: both ignite in contact with air

Consult with EH&S before using air- or water sensitive compounds.

e. Peroxide-Forming Compounds

Some organic compounds are unusually susceptible to atmospheric oxidation. They require special storage and handling procedures to minimize the formation of peroxides that may create an explosion hazard. Once formed, peroxides are thermally unstable and may also be shock-sensitive.

The types of organic compounds that are most apt to form peroxides include:

- Aldehydes and ketones
- Ethers-especially those with secondary alkyl groups
- Allylic or benzylic structures
- Vinyl and vinylidine compounds
- Perfluoroethylene

Avoid distilling compounds that may contain peroxides. Test sticks for detecting peroxide compounds are available from EH&S. Peroxide forming compounds must be dated upon receipt. Inhibited ethers can be stored for a maximum of one year. Uninhibited ethers may only be stored for six months. After these dates, peroxide formation may increase, thereby increasing the instability of the material. Consult with EH&S for testing for peroxides and for disposal of peroxide-containing materials.

f. Explosive and Shock-Sensitive Compounds

Shock-sensitive and/or explosive compounds are an obvious safety problem even for laboratory-scale quantities. The first step in safe operations with such substances is a recognition of the potential for damage and personal injury. If possible, avoid their use.

Examples of Compounds:

- Heavy-metal Azides, such as lead azide
- Organic azides with a nitrogen content > 40 %
- Polynitro-Compounds, such as Trinitrotoluene (TNT) or Nitroglyco
- Perchlorates, namely perchlorate salts
- Picrates, namely picric acid and its salts
- Peroxides, namely benzoyl peroxide

Consult with EH&S before using any of these compounds and work on the smallest scale possible. Work with perchloric acid may only be performed in a dedicated fume hood and in the absence of organic compound. Potentially explosive compounds, such as picric acid or benzoyl peroxide are phlegmatized with water and must not be allowed to dry out. Workers must check every six months.

g. Incompatible Materials

Some materials when mixed together, can react violently and/or liberate toxic gas. Groups of materials that do so are termed incompatible. The classic example of materials that are incompatible are cyanides or sulfides and acid. A mixture of the two generates hydrogen cyanide or hydrogen sulfide, respectively, both very deadly gases. Laboratory staff must be aware of the groups of materials in their labs that could be incompatible. These materials must be physically isolated from their incompatible counterparts. Emergency procedures must also be in place to guide laboratory staff action in the event that materials are inadvertently mixed together

h. Laser Installations

Lasers produce non-ionizing radiation capable of causing eye injury. Lasers operating outside of the visible light region (ultraviolet or infrared red) are especially hazardous. Laser operators must trap the primary beam and must avoid specular reflections.

Laser dyes are complex fluorescent organic compounds. In solution with organic solvents, these dyes form a lasing medium. Toxicity information on commercially available laser dyes is not extensive. However, the current research has found a number of the dyes to be mutagenic and possibly carcinogenic. The active dyes identified thus far include:

- Cresyl Violet 670 Perchlorate, Coumarin 7
- Coumarin 102 Coumarin 535
- DCM DODCI
- LD 490 Nile Blue 690 Perchlorate
- Oxazine 720 Perchlorate p,p-Diaminoterphenyl
- N,N,N'N'-Tetraethyldiaminoterphenyl
- Oxazine 170 Perchlorate

Because the toxicological properties of most laser dyes have not been fully investigated, these compounds must be handled with care.

i. Formaldehyde

OSHA has singled out formaldehyde for special regulation. This is due in part, to formaldehyde being a sensitizer and possible carcinogen. OSHA's requirement for a formaldehyde program requires the employer to document exposure levels, provide training, and in some cases, medical monitoring. Staff that work with formaldehyde should contact OEHS to assure they are in compliance with the standard.

j. Mercury

Mercury and mercury compounds are highly toxic and a cumulative poison. Mercury compounds, other than metallic mercury, are extremely difficult to dispose of. There are currently no disposal facilities in the United States capable of taking this type of waste. Staff are therefore encouraged to minimize mercury use and to eliminate it when possible. Elemental mercury should be stored in a non-breakable container in the fume hood. Mercury spills can be cleaned up with a mercury spill kit. Do not use powdered sulfur or similar, it reacts too slow.

Remember Karen Wetterhahn! Remember Alfred Stock!

B.5 General Biological Safety

a. Universal Precautions

Universal precautions shall be observed throughout all areas of NMHU where skin, eye, mucous membrane, or parenteral contact with blood or other potentially infectious material is can be reasonably anticipated. Universal precautions means that all blood or other potentially infectious material will be considered infectious regardless of the perceived status of the source individual. Engineering and work practice controls will be employed to eliminate or minimize exposure to employees at the University. Where occupational exposure remains after institution of these controls, personal protective equipment shall also be used.

b. Containers for Contaminated Material

Reusable contaminated sharps shall be placed immediately, or as soon as possible, after use into appropriate sharps containers. These containers shall be:

- Puncture resistant
- Labeled or color-coded in accordance with the Hazard Communication Plan
- Leakproof on the sides and bottom
- Reusable sharps that are contaminated with blood or other potentially infectious material shall not be stored or processed in a manner that requires employees to reach by hand into the containers where these sharps have been placed.

Disposable contaminated sharps shall be discarded immediately or as soon as feasible in containers that are:

- Closable and puncture resistant;
- Leakproof on sides and bottom
- Labeled or color-coded in accordance with Hazard Communication Plan

Contaminated waste other than sharps shall be placed in containers which are

- Closable;
- Constructed to contain all contents and prevent leakage of fluids during handling, storage, transport, or shipping
- Labeled or color-coded in accordance with Hazard Communication Plan

c. Work Area Restrictions

In work areas where there is a reasonable likelihood of exposure to blood or other potentially infectious material, personnel are not to eat, drink, apply cosmetics or lip balm, smoke, or handle contact lenses. Food and drink shall not be kept in laboratories or spaces where blood or other potentially infectious materials are present. All procedures involving blood or other potentially infectious material shall be performed in such a manner as to minimize splashing, spraying, spattering, and generation of droplets of these substances.

d. Biosafety Cabinets

All biosafety cabinets shall be maintained according to National Sanitation Foundation Standard 49. Check with your supplier or EHS to see if this standard is being met.