STONY BROOK STATE UNIVERSITY OF NEW YORK	Environmental Health and Safety Manual Policy Number: **4-2**	
Title: **Chemical Hygiene Plan**		
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PURPOSE

To provide the necessary work practices, procedures and information to laboratory users to protect them from potentially hazardous chemicals and processes found in the laboratory.

SCOPE

All laboratory users engaged in the handling or use of hazardous chemicals.

INTRODUCTION

The Occupational Safety and Health Administration, recognizing the unique characteristics of the laboratory workplace, tailored a standard for occupational exposure to hazardous chemicals in laboratories. This standard is often referred to as the "Laboratory Standard". Under this standard a laboratory is required to produce a Chemical Hygiene Plan which addresses the specific hazards found in its location, and its approach to them.

The Occupational Safety and Health (OSHA) Laboratory Safety standard (29 CFR 1910.1450 http://www.osha.gov or http://www.osha-slc.gov/SLTC/laboratories/index.html) requires that exposures to hazardous chemicals be maintained at or below the permissible exposure limits (PELs) specified in other OSHA standards. This is to be achieved by implementing this Chemical Hygiene Plan. The Chemical Hygiene Plan includes the necessary work practices, procedures and policies to ensure that workers are protected from all potentially hazardous chemicals in use in their work area. The Chemical Hygiene Plan also includes training, medical consultation and examinations, hazard identification, respirator use and recordkeeping requirements.

Each department that has academic or research laboratories that use hazardous chemicals must adopt this Chemical Hygiene Plan or develop their own Chemical Hygiene Plan that includes all of the elements of the OSHA Laboratory Safety Standard. The Department of Environmental Health and Safety must approve each new Chemical Hygiene Plan.

I. General Principles

A. Perform Hazard Assessment

Prior to the initiation of new experiments or procedures, assessments of potential hazards must be accomplished. Appropriate protective measures, including personal protective equipment, shall be identified and implemented. All affected employees must have the appropriate training prior to beginning work with hazardous chemicals.

B. Hazard Review

Any new procedure is subject to review, not only from a scientific standpoint, but also to assure that all safety considerations are in place prior to implementation. The Laboratory Director should review and give approval to proceed with a laboratory task whenever:

1. There is a new procedure, process or test, even if it is similar to older practices.
2. There is a change, substitution, or deletion of any of the ingredient chemicals in a procedure.
3. There is a substantial change (25% or more) in the quantity of chemicals used.
4. There is a failure of any of the equipment used in the process, especially such safeguards as fume hoods or clamp apparatus.
5. There are unexpected test results, in which case a review of how the new result impacts safety practices must be made.
6. When members of the laboratory staff become ill, suspect exposure, detect a chemical's odor, or otherwise suspect a failure of any safeguards.

There are three levels of review recommended for laboratory work with hazardous chemicals:

1. Clearance Check
   - The Clearance Check authorizes procedures for low hazard operations that use chemicals that are relatively harmless to slightly toxic and require Basic Laboratory Practices, or medium hazard situations requiring Standard Laboratory Practices where the type and level of hazard does not significantly change from

previous work experience. Each laboratory should designate a person with the appropriate level of training and experience to be responsible for the Clearance Check.

2. Local Peer Review
   - Projects that may effect the health and safety of all users in the laboratory should undergo a Local Peer Review. At a minimum, these projects or processes should be reviewed by the Laboratory Supervisor, Principal Investigator, or the Department of Environmental Health and Safety Chemical Hygiene Officer. A copy of the Hazard Review should be kept on file within the laboratory.
3. Prior Protocol Approval
   - Projects or processes involving high hazard procedures that require additional protection must undergo review by the Laboratory Safety Committee. A copy of the Hazard Review must be kept on file in the laboratory. The OSHA Laboratory Standard [29 CFR 1910.1450(e)(2)(v)] states that the Chemical Hygiene Plan must include the circumstances under which a particular laboratory operation, procedure or activity shall require prior approval from the employer or employer's designee before implementation.

C. Minimize Chemical Exposures

It is prudent to minimize all chemical exposures. Few laboratory chemicals are without hazards, therefore, general precautions for handling all laboratory chemicals should be adopted in addition to specific guidelines for particular chemicals with known hazards and protective procedures. General precautions include avoiding skin contact with chemicals at all times and keeping chemical containers closed when not in use.

D. Avoid Underestimation of Risk

Even for substances of no known significant hazard, exposures should be minimized. For work with substances that present special hazards, special precautions should be taken. One should assume that any mixture will be more toxic than its most toxic component, and that all substances of unknown toxicity are toxic.

E. Provide Adequate Ventilation

The best way to prevent exposure to airborne substances is to prevent their escape

into the working atmosphere by use of laboratory hoods and other ventilation devices. There must be a maintenance program for the laboratory hoods and other devices.

F. Follow the Chemical Hygiene Plan

Procedures described in this Chemical Hygiene Plan are designed to minimize exposures. Implementation of the program procedures should be a regular, continuing effort, not merely a standby or short-term activity.

G. Observe the PELs and TLVs

The Permissible Exposure Limits (PELs) of OSHA and the Threshold Limit Values (TLVs) of the American Conference of Governmental Industrial Hygienists (ACGIH) must not be exceeded. Where there are no PELs or TLVs, other recognized exposure limits should be followed.

II. Responsibilities

A. University President

The University President, in Policy 609, has given responsibility for all safety and health compliance to the Director of Environmental Health and Safety.

B. Director of Environmental Health and Safety

The Director of the Department of Environmental Health and Safety has the ultimate responsibility for laboratory safety within the institution and, along with other officers and administrators, provides continuing support for efforts to improve laboratory safety and health.

C. Chemical Hygiene Officer

The Chemical Hygiene Officer is a member of the Department of Environmental Health and Safety, and is given the authority to shut down or suspend operations that do not conform to health and safety practices required by this Chemical Hygiene Plan. The Chemical Hygiene Officer will exercise the authority in order to minimize the short and long-term dangers to laboratory employees, other workers, the community, and to the environment.

The major duties of the Chemical Hygiene Officer are to:

1. Coordinate functions of the Laboratory Safety Committee and work with that committee to evaluate, implement, and update the Chemical Hygiene Plan.
2. Provide technical expertise to the laboratory community in the area of laboratory safety and health, and direct inquiries to appropriate resources.
3. Ensure that hazardous substances are appropriately labeled, handled, and stored and that specific standard operating procedures that instruct personnel in the safe use of these substances are developed and followed.
4. Review specific operating procedures developed by Principal Investigators and department personnel for the use, disposal, spill cleanup, and decontamination of extremely hazardous chemicals and substances.
5. Review new research protocols prior to their initiation to determine if hazardous chemicals are used and, if so, to ensure that proper measures are taken to protect

laboratory personnel.

6. Conduct annual inspections of laboratories and storage areas with other members of the Laboratory Safety Committee and provide inspection forms to departmental personnel and Principal Investigators to conduct their own routine inspections.
7. Write inspection reports and recommend follow-up activities (with input from other members of the inspection team).
8. Review and approve the operation, acquisition, and maintenance of fume hoods, emergency safety showers, eyewashes, and fire extinguishers in all laboratories where chemicals are handled.
9. Conduct (or coordinate) department-specific laboratory employee health and safety orientation sessions along with other department personnel and assist laboratory supervisors in developing and conducting hands-on sessions with employees.
10. Investigate all reports of laboratory hazards incidents, chemical spills, and near-misses to prevent repeat occurrences.
11. Act as a liaison between the laboratory and the departmental administrator and, if necessary, bring unresolved and potentially serious health and safety problems to the administrator's attention.
12. Maintain records and make them available to employees and administrative personnel.
13. Ensure that hazardous waste generated in laboratories is disposed of in accordance with University policy.
14. Review and approve the creation, modification or closing of laboratories.
15. Remain aware of campus-wide safety- and health-related activities.

D. Laboratory Safety Committee

The Laboratory Safety Committee oversees and monitors the effectiveness of the Chemical Hygiene Plan and revises and updates it annually.

The duties of the Laboratory Safety Committee members are to:

1. Attend committee meetings
2. Periodically review and update the Chemical Hygiene Plan
3. Review academic research protocols and ensure that appropriate controls and laboratory space are available to protect employees
4. Participate in annual inspections of laboratories with the Chemical Hygiene Officer and follow-up visits to laboratories not meeting initial compliance
5. Stay informed of plans for renovation or new laboratory construction projects at the institution and ensure involvement of appropriate laboratory personnel in its planning stages to integrate lab safety in the design process
6. Bring unresolved departmental issues to the attention of the committee

E. Department Chair

The department chair is responsible for chemical safety in the department and must know and understand the goals of the Chemical Hygiene Program. The duties of the department chair are to ensure the:

1. Completion of an annual inventory of all chemicals in storage rooms and laboratories in the department.
2. Routine identification of expired and unusable chemicals for disposal.
3. Maintenance of Material Safety Data Sheets (MSDSs) for chemicals used in laboratories in the department.
4. Ensure the training of all laboratory employees and other departmental personnel who may come in contact with hazardous chemicals.
5. Routine inspections of departmental laboratories and maintenance of a file of completed inspection forms.
6. Purchase and ensure the use of safety equipment in the department laboratories.
7. Inform the Chemical Hygiene Officer of the creation, modification or closing of department laboratories.

F. Principal Investigators and Laboratory Supervisors

Principal Investigators, faculty, and other laboratory supervisors have ultimate responsibility for chemical hygiene in the research or teaching laboratories in which they work. It is their duty to:

1. Know and implement the guidelines and procedures of the Chemical Hygiene Plan.
2. Write specific operating procedures for handling and disposing of hazardous substances used in their laboratories and submit these procedures to the Chemical Hygiene Officer for review.
3. Train laboratory personnel in these operating procedures and ensure the use of proper control measures.
4. Conduct routine inspections of laboratories with their laboratory employees.
5. Ensure that all appropriate controls including fume hoods and safety equipment are available and in good working order in their laboratories.
6. Ensure that all incidents occurring in their laboratories are reported to the Chemical Hygiene Officer and that a written Incident Report is filed.
7. Complete annual inventories of chemicals in their laboratories and provide them to designated departmental representatives.

8. Supervise the maintenance of Material Safety Data Sheets (MSDSs) and ensure laboratory employee access to MSDSs and standard operating procedures.
9. Include provisions for Chemical Hygiene Plan compliance in grant proposals.

G. Laboratory Employees, Users, Volunteers and Visitors

Laboratory employees, users, volunteers and visitors are those who, in the course of their work, are present in the laboratory or are at risk of possible exposure on a regular or periodic basis. These include laboratory technicians, instructors, researchers, secretaries, graduate assistants, student aides, part-time and temporary employees. All employees, users, volunteers and visitors will:

1. Follow procedures and guidelines outlined in the Chemical Hygiene Plan and standard operating procedures.
2. Report any unsafe working conditions, faulty fume hoods, or problems with emergency safety equipment to the laboratory supervisor and Chemical Hygiene Officer.
3. File incident reports with the supervisor.
4. Conduct hazard reviews for procedures conducted in the laboratory and maintain a file of those evaluations.

III. Laboratory Facility Requirements

A. Design

1. All laboratories must have the following minimum safety features:
   a. Local exhaust ventilation for chemical usage (e.g., fume hoods).
   b. Chemical storage areas and cabinets, including:
      i. hazardous waste area,
      ii. compressed gas cylinder rack,
      iii. storage cabinets for flammable liquids, acids, bases, and solvents as needed.
   c. Laboratory sinks.
   d. Handwashing facilities.
   e. Emergency eyewashes in the laboratory, and emergency showers that are readily accessible to the laboratory.
   f. Fire extinguishers.
   g. Spill control station.
   h. Room pressurization must be negative compared to the hallway.

2. New laboratories or laboratories that are undergoing remodeling must also include:
   a. Emergency fuel gas shut off.
   b. Master electrical disconnect switch.
   c. Ground fault circuit interrupters (GFCI) at each electrical outlet or for the entire laboratory.
   d. Continuous air flow monitoring devices for the fume hoods.

3. Laboratories that will be using particularly hazardous chemicals should include:
   a. Seamless construction of the walls and floors.
   b. Vacuum systems protected with HEPA filtered traps.
   c. Change and shower rooms or areas.

B. Signs

All employees must be alerted to hazards that exist in an area they enter. Signs must be posted to inform employees that they have the right to information from their employer regarding the toxic substances found in the workplace. The hazard warning signs must be removed when no longer needed. The location of information and emergency equipment must be clearly marked. The following signs must be

posted wherever required:

1. Laboratory: Potentially Hazardous Substances

A sign with the above words in red on a white background must be posted on the door outside of each laboratory at the midpoint of the height of the door.

2. Emergency Equipment and Exit Identification

Signs indicating the location of each safety shower, eyewash station, fire extinguisher, and exit must be posted and must be large and conspicuous.

3. Emergency Telephone Numbers

Telephone numbers of emergency personnel, building manager, physical plant, supervisors, Principal Investigators and the Chemical Hygiene Officer must be posted next to the phone in each laboratory, storeroom or stockroom, and storage area. If there is no phone in the room, a sign should be posted indicating the location of the nearest phone (which should have posted next to it all the pertinent telephone numbers).

4. Special Hazards

All laboratories in which the following materials are used must post signs outside the laboratory and storage area indicating the presence of these hazards:

Designated Areas
Water-reactive chemicals
Carcinogens
Flammable gases or explosives
Reproductive Hazards
Toxic gases (e.g. cyanide, hydrogen sulfide)
Radioactive materials
Biohazardous materials
Lasers

5. Flammable Storage Cabinets and Refrigerators

A sign stating "Store no flammables flashing below 100^{o} F" must be posted on refrigerators that are not explosion-proof and on walk-in cold rooms.

C. Closing or Vacating a Laboratory

1. The Principal Investigator or Laboratory Director must notify the Department of Environmental Health and Safety Chemical Hygiene Officer at least 60 days prior to vacating a laboratory.
2. Transportation of hazardous materials from one location to another unless conducted in accordance with existing Department of Transportation regulations can result in severe financial penalties to individuals transporting the material. Therefore, arrangement for surveys, packaging, and transportation of such materials should be made in consultation with the Department of Environmental Health and Safety Chemical Hygiene Officer.
3. Each Principal Investigator shall ensure that all areas of the laboratory that are contaminated with hazardous material are permanently decontaminated.
4. Each Principal Investigator shall ensure that pre-decommissioning surveys are carried out and that arrangements are made for the removal of all hazardous waste and hazardous waste containers. In addition, all storage areas (including containers, drawers, cabinets, refrigerators, safes, and rooms) are free and clear of all hazardous materials.
5. Upon notification from the Principal Investigator that the laboratory is ready for decommissioning, the Chemical Hygiene Officer will perform a close-out survey on the lab areas and generate a permanent decommission report for the Department Chair.
6. Should contamination or hazardous material be discovered, the Principal Investigator will be notified of all the details of the survey. After corrective action is taken by the Principal Investigator, step #5 will be repeated until the laboratory is found to be free and clear of any contamination or hazardous material.

IV. Criteria Used to Determine and Implement Control Methods

A. Recognition of Potential Hazards

1. Departments and Principal Investigators are responsible for recognizing potential hazards in the work areas under their jurisdiction. This requires familiarity with the processes and work operations involved, maintenance of an inventory of the chemical and physical agents associated with those processes, and periodic review of the different job activities of a work area. Departments shall also study the effectiveness of the existing control measures.
2. The Department of Environmental Health and Safety Chemical Hygiene Officer will assist departments and Principal Investigators in reviewing the job activities for potential hazards.

B. Evaluation of Potential Hazards

Departments and Principal Investigators shall evaluate the degree of risk arising from exposure to chemical, physical and biological agents. Evaluation involves making a judgement based on observation and measurement of the magnitude of these agents. Evaluation involves determining the quantity of agents, hazard class, toxicity, routes of entry, possibility of reaction with another agent, duration of employee exposure, exposure concentration, process hazards, and effectiveness of control methods.

1. Chemical Hazard Class

   Chemicals must be classified by “Hazard Class” in order to understand degree of chemical hazard associated with materials used in the laboratory, and thus the engineering controls and personal protective equipment necessary for their safe use.

2. Process Hazards

   a. Process hazards include, but are not limited to, any of the following:

      i. Exothermic reactions
      ii. Cryogenic materials or endothermic reactions
      iii. High vacuum or pressure
      iv. Electrical hazards

v. Hazards associated with machinery and tools (e.g. guarding)
vi. Compressed gases

b. See Appendix A for additional information for determining process hazards

C. Hazard Identification

1. Labels

a. Labels on all chemical containers will be maintained and not defaced. Labels must include the following information:
   i. The common name of the chemical
   ii. Name, address, and emergency telephone number of company responsible for the product
   iii. A hazard warning indicating the most serious health or safety hazard the chemical poses (e.g., corrosive, carcinogen, water-reactive, flammable), including target organs

b. Smaller, secondary containers must be labeled with the information described above. This information can be found on the original label or on the Material Safety Data Sheet for the product.

c. Adequacy of container labeling will be assessed during routine inventory of chemicals and inspections of laboratories and storage areas by the Laboratory Safety Committee and departmental laboratory employees. Unlabeled containers, if unidentifiable, will be disposed of according to the New York State Department of Environmental Conservation regulations and this institution's hazardous waste disposal policy. Waste of unknown or incorrectly described composition presents difficult handling and disposal problems and may require costly analysis before removal and disposal can be accomplished.

d. All employees involved in unpacking chemicals are responsible for inspecting each container to ensure that it arrives properly labeled. When there is a problem with an incoming product label, the Department of Environmental Health and Safety should be contacted. All employees should reject shipment of improperly labeled products.

e. Any laboratory employee finding a container without the minimum required information, an unlabeled container, or a label that is torn or illegible must report it immediately to their supervisor.

2. Chemical Inventory

a. Each laboratory or department is responsible for maintaining an accurate inventory of all chemicals used and stored in the work area. See Appendix for the appropriate form. A copy of the inventory must be forward to the

Department of Environmental Health and Safety Chemical Hygiene Officer.

b. The Department of Environmental Health and Safety will maintain a master inventory of all chemicals used and stored at this University.

3. Material Safety Data Sheets

a. Material Safety Data Sheets must be collected and maintained in each department to ensure that all employees have access to them. Copies of MSDS are provided on request to employees or their representatives. A copy of each and every MSDS received by individual departments or laboratories must be forwarded to the Department of Environmental Health and Safety Chemical Hygiene Officer.

b. The Department of Environmental Health and Safety will assist departments in obtaining the MSDSs, and will also maintain a master inventory of MSDSs that are used at this University.

c. Other hazard information resources that must also be made available to employees are discussed further in Laboratory Employee Training and Information.

4. Newly Synthesized Chemicals

a. Principal Investigators in research laboratories will be responsible for ensuring that newly synthesized chemicals are used exclusively within the laboratory and are properly labeled. If the hazards of a substance produced in the laboratory are unknown, it must be assumed to be hazardous, and the label must indicate that the potential hazards of that substance have not been tested and are unknown. The Principal Investigator should develop a preliminary Material Safety Data Sheet (MSDS) at the earliest opportunity, and add to it as properties of the chemicals become known.

b. If the chemical is to be transferred outside of the laboratory, the Principal Investigator shall comply with the University Hazard Communication Right to Know Program, including labeling and preparation of the MSDS.

c. Newly synthesized chemicals may be subject to the requirements of the Environmental Protection Agency Toxic Substances Control Act (TSCA), 40 CFR 700. Chemical substances manufactured solely for non-commercial research and development purposes are exempt from TSCA reporting requirements unless the activity is for eventual commercial purposes. TSCA requires that notification of health and safety hazards for chemical substances used for research must be made to all persons handling the chemical, particularly if the chemical is sent to another laboratory on or off campus. Contact the Department of Environmental Health and Safety Chemical Hygiene Officer for specific requirements.

V. Hazard Review and Prior Protocol Approval

A. Hazard Reviews

1. Purpose

The Hazard Review process promotes health, safety and environmental compliance and emphasizes prudent laboratory practices when introducing new hazards into the workplace. The results of the Hazard Review become the standard operating procedures for the project or process and must be communicated to all affected employees. This can be done through labeling, signs, memos, training and forms.

2. Initiate a Hazard Review:

a. When starting a new project or process, a new project phase, the restart of an idle project or process, or the scale up of a project or process.
b. When there is a significant change to a project due to a change in raw materials which present a new hazard, an equipment or instrumentation modification which introduces a new hazard, or a change in personnel.
c. When significant new hazards are recognized due to a change in toxicological data or a newly discovered or suspected hazard is documented.
d. When there is an unexpected event involving real or potential damage to people, property or the environment.
e. When there is no previous hazard review.

3. Review Information

The Hazard Review form found in the Appendix can be used to compile the following information:

a. Quantities of materials to be handled.
b. Types of health and physical hazards involved in project or process.
c. Use of containment devices or other engineering controls.
d. Chemical storage requirements.
e. Process safety considerations.
f. Procedures for handling reaction chemicals, product, and by-product.
g. Hazardous waste handling, packaging, and labeling requirements and procedures.
h. Spill and release response materials and procedures.
i. Decontamination procedures.

j. Personal protective equipment.
k. Personal hygiene practices.
l. Availability, location, and use of emergency response equipment.
m. Requirements for isolating materials and/or equipment to a designated chemical area.
n. The need for exposure monitoring.
o. The need for medical consultations, examinations, or surveillance.
p. The need to provide hazard information and training to laboratory employees, custodians/housekeepers, maintenance employees, support staff and visitors.

3. Laboratory Review

a. All projects involving chemicals must undergo an initial safety review. Each laboratory must designate a person with the appropriate level of training and experience to be responsible for the safety review. Copies of the safety review must be kept on file within the laboratory.

4. Incident Review

a. The Laboratory Safety Committee will conduct a Hazard Review when there is an unexpected event involving real or potential damage to people, property or the environment.
b. The review will identify what happened, how the incident was handled, and what corrective action must be taken to prevent a reoccurrence.

B. Prior Protocol Approval

The OSHA Lab Safety Standard requires that the University's Chemical Hygiene Plan include: "The circumstances under which a particular laboratory operation, procedure or activity shall require prior approval from the employer or the employer's designee before implementation". The OSHA standard is a performance based standard, and it is to be determined by the "employer" how to meet this requirement. Therefore, this requirement must be meet by each department and/or individual laboratory. The Department of Environmental Health & Safety recommends that the researcher reviews the non-mandatory appendix included in this Chemical Hygiene Plan.

VI. Control Measures for Chemical Use

A. Hazard Potential

1. Once a Hazard Review has been conducted, the hazard potential of the operation can be determined. The hazard potential of an operation will determine the type of control measures that must be used to protect the safety and health of the laboratory users.
2. Control measures are briefly described in this section. Refer to appropriate sections of this plan for more detailed requirements.

B. Types of Control Measures

1. Engineering controls, such as local exhaust ventilation, reduce or eliminate exposures by modifying the source or reducing the quantity of contaminants released into the air.
2. Administrative controls include job rotation, work assignment or time periods away from the contaminant, and performing hazardous operations in a safe manner.
3. Personal protective equipment (PPE) includes respirators, gloves, eye protection, and other protective equipment. PPE is used after engineering and administrative controls have reduced, but not eliminated, the hazards.

C. Low Hazard Operations

1. Low hazard operations include work with chemicals that are relatively harmless to slightly toxic, have no potential for uncontrolled process hazards, and staff have previous experience with the type of work.
2. Observe Good Laboratory Practices when conducting a low hazard operation:
    a. Personal Hygiene
        i. Never store food or beverages in storage areas, refrigerators, glassware, or utensils that are also used for laboratory operations.
        ii. Do not eat, drink, smoke, chew gum, take medicine, or apply cosmetics in laboratories where chemicals or other hazardous materials (e.g., radioactive or biohazardous materials) are present.
        iii. Mouth pipetting is prohibited. Always use a pipet bulb or other mechanical pipette filling device.
        iv. Wash areas of exposed skin well before leaving the laboratory.

v. Remove contaminated personal protective equipment (e.g., lab coats) before leaving the laboratory.

b. Wear Appropriate Personal Apparel
   i. Confine long hair and loose clothing. Wear shoes at all times in the laboratory but do not wear sandals, perforated shoes, or canvas sneakers.
   ii. Always wear long-sleeved and long-legged clothing. Jewelry should not be worn that interferes with gloves and other protective clothing or that could come into contact with electrical sources or react with chemicals.

c. Proper Equipment Use
   i. Use equipment only for its intended purpose.
   ii. Inspect equipment or lab apparatus for damage before use. Never use damaged equipment such as cracked glassware or equipment with frayed electrical wiring.
   iii. Shield or wrap Dewar flasks and other evacuated glassware to contain chemicals and glass fragments should explosion occur.

d. Transport of Chemicals

   The following guidelines will be used when transporting all chemicals within facilities, from building to building, and on public streets.
   i. Hand-carried chemicals should be placed in a secondary container or acid carrying bucket to protect against breakage.
   ii. Wheeled carts used to transport chemicals should be stable and move smoothly over uneven surfaces without tipping or stopping suddenly, and should have lipped surfaces that would contain the chemicals if the containers break.
   iii. Laboratory employees transporting chemicals must wear splash goggles and a lab coat or apron in case containers break or chemicals are splashed.
   iv. Use freight elevators when available. Passenger elevators should be used only during low-use time periods and only by those who are handling the chemicals.
   v. Compressed gas cylinders should be transported with hand trucks only with the cylinder strapped in place. Cylinders should NEVER be rolled or dragged. Keep the cylinder capped until it is used.

e. Housekeeping
   i. All work areas, including work benches and floors must be kept clean, dry, and uncluttered.
   ii. Access to emergency equipment, fire extinguishers, utility controls, showers, eyewash stations, and laboratory exits must never be blocked.

f. Toxic Discharges and Waste Disposal

i. Deposit chemical waste in their appropriate, labeled receptacles and follow all other disposal procedures described in this Chemical Hygiene Plan.
ii. Be particularly careful not to release hazardous substances into designated "cold" or "warm" rooms, since these facilities have recirculated atmospheres.
iii. Minimize the release of toxic vapors into the laboratory by using venting apparatus such as vacuum pumps and distillation columns into local exhaust devices. When especially toxic or corrosive vapors are involved, they should pass through scrubbers prior to being discharged from the local exhaust system.

g. Working Alone

Employees should avoid working alone when conducting research and experiments involving hazardous substances and procedures.

i. Undergraduate teaching laboratories: A University representative trained in chemical safety must be present in the laboratory at all times when undergraduate students are conducting experiments.
ii. Research Laboratories: Personnel working alone should contact University Police to make them aware of their presence in the facility. University Police should make periodic checks of all laboratories. These personnel should plan a route of escape in case of an emergency. If the operation must be left unattended, place an appropriate sign on the door and provide for containment of toxic substances in the event of failure of a utility service to an unattended operation.

h. Unattended Operations

i. All chemical containers, including reaction vessels and process equipment, must be labeled.
ii. An emergency phone number for the responsible person must be posted on the laboratory door.
iii. A sign stating "Let Run" must be posted near the process.
iv. The laboratory light must be kept on at all times.
v. Provide for the containment of toxic substances in the event of failure of a utility service, such as cooling water. Additional controls are needed for particularly hazardous chemicals.

D. Medium Hazard Operations

1. Medium hazard operations include work with chemicals that are identified as:
   a. Allergen
   b. Cause burns

c. Corrosive
d. Flammable
e. Heavy Metal
f. Lachrymator
g. Neurotoxin
h. Oxidizer
i. Peroxide or Peroxide forming
j. Reactive
k. Sensitizer
l. Toxic
m. Unstable
n. Water Reactive

2. Observe the following Standard Laboratory Practices in addition to Good Laboratory Practices for work with medium hazard operations.
   a. Engineering Controls
      i. Use an appropriate laboratory hood if material is volatile or the process may produce aerosols.
      ii. Use appropriate storage containers for raw materials and waste materials (e.g., flammable safety cans).
   b. Administrative Controls
      i. Have an appropriate Standard Operating Procedure (SOP) available for chemicals and procedures. Ensure that all laboratory users are familiar with SOPs.
      ii. Wash hands and any other potentially exposed skin immediately after working with chemicals.
      iii. Never eat, drink, smoke, chew gum, apply cosmetics, take medicine, or store food where chemicals are used.
      iv. Ensure all chemical containers are appropriately labeled.
      v. Cover work surfaces with absorbent plastic backed paper to simplify clean-up.
      vi. Have an appropriate waste disposal plan for waste chemicals.
      vii. Have an appropriate spill plan for chemicals.
      viii. If required by Hazard Review, conduct exposure monitoring and medical consultations.
   c. Personal Protective Equipment
      i. Glove material must be compatible with chemical.
      ii. Laboratory coat with long sleeves worn closed (snaps are preferred).
      iii. Appropriate safety goggles.

E. High Hazard Operations

1. High hazard operations include work with particularly hazardous chemicals that are identified as:
    a. Carcinogens
    b. Reproductive Toxins
    c. Highly Toxic
        i. Extremely Toxic
        ii. Fatal
        iii. Poison
    d. Severe allergens
    e. Causes severe burns
    f. Explosive
    g. Pyrophoric
    h. Strong oxidizers
    i. Strong sensitizers
2. High hazard operations require additional protection. Refer to Section VII for specific control measures.

VII. Special Control Measures for Particularly Hazardous Chemicals

A. General

1. During the planning of a high hazard operations, substitution of highly toxic substances with less toxic alternatives and the use of the smallest amount of material that is practical for the conduct of the experiment should be considered.
2. All laboratory users working with particularly hazardous chemicals must receive additional training on the special control measures required.
3. Laboratories conducting high hazard operations must have restricted access. All entrances to a laboratory or storage area where particularly hazardous chemicals are present must be posted with permanent signs indicating the use of specific classes of chemicals and stating "Authorized Personnel Only". If necessary, such as during unattended operations or storage rooms, the rooms must be locked. Only personnel with special instruction on the hazards and safe handling of the particularly hazardous substances must be permitted access to the areas.
4. Laboratory Standard Operating Procedures (Section V) for high hazard operations must include specific information on the use of designated areas, engineering controls, personal protective equipment, and decontamination procedures.
5. It is desirable first to conduct a "dry run" of the experiment, without the use of the particularly hazardous chemicals. The "dry run" will serve as a training tool, and will also assist in determining if adequate control measures have been selected.

B. Designated Areas

1. All high hazard operations must be conducted in a designated area.
2. Designated areas can be the entire laboratory, a portion of the laboratory, or equipment, such as the fume hood or glove box.
3. Warning signs must be posted to identify the designated area. The sign must include the name of the hazardous chemical or process, and the appropriate hazard warning.

C. Engineering Controls

1. Containment devices, such as fume hoods or glove boxes, must be used in the following circumstances:

a. When the particularly hazardous chemical is volatile
b. When conducting manipulations that may result in the generation of aerosols
c. When conducting any manipulation, handling or reaction that may result in the uncontrollable release of the particularly hazardous chemical.

2. Fume hoods used in high hazard operations must have a continuous air flow monitor or some other mechanism for ensuring the performance of the hood.
3. Glove boxes must be used under negative pressure. The gloves must be checked for integrity and compatibility with the hazardous substance. They should have at least 2 air changes per hour.

D. Personal Protective Equipment

1. Personal protective equipment (PPE), when practicable, should be disposable. Reusable PPE must be appropriately decontaminated after use and checked before use for wear and tear.
2. PPE used with high hazard operations must be removed in the designated area.
3. Double gloves should be used when handling particularly hazardous chemicals.
4. Hands, neck, arms and face must be washed after removing contaminated PPE.

E. Decontamination

1. All work surfaces in the designated area must be thoroughly washed and rinsed after using particularly hazardous chemicals and before resuming normal laboratory activities.
2. Clean floors with a wet mop or a vacuum cleaner equipped with a high-efficiency particulate air (HEPA) filter. DO NOT dry sweep the area with a broom.
3. Laboratory equipment, such as vacuum pumps, contaminated with particularly hazardous chemicals must be decontaminated after use. This should be done in the fume hood.
4. Additional decontamination procedures may be required depending on the hazardous material being used.

VIII. Engineering Controls

A. General Laboratory Ventilation

1. General laboratory ventilation shall comply with the ASHRAE Handbook of Fundamental Guidelines and state building codes.
2. General laboratory ventilation shall operate continuously during working hours to provide a source of air for input to local ventilation devices ("make-up air"). In general, a change of room air four to twelve times per hour is adequate.
   a. Doors to laboratories must be kept closed as containment of hazardous materials is partially dependent on proper balance of air flow. Disruption of the positive pressure in the corridor by a laboratory door opened for an extended period of time may result in transmission or airborne materials from the laboratory to the corridor. Laboratory fume hoods will also function more efficiently when the door is kept closed.
3. General laboratory ventilation shall not be relied on for protection from toxic substances. The ventilation system shall direct air flow into the laboratory from non-laboratory areas and out to the exterior of the building.

B. Local Exhaust Ventilation

1. Local exhaust ventilation systems shall be used after every effort has been made to control the contaminant by isolation, a change in the process, or by substitution of a less harmful material.
2. At a minimum, the following activities must be conducted in a laboratory fume hood:
   a. Reactions
   b. Heating or evaporating solvents
   c. Work involving explosive or reactive chemicals
   d. Working with 100 milliliters or more of a chemical which is a fire hazard.
3. The following activities must have local exhaust ventilation, such as a canopy or a spot exhaust:
   a. Vacuum pump exhausts
   b. Gas chromatograph exit ports
   c. Liquid chromatographs
   d. Distillation columns

D. Fume Hoods

1. Refer to Environmental Health and Safety Policy 4-5 *Laboratory Hood Safety* for design and failure protocols.
2. Work Practices
   a. The user shall establish work practices that minimize emissions and employee exposure.
   b. The following list concerns only those work practices related directly to hood performance and applies only when hazardous materials are to be used in the hood:
      i. The worker shall not lean into the hood so that his/her head is inside the plane of the hood face without adequate respiratory and personal protection, except for setup work or hood maintenance;
      ii. Equipment in the hood should not block airflow to slots in the baffle;
      iii. Equipment that might be a source of emission (including in case of breakage) should not be placed closer than 6 inches from the plane of the hood face;
      iv. Flammable liquids should not be stored permanently in the cabinet under the hood unless that cabinet meets the requirements of ANSI/NFPA 30 and 45 for flammable liquid storage. Storage of flammable or otherwise hazardous materials (including compressed gas cylinders) in the active work areas of the laboratory should be kept to a minimum. Normally, a one or two day supply should be sufficient;
      v. The hood sash or panels shall not be removed except for setup work without hazardous chemicals in the hood;
      vi. The hood sash or panels should be closed to the maximum position possible while still allowing comfortable working conditions;
      vii. A hood that is more than 10% below standard in exhaust volume shall not be used unless its condition is labeled and the maximum sash opening marked clearly.
   c. Each hood shall be posted with a notice giving the date of the last periodic field test. If the hood failed the performance test, it shall be taken out of service until repaired, or posted with a restricted use notice. The notice shall state the partially closed sash position necessary and any other requisite precautions concerning the type of work and materials permitted or prohibited.
   d. Each laboratory hood shall be evaluated for catastrophe potential in terms of the maximum credible accident, involving the properties and quantities of the chemicals used and the nature of the operations. Examples of such a catastrophe would be:

i. explosion
ii. violent ejection of life threatening chemicals into the room
iii. overheating of the exhaust duct

If the potential for a catastrophe is present, special designs to prevent the event or limit the consequences should be implemented. Examples of such provisions would be:

i. special hood design
ii. fire or explosion suppressing systems
iii. redundant installed spare exhaust blowers
iv. emergency power supply

4. Fume Hood Failure Procedures
   a. If it is noted by the users that their fume hood is not drawing enough air, they should:
      i. Immediately stop all work in the hood.
      ii. Report the problem to:
         a. Their supervisor
         b. Physical Plant (East Campus 4-2400; West Campus 2-6400)
         c. Environmental Health and Safety (2-6410)
   b. Notify others in the area and on additional shifts that the fume hood is not operating and cannot be used. This may be done by posting the hood with a sign. **This must be strictly enforced.**
   c. Seal off any opened/exposed containers of chemical or radioactive materials currently under the hood, or remove any supplies or equipment which may be required as access to hood may be denied due to repair.
   d. Work with the supervisor and other departments to either arrange for the use of other fume hoods which are operating properly or postpone work until repairs are made.
   e. The fume hood must not be returned to use until retested and approved for use by the Department of Environmental Health and Safety.

E. Glove Boxes

1. Glove boxes and glove bags are isolation units used for handling highly toxic chemicals and carcinogens. These units are negative pressure, so air leakage is into the unit. The ventilation rate must be at least 2 volume changes per hour and pressure at least 0.5 inches of water.
2. Some units are positive pressure, so there is the potential for leakage into the laboratory.
   a. Positive pressure units are used when protection from atmospheric moisture or oxygen is required. Never use toxic chemicals in a positive pressure unit.

b. These units must be regularly tested for leaks and must have a shutoff valve and pressure gauge installed.

3. Exhaust air is treated by scrubbing and/or absorption prior to release into the regular exhaust system.

IX. Chemical Storage

A. General Requirements

1. Every chemical will have an identifiable storage place and must be returned to that location after use.
2. A storage scheme must be developed in each chemical storage area to ensure the segregation of incompatibles. An effort must be made to isolate particularly flammable, reactive, and toxic materials. Because of the risk of placing incompatible materials side-by-side, a storage scheme based solely on alphabetizing is prohibited.
3. The storage of working containers on bench tops will be minimized to prevent the accidental spilling of chemicals and to reduce the risk of fire.
4. Compatible chemicals should be grouped by container size to make it easier to retrieve chemicals and to reduce the possibility of bottle breakage. Large containers should be stored on lower shelves. Chemicals will not be stored on the floor.
5. Chemical storage in hoods should be kept to a minimum. Storing containers inside the hood interferes with airflow, reduces the work space, and increases the risk of a spill, fire, or explosion. Where possible, chemicals will be stored in cabinets that vent directly into the fume hood or toxics exhaust system.
6. Labels must be maintained on all stored materials. New labels must be created for secondary containers.
7. Stored chemicals should be stored in amber bottles and must not be exposed to direct sunlight or heat.
8. Storage trays should be used to minimize the spread of a spill.
9. Do not store food in laboratory refrigerators.
10. All chemical containers left out of storage areas will be checked at the end of each workday. Unneeded items will be returned to chemical areas or stockrooms.
11. All chemical containers in the following groups will be dated when they are initially opened:
    a. Picrics
    b. Peroxides
    c. Other materials known to deteriorate, or become unstable over time
    d. Polymerizers that react violently in polymerization or become hazardous after polymerization
    e. Perchlorates
    f. Peroxidizable materials (aldehydes, ethers, and compounds containing benzylic hydrogen atoms, e.g. isopropyl benzene and most alkene, vinyl and vinylidene compounds)

Expiration dates will be assigned to these chemicals. When provided, the manufacturers' expiration date should be displayed.

Peroxidizable materials must be tested routinely for peroxides. (See the table "Common Peroxide-Forming Chemicals" in Appendix D for a more complete list of these chemicals and testing instructions.)

12. When a laboratory is being closed or relocated, the laboratory supervisor and Chemical Hygiene Officer will arrange for the removal or safe storage of all hazardous materials remaining in their work area.
13. Appropriate spill-control, cleanup, and emergency equipment must be available wherever chemicals are stored.

C. Segregation of Incompatible Chemicals

Chemicals must be segregated to prevent mixing of incompatible chemical vapors or liquids in the event that containers break or leak. Chemicals must not be arranged alphabetically or haphazardly in stockrooms or in laboratory work areas. It is acceptable to store solid chemicals alphabetically if hazard classes are segregated. Particular attention must be paid to isolating flammables, air-reactives, peroxidizables, and toxic chemicals.

Special attention must be paid to the following chemicals because of their potential instability.

Inorganic

- Nitrates, nitrites, and azides
- Perchlorates
- Perchloric acid
- Peroxides
- Phosphorous
- Phosphorous pentoxide

Organic

Ether

- Azides

D. Chemical Stockrooms

Stockrooms are areas in facilities in which relatively large quantities of chemicals are stored for laboratory use.

1. General Requirements for All Stockrooms

   a. Stockroom access must be strictly limited to specified personnel. All laboratories, preparation rooms, and storeroom/stockrooms must be locked and secured when designated laboratory employees are not present.
   b. A mechanical exhaust ventilation system must be in place and must provide at least 6 air changes per hour. Additional local exhaust may be required if activities such as dispensing take place in the storage area.
   c. Each storage area must have at least one large sink, safety shower, eyewash station, and appropriate fire extinguisher with adequate extinguishing capacity.
   d. Each chemical storage area must have a master control shutoff valve for water, electricity, and gas.
   e. Shelving must be secure and well-braced. The weight limit provided by the manufacturer of the shelving unit must not be exceeded. Other shelving characteristics should include:
      i. Antiroll lips on all shelves to prevent containers from falling off shelves
      ii. Metal shelves should be corrosion-resistant.
      iii. Aisles at least 3 feet between standing shelving
      f. All chemical storerooms and stockrooms must have clearly marked, unobstructed exits. Each area must have two exits that are not right next to each other.
   g. Chemical stockrooms must be well-lit so that labels can be easily read.
   h. No aisle is permitted to dead end. Aisles must be kept clear of clutter.
   i. The environment in stockrooms must be controlled to avoid extremes of temperature and high humidity. Open flames, smoking, humidifiers, and heating units such as space heaters, hot plates and coffee makers are not permitted.
   j. Floors must be kept clean and dry.
   k. Wherever toxic chemicals are stored and could be released, self-contained escape respirators or self-contained breathing apparatus must be made available.

2. Flammable Materials Stockrooms

Flammable materials not currently in use should be isolated in stockrooms. Storage facilities for flammables must meet the following specifications:

   a. The walls, ceilings, and floors of an inside storage room for flammable materials must be constructed of materials having at least a 2-hour fire resistance.

b. All doors between the room and the building must be self-closing Class B fire doors.
c. Adequate mechanical ventilation must be provided and controlled from a switch outside the stockroom door. Ventilation should be at floor level since flammable vapors tend to sink.
d. In areas where Class I flammable liquids are stored or dispensed, electrical power, lights, switches, and sockets must be explosion-proof.
e. Fan motors and ventilation equipment motors must be nonsparking.
f. All smoking and lighting of matches are prohibited.
g. An inside storage room meeting all the above specifications and not exceeding 150 square feet in floor area is permitted to contain no more than 2 gallons of flammables per square foot of floor area. Five gallons per square foot are allowed if in addition the room has an automatic sprinkler system.
h. Chemical storage must meet applicable local fire codes.

E. Chemical Storage Outside Stockrooms

The nature of laboratory work calls for a certain amount of chemicals to be on hand for easy access. However, all laboratory employees must limit, as much as possible, the amounts of chemicals stored on bench tops, in hoods, under sinks or other exposed areas. When these chemicals are flammable, combustible, reactive, toxic, or corrosive, the following rules will be observed.

1. Flammables and Combustibles

Legal limits on amounts of flammables, combustibles, reactives, and unstable chemicals in laboratories will be determined and observed for each laboratory.

a. Flammable Liquids Storage Cabinets
   i. Flammable materials must be stored in cabinets that meet OSHA and National Fire Protection Association specifications that cabinet contents be protected from temperatures exceeding 325 □F for at least 10 minutes, enough time for personnel to evacuate the area.
   ii. NO MORE THAN 60 GALLONS OF FLAMMABLES AND 120 GALLONS OF COMBUSTIBLES MAY EVER BE STORED IN THESE CABINETS.
b. Maximum Container Sizes
   i. OSHA and NFPA limit the size of the container for classes of flammable and combustible materials. The more fire-resistant a container, the larger it may be. Only certified containers will be used. See Table *.
c. Safety Cans for Flammables

i. Portable and approved safety cans should be used when possible for storing flammable liquids. Flammable liquids in quantities greater than 1 liter (2.2 quarts) will be stored in metal containers. Flammable liquids purchased in large containers should be repacked into smaller safety cans for distribution to laboratories. The cans must be grounded and bonded during transfer.

d. Flammable and Other Compressed Gases
   i. The names of compressed gases must be prominently posted.
   ii. Storage of flammable gases in laboratories is not permitted, except when being used. No more than twice the procedure's requirements will be present in the laboratory.
   iii. Flammable gas cylinders should be stored in a separate area from other types of compressed gases.
   iv. Cylinders of incompatible gases must be segregated by distance. Cylinders must be grouped by the type of gas (e.g. toxic, corrosive, etc.)
   v. Empty cylinders should be separated from nonempty cylinders and labeled "empty" or "MT."
   vi. All compressed gases must be stored away from direct or localized heat (including radiators, steam pipes, or boilers) in well-ventilated and dry areas and away from areas where heavy items may strike them (e.g., near elevators or service corridors).
   vii. All compressed gases, including empty cylinders, must be secured in an upright position with chains, straps or special stands of adequate strength and must be capped when stored or moved.
   viii A hand truck must be available for transporting gas cylinders to and from storage areas.

2. Oxidizers
   a. Oxidizers must be stored away from incompatible materials such as:
      i. Flammables and combustible materials
      ii. Greases
      iii. Paper trash bins
      iv. Finely divided metals
      v. Organic liquids
      vi. Other oxidizers
   b. Nitric acid, sulfuric acid, and perchloric acid should be stored separately from organic acids in rooms, cabinets, or break-resistant containers and placed in acidic-resistant trays.
   c. Strong oxidizing agents should be stored and used in glass or other inert containers. Corks and rubber stoppers should not be used. High energy oxidizers should be segregated.

3. Peroxides and chemicals that tend to form peroxides must be stored in airtight containers in a dark, cool, and dry place.
   a. To minimize the rate of decomposition, peroxides and peroxidizable materials should be stored at the lowest possible temperature consistent with their solubility and freezing point. Liquid peroxide or solutions should not be stored at or below temperature the peroxide freezes or precipitates at, because peroxides in these forms are extremely sensitive to shock and heat.

4. Toxics
   a. Extremely toxic substances must be stored in unbreakable chemically resistant secondary containers.
   b. Adequate ventilation must be provided in storage areas especially for toxics that have a high vapor pressure.
   c. All dispensing of these materials must be conducted in a fume hood.

X. Personal Protective Equipment

A. General

1. Personal Protective Equipment (PPE) is used after engineering and administrative controls have been put into place, but the potential for exposure to hazardous materials still remain.
2. PPE includes, but is not limited to protective eyewear, gloves, respirators and clothing.
3. PPE must be evaluated by the Chemical Hygiene Officer for chemical compatibility and suitability for use with the potential hazards.
4. Users must be trained in the proper use of PPE. If respiratory protection is required, medical clearance and fit testing are also required. Refer to Environmental Health and Safety Policies 7-1 *Personal Protective Equipment* and 7-2 *Respiratory Protection* for additional information.
5. Laboratory Standard Operating Procedures (Section V.) must include specific information on the type of PPE required for each hazardous chemical or process.

B. Requirements

1. **Eye Protection:** When an operation or activity has the potential of an eye injury from dust, liquids, impact, glare, or any other foreign object entering the eye.

2. **Face Protection:** When an operation or activity has the potential of a face injury from flying objects, chemical splash, or injurious radiation. Eye protection must always be worn under face protection.

3. **Respiratory Protection:** When an operation or activity has a potential of harmful concentrations of dusts, fumes, gases, vapors, or radionuclides being present in the work environment.

4. **Hearing Protection:** When working in an area designated as a hearing protection area and/or when working near equipment with a noise level of 85 dB or greater.

5. **Hard Hats:** When working at or visiting construction sites, designated hard hat areas, or any other area where tools or objects may fall from above. When working with equipment used for lifting or excavating, or working on high voltages that require rubber gloves.

6. **Safety Shoes:** When an operation or activity has the potential of a foot injury from falling and/or rolling objects, from piercing the sole, or from electrical hazards.

7. **Gloves:** When an operation or activity has the potential to cut, burn, blister or bruise the hands, especially when working with chemicals, high voltages, metal

plates, or pipes.

8. **Safety Belts:** When working from an aerial lift, riding in a man-lift or working on any unguarded raised platform or roof.
9. **Safety Harness:** When working in Confined Space Operations.
10. **Disposable Clothing:** When an operation or activity has the potential of an exposure to asbestos, PCB oil, pesticide spray, or any other contaminant.
11. **Protective Clothing:** Whenever engaged in an activity or operation where the normal working attire will not afford suitable protection from injury.

C. Eye and Face Protection Selection Chart

Source	Assessment of Hazard	Protection
IMPACT - Chipping, grinding, machining, masonry work, woodworking, sawing, drilling, chiseling, powered fastening, riveting, and sanding.	Flying fragments, objects, large chips, particles of sand, dirt, etc.	Spectacles with side protection, goggles, face shields. See notes (1), (3), (5), (6), (10). For severe exposure, use faceshield.
HEAT - Furnace operations, pouring, casting, hot dipping, and welding.	Hot sparks..... Splash from molten metals.. High temperature exposure..	Face shields, goggles, spectacles with side protection, For severe exposure use faceshield. See notes (1), (2), and (3). Face shields worn over goggles. See notes (1), (2), and (3). Screen face shields, reflective face shields. See notes (1), (2), and (3).
CHEMICALS - All chemical handling.	Splash..... Irritating mists.....	Goggles, eyecup and cover types. For severe exposure, use face shield. See notes (3), (11). Special purpose goggles.
DUST - Woodworking, buffing, general dusty conditions.	Nuisance dust	Goggles, eyecup and cover types. See note (8).
LIGHT RADIATION - Welding: Electric arc Welding: Gas Cutting, Torch brazing, soldering	 Optical radiation..... Optical radiation..... Optical radiation.....	 Welding helmets or welding shields. Typical shades: 10-14. See notes (9), (12). Welding goggles or welding face shield. Typical shades: gas welding 4-8, cutting 3-6, brazing 3-4. See note (9). Spectacles or welding face shield. Typical shades 1.5-3. See notes (3), (9).

Notes to Eye and Face Protection Selection Chart:

(1) Care should be taken to recognize the possibility of multiple and simultaneous exposure to a variety of hazards. Adequate protection against the highest level of each of the hazards should be provided. Protective devices do not provide unlimited protection.
(2) Operations involving heat may also involve light radiation. Protection from both hazards must be provided.
(3) Face shields should only be worn over primary eye protection (spectacles or goggles).
(4) Filter lenses must meet the requirements for shade designations in 29 CFR 1910.133(a)(5). Tinted and shaded lenses are not filter lenses unless they are marked or identified as such.
(5) Persons whose vision requires the use of prescription (Rx) lenses must wear either protective devices fitted with prescription (Rx) lenses or protective devices designed to be worn over regular prescription (Rx) eyewear.
(6) Wearers of contact lenses must also wear appropriate eye and face protection devices in a hazardous environment. It should be recognized that dusty and/or chemical environments may represent an additional hazard to contact lens wearers.
(7) Caution should be exercised in the use of metal frame protective devices in electrical hazard areas.
(8) Atmospheric conditions and the restricted ventilation of the protector can cause lenses to fog. Frequent cleansing may be necessary.
(9) Welding helmets of face shields should be used only over primary eye protection (spectacles or goggles).
(10) Non-side shield spectacles are available for frontal protection only, but are not acceptable eye protection for the sources and operations listed for "impact".
(11) Ventilation should be adequate, but well protected from splash entry. Eye and face protection should be designed and used so that it provides both adequate ventilation and protects the wearer from splash entry.
(12) Protection from light radiation is directly related to filter lens density. See note (4). Select the darkest shade that allows task performance.

D. Selection Guidelines for Hand Protection

Gloves are often relied upon to prevent cuts, abrasions, burns, and skin contact with chemicals that are capable of causing local or systemic effects following dermal exposure. There are no gloves available that provide protection against all potential hand hazards, and commonly available glove materials provide only limited protection against many

chemicals. Therefore, it is important to select the most appropriate glove for a particular application and to determine how long it can be worn, and whether it can be reused. Hypoallergenic gloves must be provided if necessary.

The chart in the Appendix can be used as a guide in determining the correct chemical protective clothing material for the chemical hazard. For the best protection, check with the manufacturer for degradation and permeation information.

E. Respirator Selection and Use

1. Selection of respirators and respirator accessories, fit testing and training must be coordinated through the Department of Environmental Health and Safety.
2. The Department of Environmental Health and Safety will evaluate the work area for chemical toxicity, the potential for exposure, the concentration and duration of exposure, and the limitation of the various types of respiratory protection that are available.
3. A respirator must never be worn before an evaluation has been made. Use of a respirator by an untrained individual, or in an application other than that for which it was designed, can prove extremely dangerous. In addition, a single respirator facepiece cannot be designed to fit the entire working population.
4. Any laboratory user who is required to wear a respirator must receive medical clearance, be fit tested and trained before using the respirator.

XI. Emergencies

A. General

For emergencies such as fires, explosions, spills or transportation accidents, the basic protocol is:

1. Rescue anyone immediately affected by the emergencies. Only perform the rescue if it does not put yourself at risk. If trained, provide first aid to the victims.
2. Notify the proper authorities:
   a. If the emergency involves a fire, use the manual pull box to activate the alarm.
   b. For other emergencies, contact University Police at 333, and describe the emergency. Request the Hazardous Materials Response Team (HAZMAT) for biological and chemical emergencies, and the Radiation Protection Officer if radiological materials are involved.
3. Warn others in the area about the emergency, and stay clear of the area.
4. Follow the directions of the Emergency Responders (i.e. Fire Department personnel, Department of Environmental Health and Safety personnel). Do not reenter the area until the area is deemed safe by the Department of Environmental Health and Safety or other emergency responders.
5. Laboratory Standard Operating Procedures must include information on preventing and responding to spills for each hazardous chemical or process.

B. Chemical Spills

1. Employee Contamination

a. If the skin becomes contaminated with hazardous materials, wash the affected area thoroughly with copious amounts of water. If available, use the Emergency Shower for at least 15 minutes.
b. If hazardous material is splashed into the eyes, immediately use the eyewash station, and flush for at least 15 minutes.
c. Remove grossly contaminated clothing immediately. Place the contaminated clothing in a plastic bag.
d. Report the spill to the Supervisor, and seek medical attention.

2. Small Chemical Spill Clean Up

a. Small spills are less than 20 to 30 cc, or 1 ounce. These spills can be cleaned up by trained laboratory personnel.

b. Wear the appropriate personal protective equipment (PPE) to clean up the spill. At a minimum, this includes gloves, and protective eyewear. Depending on the size and type of spill, protective clothing, protective foot coverings and a respirator may be needed.
c. Pick up any broken glass with tongs or some other mechanical device. Do not use your hands.
d. Place absorbent material over the spill, making sure not to spread the liquid.
e. Dispose of all contaminated material in a plastic bag. Label the bag with the name of the hazardous material. Contact the Department of Environmental Health and Safety for disposal.

3. Large Chemical Spill Clean Up

a. Large chemical spills are spills greater than 20 to 30 cc, or any quantity of a chemical that has a highly hazardous material.
b. Immediately evacuate the area and close all doors. Notify others not to enter the area.
c. For spills of highly hazardous material, activate the fire alarm by pulling the nearest fire alarm box.
d. Contact University Police at 333 and request the Hazardous Materials Response Team.
e. Inform the Hazardous Materials Response Team the location, the name of the material that spilled and the approximate quantity of spilled material.
f. Do not reenter the area until advised by the Department of Environmental Health and Safety that it is safe to do so.

D. Reporting

1. All fire, chemical or biological emergencies or injuries to laboratory workers due to laboratory work, must be reported to the Department of Environmental Health and Safety within 48 hours.
2. The incident report must include the following:
    a. Type of emergency
    b. Name of material spilled, including pH, strength, concentration, etc.
    c. Area of spill and estimate of volume
    d. Remediation performed
    e. Any follow-up that may be necessary
    f. Contact person
    g. Names of people who may have been exposed to substance

XII. Hazardous Waste Disposal

A. General

1. Laboratory Standard Operating Procedures (Section V.) must include information on waste disposal for each hazardous chemical or process.
2. Refer to Environmental Health and Safety Policy 8-1 *Hazardous Waste Management* for more specific guidance.

B. Work Practices

1. The generation of hazardous waste is to be minimized. Investigators are encouraged to develop and use validated experimental procedures that replace hazardous materials with non-hazardous materials, minimize generation of hazardous wastes, or result in effective treatment of wastes to reduce or eliminate hazardous characteristics.
2. When packaging any type of waste for collection, do not put more than 40 pounds of waste in a single container nor fill more than 3/4 full. Allow space in containers for expansion of vapors.
3. All materials that pose a potential puncture hazard (e.g., hypodermic needles, broken glass, and plastic-ware) must be packaged in puncture resistant containers prior to removal from the work area.
4. Do not mix general waste with hazardous wastes (e.g., Regulated Medical Waste, Asbestos, Chemical, or Radioactive Waste). Do not commingle hazardous waste categories (e.g., Flammables and Poisons). Do not package general waste in hazardous waste containers.
5. Non-water soluble materials, Primary Radioactive Wastes, and Hazardous Chemical Wastes such as Corrosives, Flammable Liquids, Carcinogens, Mutagens and other toxic or reactive chemicals shall not be discharged into any sanitary or storm drain systems. Any exceptions must be approved by the Department of Environmental Health and Safety prior to disposal.
6. Hazardous wastes must never be left on loading docks, freight elevator lobbies, hallways or any other unrestricted locations.
7. All hazardous wastes must be identified before being offered for disposal. Waste of unknown or incorrectly described composition presents difficult handling and disposal problems and may require costly analysis before removal and disposal can be accomplished. The cost of this analysis and disposal is the responsibility of the generator.

8. Before initiating treatment or recycling of a hazardous waste, generators are requested to contact the Department of Environmental Health and Safety to ensure that the proposed treatment process meets safety, regulatory, and recordkeeping requirements.

XIII. Exposure Monitoring and Evaluation

A. Exposure Monitoring

1. Monitoring for airborne concentrations of hazardous materials is not normally needed. OSHA regulated chemicals (e.g., formaldehyde, benzene, methylene chloride and cadmium) may require initial monitoring, and additional monitoring if the Action Level or Permissible Exposure Level (PEL) is exceeded.
2. Exposure monitoring for non-OSHA regulated chemicals will be conducted under the following circumstances:
   a. when large quantities of a hazardous chemical is used for a long period of time
   b. when the PI or Laboratory Supervisor requests monitoring.
   c. an accident involving release of air contaminants
3. Within 15 days of receipt of monitoring results, laboratory users will be notified of the results in writing either individually or by posting results in an appropriate location.
4. Laboratory Standard Operating Procedures must include information on whether or not exposure monitoring is required for each hazardous chemical or process.

B. Exposure Evaluation

1. An exposure evaluation is performed to determine whether there was an exposure that might have caused harm to one or more laboratory users and if so, to identify the hazardous chemical, or chemicals, that were involved and the equipment and procedures relevant to the event.
2. Events or circumstances which might reasonably be considered as evidence that an overexposure to hazardous chemicals has occurred include:
   a. uncontrolled release of a hazardous chemical
   b. any monitoring or air sampling results indicating an exposure above acceptable levels
   c. direct skin or eye contact with a chemical
   d. detection of an odor, especially if the person was working with any chemical which has a lower PEL or TLV than odor threshold
   e. the manifestation of health hazard symptoms
   f. disappearance of some or all symptoms when the person is taken away from the chemical area and into fresh air
   g. reappearance of prior symptoms soon after person resumes working with

chemicals again

h. complaints from more than one person in the same work area.

3. The following procedure will be followed for an exposure evaluation (see also Appendix):
   a. Interview the person reporting the event, and any other persons potentially exposed.
   b. List essential information about the circumstances of the event, including:
      i. Specific chemical(s) involved
      ii. Other chemical used by workers involved in the event
      iii. Other chemicals used by others in the immediate area
      iv. Other chemicals stored in that area
      v. Symptoms exhibited or described by workers
      vi. Symptoms stated in the MSDSs or other pertinent references for chemicals in the area
      vii. Description of control measures, such as fume hoods and PPE, and the way they were used at the time of the event
      viii Results of any air sampling or monitoring devices in place
   c. Sample air and work surfaces as appropriate in the area
   d. Determine how the worker's symptoms compare to the information in the literature
   e. Decide whether to send the worker for preliminary medical evaluations
   f. Review the adequacies of present control measures and safety procedures

XIV. Medical Consultations and Exams

1. Employees who work with hazardous chemicals are provided the opportunity to receive a medical consultation and examination whenever:
   a. An employee develops signs and symptoms of exposure associated with chemicals they are using, or may be in contact with, in the laboratory.
   b. OSHA regulated substances are measured above permissible exposure limits (PEL).
   c. Whenever an event takes place in the work area such as a spill or leak resulting in the likelihood of a hazardous exposure, the affected employee shall be provided an opportunity for a medical consultation. Such consultation shall be for the purpose of determining the need for a medical examination.
2. All medical examinations and consultations must:
   a. Be performed by or under the direct supervision of a licensed physician. Every effort should be made to refer employees to licensed physicians who have been trained to recognize signs and symptoms of chemical-related exposure and disease.
      i. Medical exams and consultations should be performed by the Center for Occupational and Environmental Medicine, Stony Brook Medical Park, 444-2167.
   b. Be provided at no cost to the employee.
   c. Be provided without loss of pay to the employee.
   d. Be performed at a reasonable time and place for the employee. Every effort should be made to schedule medical examinations and consultations during the employee's regularly scheduled work hours, provided there is no undue delay in medical attention. Note: The consultation and the exam are not mandatory for the employee.
3. The Department must provide to the examining physician:
   a. The generic and trade names of all hazardous chemicals and chemical compounds to which the employee may have been exposed. The employer should also provide to the physician copies of Material Safety Data Sheets for any suspect chemical.
   b. Conditions under which the exposure occurred. The employer must provide all available information including data pertaining to experiments or procedures involved.
   c. Signs or symptoms of exposure experienced by the employee during, soon after, and within 72 hours after the incident. Everyone in the proximity of the exposure should be interviewed to determine if others experienced similar symptoms. In the event that the employee is not able to communicate,

others in the laboratory may be able to recall symptoms they observed or know the employee complained of.

4. The Department must obtain a written opinion from the examining physician. The written opinion must include:
   a. Recommendations for medical follow-up
   b. The results of all medical examinations and tests
   c. Any medical condition the employee has that places him or her at risk as a result of future exposures to hazardous chemicals
   d. A statement confirming that the employee has been advised of the results of the examinations and tests, including any medical conditions relevant to occupational or chemical exposures. The written opinion must not reveal specific findings of diagnoses unrelated to occupational exposure.
5. Medical records well be kept by the Department for 40 years. Medical records are considered privileged information, and must be kept in a secured location.

XV. Employee Information and Training

A. Information

Each division or department must make health and safety information for each chemical (or hazard class of chemicals) used or stored in the lab readily available to all laboratory employees during working hours. Access to Material Safety Data Sheets and other reference texts on chemical health hazards, fire hazards, reactivity hazards, and properties (vapor density, vapor pressure, lower and upper explosive limits, etc.) will be provided on each shift. Employees must have access to a copy of the OSHA Laboratory Standard and its appendices, as well as to a list of OSHA permissible exposure limits.

B. Training

1. General

All laboratory employees including faculty, graduate student teaching assistants, postdoctoral candidates, secretaries, laboratory technicians, and maintenance and custodial employees who may come in contact with the laboratory environment must attend a laboratory employee training session at the time of initial employment and each year thereafter. The training will cover their rights and responsibilities under the OSHA Laboratory Standard, and specific operating procedures for working with chemicals. Additional training will be provided when new hazards are introduced.

2. Training Program Elements

   a. Orientation sessions

      A department-specific chemical hazard orientation session will be conducted for each department by the Chemical Hygiene Officer. Specific focus for training sessions will be developed by the Chemical Hygiene Officer in conjunction with departmental representatives. All laboratory employees must attend this session at least once a year. Training must be given in languages that can be understood by all employees. The Chemical Hygiene Officer will coordinate attendance through designated Department personnel. These orientation sessions will cover the following topics:

      i. New York State Right-to-Know Law Provisions

ii. Contents of the OSHA Laboratory Standard and its appendices and how the institution has responded to meet its responsibilities
iii. Location and availability of the Chemical Hygiene Plan, Material Safety Data Sheets, and additional resources on all aspects of laboratory health and safety relevant to employee exposure
iv. How to read a Material Safety Data Sheet
v. Physical and health hazards of chemical classes (flammable, reactives, carcinogens, corrosives, etc.) used by employees and general operating procedures for handling, storing, and disposing of these materials
vi. Signs and symptoms of exposure to chemicals and availability of medical consultations and exams
vii. Use of fume hoods and personal protective equipment
viii Special operating procedures to be used for extremely hazardous chemicals
ix. How to conduct a hazard evaluation of lab operations
x. How to conduct a laboratory inspection
xi. Protocol for dealing with faulty hoods and equipment and lack of proper safety equipment
xii. OSHA permissible exposure limits and other recommended limits (National Institutes for Occupational Safety and Health, American Conference of Governmental Industrial Hygienists).
xiii Filing incident report forms

b. Hands-on Instruction

All laboratory supervisors will conduct training with assistance from the Chemical Hygiene Officer or other capable individual to ensure that all employees in the laboratory receive hands-on experience with:

i. Proper use of fume hoods and other local exhaust system and assessment of hood performance
ii. Use of emergency showers and eyewash stations
iii. Location and use of spill-control equipment
iv. Emergency protocol and telephone numbers
v. Chemicals and standard operating procedures used in the lab

When feasible, spill scenarios (derived from selected hazard evaluations of procedures conducted in the laboratory) and potential medical emergencies will be simulated (using inert materials) and discussed.

3. Refresher and New Hazard Training

Training for experienced workers will be scheduled whenever new hazards are introduced, and when lab conditions or practices change. Refresher training will be scheduled or integrated into other lab activities as needed.

4. Training Materials

The following materials, at a minimum, will be distributed in each initial training program:

i. Right to Know fact sheet
ii. Laboratory Standard fact sheet
iii. List of key emergency telephone numbers including Chemical Hygiene Officer
iv. Sample MSDS and fact sheet on how to read
v. Chemical storage scheme chart
vi. List of hazard classes and chemical examples
vii. Hazard review checklist
viii Laboratory inspection form
ix. Incident report form

C. Recordkeeping

Each department must maintain records of all laboratory training sessions, including sample agendas, handouts, sign-in sheets, course date, and the number of hours participants attended. Copies of these records must be provided to the Chemical Hygiene Officer after each training session. The Chemical Hygiene Officer will maintain training records. Records will be maintained for three (3) years.

XVI. Resources

Journals

- *Applied Occupational and Environmental Hygiene*. Cincinnati, OH: American Conference of Governmental Hygienists.
- *Chemical and Engineering News*. Washington, D.C.: American Chemical Society.
- *Journal of Chemical Education*. Easton, PA: American Chemical Society, Division of Chemical Education.
- *Chemical Health & Safety*, Washington, D. C.: Division of Chemical Health and Safety and the American Chemical Society.
- *Laboratory Safety and Environmental Management*. Burbank, CA: Target Group.

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- Mayo, D.W., et. al. *Microscale Organic Laboratory*; Wiley: New York, 1989.
- Pipitone, D.A., Ed. *Safe Storage of Laboratory Chemicals*; 2nd ed.; Wiley/Interscience: New York, 1991.
- Stricoff, R. S. *Handbook of Laboratory Health and Safety*, 2nd ed.; 1995.
- Young, J.A., Ed. *Improving Safety in the Chemical Laboratory: A Practical Guide*; 2nd ed.; Wiley/Interscience: New York, 1991.
- *Design of Safe Chemical Laboratories: Suggested References*; Committee on Chemical Safety; American Chemical Society: Washington, D.C., 1991.
- *Prudent Practices in the Laboratory: Handling and Disposal of Chemicals*; National Academy of Sciences: Washington, D.C., 1995.
- *Safety in Academic Chemistry Laboratories*; 6th ed., American Chemical Society: Washington, D. C., 1995.
- *Safety in the Chemical Laboratory*; 4 vols.; Reprints from J. Chem. Educ., Journal of Chemical Education: Easton, PA, 1964-1980.
- *Understanding Chemical Hazards: A Guide for Students*; American Chemical Society: Washington, D.C., 1994.
- McKusick, B.B. "Procedures for Laboratory Destruction of Chemicals", J. Chem. Educ. 61, A152 (1984).

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- Burton, J. *Laboratory Ventilation Workbook*; 2nd ed.; IVE: Cincinnati, OH, 1994.
- DiBerardinis, L. J.; et al. *Guidelines for Laboratory Design: Health and Safety Considerations*, 2nd ed.; Wiley/Interscience: New York, 1993.
- Saunders, G. T. *Laboratory Fume Hoods: A User's Manual*; Wiley/Interscience: New York, 1993.
- *Industrial Ventilation; A Manual of Recommended Practice*; 22nd ed.; American Conference of Governmental and Industrial Hygienists: Cincinnati, OH, 1995.
- *Fundamentals Governing the Design and Operation of Local Exhaust Systems, ANSI Z9.2-1992*; American National Standards Institute: New York, 1992.
- *Methods of Testing Performance of Laboratory Fume Hoods, ANSI/ASHRAE 110-1985*; American Society of Heating, Refrigerating, and Air Conditioning Engineers, Atlanta, GA, 1985.
- Mikell, W. G.; Fuller, R. H. "Good Hood Practices for Safe Hood Operation", J. Chem. Educ. 65, A36 (1988).

Hazardous Substances Information

- Budavari, S. *The Merck Index of Chemicals and Biologicals*, 12th ed.; Rahway, NJ: Merck and Company.
- Clayton, F. & G., eds. *Patty's Industrial Hygiene and Toxicology* (5 vols), New York: John Wiley and Sons, Inc., 1994.
- Sax, N. I. *Dangerous Properties of Industrial Materials*, 9th ed.; New York: Van Nostrand Reinhold.
- Sittig, M. *Handbook of Toxic and Hazardous Chemicals and Carcinogens*, 3rd ed. Park Ridge, NJ: Noyes Publications, 1992.
- American Conference of Governmental Industrial Hygienists (ACGIH). *Threshold Limit Values for Chemical Substances and Physical Agents in the Work Environment and Biological Exposure Indices*; Cincinnati, OH; ACGIH.
- National Institute for Occupational Safety and Health (NIOSH). *Pocket Guide to Chemical Hazards*; NIOSH Publication 90-117. Washington, D. C.; US Government Printing Office.
- Occupational Safety and Health Administration. Toxic and Hazardous Substances, 29 CFR Part 1910.1000-1101. Washington, D. C.; US Government Printing Office.
- Registry of Toxic Effects of Chemical Substances (RTECS); DHHS (NIOSH); Governmental Printing Office: Washington, D. C.

Carcinogens

- International Agency for Research on Cancer (IARC). *Monographs on the Evaluation of the Carcinogenic Risk of Chemicals to Man*. Albany, NY: World Health Organization.
- Castegnaro, M.; Sansone, E. B. *Chemical Carcinogens: Some Guidelines for Handling and Disposal in the Laboratory*; Springer-Verlag: New York, 1986.
- Walters, D. B. Ed. *Safe Handling of Chemical Carcinogens, Mutagens, Teratogens, and Highly Toxic Substances*; Ann Arbor Science/ CRC Press: Boca Raton, FL, 1980.
- *Carcinogens - Regulation and Control: A Management Guide to Carcinogens, Regulation and Control*; NIOSH, DHEW Publication 77-205; US Government Printing Office; Washington, D. C., 1977.
- *Carcinogens - Working with Carcinogens - Regulation and Control. Working with Carcinogens - A Guide to Good Health Practices*; NIOSH, DHEW Publication 77-206; US Government Printing Office: Washington, D. C., 1977.
- *NIH Guidelines for the Laboratory Use of Chemical Carcinogens*; National Institutes of Health, DHSS; US Government Printing Office: Washington, D. C., 1981.
- *Annual Report on Carcinogens; DHHS (NTP), a summary from National Toxicology Program*; Public Information Office: Research Triangle Park, NC, 1994.

Reproductive Toxins

- Shepard, T. H. *Catalog of Teratogenic Agents*; 8th ed.; Johns Hopkins: Baltimore, MD, 1995.
- Messite, J.; Bond, M. B. "Reproductive Toxicology and Occupational Exposure", Chapter 54. In: *Occupational Medicine*, C. Zenz ed.; Chicago, IL, Yearbook Medical Publishers, 1988.
- *Reproductive Health Hazards in the Workplace*; Office of Technology Assessment; US Government Printing Office: Washington, D. C., 1985.
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- Gosselin, R. E., Ed. *Clinical Toxicology of Commercial Products*; 5th ed.; Williams and Wilkins: Baltimore, MD, 1984.
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Reactive Chemicals

- Bretherick, L. *Bretherick's Handbook of Reactive Chemical Hazards*; 4th ed.; Butterworths: London, 1990.
- *Manual of Hazardous Chemical Reactions; NFPA Manual 491M*; National Fire Protection Association: Quincy, MA, 1986.

Compressed Gases

- Braker, W.; Mossman, A. L. *Gas Data Book*; 6th ed.; Matheson Gas Products: East Rutherford, NJ, 1980.
- *Handbook of Compressed Gases*; 3rd ed.; Compressed Gas Association: Arlington, VA, 1990.

Biosafety

- Fleming, D. O., et. al. *Laboratory Safety: Principles and Practices*, 2nd ed.; American Society for Microbiology: Washington, D. C., 1995.
- *Biosafety Reference Manual*; 2nd ed.; American Industrial Hygiene Association: Fairfax, VA., 1995.
- *Biosafety in the Laboratory: Prudent Practices for the Handling and Disposal of Infectious Materials*; National Academy Press: Washington, D. C., 1989.
- *Biosafety in Microbiological and Biomedical Laboratories*, 3rd ed.; Centers for Disease Control and Prevention and National Institutes of Health; HHS Publication No. (CDC) 93-8395; U. S. Government Printing Office, Washington, D.C., 1993.

Appendices

Appendices are available by contacting the Department of Environmental Health and Safety at 632-6410.

Appendix A. Health and Safety Standard Operating Procedures

1. Preparing Standard Operating Procedures
2. Flammable/Combustible Materials
3. Corrosives
4. Oxidizers
5. Water Reactive Materials
6. Pyrophoric Materials
7. Peroxidizable Chemicals
8. Light Sensitive Materials
9. Unstable Materials
10. Cryogenic Materials
11. Compressed Gases
12. Electrical Hazards
13. Machinery and Tools
14. High Vacuum or Pressure Hazards
15. Allergens
16. Embryotoxins
17. High Acute Toxicity
18. High Chronic Toxicity
19. Animal Work
20. Chemical Compatibility Table

Appendix B. Forms

1. Laboratory Safety Survey
2. Hazard Review
3. Prior Protocol Approval
4. Laboratory Safety Inspection Checklist
5. Laboratory Ventilation Deficiencies
6. Chemical Inventory
7. Initial Investigation of Possible Overexposure
8. Physician's Written Opinion for Medical Consultation

Appendix – Hazard Review and Prior Protocol Approval

This is a non-mandatory recommendation to Departments to assist Departments and laboratories with complying with the Laboratory Safety Standard requirement of "Prior Protocol Approval".

1. Clearance Check
    a. All projects involving chemicals must undergo an initial clearance check. Each laboratory must designate a person with the appropriate level of training and experience to be responsible for the Clearance Check. Copies of the Hazard Review must be kept on file within the laboratory.
    b. The Clearance Check authorizes procedures for low hazard operations that use chemicals that are relatively harmless to slightly toxic and require Basic Laboratory Practices, or medium hazard situations requiring Standard Laboratory Practices where the type and level of hazard does not significantly change from previous work experience.
        c. Procedures that do not meet the above requirements must be reviewed at the next level.

2. Local Peer Review

    a. Projects that may effect the health and safety of all users in the laboratory must undergo a Local Peer Review. At a minimum, these projects or processes are reviewed by the Laboratory Supervisor, Principal Investigator, or the Department of Environmental Health and Safety Chemical Hygiene Officer. A copy of the Hazard Review should be kept on file within the laboratory.
    b. The Local Peer Review authorizes procedures for medium hazard operations requiring Standard Laboratory Practices where new hazards are introduced, and high hazard situations requiring additional protection where the type and level of hazard does not significantly change from previous work experience. These practices are satisfactory for handling:
        i. most corrosive substances;
        ii. chemicals that are not known to cause cancer in humans, but may cause cancer in animals;
        iii. chemicals with up to a moderate chronic or acute toxicity rating;
        v. chemicals or processes involving flammable or reactive materials.
        c. Procedures that do not met the above requirements must receive Prior Protocol Approval from the Laboratory Safety Committee.

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3. Incident Review

a. The Laboratory Safety Committee will conduct a Hazard Review when there is an unexpected event involving real or potential damage to people, property or the environment.
b. The review will identify what happened, how the incident was handled, and what corrective action must be taken to prevent a reoccurrence.

4. Prior Protocol Approval

1. Laboratory Safety Committee Review

a. Projects or processes involving high hazard procedures that require additional protection where new hazards are introduced must undergo review by the Laboratory Safety Committee. A copy of the Hazard Review and the people involved with the review must be kept on file in the laboratory.
b. This review authorizes high hazard procedures that involve:
   i. Carcinogens;
   ii. Reproductive Toxins;
   iii. Acute and Highly Toxic Chemicals
   iv. Processes that involve explosive, highly unstable or pyrophoric materials, or very high or low pressures.
c. The Hazard Review form and the Prior Protocol Approval form found in the Appendix can be used to submit the project to the Laboratory Safety Committee.

2. Approval

a. If the Laboratory Safety Committee is satisfied that all safety and health concerns have been adequately addressed, approval will be granted.
b. If the Laboratory Safety Committee is not satisfied that all safety and health concerns have been adequately addressed, the committee will assist the Principal Investigator in completing the approval application.

Appendix - Definitions

i. Flammable Liquid

A liquid having a flash point below 100 degrees F (38.7 degrees C) and having a vapor pressure not exceeding 40 pounds per square inch (2.72 atm) absolute at 100 degrees F is designated a Class I liquid. This class is subdivided as follows:

a. Class IA is a liquid having a flash point below 73 degrees F (22.8 degrees C) and having a boiling point below 100 degree F (38.7 degrees C).
b. Class IB is a liquid having a flash point below 73 degrees F (22.8 degrees C) and having a boiling point at or above 100 degrees F (38.7 degrees C).
c. Class IC is a liquid having a flash point at or above 73 degrees F (22.8 degrees C) and below 100 degrees F (38.7 degrees C).

ii. Combustible Liquid

A liquid having a flash point at or above 100 degrees F (38.7 degrees C) and below 140 degrees F (60 degrees C). This class is subdivided as follows:

a. Class II is a liquid having a flash point at or above 100 degrees F (38.7 degrees C) and below 140 degrees F (60 degrees C).
b. Class IIIA is a liquid having a flash point at or above 140 degrees F (60 degrees C) and below 200 degrees F (93.4 degrees C).
c. Class IIIB is a liquid having a flash point at or above 200 degrees F (93.4 degrees C).

iii. Reactive Chemical

Any chemical which fits any one of the following:

a. Identified or described in the MSDS or on the label as unstable or reactive.
b. Ranked by the NFPA as 3 or 4 for reactivity.
c. Determined by the U.S. DOT (49 CFR 173) as either an

oxidizer, an organic peroxide, or an explosive.

d. Determined by the U.S. EPA (40 CFR 261.23) as reactive:
   1. It is normally unstable and readily undergoes violent change without detonating.
   2. It reacts violently with water.
   3. It forms potentially explosive mixtures with water.
   4. When mixed with water, it generates toxic gases, vapors, or fumes in a quantity sufficient to present a danger to human health or the environment.
   5. It is a cyanide or sulfide material which, when exposed to pH conditions between 2 and 12.5, can generate toxic gases, vapors or fumes in a quantity sufficient to present a danger to human health or the environment.
   6. It is capable of detonation or explosive reaction if it is subjected to a strong initiating source or if heated under confinement.
   7. It is readily capable of detonation or explosive decomposition or reaction at standard temperature and pressure.
e. Meets the OSHA Laboratory Standard definition of "Unstable": a chemical which in the pure state, or as produced or transported, will vigorously polymerize, decompose, condense, or will become self-reactive under conditions of shocks, pressure or temperature.
f. In the experience of the Principal Investigator or the Laboratory Supervisor, is known or found to be reactive with ordinary substances.

iv. Corrosive Chemical

Any chemical which fits any one of the following:

a. Is identified or described in the MSDS or on the label as corrosive.
b. Is identified by the DOT (49 CFR 173) as corrosive.
c. Meets the EPA (40 CFR 261.22) definition of corrosive:
   1. An aqueous solution and has a pH less than or equal to 2 or greater than or equal to 12.5.
   2. A liquid and corrodes steel at a rate greater than 6.35 mm per year at a test temperature of 55 degrees C (130 degrees F).
d. Meets the OSHA definition of corrosive: A chemical that

causes visible destruction of, or irreversible alteration in, living tissue by chemical action at the site of contact.

e. In the experience of the laboratory supervisor or Principal Investigator, is known or found to be corrosive.

v. Contact Hazard

Any chemical which fits any one of the following:

a. Is identified or described as an allergen or sensitizer in the MSDS or on the label.
b. Is identified or described in the medical or industrial hygiene literature as an allergen or sensitizer.
c. In the experience of the laboratory supervisor or Principal Investigator, is known or found to be an allergen or sensitizer.

vi. Carcinogen

Any chemical which fits any one of the following:

a. Is identified or described as a carcinogen in the MSDS or on the label.
b. Is regulated by OSHA as a carcinogen.
c. Is listed under the category "known to be carcinogens" or "reasonably anticipated to be carcinogens" in the Annual Report on Carcinogens published by the National Toxicology Program (NTP).
d. Is listed under Group 1 "carcinogenic to humans", Group 2A or 2B by the International Agency for Research on Cancer Monographs (IARC).

vii. Reproductive Toxin

Any chemical which fits any one of the following:

a. Is identified or described as a reproductive toxin, mutagen or teratogen in the MSDS or on the label.
b. Is known or suspected to affect the reproductive capabilities including chromosomal damage (mutations) and effects on fetuses (teratogenesis).
c. Is identified or described in the medical or industrial hygiene literature as a reproductive toxin.

viii. High Acute Toxicity

Any chemical which fits any one of the following:

a. Is identified or described as highly toxic in the MSDS or on the label.
b. Meets the OSHA definition of highly toxic:
    1. The median lethal dose (LD50) is equal to or less than 50 mg/kg of body weight when administered orally to rats.
    2. The median lethal dose (LD50) is equal to or less than 200 mg/kg of body weight when administered by continuous contact for 24 hours (or less if death occurs within 24 hours) with the bare skin of rabbits.
    3. The median lethal concentration (LC50) in air is equal to or less than 200 parts per million (ppm) by volume or less of gas or vapor, or equal to or less than 2 mg per liter or less of mist, fume, or dust, when administered by continuous inhalation for 1 hour (or less if death occurs within 1 hour) to rats.
c. The Threshold Limit Value (TLV) or Permissible Exposure Level (PEL) is equal to or less than 5 ppm or 5 milligrams per cubic meter.
d. The median tolerance limit is equal to or less than 10 ppm by weight of material in water, or the median aquatic lethal concentration is equal to or less than 10 mg/L of material, when administered for 96 hours to a medium sensitivity warm water or cold water species of fish.
e. Is identified or described in the medical or industrial hygiene literature as being acutely toxic.

ix. Unknown Toxicity

a. Any chemical for which there is no known statistically significant study conducted in accordance with accepted scientific principles that establishes its toxicity.

Appendix – Glove Material Selection

Chemical	Excellent	Good	Do Not Use
Acetaldehyde	None	Natural Rubber Neoprene	Nitrile Polyvinyl Alcohol (PVA) Polyvinyl Chloride (PVC)
Acetic Acid (Glacial)	Neoprene	Natural Rubber Nitrile	PVA PVC
Acetone	None	Natural Rubber Neoprene	Nitrile PVA PVC
Benzene	None	PVA	Natural Rubber Neoprene Nitrile
Butanol	Natural Rubber Neoprene Nitrile	PVC	PVA
Butyl Cellosolve (2-butoxyethanol)	Neoprene Nitrile	Natural Rubber	PVA PVC
Butyl Acetate	PVA	Nitrile	Natural Rubber Neoprene PVC
Cellosolve (2-ethoxyethanol)	Neoprene	Nitrile	Natural Rubber PVA PVC
Chloroform	PVA	None	Natural Rubber Neoprene Nitrile PVC
Ethyl Acetate	None	Natural Rubber Neoprene PVA	Nitrile PVC
Ethyl Ether	Nitrile PVA	Neoprene	Natural Rubber PVC
Ethylene Glycol	Natural Rubber Neoprene Nitrile PVC	None	PVA

Chemical	Excellent	Good	Do Not Use
Formaldehyde (>10%)	Nitrile	Natural Rubber Neoprene PVC	PVA
Hexane	Neoprene Viton	PVA	Natural Rubber PVC
Hydrochloric Acid (concentrated)	Neoprene Nitrile PVC	Natural Rubber	PVA
Isobutyl Alcohol	Natural Rubber Nitrile Viton	Supported Neoprene	PVC Unsupported Neoprene
Isopropanol	Natural Rubber Neoprene Viton	PVC	PVA
Methanol	Natural Rubber Neoprene	PVC	PVA
Methylene Chloride	None	PVA Viton	Natural Rubber Neoprene PVC
Methyl Ethyl Ketone	None	Natural Rubber PVA	Neoprene Nitrile PVC
Methyl Isobutyl Ketone	None	Natural Rubber PVA	Neoprene Nitrile PVC
Mineral Spirits	Nitrile PVA	Neoprene	Natural Rubber PVC
Nitric Acid (70%)	Neoprene	PVC	Natural Rubber Nitrile PVA
Perchloroethylene	PVA Viton	None	Natural Rubber Neoprene PVC
Sodium Hydroxide	Natural Rubber Neoprene Nitrile	PVC	PVA
Sulfuric Acid (95%)	PVC	Neoprene	Natural Rubber Nitrile PVA

Chemical	Excellent	Good	Do Not Use
Toluene	Viton	PVA	Natural Rubber Neoprene PVC
1,1,1 Trichloroethane	PVA	None	Natural Rubber Neoprene PVC
Xylene	PVA Viton	None	Natural Rubber Neoprene PVC