WAYNE STATE UNIVERSITY

Chemical Hygiene Plan

In Accordance with 29 CFR 1910.1450 and R325.70106
Occupational Exposure to Hazardous Chemicals in Laboratories

Office of Environmental Health & Safety
5425 Woodward, Suite 300
Detroit, MI 48202
313.577.1200 phone
313.993.4079 fax
www.oehs.wayne.edu

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A. Introduction

1. Office of Environmental Health and Safety Mission Statement

The Office of Environmental Health and Safety (OEHS), as a division of research support, is committed to providing quality environmental health and safety support. We support Wayne State's mission for excellence in research, teaching, and community service by fostering a safe and healthy work and learning environment at the University.

We are dedicated to educating the University community about occupational and environmental health and safety issues. We will consistently provide professional services in a timely manner in the areas of hazardous waste minimization and disposal, biosafety, radiation safety, food safety, indoor air quality, health and safety training, and consultations.

In collaboration with other University department and safety-oriented committees, OEHS strives to develop and implement effective health and safety programs that will ensure compliance with all local, state, and federal public health regulations. We are dedicated to adequately anticipating potential workplace hazards, preventing and reducing occupational injuries and illnesses, and providing timely response to health and safety emergencies.

2. The OSHA / MIOSHA Laboratory Standard

In January 1991, the Occupational Safety and Health Administration (OSHA) promulgated a final rule for ***Occupational Exposure to Hazardous Chemicals in Laboratories (29 CFR 1910.1450)***. The Michigan Occupational Safety and Health Administration (MIOSHA) adopted the rule on January 1, 1992. OSHA has determined that laboratories differ from industrial operations in the use and handling of hazardous chemicals. The Laboratory Standard applies to all laboratories that use hazardous chemicals in accordance with the definitions of laboratory use and scale provided in this document. Included in the Laboratory Standard is the requirement that all employees covered by the standard must carry out the provisions of a Chemical Hygiene Plan (CHP).

A CHP is a written program which sets forth policies and procedures for protecting employees from the health hazards presented by potentially hazardous chemicals (and other agents) used in a laboratory setting. Components of a CHP must include:

1. Designation of personnel responsible for implementation of the CHP including the assignment of a Chemical Hygiene Officer.

2. Standard Operating Procedures relevant to safety and health to be followed whenever laboratory work includes the use of hazardous chemicals and other agents.

3. Provisions for employee information and training to be provided before the assignments to work areas where hazardous chemicals are present and prior to assignments involving new exposure situations. Information to be provided includes:

    - Contents of Standard 29 CFR 1910.1450
    - Location of laboratory's CHP
    - Inventory of laboratory chemicals

- Methods and means to evaluate potential hazards, including discussion of permissible exposure limits.

4. Employee training including, as a minimum:

   - Physical and health hazards associated with the hazardous chemicals in the work area
   - Measures employees can take to protect themselves from these hazards
   - Methods and observations to help detect the presence or release of hazardous chemicals
   - Signs and symptoms associated with overexposures to hazardous materials used in the laboratory.

5. Determination and implementation of control measures to reduce employee exposures to hazardous chemicals by using:

   - Engineering controls
   - Personal protective equipment
   - Safe work practices and personal hygiene

6. Requirements that fume hoods and other protective equipment are functioning properly and for maintaining adequate performance of such equipment.

7. Availability of Safety Data Sheets (SDS) and other sources of information, to describe potential hazards and safety precautions for specific chemicals.

8. Provisions, as may be needed, for additional employee protection for work involving particularly hazardous substances and conditions, including situations which may require special approval from the laboratory director (or designee) prior to implementation.

B. Chemical Hygiene Responsibilities

Responsibility for chemical hygiene rests at all of the following levels:

1. Office of Environmental Health & Safety (OEHS) Responsibilities

The Director of the Office of Environmental Health and Safety has the ultimate responsibility for chemical hygiene within the University, and, along with the OEHS staff and Principal Investigators, must provide continuing support for chemical hygiene.

The OEHS Chemical Hygiene Officer is responsible for implementation of the Chemical Hygiene Plan and the Laboratory Safety Audit Program, assuring that the labs are meeting the requirements of the Laboratory Standard.

The OEHS Program Coordinator is responsible for training laboratory employees in the contents of the Laboratory Standard, the Chemical Hygiene Plan and general lab safety.

The overall responsibilities of OEHS are as follows:

a. Assisting each Principal Investigator in the development and implementation of appropriate chemical hygiene policies and practices.

b. Monitoring procurement, use and disposal of chemicals used in the lab.

c. Ensuring that appropriate inspections are conducted and maintained.

d. Assisting Principal Investigators in the development of safety precautions in new and existing laboratory processes.

e. Determining if medical surveillance is necessary.

f. Closing labs that pose a serious threat to the health of the workers.

2. Principal Investigator Responsibilities

a. Develop written standard operating procedures (SOPs) for employees to follow when working with highly hazardous chemicals.

b. Ensure that all lab employees and students receive training in the laboratory SOPs.

c. Ensure that all facilities and training are adequate for the use of all materials handled and ordered by the lab.

d. Determine and provide the appropriate personal protective equipment (PPE).

e. Provide regular, formal chemical hygiene and housekeeping inspections of emergency and personal protective equipment.

f. Ensure that all laboratory employees know and follow the chemical hygiene rules.

g. Ensure that appropriate personal protective equipment is:

- available to all employees working in the lab
- utilized by all employees when they are in the lab
- in good condition

h. Provide appropriate training to employees on the proper selection, use and limitations of personal protective equipment.

3. Employee Responsibilities

Each lab researcher, technician and student assistant is responsible for planning and conducting operations in accordance with the Chemical Hygiene Plan and the lab's standard operating procedures, once he/she has been informed of these policies. Each individual is responsible for developing safe personal laboratory habits. Employees and students also have a responsibility to inform their supervisors of accidents, as well as work practices or conditions they believe to be potential health and safety hazards.

C. The Laboratory Facilities

1. Design

The laboratory facility should have:

a. An appropriate general ventilation system with air intakes and exhausts located so as to avoid intake of contaminated air;

b. Adequate, well-ventilated stockrooms/storerooms;

c. Laboratory hoods and sinks;

d. Other safety equipment, including eyewash fountains and drench showers, that meet the American National Standards Institute (ANSI) requirements.

2. Maintenance

Mechanical laboratory equipment (i.e. vacuum pumps, grinders etc.), should be inspected regularly and repaired or replaced as needed. Exposed belts or moving parts should be guarded.

3. Usage

The type of work conducted and the workload must be appropriate for the physical facilities available and the quality of ventilation in the lab.

4. Ventilation

a. General laboratory ventilation

The ventilation system should provide a source of air for breathing and for input to local ventilation devices. It should not be relied upon solely for protection from toxic substances released into the laboratory. Laboratory air should be continually replaced, preventing an increase of air concentrations of toxic substances during the working day. Airflow should be directed into the laboratory from non-lab areas and out to the exterior of the building.

b. Chemical Fume Hoods

Work with chemicals should be performed in a chemical fume hood. A hood should be used when working with toxic materials and when transferring chemicals or mixing solutions into new containers, especially highly corrosive, flammable, reactive, and/or toxic materials. Each hood should have a continuous monitoring device to allow convenient confirmation of adequate hood performance before use,

and a 20 cm (6 inch) line drawn from the edge, designating the safe work zone. If it is not possible to meet these recommendations, do not work with materials of high or unknown toxicity.

OEHS has established an acceptable range of **80 to 120 linear feet per minute (lfm)** face velocity for fume hood certification. Face velocity is a measurement of the average velocity at which air is drawn through the face of the fume hood. Face velocities too high or too low can be detrimental to the performance of the fume hood. Velocities greater than 125 lfm face velocity may create turbulence, causing contaminants to flow out of the hood and into the user's breathing zone. To reduce energy consumption, OEHS supports efforts to maintain face velocities closer to, but greater than the lower end of the acceptable range (80 lfm) during use.

If items such as experimental apparatus need to be used in the hood, we suggest elevating them a few inches on a shelf -- this will allow air to properly circulate around the equipment. Anything that you are not using should not be stored in the hood. For strong smelling chemicals, look into alternative products. If no alternative exists, store it in a dedicated, ventilated stockroom. It is helpful to place Parafilm® around the bottle cap, then store it in a secondary container, such as a paint can, Rubbermaid container, or a 5-gallon pail. This will eliminate the odor at a minimum cost.

c. Biological Safety Cabinets

Biological safety cabinets shall be evaluated annually in accordance with the National Safety Foundation (NSF) Standard 49. If your biological safety cabinet hasn't been certified within the past year, contact OEHS.

d. Other local ventilation devices

Ventilated storage cabinets, canopy hoods, etc. should be provided as needed and should have separate exhaust ducts. Flammable storage cabinets need not have separate exhaust ducts.

e. Special ventilation areas

Exhaust air from extremely toxic sources should pass through scrubbers or other treatments before release, if it has been determined that public health is at risk.

f. Modifications

Any alteration in the ventilation system should be made only after testing indicates that worker protection from airborne toxic substances will continue to be adequate.

g. Quality and performance

General airflow should not be turbulent and should be relatively uniform throughout

the laboratory, with no high velocity or static areas. A ventilation rate of 6-12 room air changes per hour is normally adequate.

h. Evaluation

Ventilation systems should be evaluated upon installation, regularly monitored and reevaluated whenever changes in local ventilation devices are made.

D. General Standard Operating Procedures

The University Chemical Hygiene Plan has been developed in compliance with the requirements of the MIOSHA Laboratory Standard to protect Wayne State University employees and students from exposures to hazardous or potentially hazardous laboratory chemicals. The provisions in this document shall be implemented for all work involving hazardous or potentially hazardous substances in laboratories.

All laboratory personnel who handle hazardous chemicals must comply with the following standard operating procedures. In addition, laboratory Principal Investigators must develop specific standard operating procedures (SOPs) which address the specific hazards present in the lab's protocols. These written SOPs must be maintained in the laboratory, used in laboratory training, and made available upon request to laboratory workers. Employees should read and sign SOPs when beginning work and whenever the SOPs are updated or modified.

1. Basic Principles for Work with Laboratory Chemicals

In addition to the more detailed recommendations available in the manual, *Prudent Practices for Handling Hazardous Chemicals in Laboratories*, https://www.ncbi.nlm.nih.gov/books/NBK55878/ general principles for safe laboratory work include the following:

a. Minimize all chemical exposures. Because few laboratory chemicals are without hazards, general precautions for handling all laboratory chemicals should be adopted, rather than specific guidelines for particular chemicals. Skin contact with chemicals should be avoided as a cardinal rule.

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

c. Provide adequate ventilation. The best way to prevent exposure to airborne substances is to prevent their escape into the working atmosphere by the use of hoods and other ventilation devices.

d. Institute a chemical hygiene program. A mandatory chemical hygiene program designed to minimize exposures is needed and should be a regular, continuing effort,

and the recommendations should be followed by all laboratory workers.

e. Observe the Permissible Exposure Limits (PELs) and the Threshold Limit Values (TLVs). PELs, set by OSHA, or TLVs, set by the American Conference of Governmental Industrial Hygienists (ACGIH) should not be exceeded.

f. Develop written standard operating procedures (SOPs). For work involving highly toxic chemicals, SOPs should be developed which include general safety procedures, housekeeping practices, personal protective equipment, waste disposal and emergency response procedures, etc.

2. Rules and Procedures

a. Exposures, Injuries and Illnesses

Report to the Employee Health Service, located at 4K University Health Center (UHC) DMC, 4201 St. Antoine Blvd., Detroit, MI 313 745-4522 for treatment of a non-emergency type injury/illness between the hours of 9:00 a.m. and 5:00 p.m., Monday through Friday. An appointment is not necessary.

If immediate treatment is necessary or the Employee Health Service is closed, report to Detroit Receiving Hospital or the nearest hospital emergency room.

If transportation is needed for an emergency situation, contact the University Police at 313 577-2222.

Eye contact: Promptly flush eyes with copious amounts of water for a prolonged period (at least 15 minutes) and seek medical attention

Ingestion: Consult physician immediately and seek medical attention. See first aid section of chemical Safety Data Sheet (SDS).

Skin contact: Promptly flush the affected area with water and remove any contaminated clothing. If symptoms persist after washing, or if damage to the skin has occurred, seek medical attention.

Inhalation: Get to a source of fresh air. Seek medical attention.

Complete a Report of Injury form for any injury/illness requiring medical attention within 24 hours of the incident. Forms are available from the Office of Risk Management, 313 577-3110.

b. Avoidance of "routine" exposure

Develop and encourage safe habits. Avoid unnecessary exposure to chemicals by any route. Never smell or taste chemicals.

Vent apparatus that may discharge toxic chemicals (vacuum pumps, distillation

columns, etc.) into local exhaust devices. Do not release toxic substances into the laboratory. Inspect glove boxes before each use.

Inspect gloves, lab coat, eye protection and all personal protective equipment before each use.

c. Choice of chemicals

Use only those chemicals for which the quality of the available ventilation system is appropriate. Be familiar with the hazards and the precautions to take before beginning work with any chemicals.

d. Eating, drinking, smoking, etc.

Avoid eating, drinking, smoking, gum chewing, or application of cosmetics in areas where laboratory chemicals are present. Wash hands before leaving the lab and conducting these activities.

Never store food or beverages in refrigerators used for chemicals. Have an appropriately labeled refrigerator and storage area for food, away from chemicals.

e. Equipment and glassware

Handle and store laboratory glassware with care to avoid damage, and do not use damaged glassware. Use metal or cardboard containers for the disposal of glassware. Use equipment only for its designed purpose.

f. Exiting

Remove all protective equipment and clothing before leaving the lab. Wash hands and areas of exposed skin.

g. Horseplay

Avoid practical jokes or other behavior that might confuse, startle or distract another worker.

h. Mouth pipetting

Do not use mouth suction to pipette chemicals or to start a siphon. A mechanical means of pipetting should be used to provide vacuum.

j. Personal apparel

Confine long hair and loose clothing. Wear shoes at all times in the laboratory. Do not wear sandals, perforated shoes, sneakers or shorts.

k. Housekeeping

Keep the work area clean, organized and uncluttered. Clean up the work area on completion of an operation and at the end of the day.

l. Personal protective equipment

Assure that appropriate eye protection is worn by all persons, including visitors, where chemicals are stored or handled.

Wear appropriate gloves when there is a potential for skin contact with chemicals. Inspect gloves before each use, and never wash or reuse disposable gloves. Wash rubber and utility gloves before removal, and replace them whenever there are cracks or tears in the material. See Appendix VIII for glove selection guidelines.

When air contaminant concentrations are not sufficiently restricted by engineering controls, use of an air-purifying respirator may be necessary. In order to wear a respirator, you must contact OEHS at 313 577-1200 to obtain training and fit-testing.

Use any other personal protective equipment appropriate for lab tasks.

Remove lab coat, gloves and other personal protective equipment if it becomes contaminated and before leaving the lab. Always wash your hands.

m. Planning

Seek information and advice about hazards, plan appropriate protection procedures, and plan positioning of equipment before beginning any new operation. Contact OEHS for assistance in this area.

n. Unattended operations

If possible, avoid procedures that cannot be attended at all times. If it is necessary to leave an operation unattended, leave lights on, place an appropriate sign on the door, and provide for containment of toxic substances in the event of failure of a utility service (such as cooling water). Never leave open flame burners, heating elements, etc. unattended.

o. Use of fume hood

Use the hood for operations which may result in the release of toxic chemical vapors, dusts, mists or aerosols. It is against the OEHS policy to use a non-ducted fume hood.

Use the hood or other local ventilation devices when working with any appreciably volatile substance with a TLV or PEL of less than 50 parts per million (ppm).

Confirm adequate hood performance before use. Keep the sash closed except when work or adjustments are being done within the hood. Do not use the hood to store chemicals or other materials. Only perform work in the hood when the sash is set at the proper level for the correct face velocity. Face velocity should measure between 80 - 120 fpm (linear feet per minute).

p. Vigilance

Be alert to unsafe conditions and see that they are reported to the appropriate department and corrected when detected.

q. Waste disposal

Chemical waste disposal is carried out by OEHS. The plan for each laboratory operation should include planning and mandatory training on waste disposal procedures (RCRA Hazardous Waste and Emergency Procedures Training).

r. Working alone

Avoid working alone in a building, and never work alone in a laboratory if the procedures being conducted are hazardous.

2. Chemical Procurement, Distribution, and Storage

a. Procurement

Laboratories are responsible for maintaining a chemical inventory of materials and must produce inventory control records at the request of regulatory agencies or the Chemical Hygiene Officer.

When a substance is received and before it is used, information on proper handling, storage, and disposal should be made known to those who will be working with the chemical. If a safety data sheet (SDS) accompanies the shipment, it must be kept on file in the laboratory. Laboratory workers need to be informed on how to access the SDSs. The OEHS website has links for accessing SDS information. In the event that SDS information is incomplete, or in cases where the chemical is generated by the laboratory itself, additional information may be necessary and must be provided before the operation begins. Many health and safety reference materials and internet links are available on departmental and OEHS website.

Whenever possible, all chemical shipments must be received and logged in at designated departmental locations (such as Science Store, Purchasing, etc.) In order to satisfy inventory control requirements, shipments may not be received directly by

a laboratory worker, or student.

Expiration dates must be clearly marked for materials known to deteriorate or to become unstable or reactive, including:

Picrics originating at less than 10% hydration

Perchlorates

Peroxides

Peroxidizable materials

Polymerizers that react violently or become hazardous after polymerization

Stored chemicals must be examined periodically (at least annually) for deterioration and container integrity. Dated chemicals must be disposed of before expiration. Since ethers form explosive peroxides over time, they must be disposed of either 12 months after date of receipt or six months after being opened, whichever comes first.

b. Distribution

When transporting chemicals, use a secondary container, such as, a cart with sides, a bucket, or a bottle carrier. Gas cylinders should be capped during transport and when not in use. Cylinders should always be transported individually using a secure gas cylinder dolly. "Freight-only" elevators should be used if possible

c. Laboratory storage

All laboratory chemicals should be stored in approved, labeled storage cabinets/containers by compatibility and not alphabetically. Do not store any chemicals on the floor, in the aisles or on top of cabinets. Do not store more chemicals in the lab than necessary. Store only those amounts that will be used in a reasonable amount of time.

Hazardous substances shall be stored so that incompatible substances are properly segregated. Refer to Appendix VII for more information on incompatible chemicals.

Flammable materials must be stored in premises that comply with NFPA 45 and the Michigan Flammable and Combustible Liquid Rules (Rule 8). Flammable gases may be stored only in laboratory units where there is an on-going operation requiring their use. Such operations shall allow for storage of flammable gases sufficient to meet the operating requirements of the equipments in that laboratory plus an equal reserve. A FLAMMABLE GAS sign must be posted at the entrance of the laboratory.

Flammable liquids shall be stored in flammable cabinets or safety cans. Large volumes of solvents shall be stored in separate chemical storage areas outside of the laboratory. Chemicals requiring refrigeration must be stored in a labeled, explosion proof refrigerator.

Containers of acid can be stored in plastic bins. Store nitric acid on plastic away from other acids, bare metals, and woods. Avoid storage of chemicals on bench tops, in fume hoods, on the floor, or near exits. Avoid exposing chemicals to heat or direct sunlight.

Highly toxic materials shall be stored in a separate, labeled area. For detailed information on proper chemical storage, contact OEHS.

c. Gas cylinder storage

All gas cylinders must be secured to a rigid surface. Oxidizers must be stored at least 20 feet away from flammable gas cylinders, or separated by a barrier.

3. Environmental Monitoring

Past monitoring data have indicated that airborne levels of hazardous chemicals at Wayne State University are well below the Permissible Exposure Limits mandated by OSHA. Thus regular monitoring of airborne concentration is not usually required. However, air monitoring is always conducted upon request by a laboratory employee, Principal Investigator, etc. When work methods or conditions indicate a potential for exposure at or above the action level, air monitoring is conducted. Such work methods or conditions may include:

- Use of an open vessel instead of a closed system
- Use of a procedure that involves significant quantities of hazardous chemicals over an extended period of time.
- Signs or symptoms of exposure (skin and eye irritation, shortness of breath, nausea, headache. Etc. experienced by laboratory workers)

4. Housekeeping, Maintenance, and Inspections

a. Cleaning

Floors, bench tops and work areas should be cleaned daily.

b. Inspections

Principal Investigators and the research staff shall conduct a visual survey of their laboratories on a regular basis to ensure safe working conditions. Please see appendix XI for a LABORATORY SAFETY SURVEY CHECKLIST. Formal housekeeping inspections should be performed regularly by the Principal Investigator and the research staff.

c. Equipment maintenance

Flush eyewash fountains weekly. Safety showers should be tested every six months by OEHS personnel. Inspect respirators and other personal protective equipment before and after each use. All emergency equipment, including eye washes, safety showers and fire extinguishers must be visible, unobstructed and readily accessible. Before performing any maintenance work on electrical lab equipment, unplug the equipment and follow proper lockout procedures. Call 313 577-1200 for more information.

d. Passageways

There should be clear walkways/stairways, with unobstructed exits and no slipping/tripping hazards such as containers on the floor or outlet strips or extension cords. walkways and hallways should not be used for storage. Never block emergency equipment, or utility controls. All aisles in the lab should be at least three feet wide.

5. Medical Program

a. Routine surveillance

Routine medical surveillance should be established if required by any regulations, (e.g. respiratory protection program, lead standard, or any other substance specific OSHA standard). Employee Health Service at UHC and OEHS will determine the need for and the frequency of medical surveillance for specifically regulated materials. Medical monitoring of laboratory personnel, including follow-up exams, shall occur when:

An employee develops signs and symptoms of exposure to a hazardous chemical. Such symptoms may include headache, rash, nausea, coughing, tearing, irritation or redness to the eye, irritation of the nose or throat, dizziness, or loss of motor ability or judgment.

An employee has direct skin or eye contact with a hazardous chemical.

A chemical release (spill, leak, fire, explosion) results in the likelihood of a hazardous exposure.

Air monitoring reveals an airborne concentration of a hazardous substance routinely above the OSHA regulated substance for which there are exposure monitoring and medical surveillance requirements.

b. Bloodborne Pathogen Program

If laboratory work involves the use of human blood, body fluids or tissue, the Hepatitis B vaccination must be made available to all employees at risk of exposure at the beginning of their employment. Vaccinations must be paid for by the employer

and are available through the Employee Health Service, located at 4K UHC, DMC 313 745-4522. For more information on the Bloodborne Pathogen Standard and the WSU Exposure Control Plan, contact OEHS.

c. Injury reports

A Report of Injury form must be completed for any laboratory accident that results in an injury, illness and/or exposure. Report of Injury forms are available at the Office of Risk Management http://idrm.wayne.edu/risk/ or 313 577-3110.

6. Recordkeeping

a. Completion of a Report of Injury form is required in the event of any job-related injury or illness needing medical attention. Report of Injury forms should be prepared by the injured or ill employee whenever possible, and signed by the employee's supervisor. The completed form should be sent to Risk Management within 24 hrs.

b. Laboratory Health and Safety Training Records are maintained in the OEHS office. Any laboratory health and safety training conducted by Department or Administrative Units must be documented and must contain the following information: date, training outline, length of training, persons conducting the training, and employee's printed name, signature, and classification. A copy of information must be sent to OEHS.

c. Inventory and usage records for highly toxic substances should be kept by the lab manager and made available to the OEHS office upon request.

d. Written SOPs should be read and signed by all lab personnel. Chemical Hygiene Plan records should document that laboratory facilities and procedures are compatible with current knowledge and regulations.

e. Chemical Emergency Release and Incident Reports are prepared by and maintained by the OEHS office.

7. Signs and Labels

a. Emergency signs

Emergency notification stickers (available through OEHS) should be placed on the lab door and should list the following names and phone numbers:

- principal investigator
- laboratory supervisor
- University Police 313 577- 2222

b. Hazard signs

Post the type(s) of hazard(s) (biohazard, cancer hazard, radioactive hazard, UV radiation, etc.) on the laboratory door, in areas where work is performed using those chemicals (e.g. fume hood), and in storage areas.

c. Chemical labeling

All chemical and waste containers must be correctly labeled. Chemicals from a manufacturer must have the following information included on the label:

- name of chemical
- signal word (Danger and Warning)
- type of hazard (poison, irritant, inhalant, carcinogen, etc.)
- precautions (i.e., avoid skin contact, use in well ventilated area, etc.)
- instructions in case of emergency.
- storage requirements and expiration date if applicable.

d. Chemicals removed from the original container and poured into a secondary container, or solutions mixed in the lab, must be labeled with regard to the name of the chemical and the principle hazard, and expiration date if applicable (e.g. ether and other peroxidizable chemicals).

e. Location signs must be prominently posted to indicate safety showers, eyewash stations, other safety and first aid equipments, exits, and where food and beverage consumption and storage are permitted.

8. Hazardous Material Spills / Releases / Accidents

Laboratory emergencies require prompt action to prevent or reduce undesirable effects. Laboratory employees must be able to immediately take control of the situation and quickly assess the existing and potential hazards and carry out the appropriate response actions. Immediate hazards of fire, explosion, and releases of toxic vapors are of prime concern. The following written emergency response procedures contain minimum specifications that must be followed by all WSU laboratory workers. In addition, written emergency response actions for specific hazards in the laboratory must be developed by the Principal Investigator, approved by the OEHS office, and provided to the laboratory workers. These written emergency response procedures must also specify the proper spill control equipment or material to be used.

In the event of a large spill, call the Office of Environmental Health & Safety at 313 577-1200, or the University Police at 313 577-2222.

Prevent spills through proper storage of chemicals, use of standard operating procedures, monitoring and inspection of storage areas and training of laboratory personnel. For minor spills, contain the spill with sand or absorbent materials. Wash

area thoroughly after clean up and notify OEHS for further clean-up and to dispose of waste materials.

For skin or eye contact, flush area with water immediately. For spills on clothing, remove clothing immediately, including shoes, to prevent soak through, and flush affected area with water.

When there is acute inhalation of a hazardous material, escort victim to a source of fresh air; seek medical attention if necessary.

a. Spill Control Equipment:

The principal Investigators shall make available appropriate spill control items in each laboratory. Such items may include commercial spill control products as absorbent pads, pillows, rolls, etc. and/or other suitable neutralizing or absorbing items such as sodium bicarbonate for acid spills, boric acid, citric acid for alkali spills, or activated charcoal for solvent spills. The Office of Environmental Health and Safety is available for assistance in selecting proper spill control equipment.

b. Spill Control for Acids, Alkalies, and Solvents

As a general guideline, spills of less than 1 liter of these materials are considered small. However, spills of particularly hazardous substances, regardless of the amount spilled, may require immediate OEHS notification and assistance. Particularly hazardous substances include select carcinogens, reproductive toxins and substances with high degree of acute toxicity.

Respirators may be necessary even in small spill clean-up, depending on the substance. Only those employees approved by OEHS to wear respirators can attempt spill clean-up requiring respiratory protection.

Use the proper spill clean-up material. Commercial pads, pillows, rolls, etc are available from several manufacturers, but vary in what substance they control. In addition to commercial clean-up material The following can be used:

(i) Sodium bicarbonate for acid spills
(ii) Boric acid or citric acid for alkalies
(iii) Activated charcoal for solvent spills

Confine the spill to a small area. Do not let it spread. Dispose of all spill-clean up material in an appropriately marked hazardous waste bag, label the contents and contact OEHS to arrange for correct disposal.

c. Mercury Spills:

Regardless of the size of the spill, you must contact OEHS. This office has a mercury vapor analyzer to measure airborne concentrations of mercury and equipment designed specifically to clean-up mercury spills. For tiny amounts (< 2 cc) of spilled

mercury, use available mercury spill control kits or mercury spill amalgam to minimize vaporization while awaiting OEHS. Never use a laboratory sinks or drains to dispose of mercury or mercury-contaminated waste.

d. Biological Spills:

Quickly assess whether there are any injured persons and attend to any person who may have been contaminated. Remove contaminated clothing immediately and decontaminate. (OEHS is available for assistance in the selection of proper disinfectants.)

To clean up the spill and decontaminate the area, wear personal protective equipment (laboratory coat, mask, goggles and two pairs of gloves) and:

Cover spill area with an absorbent material;

Apply a 1:10 or 10% sodium hypochlorite (household bleach) solution directly to the spill area;

Allow the solution to remain for at least 30 minutes before rinsing;

Dispose of all material using a mechanical device such as forceps and place in a BIOHAZARD BAG. Do not autoclave bleach solutions.

e. Leaking Compressed Gas Cylinders:

Occasionally, a cylinder or one of its component part develops a leak. Such leaks often occur around the manifold in areas such as valve threads, safety device, valve stem, and valve outlet. If a leak is suspected, use a flammable gas leak detector or soapy water or other suitable solution. If the leak cannot be remedied by tightening a valve gland or packing nut, follow the departmental notification. Laboratory employees should never attempt to repair a leak at the valve threads or safety devices.

The following are generic standard operating procedures:

Follow the notification procedures for your laboratory. Promptly alert the predetermined “chain of notification” personnel, i.e., Principal Investigator, graduate instructor, etc.

- FLAMMABLE, INERT or OXIDIZING GASES: Move the cylinder to an isolated, well-ventilated area, if possible, post warning signs describing the hazard and precautions to be taken.

- CORROSIVE GASES: Corrosive gases may increase the size of the leak during release and some corrosives are also oxidizers or flammable. Move the cylinder to an isolated, well-ventilated area and if possible, use suitable means to direct the gas into an appropriate chemical neutralizer. Post warning signs describing the hazard and precautions to be taken.

- TOXIC GASES: Move cylinder to an isolated, well-ventilated area and use suitable means to direct the gas into an appropriate chemical neutralizer. Post warning signs describing the hazard and precautions to be taken.

f. Equipment Failure

Malfunctioning laboratory equipment that presents a health and safety hazard, e.g. mantels that overheat, should be immediately removed from service and labeled as malfunctioning. The equipment should be promptly repaired or discarded.

Facilities equipment failure such as circuit breaker overload, ventilating equipment, should be reported to Facilities Planning & Management (FPM) at 313 577-4315.

9. Information and Training Program

a. Aim

A comprehensive training program is the single most important aspect of employee protection. The aim of the institutional training program is to ensure that all individuals at risk are adequately informed about the operations and substance in their laboratory, their risk, and the proper precautions to take to protect their safety and health in the laboratory. Department and Administrative Units are required to provide health and Safety training and information to their laboratory employees.

All employees must be trained at the time of initial assignment and prior to the use of a new hazardous chemical or procedure. Refresher training shall be determined by the Principal Investigator. All training must be documented and contain the following information:

i) Date, location, length of training program
ii) Employee name, signature and WSU access ID
iii) Training outline copies of all training documentation must be sent to OEHS for record keeping.

b. Emergency and personal protective equipment training

Every laboratory worker should know the steps to take in the event of an accident, injury, exposure or spill. Laboratory workers should know the location and proper use of personal protective equipment, including lab coats, gloves and eye protection.

c. Laboratory safety and Chemical Hygiene Plan training

Chemical Hygiene Plan/laboratory safety training is required for all lab employees before beginning work in the lab. The OEHS office provides university-wide assistance to accomplish this goal. Contact OEHS at 313 577-1200 or on-line at www.oehs.wayne.edu and click on training for training sessions information. Training records must be kept in the lab.

d. Safety Data Sheets (SDSs)/reference material

Literature/reference material concerning chemical hazards, including Safety Data Sheets (SDSs), should be readily available to laboratory personnel in the SOPs. Laboratory personnel need to be knowledgeable on how to access SDS information either as a hardcopy in the laboratory or from an Internet sources. Copies of SDSs for highly hazardous materials being used should be kept in the lab with the Chemical Hygiene Plan and the SOPs. Reference material is available through OEHS.

10. Waste Disposal Program

a. Aim

To assure that minimal harm to people, other organisms, and the environment will result from the disposal of waste laboratory chemicals, as well as to ensure compliance with all applicable city, state and federal waste disposal regulations.

b. Chemical waste disposal procedures

It is the responsibility of the Principal Investigator to develop and implement procedures to ensure safe, efficient and legal waste disposal practices, consistent with the University's hazardous waste program. Do not discharge into the sewer concentrated acids or bases, highly toxic, malodorous, or lachrymatory substances, or any other substances which might interfere with the biological activity of waste water treatment plants, create fire or explosion hazards, cause structural damage or obstruct flow. Disposal of hazardous waste by adding them to mixed refuse for landfill burial is absolutely forbidden.

Collect all chemical waste in appropriate receptacles. When chemical waste is first added to a container, a waste tag with start date must be placed on the container too. Chemical waste containers and waste tags are available from OEHS. Please see our website for more information on proper disposal of chemical waste and to initiate disposal of hazardous waste http://research.wayne.edu/oehs/index.php.

c. Methods of disposal

OEHS determines the proper disposal method for all hazardous wastes generated at the university. Chemicals should never be dumped down drains into the sewer system, or evaporated through the hood. Never mix incompatible materials in the same waste container. For example, do not mix acids and solvent waste. Segregate containers of incompatible materials.

11. Personal Protective Equipment:

Personal protective Equipment (PPE) shall be used as necessary to augment the protection provided by engineering controls, experiment design, standard operating procedures, and good work practices. PPE should not be used as the primary means of controlling hazardous chemical exposure! Selection of PPE shall take into account a variety of factors including the identification of the hazard and task-specific conditions, the routes of exposure (inhalation, skin absorption, eye or skin contact, and/or ingestion), and the performance of the PPE material in providing a barrier to these hazards.

PPE selection should be specified by the Principal Investigator in conjunction with the OEHS office. Respirator use in the laboratory must be approved by the OEHS office and must comply with respiratory protection requirements specified by OSHA 1910.134

The following PPE procedure shall apply: All persons, including visitors, must wear appropriate eye protection where chemicals are stored or handled.

Appropriate gloves must be worn when the potential for skin contact with a toxic material exist. Gloves selection should be based on the dermal toxicity of the chemical, the chemical resistance of the glove material, and the exposure potential (potential for splash, immersion, etc.). Chemical permeation glove selection charts are available from specific manufacturers or appendix IX. Inspect reusable gloves before each use, wash them with soap and water after use and replace them as needed.

All other personal protective equipment such as face shields, lab coats, shoe covers, etc. specified by the Principal Investigator must be used as directed.

PPE such as laboratory coats must be removed immediately upon significant contamination.

12. Fire Safety:

LABORATORY INSPECTION:

Means of egress from the laboratory must not be blocked. An unobstructed path to the exit must be maintained at all times. Access to emergency equipment, safety showers, eye washes, fire extinguisher, first aid kit, etc. must not be obstructed. Exposed chemical storage must be limited to daily needs only. Chemicals not required for the procedure(s) in progress are to be promptly stored.

Fire extinguisher must be tagged, charged and dated.

CORRIDOR INSPECTION:

Exit signs must be illuminated.

Annual inspection of fire extinguisher, charged and dated.

Stairwell doors operational.

Stairwells cleared and obstructed.

EVACUATION:

Upon hearing the alarm:

Total evacuation of the building is required each and every time the alarm sounds

Exit your laboratory, turning off all equipment in your path of travel, and close the laboratory door as you exit.

Exit the building via the staircase. Never use the elevator. Do not reenter the building for any reason until you are permitted by security, or the city's Fire Department.

Upon discovering a fire:

Evacuate the area, closing all doors in your path of travel.

Alert all occupants by sounding the building alarm system from the manual pull stations located at the exits stairways throughout the building.

Notify the University Police 313 577-2222 from an adjoining building to assure their reception of the alarm signal.

The individual discovering a fire must report as much information as possible to arriving police and firefighters including floor of incident, room number, type of room (laboratory, office, store room, etc.), substances and materials involved if known, and any other pertinent information such as explosives, water-reactives, etc.

FIRE EXTINGUISHMENT: Extinguisher should only be attempted on small fires that can be extinguished with the available portable fire extinguisher by an individual who has been trained in its use. In general:

Remove the extinguisher from its bracket, maintain the means of egress to your back to provide a means of escape in the event the fire is not extinguished.

For Fire Extinguisher Training, Contact the Office of Risk Management, Fire Safety Officer at 313 577-3110.

E. General Procedures (SOPs) for Working with Highly Hazardous Chemicals

1. Working with Allergens and Teratogens

a. Allergens: diazomethane, chromium, nickel, isocyanates, bichromates, formaldehyde, certain phenols, etc.

   One should wear gloves to prevent hand contact with allergens or substances of unknown allergenic activity. Conduct aerosol producing procedures in a fume hood.

b. Teratogens and embryotoxins: organomercurials, lead compounds, formamide, etc. (for a complete list see Appendix V)

   Women of childbearing age should only handle these substances in a hood that has a confirmed satisfactory performance, using appropriate protective apparel (especially gloves) to prevent skin contact. Because the period of greatest susceptibility to embryotoxins is the first 8 - 12 weeks of pregnancy, which includes a period when a woman may not know she is pregnant, women of childbearing potential should avoid skin contact with all chemicals.

   If you are pregnant, or plan on becoming pregnant, contact OEHS before beginning work with any of these materials.

   Store these substances, properly labeled, in an adequately ventilated area in an unbreakable secondary container.

   Notify Principal Investigator and OEHS of all incidents of exposure or spills. Consult the University Health Center in the event of an exposure.

2. Working with Chemicals of Moderate Chronic or High Acute Toxicity

   Examples include diisopropylfluorophosphate, hydrofluoric acid, and hydrogen cyanide.

   a. Records

      Maintain an inventory of names and amounts of these materials on hand, amounts used, safety data sheets, and names of workers involved.

   b. Personal protective equipment

      Always avoid skin contact by wearing gloves and lab coats. Always wash hands and arms immediately after working with these materials.

   c. Storage

      Use and store these substances only in areas of restricted access with special hazard warning signs. Store breakable containers in chemically resistant trays.

   d. Engineering controls

      Always use a chemical fume hood (currently evaluated to confirm adequate performance with a face velocity of at least 80 linear feet per minute) or other containment devices for procedures which may result in the generation of aerosols or

vapors containing the substance.

e. Prevention of spills and accidents

Assure that at least two people are present at all times if a compound in use is highly toxic or of unknown toxicity.

If a major spill occurs outside of the hood, evacuate the area, and contact OEHS at 313 577-1200 or University Police at 313 577-2222.

f. Waste

Arrange waste disposal through the OEHS website:
http://research.wayne.edu/oehs/hazardous/index.php

3. Working with Chemicals of High Chronic Toxicity

Examples include Dimethylmercury, nickel carbonyl, benzo-a-pyrene, N-nitrosodiethylamine, other human carcinogens or substances with high carcinogenic potency in animals. (See the Appendices for a complete list.)

a. Access

Conduct all transfer and work with these substances in a "controlled area", such as a restricted access hood, glove box, or a specific area in the lab, designated for use of highly toxic substances. All people with access should be aware of the substances being used and the necessary precautions to take to prevent exposure.

b. Approvals

Prepare a standard operating procedure (SOP) for the use and disposal of these materials, and obtain the approval of the Principal Investigator and laboratory supervisor.

c. Decontamination

Decontaminate the controlled area before normal work is resumed.

d. Medical surveillance

If using toxicologically significant quantities of such a substance on a regular basis (e.g., 3 or more times per week), consult OEHS and the University Health Center concerning medical surveillance.

e. Records

Keep accurate records of the amounts of these chemicals stored and used, SDSs for each chemical, dates of use, and names of the users.

f. Signs and labels

Assure that the controlled area and storage areas are conspicuously marked with warnings and restricted access signs, and that all containers of these chemicals are clearly labeled as to their hazard.

g. Chemical spills

Assure that Standard Operating Procedures, equipment, and materials to minimize exposures of people and property are available in the event of an accident.

h. Storage

These chemicals should be stored in well-ventilated, labeled, limited access areas in appropriately labeled, unbreakable, secondary containers.

i. Gloves boxes

For a negative pressure glove box, ventilation rates must be at least 2 volume changes per hour and pressure at least 0.5 inches of water. For a positive pressure glove box, thoroughly check for leaks before each use. In either case, trap the exit gases or filter them through the approved mechanism.

APPENDIX I

PART 1910--OCCUPATIONAL SAFETY AND HEALTH STANDARDS
SUBPART Z - TOXIC AND HAZARDOUS SUBSTANCES

Air contaminants
Asbestos, includes chrysotile, amosite, crocidolite, tremolite asbestos, anthophyllite asbestos, actinolite asbestos, and any of these minerals that have been chemically treated and/or altered.
Coal tar pitch volatiles
4-Nitrobiphenyl
alpha-Naphthylamine
Methyl chloromethly ether
3,3'-Dichlorobenzidine (and its salts)
bis-Chloromethyl ether
beta-Naphthylamine
Benzidine
4-Aminobiphenyl
Ethyleneimine
beta-Propiolactone
2-Acetylaminofluorene
4-Dimethylaminoazobenzene
N-Nitrosodimethylamine
Vinyl chloride
Inorganic arsenic
Lead
Benzene
Coke oven emissions
Cotton dust
1,2-dibromo-3-chloropropane
Acrylonitrile
Ethylene oxide
Formaldehyde

If you are working with any of the above chemicals, please contact the Office of Environmental Health and Safety at 313 577-1200.

APPENDIX II

PEROXIDIZABLES

The following materials may form explosive peroxides. Ensure that the label has an expiration date. Do not store peroxidizables after they are expired. Please indicate if any of these are present in your lab:

SOLIDS

sodium amide

LIQUIDS

acetal
cyclohexene
decahydronaphthalene
dicyclopentadiene
diethyl ether
diethylene glycol
dimethyl ether (liquid or gas)
dioxane
divinyl acetylene
ethyl ether
ethylene glycol dimethyl ether (glyme)
tetrahydronaphthalene
isopropyl ether
tetrahydrofuran
vinyl ethers
vinylidene chloride

GASES

diacetylene
dimethyl ether (gas or liquid)
methyl acetylene

If you have any of the materials in Appendix II or IIII in defective containers, or if they have been stored past the expiration date, please contact the Office of Environmental Health and Safety for disposal at 313 577-1200.

APPENDIX III

SHOCK SENSITIVE MATERIALS
The following are examples of materials which can be shock sensitive:
Please indicate if any of these are present in your lab.

SOLIDS
acetylides
aluminum ophorite explosive
amatol
ammonal
ammonium nitrate
ammonium perchlorate
ammonium picrate
ammonium salt lattice
butyl tetryl
calcium nitrate
copper acetylide
cyanuric triazide
cyclotrimethylenetrinitramine
dinitroethyleneurea
dinitrophenol
dinitrophenyl hydrazine
dinitrotoluene
dipicrylamine
dipicryl sulfone
erythritol tetranitrate
fulminate of mercury
fulminate of silver
fulminating gold
fulminating mercury
fulminating platinum
gelatinized nitrocellulose
guanyl nitrosamino guanyltetrazene
guanyl nitrosamino guanylidene
guanylidene
hydrazine
heavy metal azide
hexanite
hexanitrodiphenylamine
hexanitrostilbene
hexogen
lead azide
lead mannite
lead mononitroresorcinate
lead picrate
lead salts
lead styphnate
magnesium ophorite
mannitol hexanitrate
mercury oxalate
mercury tartrate
nitrated carbohydrate
nitrated glucoside
nitrogen tri-iodide
nitroguanidine
nitronium perchlorate
nitrourea
organic nitramines
picramic acid
picramide
picric acid
picryl chloride
picryl fluoride
organic amine nitrates
potassium nitroaminotetrazole
robenzoic acid
silver acetylide
silver azide
silver styphnate
silver tetazene
sodatol
sodium amatol
sodium nitrate-potassium explosive mixtures
sodium picramate
syphnic acid
tetranitrocarbazole
tetraze

SHOCK SENSITIVE MATERIALS cont.

tetrytol
trinitroanisole
trinitrobenzene
trinit
trimonite
trinitronaphthalene
trinitrophenetol
trinitrotoluene
urea nitrate

LIQUIDS

dinitroglycerine
hydrazoic acid
nitroglycerin
nitroglycide
nitroglycol
nitroparaffins
nitrotoluene
sodium dinitro-ortho-cresolate

SOLID OR LIQUID

dinitrophenolates
hydrazine mixtures
hyrazinium nitrate
nitrogen trichloride
organic peroxides (t-butyl peroxide)

APPENDIX IV

KNOWN CARCINOGENS - American Conference of Government Industrial Hygienists (ACGIH)

Please indicate if any of the following are present in your lab.

SOLIDS

4-aminobiphenyl
asbestos-amosite, chrysotile, crocidolite
arsenic and certain arsenic compounds
benzidine
chromite ore (processing as Cr)
chromium (VI) compounds (certain water insoluble)
coal tar pitch volatiles (as benzene solubles)
B-naphthylamine
nickel
4-nitrodiphenyl (solid or liquid)
particulate polycyclic aromatic-hydrocarbons (coal tar pitch)
vinyl chloride (solid or gas)

LIQUIDS

bis(chloromethyl)ether

GAS

vinyl chloride (gas or solid)

APPENDIX V

SUSPECTED CARCINOGENS

Please indicate if any of the following are present in your lab.

SOLIDS

acrylamide
antimony trioxide(production)
arsenic trioxide(production)
beryllium (& compounds)
cadmium (& compounds)
chrysene
3,3-dichlorobenzidine
4,4-methylene bis (2-chloroaniline)
4,4-methylene dianiline
N-phenyl-beta-naphthylamine
potassium bromate
o-tolidine
p-tolidine

LIQUIDS

acrylonitrile
benzene
carbon tetrachloride
chloroform
chloromethyl methyl ether
dimethyl carbamoyl chloride
1,1-dimethylhydrazine
dimethyl sulfate
ethylene dibromide
ethylene oxide (at 12°C)
ethyl acrylate
formaldehyde
hexachlorobutadiene
hexamethyl phosphoramide
methylene chloride
methyl hydrazine
methyl iodide
N-nitropropane
N-nitrosodimethylamine
phenylhydrazine
B-propiolacetone
propylene imine
propylene oxide
vinyl cyclohexene dioxide
xylidine (mixed isomers)

GASES

1-3 butadiene
ethylene oxide

APPENDIX VI

TERATOGENS

The following are examples of materials that can cause genetic mutations or abnormalities in a developing fetus. Please indicate if any of these are present in your lab.

SOLIDS

arsenic
barium
bismuth
cadmium
caffeine
cannabis
carmine (sod.& lith.)
cesium-137
cobalt
codeine
congo red
cycloheximide
dinitrophenol
dioxin
diphenylamine
ethionamide
evans blue
hexachlorophene
iodoacetate
lead
lithium carmine
lithium chloride
LSD
marijuana
methyl arsenate
methyl mercury
methylurea (di-, tri-, tetra-)
niagara blue
nitrite (sodium)
nitrosurea
phenylalanine
picric acid
rhodium chloride
selenium
semicarbazide HCL
strontium (SR-90)
sodium cyanide
sodium nitrite
tellurium
thallium
thiosemicarbazide
triethanomelamine
trypan blue
urethane

LIQUIDS

benzene
benzyl alcohol
carbamate pesticides
carbon tetrachloride
chlorodan
diethylnitrosamine
dimethylacetamide
formamide
halothane
hydrazine(s)
mercury
methyl hydrazine
monomethylformamide
nicotine
organophosphate pesticides
propylene glycol
toluene
xylene

TERATOGENS con't

GASES

carbon monoxide
hexafluoroacetone
methane
ozone
tritium(H-3)

SOLID OR LIQUID

alkylating agents
azide
boric acid
chlorocholine chloride
cortisone
janus green B
nitrosomethylaniline
tetrachloroacetone

LIQUID OR GAS

anesthetic agents
bromide
dimethyl sulfoxide
ethylene oxide

SOLID, LIQUID OR GAS

chromium compounds
cyanide (sodium)

OTHERS

metahexamide
methyl arsenate
sodium carmine
sulphonamides

APPENDIX VII

INCOMPATIBLE CHEMICALS

Certain hazardous chemicals cannot be safely mixed or stored with each other because a severe reaction can take place or a toxic product can result. Chemicals should be stored by the hazard class and not alphabetically. The label and the SDS of a chemical will contain information on incompatibilities. The following are examples of incompatible chemicals:

- acetic acid: chromic acid, nitric acid, hydroxyl compounds, perchloric acid, peroxides, permanganates
- acetylene: chlorine, bromine, copper, fluorine, silver, mercury
- alkali metals: water, carbon tetrachloride or other chlorinated hydrocarbons, carbon dioxide, the halogens, alcohols, aldehydes, ketones, acids
- ammonia: anhydrous mercury, chlorine, calcium hypochlorite, iodine, bromine, hydrofluoric acid
- ammonium nitrate: acids, metal powders, flammable liquids, chlorates, nitrites, sulfur, finely divided organic or combustible materials
- aniline: nitric acid, hydrogen peroxide
- bromine: same as chlorine
- carbon, activated: calcium hypochlorite, all oxidizing agents
- chlorates: ammonium salts, acids, metal powders, sulfur, finely divided organic or combustible materials
- chromic acid: acetic acid, naphthalene, camphor, glycerin, turpentine, alcohol, flammable liquids in general
- chlorine: ammonia, acetylene, butadiene, butane, methane, propane (or other petroleum gases), hydrogen, sodium carbide, turpentine, benzene, finely divided metals
- chlorine dioxide: ammonia, methane, phosphine, hydrogen sulfide
- copper: acetylene, hydrogen peroxide
- cumene hydroperoxide: acids, organic or inorganic

- flammable liquids: ammonium nitrate, chromic acid, hydrogen peroxide, nitric acid, sodium peroxide, halogens
- hydrocarbons: fluorine, chlorine, bromine, chromic acid, sodium peroxide
- hydrocyanic acid: nitric acid, alkali
- hydrofluoric acid: ammonia, aqueous or anhydrous
- hydrogen peroxide: copper, chromium, iron, most metals or their salts, alcohols, acetone, organic materials, aniline, nitromethane, flammable liquids, oxidizing gases
- hydrogen sulfide: fuming nitric acid, oxidizing gases
- iodine: acetylene, ammonia (aqueous or anhydrous), hydrogen
- mercury: acetylene, fulminic acid, ammonia
- nitric acid: acetic acid, aniline, chromic acid, hydrocyanic acid, hydrogen sulfide, flammable liquids, flammable gases
- oxalic acid: silver, mercury
- perchloric acid: acetic anhydride, bismuth and its alloys, alcohol, paper, wood
- potassium: carbon tetrachloride, carbon dioxide, water (see alkali metals)
- potassium chlorate: sulfuric and other acids
- potassium permanganate: glycerin, ethylene glycol, benzaldehyde, sulfuric acid
- silver: acetylene, oxalic acid, tartaric acid, ammonium compounds
- sodium: carbon tetrachloride, carbon dioxide, water (see alkali metals)
- sodium peroxide: ethyl or methyl alcohol, glacial acetic acid, acetic anhydride, benzaldehyde, carbon disulfide, glycerin, ethylene glycol, ethyl acetate, methyl acetate, furfural
- sulfuric acid: potassium chlorate, potassium perchlorate, potassium permanganate (or compounds with similar light metals, such as sodium, lithium, etc.)
- tellurides: reducing agents

Guide for Safety in the Chemical Laboratory, 2nd ed., Manufacturing Chemists' Association, Van Nostrand Reinhold: New York, 1972, pp.215-217.

APPENDIX VIII

DEFINITIONS

ACUTE HAZARDS -- manifested after a single brief exposure and do not show permanent effects. These include:

1. Irritant: A chemical which causes reversible inflammation at the site of contact.

2. Cutaneous Hazard: A chemical that will affect the dermal layer of the body; causing defatting of the skin, rashes or skin irritations.

3. Toxic Agent: A substance defined by one of the following:

a. It has an LD50* for oral doses in rats between 50 milligrams per kilogram body weight (mg/kg) and 500 mg/kg, or,

b. It has an LD50* for skin in a 24-hour exposure in rabbits of between 200 mg/kg and 1000 mg/kg.

c. It has an LC50* for inhalation doses administered for a one-hour duration in rats between 200 parts per million (ppm) and 2000 ppm.

*The LD50 and LC50 refers to the lethal dose and lethal concentration, respectively, at which one half of the test animals died.

4. Highly Toxic Agents: A substance defined by one of the following:

a. It has an LD50 (oral, rat) of less than 50 mg/kg, or,

b. an LD50 (skin, rabbit) of less than 200 mg/kg; or,

c. an LC50 (inhalation, rat) of less than 200 ppm.

5. Corrosive materials: Chemical that cause visible destruction of, or irreversible alterations in, living tissue at the site of contact, by chemical action.

6. Eye Hazards: Materials that affect the eyes or visual capacity by causing conjunctivitis or corneal damage. Common types include organic solvents, acids, and alkalis.

7. Hematopoietic Agents: Chemicals that act on the blood or hematopoietic system. These substances decrease the hemoglobin function and deprive the body tissues of oxygen. Cyanosis and loss of consciousness are typical symptoms. Examples of these materials include carbon monoxide and cyanides.

CHRONIC HAZARDS -- These are chemicals which cause long term health effects. The effects may be slow to develop, and often are the result of repeat or continuous exposure over a long period of time. These include:

1. Sensitizer: A chemical that causes a number of exposed people or animals to develop an allergic reaction in normal tissue after repeated exposure.

2. Carcinogen: These include chemicals which are listed as a carcinogen in one of the following sources: National Toxicology Program (NTP), Report on Carcinogens, or OSHA's 29 CFR 1910 subpart Z.

3. Reproductive Toxin: A substance which can cause birth defects or sterility. Our knowledge about reproductive toxins is more recent than that of many other health hazards and not as extensive. It is also more difficult to obtain reliable information about such effects in humans. As a result of the uncertainties, some authorities recommend that pregnant women avoid contact with any chemicals whatsoever. Examples of reproductive toxins include PCBs and vinyl chloride.

4. Hepatotoxin: A chemical that can cause liver damage such as enlargement or jaundice. Examples include carbon tetrachloride, vinyl chloride, chloroform, and ethyl alcohol.

5. Nephrotoxin: A chemical that can cause kidney damage such as edema or proteinuria. Some examples are halogenated hydrocarbons and vinyl chloride.

6. Neurotoxin: A chemical that causes primary toxic effects on the central nervous system, such as narcosis, behavioral changes or decreased motor function. Common examples are mercury, ethyl alcohol, and tetraethyl lead.

7. Agents That Damage the Lungs: These agents irritate the pulmonary tissue, resulting in cough, tightness in the chest, and shortness of breath. Examples include silica, asbestos fibers, and toluene diisocyanate.

PHYSICAL HAZARDS OF CHEMICALS

1. Combustible Liquid: A liquid having a flash point between 100 and 200 degrees F. The flash point is the temperature above which a flame will propagate through the vapors from an ignition source to the nearby surface of the liquid. A combustible liquid presents a fire danger at slightly elevated temperatures, but not when it is at or below room temperature. Examples include No. 1 fuel oil, and mineral spirits.

2. Flammable Aerosols. An aerosol that yields either: (1) a flame projection of more than 18 inches at full valve opening, or (2) a flame extending back to the valve at any valve opening. All aerosols are mixtures. Whether a particular aerosol is flammable often depends on the particular propellant formation.

3. Flammable Gas: Defined in two different ways: (1) a gas with a lower flammability limit (LFL) less than 13% by volume in air; or (2) a gas with an upper flammability limit (UFL) more than 12% higher than its LFL, regardless of the value of the latter.

4. Flammable Liquid: A liquid with a flashpoint below 100 degrees F. This presents a real fire hazard if present in open containers near a source of ignition at or below normal room temperatures. Examples include acetone, turpentine, and gasoline.

5. Flammable Solid: A solid which ignites and burns with a self-sustained flame at a rate of at least 0.1 in./sec along its major axis. This does not include blasting agents or explosives. Examples include magnesium metal and nitrocellulose film.

6. Oxidizer: A chemical, other than a blasting agent or an explosive, that initiates or promotes combustion in other materials, causing fire through the release of oxygen or other gases. Examples include oxygen, nitric acid, and hydrogen peroxide.

7. Pyrophoric Materials: Substances that will ignite spontaneously in air at temperatures below 130 degrees F. An example is white phosphorus.

8. Compressed Gases: Defined in three ways: (1) a confined gas or mixtures of gases having an absolute pressure of at least 40 psi at 70 degrees F, or (2) a confined gas or mixture of gases having an absolute pressure of at least 104 psi at 130 degrees F; or (3) a liquid having a vapor pressure of at least 40 psi at 100 degrees F. Examples include nitrogen, oxygen, argon, propane, and carbon dioxide.

9. Explosives: Chemicals that cause a sudden, almost instantaneous release of pressure, gas, and heat when subjected to shock, pressure or high temperatures. Examples include nitroglycerine and gun powder.

10. Organic Peroxides: A derivative of hydrogen peroxide in which one or both hydrogen atoms have been replaced by an organic radical or radicals. This definition also covers the class of compounds known to chemists as organic hydroperoxides. Examples include methyl ethyl ketone peroxide and benzoyl peroxide.

11. Unstable Materials: A chemical which in the pure state, or as produced or transported, will vigorously polymerize, decompose, condense or become self reactive under conditions of shock, pressure, or high temperature. Examples include benzoyl peroxide and butadiene.

12. Water-Reactive Materials: A chemical that reacts with water to produce a gas that is either flammable or presents a health hazard. Some examples include acetic sodium metal and calcium carbide.

APPENDIX IX

GLOVE SELECTION CHART

RESISTANCE OF MATERIALS

CHEMICAL	Neoprene	Vinyl Plastic	Rubber Latex	Nitrile	Synthetic Latex	Natural Latex
alcohols	E	E	G	E	E	G
caustics	E	E	E	E	E	E
chlorinated solvents	G	F	NR	E	G	NR
ketones	G	NR	G	G	G	G
petroleum solvents	E	G	F	S	E	F
organic acids	E	E	E	E	E	E
inorganic acids	E	E	E	E	E	E
non-chlorinated solvents	G	F	NR	G	G	NR
insecticides	E	E	F	S	E	F
inks	E	E	F	S	E	F
formaldehyde	E	E	E	S	S	E
acrylonitrile	E	G	E	S	E	E
hydraulic fluid	E	E	F	S	E	F
carbon disulfide	NR	F	G	F	NR	G
paint remover	F	F	NR	E	F	NR

S = Superior
E = Excellent
G = Good
F = Fair
NR = Not Recommended

Supplier chemical resistance guides:

Microflex: https://microflexpublic-ansellhealthcare.msappproxy.net/Products/~/media/Files/Literature/Domestic%20Reference%20Materials/DOM_Reference_Chemical%20Resistance.ashx

North by Honeywell: http://207.20.33.136/CEGlovesMain.aspx

Ansell: http://www.ansellpro.com/specware/guide.asp