

**The Ohio State University
Occupational Exposure to
Hazardous Chemicals in Laboratories**

Chemical Hygiene Plan for:

(Department)

(Laboratory Supervisor or Principal Investigator)

(Laboratory Location(s) where this Chemical Hygiene Plan applies)

Generic Plan Prepared by

The Office of Environmental Health and Safety

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1.0 PURPOSE

The purpose of this Chemical Hygiene Plan (CHP) is to provide guidance and protocols for the protection of University laboratory employees from health effects associated with hazardous chemicals used in the laboratory. The facilities and precautions in this CHP are compatible with current knowledge and regulations.

2.0 SCOPE

The CHP applies to all laboratory employees working on laboratory scale operations involving laboratory use of hazardous chemicals.

3.0 DEFINITIONS (As found in 29 CFR 1910.1450)

Action Level - a concentration designated in 29 CFR part 1910 for a specific substance, calculated as an 8-hour time weighted average (TWA), which initiates certain required activities.

Chemical Hygiene Officer - An employee who is qualified by training or experience, to provide technical guidance in the development and implementation of the provisions of the CHP. (A Chemical Hygiene Committee may also be designated to represent each laboratory.)

Chemical Hygiene Plan - A written program developed and implemented which sets forth procedures, equipment, personal protective equipment and work practices that are capable of protecting employees from the health hazards presented by hazardous chemicals used in the laboratory. This plan shall be reviewed and updated at least annually.

Designated Area - An area which may be used for work with select carcinogens, reproductive toxins or substances which have a high degree of acute toxicity. A designated area may be the entire laboratory, an area of a laboratory or a device such as a laboratory hood.

Hazardous Chemical - A chemical for which there is statistically significant evidence, based on at least one study conducted in accordance with established scientific principles, that acute or chronic health effects may occur in exposed employees. The term "health hazard" includes chemicals which are carcinogens, toxic or highly toxic agents, reproductive toxins, irritants, corrosives, sensitizers, hepatotoxins, nephrotoxins, neurotoxins, agents which act on the hematopoietic systems and agents which damage the lungs, skin, eyes or mucous membranes.

Laboratory - A facility where the laboratory use of hazardous chemicals occurs. It is a workplace where relatively small quantities of hazardous chemicals are used on a non-production basis.

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

Laboratory Use of Hazardous Chemicals - Handling or use of such chemicals in which all of the following conditions are met:

1. Chemical manipulations are carried out on a laboratory scale,
2. Multiple chemical procedures or chemicals are used,
3. The procedures involved are not part of a production process nor in any way simulate a production process, and
4. Protective laboratory practices and equipment are available and in common use to minimize the potential for employee exposure to hazardous chemicals.

Laboratory Worker - An individual employed in a laboratory workplace who may be exposed to hazardous chemicals in the course of his or her assignments.

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

Select Carcinogen - Any substance which meets one of the following criteria:

1. It is regulated by OSHA as a carcinogen, or
2. It is listed under the category, known to be carcinogens, in the Annual Report on Carcinogens published by the National Toxicology Program (NTP) (latest edition), or
3. It is listed under Group 1 (carcinogenic to humans) by the International Agency for Research on Cancer Monographs (IARC) (latest editions), or
4. It is listed in either Group 2A or 2B by IARC or under the category, reasonably anticipated to be carcinogens by NTP, and causes statistically significant tumor incidence in experimental animals in accordance with any of the following criteria:
 - a. After inhalation exposure of 6-7 hours per day, 5 days per week, for a significant portion of a lifetime, to dosages of less than 10 mg / m³,
 - b. After repeated skin application of less than 300 (mg / kg of body weight) per week, or
 - c. After oral dosages of less than 50 mg / kg of body weight per day.

4.0 RESPONSIBILITIES (As Per 29 CFR 1910.1450.e.3.vii)

Vice President for Research -The Vice President for Research has ultimate responsibility for the University Chemical Hygiene Plan (CHP) and shall provide endorsement and support for its implementation at the departmental level.

Department Chairman - The Department Chairman has ultimate responsibility for implementing the chemical hygiene at the department level and shall provide continuing support for chemical hygiene.

Laboratory Supervisor (or Principle Investigator) - The Laboratory Supervisor is responsible for chemical hygiene in the laboratory. The Laboratory Supervisor shall ensure:

1. Laboratory workers know and follow the chemical hygiene rules,
2. Protective equipment is available and in working order, (See Sections 9.2 - Inspections, 12.1 - Personal Protective Equipment, and Appendix F - Glove Selection Chart for other relevant information)
3. Appropriate training has been provided, (See Section 14.0 - Employee Training for other relevant information)
4. Facilities and training for use of any material being ordered are adequate, (See Section 6 - Chemical Procurement, Distribution, and Storage for other relevant information)
5. Inspections of emergency equipment, chemical hygiene, and housekeeping are conducted. (See Sections 5.4 - Housekeeping, 9.2 - Inspections, and 11 - Emergency Equipment for other relevant information)

Laboratory worker - Each laboratory worker is responsible for planning and conducting all operations in accordance with the chemical hygiene procedures and developing good personal chemical hygiene habits.

Chemical Hygiene Officer - The Chemical Hygiene Officer (**Enter Name**)

is responsible for the development and implementation of chemical hygiene policies and practices in the laboratory. He / she shall:

1. Monitor the procurement, use and disposal of chemicals used in the laboratory,
2. See that appropriate audits are maintained,
3. Help the Laboratory Supervisor develop precautions and adequate facilities,
4. Know the current legal requirements concerning regulated substances,
5. Seek ways to improve the Chemical Hygiene Plan,
6. Develop and oversee implementation of the Chemical Hygiene Plan.

Laboratory Inspection Team - These individuals may be designated by the Chemical Hygiene Officer to provide laboratory inspections as described in the Chemical Hygiene Plan (**Enter Names. Attach additional page(s) as necessary**):

5.0 GENERAL LABORATORY PROCEDURES

(As Per 29 CFR 1910.1450.e.1.i and 29 CFR 1910.1450.e.3.ii)

5.1 BEHAVIOR IN THE LABORATORY

1. Employees shall act in a professional manner at all times.
2. Horseplay and practical jokes are expressly forbidden.
3. Never work alone at a potentially dangerous activity.
4. Visitors to the laboratory are to be escorted by an employee and are the responsibility of that employee. All safety regulations must be observed.
5. Only well understood reactions shall be permitted to run unattended. If a reaction is permitted to be left unattended, lights should be left on and an appropriate sign should be placed on the door. Provisions for containment of toxic substances in the event of a utility service failure (such as cooling water) to an unattended operation should be established.
6. Employees shall be aware of the location and proper operation of laboratory safety equipment (i.e., fire extinguishers, fire alarms, eyes washes, safety showers, first aid kits). (See Section 11 - Emergency Equipment and Appendix I (insert) for other relevant information)
7. The use of radioactive sources and radiation producing equipment is strictly regulated by the Nuclear Regulatory Commission and the Office of Environmental Health & Safety, Division of Radiation Safety (2-1284). Before any radioactive source or radiation producing instrument is brought into the laboratory, the Division of Radiation Safety must be consulted for appropriate permits, training and standard operating procedures. (See Section 17.8 - Radionuclides for other relevant information)

5.2 AVOIDANCE OF ROUTINE EXPOSURES

1. Skin contact with chemicals should be avoided.
2. Do not smell or taste chemicals.
3. Never pipette by mouth. Use a vacuum or a pipette bulb.
4. Apparatus which may discharge toxic chemicals must be vented into local exhaust devices (i.e., a chemical fume hood).

5.3 PERSONAL HABITS IN THE LABORATORY

1. Eating, drinking, gum chewing and cosmetic application (i.e., hand cream) are not permitted in the laboratory.
2. Smoking is not allowed in any building on campus.
3. Food shall not be eaten in places where chemicals are being used or stored. Alternatives should be discussed within the department.
4. Ice generated for laboratory use shall not be used for human consumption or food storage.
5. No glassware or utensils which are used for laboratory operations shall be used for storage, handling or consumption of food or beverages.
6. Hands should be washed before using the restrooms and before eating or smoking. Areas of exposed skin (i.e., forearms) should be washed frequently (minimally at lunch and at the end of the shift) if there is potential for contact with chemicals.

7. Confine long hair and loose clothing. Wear shoes at all times in the laboratory. The wearing of open sandals is not allowed in any laboratory.
8. Be alert to unsafe conditions and see that they are corrected when detected.
9. Any spills or accumulations of chemicals on work surfaces shall be removed as soon as possible, using techniques which minimize residual surface contamination.

5.4 HOUSEKEEPING

1. Lab areas are to be kept clean and uncluttered. This will help prevent spillage, breakage, personal injuries and unnecessary contact with chemicals.
2. Contaminated glassware is not to be left out.
3. Spills are to be cleaned up immediately from work areas and floors.
4. Floors must be maintained dry at all times.
5. Doorways and walkways shall not be blocked or used for storage.
6. Access to exits, emergency equipment and utility controls shall never be blocked. (See Section 11 - Emergency Equipment for other relevant information)

6.0 CHEMICAL PROCUREMENT, DISTRIBUTION AND STORAGE

(As Per 29 CFR 1910.1450.e.3.iv and 29 CFR 1910.1450.f.1)

6.1 PROCUREMENT

1. All chemicals in the laboratory must have approval of the Principal Investigator or Supervisor prior to purchase. Prior to purchasing approval the following must be considered:
 - a. Proper storage and handling procedures,
 - b. proper disposal procedures,
 - c. presence of adequate facilities to safely handle the material, and
 - d. adequately trained personnel to handle the material.
2. Before a substance is received, information on proper handling, storage, and disposal should be known to those who will be involved. All material safety data sheets (MSDS's) that are received with shipments to the lab shall be maintained on file. (See Section 14.2 - Reference Materials for other relevant information)
3. No container should be accepted without an adequate identifying label. The label should include as a minimum the substance name, an appropriate hazard warning, and specific target organ effects.

6.2 INVENTORY

Any laboratory which houses a chemical with a health, flammability or reactivity rating of 4 as designated by NFPA 49 shall post the name of the chemical and the quantity stored in the laboratory on the laboratory door or adjacent wall. For consistency across campus, a form similar to Appendix A shall be used.

1. The chemical inventory for the laboratory shall be kept in **(Enter Room Number and Building Name)**

(See Appendix A - Hazardous Chemical Inventory Form)

6.3 STORAGE

1. Both the storage and working amounts of hazardous chemicals shall be kept to a minimum.
2. All chemical containers must have a legible, firmly attached label. The containers shall be dated when received and also when opened.
3. Chemicals shall be stored in containers with which they are chemically compatible.
4. Chemical reagents shall be kept in closed containers when not in use.
5. Periodic inventories (at least annually) shall be conducted by the Chemical Hygiene Officer (or designee) with unneeded items being submitted for recycling or disposal in accordance with University's *Chemical Management Guidebook*. (See Sections 6.2 - Inventory and 15 - Waste Disposal Procedures for other relevant information)
6. All flammable substances must be stored in a flammable materials cabinet or refrigerator designed for flammable liquid storage as per Ohio Fire Code. (See Section 17.2 - Flammable Liquids for other relevant information.)
7. Compressed gas cylinders must be individually secured at all times. Cylinder caps should be in place on cylinders when not in use.
8. Incompatible chemicals must be segregated. Table 1 is a partial list of incompatible chemicals. At a minimum, corrosives, flammables, oxidizers, combustibles, and water reactives should have their own designated storage areas in the laboratory.

7.0 HAZARD IDENTIFICATION

(As Per 29 CFR 1910.1450.h and 29 CFR 1910.1450.f)

1. All chemical containers must have a legible, firmly attached label showing the contents of the container.
2. Labels on incoming containers of hazardous chemicals shall not be removed or defaced.
3. Material safety data sheets (MSDS's) received with incoming shipments of hazardous chemicals shall be maintained and made readily accessible to laboratory employees. Copies may be obtained from the Office of Environmental Health & Safety (2-1284). (See Section 14.2 - Reference Materials for other relevant information)
4. A hazard review of new materials not previously used in the laboratory shall be completed before actual handling has begun. This review shall be conducted by the Chemical Hygiene Officer or the Principal Investigator. (See Sections 6 - Chemical Procurement, Distribution, and Storage, and Appendix B - Job Hazard Analysis Worksheet for other relevant information)
5. Chemical substances developed in the laboratory shall be assumed to be hazardous in the absence of other information.

6. If a chemical substance is produced in the laboratory for another use outside of the laboratory, the MSDS and labeling provisions of the OSHA Hazard Communication Standard apply. The Chemical Hygiene Officer or Principal Investigator shall ensure these requirements are met. Please contact your administrative unit's OSHA Coordinator or the Office of Environmental Health & Safety (2-1284) for more information. (See Section 14.2 - Reference Materials for other relevant information)

8.0 ENVIRONMENTAL MONITORING (As Per 29 CFR 1910.1450.d)

1. Employee's exposures to OSHA regulated substances shall not exceed the permissible exposure limits specified in 29 CFR Part 1910 Subpart Z. (See Appendix C - 29 CFR Part 1910.1450 Subpart Z)
2. Employee exposures to any substance regulated by an OSHA standard shall be measured when there is reason to believe that exposure levels routinely exceed the action levels.
3. The Chemical Hygiene Officer or the Office of Environmental Health & Safety shall be consulted for assistance with environmental monitoring.
4. Monitoring results shall be provided to the Department Chemical Hygiene Officer, the Principal Investigator and to the Employee.
5. Monitoring strategy shall be followed in the event the action limit is exceeded, or as set forth by a substance specific standard.

9.0 MAINTENANCE AND INSPECTIONS (As Per 29 CFR 1910.1450.e.3.ii)

9.1 MAINTENANCE

1. All local exhaust ventilation hoods and other engineering controls shall be functioning properly.
2. Improperly functioning equipment, out of service equipment and equipment under repair shall be tagged "OUT OF SERVICE" and locked out if possible. The equipment shall not be re-started without the approval of the Chemical Hygiene Officer, Principal Investigator, Physical Facilities or Facilities Maintenance.

9.2 INSPECTIONS

Laboratory Employees

Each laboratory employee will conduct the following inspections at the specified interval.

1. The following personal protective equipment will be evaluated before each use where utilized or required:
 - a. Safety glasses, splash goggles and face shields,
 - b. Gloves,
 - c. Shoes,
 - d. Clothing,
 - e. Hearing Protection, and
 - f. Respirators.

(The inspection details are outlined in Section 12.2 - Personal Protective Equipment):

2. The following engineering controls will be evaluated before each use:
 - a. Local exhaust ventilation hoods,
 - b. Chemical fume hoods.

(See Section 16.2.1 - Daily inspections for other relevant information)

Laboratory Inspections by Chemical Hygiene Officer (or designee).

The Chemical Hygiene Officer (or designee) will conduct the following inspections at the specified intervals.

1. The following emergency equipment will be inspected at the frequency designated in Section 11.0 - Emergency Equipment:
 - a. Eye washes,
 - b. Safety showers,
 - c. Fire extinguishers,
 - d. Fire blankets,
 - e. First aid kits, and
 - f. Emergency lighting / illuminated exit signs.
2. The following items will be inspected annually (The inspection details are in Section 11 - Emergency Equipment and Section 16 - Ventilation):
 - a. Fire extinguishers,
 - b. Fire alarms,
 - c. Smoke detectors,
 - d. Fire doors,
 - e. Fire suppression systems, and
 - f. Local exhaust ventilation hoods.

10.0 MEDICAL PROGRAM (As Per 29 CFR 1910.1450.g)

1. Medical surveillance, including medical consultation and follow-up, shall be provided to employees under the following circumstances:
 - a. Where exposure monitoring is over the action level for an OSHA regulated substance which has medical surveillance requirements,
 - b. Whenever a laboratory employee develops signs or symptoms that may be associated with a hazardous chemical to which the employee may have been exposed to in the laboratory,
 - c. Whenever a spill, leak, or explosion results in the likelihood of a hazardous exposure, as determined by the Chemical Hygiene Officer,
 - d. All employees required to wear a respirator (See Section 12.1.6 - Respirators for other relevant information),
 - e. All emergency response team members.
2. All examinations shall be provided by a physician licensed in Occupational Medicine or under the direct supervision of a physician licensed in Occupational Medicine, at no cost to the employee, without loss of pay, and at a reasonable time and place.
3. First aid kits must conform with University's First Aid Kit Policy or be approved by a physician licensed in Occupational Medicine. (See Appendix D - First Aid Kit Policy)
4. Additional medical assistance, if required, is available through Employee Health Services (3-8146).
5. Emergency medical assistance, if required, is available by calling 911.
6. Where medical consultations or examinations are provided, the examining physician shall be provided with the following information:
 - a. The identity of the hazardous chemical(s) or material(s) to which the employees may have been exposed and the MSDS's if available,
 - b. A description of the conditions under which the exposure occurred including quantitative exposure data if available, and
 - c. A description of the signs and symptoms of exposure that the employee is experiencing, if any.
7. For examinations or consultations provided to employees, a written opinion from the examining physician shall be obtained by the Laboratory Supervisor or Chemical Hygiene Officer. It shall include:
 - a. Recommendations for further medical follow-up,
 - b. Results of the examination and associated tests,
 - c. Any medical condition revealed that places the employee at an increased risk of exposure to a hazardous substance found in the workplace, and
 - d. A statement that the employee has been informed of the results of the examination or consultation.

11.0 EMERGENCY EQUIPMENT (As Per 29 CFR 1910.1450.e.3.ii)

11.1 GENERAL

Emergency equipment for the Department of **(Enter Department Name)**

is located as indicated on the floor plans in Appendix I - Emergency Equipment Locations (insert). (Blue prints are available in an 8.5" x 11" format from the University Resource Planning and Institutional Analysis Office.) Each laboratory employee shall be familiar with the location, application and correct ways to operate the following equipment (where applicable):

1. Fire extinguishers,
2. Fire blankets,
3. Fire alarms,
4. Fire doors,
5. Smoke detectors,
6. Safety showers,
7. Eye wash units,
8. First aid kits.

11.2 EYE WASHES

1. Safety showers and eye washes should be within the work area for immediate emergency use.
2. Safety showers and eye washes should be plumbed. Water should be potable and provide at least 15 minutes of flushing.
3. ANSI Z358.1 (Current) provides design and performance requirements.
4. Inspections - at least weekly by the Chemical Hygiene Officer (or designee):
 - a. Access shall be maintained at all times, and
 - b. Adequate flow should be observed and documented weekly.

11.3 SAFETY SHOWERS

1. Safety showers should be within 100 feet for immediate emergency use.
2. Safety showers should be plumbed. Water should be potable and provide at least 15 minutes of flushing.
3. ANSI Z358.1 (Current) provides design and performance requirements.
4. Inspections:
 - a. The Chemical Hygiene Officer shall assure access is maintained at all times, and
 - b. Adequate flow should be observed and documented annually by the Division of Physical Facilities.

11.4 FIRE EXTINGUISHERS

1. Fire extinguishers should be provided within 30 feet of travel and located along normal paths of travel.
2. Access must be maintained and the location should be conspicuously marked in an appropriate manner.
3. The fire extinguisher type and size must be selected for the appropriate hazards. The Division of Physical Facilities' service desk must be consulted for fire extinguisher size, type and placement.
4. Inspections - Monthly by the Division of Physical Facilities or as identified by department or laboratory personnel.
 - a. The extinguisher is in its designated location,
 - b. Access is maintained,
 - c. The pin should be in place and attached with unbroken wire,
 - d. The indicator, if present, should be in the full range,
 - e. No indication of physical damage, and
 - f. The inspection should be documented.
5. Maintenance - Annually by the Division of Physical Facilities.

Maintenance of extinguishers involves a complete and thorough examination, including the mechanical parts, the amount and condition of the extinguishing agent and the agent's expelling device. The inspection shall be conducted by a qualified individual and documented.

11.5 BLANKETS / FIRE BLANKETS (IF PROVIDED)

1. Blankets should be provided in the vicinity of the safety showers to prevent shock and provide privacy.
2. Fire blankets must be available and accessible.
3. Inspections - monthly by the Chemical Hygiene Officer (or designee):
 - a. Blanket should be in its designated place,
 - b. Access should be maintained,
 - c. The location should be conspicuously marked, and
 - d. The blanket shall not be contaminated or damaged.

11.6 FIRE ALARMS

1. Fire alarms must be provided along normal paths of travel, along exit routes.
2. Inspections - Periodically by the Division of Physical Facilities:
 - a. Fire alarms should be conspicuously marked,
 - b. Fire alarms should be activated to insure proper operation per manufacturer's instructions and / or fire insurer's instructions, and
 - c. The inspections should be documented.

11.7 SMOKE OR HEAT DETECTORS

1. Should be installed and selected for the appropriate hazards per building codes, fire codes and fire insurer's requirements.
2. Inspections - Periodically by the Division of Physical Facilities.

The detection system should be tested to assure proper working order per manufacturer's and / or fire insurer's instructions.

11.8 FIRST AID KITS

1. First aid kits should be available and maintained for treatment of minor injuries or for short term emergency treatment before getting medical assistance.
2. Inspections - Monthly by laboratory personnel.

The first aid kits should be kept adequately stocked and maintained. (See Appendix D - First Aid Kit Policy for other relevant information)

11.9 FIRE DOORS

1. Fire doors should be provided as required per building codes, fire codes and fire insurer's requirements.
2. Fire doors must not be blocked open and must be able to close properly.
3. Inspections - Periodically by the Division of Physical Facilities:
 - a. Fire doors with heat activated closures should be tested to assure proper working order.

11.10 FIRE SUPPRESSION SYSTEMS

1. The fire suppression system must be selected based on the hazards.
2. Inspections - Periodically by the Division of Physical Facilities:
 - a. All system components must be checked for physical condition,
 - b. The system should be activated and checked as appropriate for the type of system, and
 - c. The inspections should be documented.

11.11 EMERGENCY LIGHTING

1. Emergency lighting must be adequate to provide lighting for egress during an emergency situation or power failure.
2. Inspections - Annually by the Division of Physical Facilities:
 - a. Emergency lighting must be activated to assure it is operational., and
 - b. Inspections should be documented.

12.0 STANDARD OPERATING PROCEDURES (As Per 29 CFR 1910.1450.e.3.i)

In addition to the following generic laboratory procedures, each laboratory should develop standard operating procedures specific to their operation. Safe work practices and the selection and use of personal protective equipment should be part of the procedures. (See Appendix E - Sample Standard Operating Procedure) **(Laboratory specific procedures should inserted on additional page(s) as necessary.)**

12.1 PERSONAL PROTECTIVE EQUIPMENT (As Per 29 CFR 1910.1450e.3.ii)

The Laboratory Supervisor (or designee) will be responsible for the selection of personal protective equipment, acquiring approved equipment, maintaining availability, and establishing cleaning and disposal procedures. A Laboratory Hazard Assessment Form must be completed for any personal protective equipment required for a job. Personal protective equipment must be provided cost-free by the employer.

Chemical protective clothing must be removed before leaving the work area.

12.1.1 Eye / Face Protection

1. Safety glasses must meet the requirements of ANSI Z87.1 (Current).
2. Safety glasses with side shields are required for everyone entering the laboratory.
3. Face shields, with safety glasses underneath, or chemical splash goggles are required when transferring or pouring corrosive materials or liquids injurious to the eyes.
4. Employees wearing contact lenses must be informed of the special hazards associated with their use (i.e., absorption of chemicals from the air).
5. Before each use, eye and face protection is to be inspected for damage (i.e., cracks, scratches, debris). If deficiencies are noted, the equipment should be cleaned, repaired or replaced before use.

12.1.2 Gloves

1. Chemical resistant gloves shall be worn whenever the potential for hazardous skin contact exists. The material safety data sheet for the substance or glove selection charts should be referenced. Contact your glove manufacturer for specific charts. (See Appendix F - Sample Glove Selection Chart for other relevant information) If the hazard is not known, as a minimum nitrile rubber gloves are recommended.
2. Standard operating procedures should specify glove requirements.
3. Gloves shall be removed before touching other surfaces (i.e., doorknobs, drawer pulls, faucet handles).
4. Heat resistant gloves shall be used for handling hot objects. Asbestos containing gloves should not be used.
5. Abrasion resistant gloves (i.e., leather) should be worn for handling broken glass or for other potentially abrasive materials. They should not be worn when handling chemicals.

6. Before each use, gloves are to be inspected for damage and contamination (i.e., tears, punctures, discoloration). If deficiencies are noted, the gloves should be cleaned, repaired, or replaced before use.

12.1.3 Shoes

1. No sandals, canvas, or open-toed shoes are to be worn by laboratory employees. The shoes worn in the laboratory should have a non-skid sole and should have a reasonable heel height.
2. Safety shoes should be worn if there is potential for injury from heavy objects (i.e., handling drums).
3. Safety shoes must meet the requirements of ANSI Z41 (Current).
4. Before each use, shoes are to be inspected for damage, deterioration, contamination, (i.e., tears, punctures, discoloration). If deficiencies are noted, the shoes should be cleaned, repaired or replaced before use.

12.1.4 Clothing

1. Laboratory coats or aprons shall be worn by laboratory employees whenever in the work area or when handling liquids that are injurious to or absorbed through the skin.
2. Laboratory coats must be cleaned regularly. If a spill occurs on the laboratory coat or personal clothing, it must be either decontaminated before reuse or disposed of.
3. The commercial launderer of any contaminated work clothing shall be notified of potentially contaminating substances.
4. Disposable clothing will be worn when working with highly toxic materials, such as carcinogens, mutagens, or teratogens. Grossly contaminated clothing shall be bagged and disposed of as hazardous waste.
5. Before each use, clothing is to be inspected for damage, deterioration, contamination (i.e., tears, punctures, discoloration). If deficiencies are noted, the clothing should be cleaned, repaired or replaced before use.

12.1.5 Hearing Protection

1. Hearing protection (noise attenuating ear muffs or plugs) is required whenever employees are exposed to 90 dBA or greater over an eight hour time weighted average. Employees exposed to 85 dBA or greater over an eight hour time weighted average are required to participate in the University's Hearing Protection Program. Please contact the Office of Environmental Health & Safety for more information (2-1284).
2. Hearing protection is to be inspected before each use for tears and contamination. If deficiencies are noted, the hearing protector should be cleaned, repaired or replaced before use.

12.1.6 Respirators

1. All employees issued respirators for any reason must follow all the requirements set forth in the Respiratory Protection Program. Please contact the Office of Environmental Health & Safety for more information (2-1284).
2. Respirators used for emergency response are to be inspected monthly and after each use, as described in the Respiratory Protection Program.

12.2 PLANNING CHEMICAL LABORATORY EXPERIMENTS

1. List all possible reactions including side-reactions before beginning.
2. Think through all reactants, intermediates, and products in terms of flammability, toxicity, and reactivity hazards.
3. Follow recognized safe practices concerning protective equipment, housekeeping, the handling of hazardous chemicals and utilization of equipment as outlined in this chemical hygiene plan.
4. If conducting an unknown reaction, always start with small quantities of material and carefully observe reaction characteristics (i.e., temperature, color, viscosity and physical state).
5. Obtain safety information about reactants and by-products. If the safety information is not available elsewhere, it may be obtained from some outside laboratories that offer a testing service for the evaluation of explosion hazards, etc.
6. If possible, determine from the thermodynamic and kinetic considerations the total quantity and the rate of evolution of heat and gases to be released during the reaction.
7. Provide adequate cooling, ventilation, pressure relief and gas purging. If possible, isolate the reaction vessel and make frequent inspections of equipment during the reaction. Do not leave a hazardous system unattended.
8. For each reactant, intermediate or product ask: What is its flash point, flammability range, auto-ignition temperature, vapor pressure and vapor density? Does it decompose? If so, how rapidly and to what products? What is its stability in storage, to heat, light, water or humidity, metals, etc.? Is it impact sensitive? Is it toxic? If so, what is the route of entry (inhalation, ingestion, skin contact)? What protective measures are required? What is the recommended first aid treatment in the case of an accidental exposure?
9. About the reaction itself, ask: How violent will it be? What is the effect of catalysts or inhibitors? Will water or air affect the reaction?
10. What would happen and what should be done if: Electric power fails? Cooling system fails? Pressure gets out of hand? Water leaks into the system? Air leaks into the system? The reaction container falls and breaks or spills its contents?
11. Remember that many explosions, fires, and asphyxiations are caused by the accidental combination of potentially dangerous substances.

12.3 EMERGENCY PROCEDURES

No universal emergency plan will do all things for all emergency situations. The most important component of emergency planning is prevention. Prevention measures range from employee training and facility inspection programs to engineering design of hazardous processes. The risks present in the laboratory include accidents or injuries, chemical releases, fires and explosions.

In an emergency, from a safe location call 911 and provide the dispatcher with the following information:

Location
Nature of emergency
Names of chemicals involved
Your name
Phone number that you are calling from

12.4 ACCIDENTS AND ACCIDENT REPORTING

Accidents or injuries which occur in the laboratory and require medical treatment must be treated immediately. If the extent or nature of the injury precludes the employee going to Employee Health Services or the OSU Emergency Department, the accident should be immediately reported by calling 911. In addition any laboratory personnel responding to the injury shall notify the following personnel. **(Attach additional page(s) as necessary.)**

1. All accidents, whether resulting in injury or damage, should be carefully analyzed with the results reported to all who might benefit.
2. Injuries requiring medical attention must be reported immediately and appropriate medical attention provided.
3. An Employee Accident Report and a Supervisor's Accident Report must be filled out and forwarded to the Office of Environmental Health & Safety.
(See Appendix G - Accident Reporting for other relevant information)

13.0 RECORDKEEPING (As Per 29 CFR 1910.1450.j)

1. Accident / Incident records shall be retained by the Administrative Unit and the Office of Environmental Health & Safety for five years. (See Section 12.4 - Accidents and Accident Reporting for other relevant information)
2. Medical records shall be retained for employment plus thirty years.
3. Industrial hygiene monitoring records shall be maintained for thirty years.

14.0 EMPLOYEE TRAINING (As Per 29 CFR 1910.1450.f)

14.1 TRAINING

1. All laboratory employees shall be trained on the hazards of the chemicals present in their work area.
2. Employees should not use any personal protective clothing until they have received instruction on the proper selection, use and limitations of the equipment.
3. The aim of the training program is to assure that all individuals at risk are adequately informed about the work in the laboratory, its risks, and what to do if an accident occurs.
4. This training shall be provided at the time of an employee's initial assignment to a work area where hazardous chemicals are present. It shall also be provided prior to assignments involving new exposure situations. The training shall be coordinated through the Chemical Hygiene Officer, Chemical Hygiene Committee, (or designee). Additional information about the training requirements may be found in the Safety Management Guidebook, Section 3 - the Laboratory Standard, or by calling the Office of Environmental Health & Safety (2-1284).
5. The training should include:
 - a. Respirator protection and fit testing program,
 - b. Handling hazardous chemicals,
 - c. Fire training - prevention and response,
 - d. Emergency response and evacuation,
 - e. Interpretation of MSDS's,
 - f. Engineering controls,
 - g. First aid,
 - h. Personal hygiene,
 - i. Personal protective equipment, and
 - j. Chemical or infectious waste disposal.

14.2 REFERENCE MATERIALS

1. Reference materials on the hazards, safe handling, storage and disposal of hazardous chemicals can be found in the OSU Libraries, the Office of Environmental Health & Safety, or in **(Enter Room Number and Building Name.)**

2. Material safety data sheets received shall be maintained by the Chemical Hygiene Officer for all hazardous chemicals used in the laboratory. The MSDS's are kept in **(Enter Room Number and Building Name.)**

14.3 TRAINING RESOURCES

The Office of Environmental Health & Safety offers the following training programs related to the Laboratory Standard:

Laboratory Standard (initial)	Bloodborne Pathogens (initial)
Respirator Training and Fit Testing	Solvent Safety
Fume Hoods	Compressed Gases
Biosafety Cabinets	Toxicology
Chemical Management (Waste)	Personal Protective Equipment
Fire Extinguisher training	Laboratory Safety (initial)

The School of Physical Activity and Educational Services (2-6787) offers First aid training.

15.0 WASTE DISPOSAL PROCEDURES (As Per 29 CFR 1910.1450.e.3.viii.C)

Waste Disposal procedures for chemical, infectious and other wastes are contained in The Ohio State University “*Chemical Management Guidebook*”. Please contact the Office of Environmental Health & Safety (2-1284) for more information.

16.0 VENTILATION (As Per 29 CFR 1910.1450.e.3.ii)

16.1 GENERAL GUIDELINES

1. General laboratory ventilation shall provide air flow into the laboratory from non-laboratory areas and out to the exterior of the building.
2. Laboratory doors should remain closed, except for egress and entrance. Laboratory doors should be fitted with clear windows made of safety glass whenever possible. Door windows, if provided, are to remain unobstructed.
3. All reactions that produce unpleasant and / or potentially hazardous fumes, vapors and gases must be run with local exhaust ventilation (i.e., within a fume hood).
4. The hood sash should remain closed when it is in use. When adjustments are needed to laboratory equipment or operations within the hood while chemical emissions are being produced the hood sash should not be raised past the 100 linear feet per minute (lfm) indicator.

16.2 MAINTENANCE AND INSPECTIONS

1. Daily inspections - Daily inspections by operators should be conducted at the beginning of each day:
 - a. Visually inspect the hood area for storage and other visible blockages, and
 - b. If hood function indicating devices are not a part of your hood, place a one inch by six inch piece of soft tissue paper at the hood opening and observe it for directional flow.

2. Periodic inspections

The quality and quantity of ventilation shall be evaluated upon installation, annually, and whenever a change in local ventilation devices is made. These evaluations are the responsibility of the Office of Environmental Health & Safety (2-1284) or **(Enter Responsible Person by Name or Title)**

within the Department of **(Enter Department Name)**.

- a. Capture velocity will be measured with a velometer. Hoods for most common chemicals must have an average face velocity of 100 linear feet per minute at sash opening of 18 inches. Face velocity readings should not vary by more than 20 %. A minimum of six readings shall be used to determine average face velocity,
- b. Other local exhaust devices shall be smoke tested to determine if the contaminants they are designed to remove are being adequately captured by the hood.

16.3 ANNUAL MAINTENANCE

Overall maintenance of the local exhaust ventilation should be performed annually by Physical Facilities.

1. Exhaust fan maintenance (i.e., lubrication, belt tension, fan blade deterioration and rpm) shall be in accordance with the manufacturer or as adjusted for appropriate hood function.
2. Ductwork shall be inspected for corrosion, buildup of condensate or particulate, and dampers checked and lubricated for appropriate operation.
3. Air cleaning equipment such a charcoal or HEPA filters should be monitored for contaminant buildup. If not supplied with differential pressure gauges or audible alarms, the filters should be leak tested.

16.4 VENTILATION FAILURE

In the event of ventilation failure the following procedures shall be followed.

(Each department must fill in the following as needed. Attach the additional page(s) as necessary.)

1. Enter protocol(s) to cease hazardous operations (i.e., operations which generate toxic or hazardous fumes, gases, or vapors) in the event of a ventilation failure.
2. Enter protocol(s) to re-start ventilation. Contact the department of Physical Facilities shop for more information to document these procedures.
3. Enter protocol(s) to re-set fume hood alarms (if applicable).

17.0 CHEMICAL HANDLING PROCEDURES (As Per 29 CFR 1910.1450e.3.i)

17.1 GENERAL

Know as much as possible about the chemical(s) you are handling. Read the label on the container, material safety data sheets, literature in the library and consult with your peers, principle investigator, or industrial hygiene and safety personnel. Common incompatible chemicals are listed in Table 1.

17.2 FLAMMABLE LIQUIDS

17.2.1 Hazards

1. Vapors can form ignitable mixtures in air. Vapors can also travel great distances and be ignited by remote ignition sources, flashing back violently to the source.
2. Many flammable liquids are toxic by inhalation and / or skin contact.
3. Flammable liquids or their vapors can cause injury to the eyes, ranging from irritation to severe eye damage.

17.2.2 Storage

Storage of flammable liquids is regulated by the Ohio Fire Code. This code references both NFPA 30 Code for Flammable and Combustible Materials and NFPA 45 Fire Protection for Laboratories Using Chemicals. Appropriate storage for flammables is dependent upon occupancy, square footage of laboratory space, type of building construction, availability of flammable storage cabinets, and the quantities of flammable and combustible materials used in the facility or laboratory unit. In general, research and laboratories outside of health care facilities should limit the amount of flammable liquids in a laboratory unit to less than 10 gallons per 100 square feet of laboratory unit space. Total amounts of flammable and combustible liquids should not exceed an additional 10 gallons per 100 square feet of laboratory unit. Contact the Office of Environmental Health and safety for your specific situation.

Restrictions on container size are found in Table 2.

17.2.3 Controls

1. Perform work with flammable liquids in a properly functioning chemical fume hood whenever possible.
2. Transfer of flammable liquids from bulk containers such as 55 gallon drums shall only be performed in adequately ventilated areas and where appropriate grounding and bonding for the containers is provided.
3. Spills of flammable materials must be cleaned up immediately. Spill procedures are contained in Section V of the *Chemical Management Guidebook*.
4. Emergency showers and eye washes should be available and used when skin or eye contact occurs.

17.2.4 Examples of Flammable Liquids

Examples of flammable liquids, and their classifications are listed in Table 3.

17.3 CORROSIVE CHEMICALS

17.3.1 Hazards

Contact with the skin, eyes, respiratory system or digestive tract with corrosive chemicals can cause severe irritation and burns.

17.3.2 Storage

1. Store concentrated acid and bases separately in appropriate acid or base resistant trays or catch basins.
2. Transport concentrated corrosives in a break resistant protective carrier.
3. Store oxidizing acids such as perchloric, nitric and sulfuric acids away from organic chemicals, paper, wood or other combustible materials. Contact of these materials with each other will cause fires and or explosions.
4. Drip tray residue must be removed daily.

17.3.3 Controls

1. Wear protective clothing.
2. In case of contact: Flush the affected area with large amounts of water for at least 15 minutes, remove contaminated clothing, seek medical attention.
3. Always add acid to water when diluting.

17.3.4 Examples of Common Laboratory Corrosives

Examples of common laboratory corrosives are in Table 4

17.4 REACTIVE CHEMICALS

17.4.1 Hazards

1. Water reactive: These chemicals react violently in contact with water.
2. Pyrophors: These chemicals ignite spontaneously in contact with air.
3. Peroxide formers: These chemicals will form shock sensitive explosives upon prolonged storage.

17.4.2 Storage

1. Water sensitive chemicals should be stored in accordance with instructions on the label or MSDS. The amount of water reactive materials should be kept to a minimum in the laboratory.

2. Pyrophoric materials should be kept in an atmosphere of inert gas or under kerosene, in air tight containers.

17.4.3 Controls

1. Wear safety equipment.
2. Read precautionary label. Understand handling instructions.
3. Use only in a chemical fume hood.

17.4.4 Examples of Water Reactive, Pyrophoric and Peroxidizable Chemicals

Examples of water reactive, pyrophoric and peroxidizable chemicals are listed in Tables 5, 6 and 7, respectively.

17.5 COMPRESSED GASES

17.5.1 Hazards

1. Compressed gases contain large amounts of energy which can cause serious injury and physical damage.
2. Compressed gases may also be flammable, toxic, or corrosive.

17.5.2 Storage

1. Compressed gases must be stored in the upright position with caps on when not in immediate use.
2. Compressed gas cylinders must be secured individually with straps, chains or stands designed especially for this purpose.

17.5.3 Controls

1. Transport cylinders only with caps in place, secured to suitable carriers.
2. Each cylinder must be matched with the appropriate fitting and regulator. The use of regulator adapters is prohibited.
3. Regulators must be fitted with check valves to prevent inadvertent mixing of gases and suck back into the cylinder.
4. Cylinder valves should always be opened slowly. Do not stand in front of regulators when “cracking open” cylinder valves.
5. If cylinder valves require special wrenches, the wrenches must be left attached to the valve while the cylinder is in use.
6. Do not totally empty a cylinder. Leave residual pressure in the cylinder, mark the cylinder as “Empty” or “MT” and return them to the empty cylinder storage area or call Store 70 to arrange for pickup.

17.5.4 Information Regarding Compressed and Liquefied Gases

Information regarding compressed and liquefied gases is in Table 8.

17.6 CARCINOGENS, MUTAGENS, TERATOGENS, AND REPRODUCTIVE TOXINS

17.6.1 Hazards

Exposures can potentially induce carcinogenesis, mutagenesis, and adverse reproductive capabilities or outcomes. Exposure may effect future generations.

17.6.2 Storage

1. Store these chemicals in a dedicated storage fume hood or glove box.
2. Maintain the minimum quantity necessary for the current project. Dispose of unneeded material(s) immediately.

17.6.3 Controls

1. Work with these chemical(s) only in designated areas.
2. Wear protective clothing appropriate for the physical state of the chemical.
3. Work only with adequate engineering controls such as glove bags, glove boxes and fume hoods.

17.6.4 Examples of Carcinogens, Mutagens, Teratogens, and Reproductive Toxins

Examples of these chemicals are listed in Tables 9, 10, 11 and Appendix H - Classes of Carcinogenic Compounds.

17.7 TOXIC METALS

17.7.1 Hazards

Toxic by inhalation, ingestion and possible skin absorption.

17.7.2 Storage

The minimum quantity necessary should be kept on hand.

17.7.3 Controls

1. Work in a fume hood whenever possible.
2. Spills should be cleaned up immediately. The work area should be properly decontaminated.
3. Wear appropriate personal protective equipment for work and cleaning up spills.

17.7.4 Examples of Toxic Metals

Examples of toxic metals are listed in Table 12.

17.8 RADIONUCLIDES

The Office of Environmental Health & Safety, Division of Radiation Safety has strict policies and procedures for the procurement, handling, use and disposal of radioactive materials. These procedures must be followed by anyone using radionuclides. Contact the Division of Radiation Safety (2-1284) for further information.

18.0 WORK WITH SUBSTANCES OF MODERATE TO HIGH CHRONIC TOXICITY OR HIGH ACUTE TOXICITY (As Per 29 CFR 1910.1450e.3.viii)

18.1 USE OF DESIGNATED AREAS

1. A designated area must be established for work with "Select Carcinogens", reproductive toxins, and substances which have a high degree of acute toxicity.
2. The following procedures must be developed and included with this chemical hygiene plan for all work with "Select Carcinogens", reproductive toxins, and substances which have a high degree of acute toxicity.
 - a. The establishment of a "designated area". This may be an entire laboratory, an area of a laboratory or a device in the laboratory, such as a hood. This area must be clearly marked (A suggested marking is illustrated in Figure 1),
 - b. Approvals required before conducting the project,
 - c. Control equipment (glove box, hood, etc.) required,
 - d. Proper storage procedures utilized,
 - e. Personal protective equipment required,
 - f. Procedures for retention of records on amounts of these materials on hand and used, and the names of the workers involved,
 - g. Procedures for the prevention of spills, accidents, and emergency response, and
 - h. Procedures for decontamination and the disposal of wastes.
3. The designated areas for use of the following classes of substances for the Department of **(Enter Department Name)**

are as follows: **(Attach additional page(s) as necessary.)**

<u>Class of chemical</u>	<u>building</u>	<u>room</u>	<u>Hood or other device</u>
_____	_____	_____	_____
_____	_____	_____	_____

4. Guidelines for classification of toxic or highly toxic substances based on the LD₅₀ in albino rats are listed in Table 13.

18.2 OPERATIONS REQUIRING PRIOR APPROVAL

(As Per 29 CFR 1910.1450.e.3.v)

Certain laboratory operations are of special concern because of the potential hazards associated with them. In these instances, laboratory personnel are instructed to obtain prior approval from the Principal Investigator, Chemical Hygiene Officer, or Supervisor prior to commencing the operation or experiment. This is to assure that safeguards are in place and that personnel are adequately trained in the procedure. Chemicals that require prior approval for use from the Principal Investigator, Chemical Hygiene Officer, or Supervisor include the following. **(List Chemicals below or attach additional page(s) as necessary.):**
