

Chemical Hygiene Plan User's Guide and Instructions

This Chemical Hygiene Plan (CHP) has been written for use by all University laboratories. The CHP contains information that is generic in nature in that it is applicable to most laboratory situations on campus. However, it is recognized that there are unique physical, chemical and administrative concerns associated with every laboratory that need to be addressed. Provisions for these concerns have been included in this document in the form of blank spaces and appendices. This document, including its referenced Tables and Appendices, will meet the CHP requirement for your laboratory when the following items are completed:

<u>Section</u>	<u>Information Required</u>
Title Page	Enter the names of the Department, Laboratory Supervisor, Laboratory Location and Person making amendments to the plan as directed on the Title Page.
4.0	Enter the name of Chemical Hygiene Officer (or Chairman of Chemical Hygiene Committee).
4.0	Enter the names of Laboratory Inspection Team members as necessary.
6.2.1	Enter the room number and building name where the laboratory hazardous chemical inventory will be kept.
6.2.1	Complete Hazardous Chemical Inventory - see Appendix A.
11.1	Include department name / floor plans indicating the locations of emergency equipment as Appendix I.
12.0	Include laboratory specific standard operating procedures.
12.4	Include a list of the names, addresses, and phone numbers of people to be notified in case of an emergency.
14.0	Training for personnel must be provided and documented.
14.2.1	Enter the room number and building name where laboratory or department reference material(s) can be found..
14.2.2	Enter the room number and building name where MSDS files will be maintained.
16.2.2	Enter the name of the person(s) responsible for ventilation evaluation(s) for the laboratory.
16.4	Include ventilation failure procedures.
18.1	Include a list of chemicals requiring prior approval for use and SOP's.
18.2	Include a list of operations requiring prior approval for use and SOP's

In addition, it is recommended that each administrative unit (i.e., laboratory, department, or college) establish some form of review (i.e., safety or CHP review committee) to ensure that the information contained in the final chemical hygiene plan for the administrative unit is correct, applicable, and enforceable.

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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 that may be used for work with select carcinogens, reproductive toxins or substances that 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.

Institutional Chemical Hygiene Officer – An employee who is qualified by training or experience, to provide oversight, technical guidance, and assistance to units in the development, implementation and auditing of the provisions of the Lab Standard and CHP's.

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 that affect reproductive capabilities including chromosomal damage (mutations) and effects on fetuses (teratogeneses).

Select Carcinogen - Any substance that 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.

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. Employee break or lunchrooms should be identified within the department.
4. Ice generated for laboratory use shall be posted "Not be used for consumption or food storage".
5. Glassware or utensils that are used for laboratory operations shall not 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. Open toed shoes or sandals are 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 daily, using techniques that minimize residual surface contamination.

5.4 HOUSEKEEPING

1. Lab areas and aisles are to be kept clean and uncluttered.
2. Contaminated glassware is to be cleaned daily.
3. Spills are to be cleaned up immediately from work areas and floors.
4. Floors must be 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)
7. Windows in laboratory doors shall remain unobstructed.

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.

8. Incompatible chemicals must be segregated. Table 1 is a partial list of incompatible chemicals. At a minimum, corrosives, flammables and combustibles, oxidizers, poisons, and water reactive chemicals should have their own designated storage areas in the laboratory.

7.0 *HAZARD IDENTIFICATION* (As Per 29 CFR 1910.1450.h and.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. The Chemical Hygiene Officer or the Principal Investigator shall conduct this review. (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 restarted without the approval of the Chemical Hygiene Officer, Principal Investigator, Physical Facilities or Facilities Maintenance.

9.2 INSPECTIONS

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 (The inspection details are outlined in Section 12.2 - Personal Protective Equipment):
 - a. Safety glasses, splash goggles and face shields,
 - b. Gloves,
 - c. Shoes,
 - d. Clothing,
 - e. Hearing Protection, and
 - f. Respirators.
2. The following engineering controls will be evaluated before each use (See Section 16.2.1 - Daily inspections for other relevant information):
 - a. Local exhaust ventilation hoods,
 - b. Chemical fume hoods.

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.

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. The test results will be documented

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 will 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 will be documented.

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

Note: In addition to the following generic laboratory procedures, each laboratory should develop standard operating procedures specific to their operations. These would include special operations and highly toxic chemicals. (*See sections 18.1 and 18.2 for details and Appendix E - Sample Standard Operating Procedure*)

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 that 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.*)

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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 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 Laboratory Supervisor (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.

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 Division of Physical Facilities -
(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.

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 and replaced as necessary.

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) your 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

The Ohio Fire Code regulates storage of flammable liquids. 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 as recommended on Material Safety Data Sheets from the manufacturer.

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 cylinders contain large amounts of potential energy which when transformed to kinetic energy 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. Stand on the side of the cylinder opposite the regulator 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 - glove bags, glove boxes, fume hoods.

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

Examples of these chemicals are listed in Tables 9,10 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 11.

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.

17.9 OXIDIZERS

17.9.1 Hazards

Oxidizers are chemicals that evolve or give off oxygen. They will greatly accelerate the rate of combustion of fuels in a fire. They are highly reactive and can form explosive mixtures with other substances.

17.9.2 Storage

Oxidizers should be stored separately (segregated) from flammable and combustible materials.

Maintain the minimum quantity necessary for laboratory work. Dispose of unneeded materials immediately.

17.9.3 Controls

Review literature regarding the reactivity of oxidizers. Utilize protective shields and perform experiments with oxidizers in a fume hood. Use the hood sash as a shield. Clean up spills of oxidizers immediately and dispose of waste accordingly.

17.9.4 Examples of Oxidizers

Examples of oxidizers are listed in Table 12

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

18.1 CHEMICALS REQUIRING PRIOR APPROVAL

1. *The following procedures must be developed and included with this chemical hygiene plan for all work with "Select Carcinogens", reproductive toxins, and substances that 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.

