Environmental Health and Safety

Chemical Hygiene Plan

January 2015

Hazardous Material Emergency – Contact Phone Numbers

Emergency – Contact Campus Police 911 from campus phone or 704-687-2200

Campus Police will make contact with Charlotte Fire Department and Environmental Health and Safety Office. Hazardous Materials Response team will respond if conditions warrant.

Non-emergency - Contact department laboratory manager or Environmental Health and Safety Office / Chemical Hygiene Officer at 704-687-1111.

TABLE OF CONTENTS

List of Appendices

1.0 Introduction

The University Chemical Hygiene Plan applies to all University employees AND students engaged in the laboratory use of hazardous chemicals. It sets forth procedures, work practices and equipment intended to protect employees from the safety and health hazards presented by the laboratory workplace. The basis for the Chemical Hygiene Plan is the Occupational Safety and Health Administration (OSHA) standard 1910.1450 - Occupational exposure to hazardous chemicals in laboratories (see Appendix O, hereafter referred to as the "Lab Standard"). Definitions of key terms used in the Chemical Hygiene Plan can be found in the definitions section of the OSHA Lab Standard - 1910.1450 (b). A review of the definitions for "hazardous chemical," "laboratory," "laboratory scale," and "laboratory use of hazardous chemicals" confirms that the Lab Standard applies to most University laboratories.

Strictly speaking, unpaid students working within academic laboratories are not considered "laboratory workers" by OSHA (OSHA's jurisdiction is limited to paid employees). However, the University requires that students comply with this document, as well as the Lab Standard. In addition, the University will apply the provisions of the Chemical Hygiene Plan to students, in order to afford them the same level of protection as University employees.

All University laboratory workers (including students) must be made aware of the Chemical Hygiene Plan and should review its contents.

The University Chemical Hygiene Plan includes:

1. The assignment of responsibilities under the plan, in addition to those set forth in the University Environmental Health and Safety Policy (Policy Statement 703);
2. General principles for working with laboratory chemicals;
3. Guidelines for the development of laboratory facilities;
4. Standard Operating Procedures (SOPs) for the use of University laboratory facilities;
5. Basic rules and procedures for working with chemicals; and
6. Several appendices that provide information useful in compliance with the Lab Standard and this document.

The Chemical Hygiene Plan and the University Handbook for Radiation Safety are both applicable to laboratories in which radioactive materials are used.

The University Chemical Hygiene Plan shall be reviewed at least annually by the EHS Chemical Hygiene Officer and revised as needed.

2.0 Chemical Safety and Hygiene Responsibilities

In addition to those defined by the University Environmental Health and Safety Policy Statement, the following individuals assume responsibility for the implementation of this plan as described below.

1. The Environmental Health and Safety Director is responsible for:

    a. Planning and recommending environmental health and safety programs which comply with all federal, state and local laws and regulations;
    b. Overseeing the activities of the Chemical Hygiene Officer;
    c. Ensuring implementation of the University Hazardous Waste Management Program

2. The Chemical Hygiene Officer, under the direction of the Environmental Health and Safety Director has responsibility to:

    a. Develop the Chemical Hygiene Plan and program;
    b. Work with administrators, principle investigators and laboratory workers to implement appropriate chemical hygiene policies and practices, including assistance with laboratory specific safety plans;
    c. Monitor procurement, use, and disposal of chemicals used in the lab;
    d. Conduct or oversee appropriate laboratory inspections to assure compliance with the Chemical Hygiene Plan;
    e. Help project managers plan adequate laboratory facilities as needed;
    f. Maintain the central Safety Data Sheet (SDS) file, which is mandated by both the OSHA Lab Standard and Hazard Communication Standard;
    g. Know the current legal requirements concerning regulated substances; and
    h. Annually review the chemical hygiene program and seek ways to improve it.

3. The Department Chair or Manager has overall responsibility for chemical hygiene within their respective department.

4. The Principle Investigator has overall responsibility for chemical hygiene in the laboratory including responsibility to:

    a. Be familiar with the regulations and University policies and programs which pertain to his or her laboratory;
    b. Ensure that a laboratory safety plan (see section 10.0) is reviewed by all personnel and is up to date with current laboratory practices;
    c. Ensure that workers know and follow the chemical hygiene rules, that protective equipment is available and in working order, and that appropriate training has been provided;
    d. Provide regular, informal chemical hygiene and housekeeping inspections, including routine inspections of emergency equipment (in addition to, or in conjunction with, laboratory reviews performed by EHS);
    e. Produce an annual chemical inventory list which includes all chemicals present in their laboratory spaces (see recommended form, Appendix L);
    f. Know the current legal requirements concerning regulated substances used in their laboratories;

g. Determine (with the assistance of EHS) the required levels of protective apparel and equipment, ensure its availability to laboratory personnel and enforce its use;
h. Request assistance from EHS as needed;
i. Allocate or secure funds for health and safety improvements as required for the conduct of new operations; and
j. Ensure that facilities and training for use of any material being ordered are adequate.
k. Ensure that the laboratory is properly decommissioned after the completion of research activities and prior to departure from the University. Please see Laboratory Decomissioning Procedure.

5. Laboratory workers (including students), are responsible for:

a. Understanding and complying with University policies and programs which pertain to his or her laboratory work, including the planning and conducting of each operation in accordance with the University Chemical Hygiene Plan and program;
b. Using appropriate personal protective equipment as required by the operation being conducted;
c. Refraining from the operation of any equipment without authorization and proper instruction;
d. Following both oral and written instructions from his or her principle investigator or supervisor;
e. Requesting information and training when unsure how to handle a hazardous chemical or procedure;
f. Reporting to his or her principle investigator or supervisor any unsafe conditions, accidents or chemical exposures; and
g. Developing and using good personal chemical hygiene habits.

3.0 The Laboratory Facility

The laboratory facility should have adequate, well-ventilated stockrooms/storerooms, laboratory hoods, sinks and other safety equipment, including eyewash fountains and drench showers. There should be an alarm system to alert occupants to fires and other incidents in all parts of the facility, including isolation areas such as cold rooms. Chemical hygiene related equipment (hoods, etc.) should be periodically inspected and repaired where applicable. The work conducted and its scale must be appropriate to the facilities.

3.1 Housekeeping

Floors should be cleaned regularly. Stairways and hallways should not be used as storage areas. Access to exits, emergency equipment, and utility controls should never be blocked. The work area should be kept clean, and chemicals and equipment should be properly stored. Lab workers should always keep their immediate work area uncluttered, and clean it up upon completion of an operation and at the end of each day.

3.2 Maintenance

Equipment should be maintained in serviceable condition. Preventive maintenance schedules should be established for equipment as required. Machine guards and shielding should remain in place, and be replaced if removed for maintenance or repairs.

3.3 Signage

The following signs shall be posted conspicuously:

1. Emergency telephone numbers of emergency personnel/facilities, supervisors, and laboratory workers (*see Appendix L for contact person label form*) should be posted on entrance door;
2. Location signs for safety showers, eyewash stations, other safety and first aid equipment;
3. Exits; and
4. Warnings at areas or equipment where special or unusual hazards exist.

3.4 Safety Equipment

Safety and emergency equipment should be available,. Drench-type safety shower, eyewash fountain and fire extinguisher, fire alarm and telephone for emergency use must be easily accessible to each lab.

3.5 General Ventilation

The general ventilation system should have air intakes and exhausts located so as to avoid the intake of contaminated air. This system must provide a source of fresh air for occupants and for replacement of air exhausted by local ventilation devices (hoods), but it should not be relied on for protection from toxic substances released into the laboratory. It must ensure that laboratory air is continuously replaced (4-12 room air changes/hour is normally adequate general ventilation if local exhaust systems such as hoods are used as the primary method of control), preventing the increase of air concentrations of toxic substances. General airflow should not be turbulent and should be relatively uniform throughout the laboratory, with no high velocity or static areas. Air diffusers and grilles should be designed and located such that air is directed over laboratory personnel and towards the lab exhaust, moving contaminated air away from workers' breathing zones. The static air pressure within the lab must be less than that of adjacent spaces, such that airflow is into the laboratory from non-laboratory areas. Any alteration of the ventilation system should be made only if thorough testing indicates that worker protection from airborne toxic substances will continue to be adequate. Quality and quantity of ventilation should be evaluated on installation, regularly monitored and reevaluated whenever a change in local ventilation devices is made. Problems with the general ventilation of the laboratory should be reported to Facilities Management Customer Service Representative at 687-0562.

3.6 Local Exhaust Ventilation (Fume Hoods)

Laboratory hoods should be selected and installed to comply with Industrial Ventilation, published by the American Conference of Governmental Industrial Hygienists (ACGIH), applicable American Society of Heating, Refrigerating and Air-conditioning Engineers (ASHRAE) standards, and the National Fire Protection Association (NFPA) codes 91

(Blower and Exhaust Systems) and 45 (Fire Protection for Laboratories Using Chemicals).

The chemical fume hood is the most important engineering control in the reduction and prevention of exposure of laboratory workers to hazardous materials found in the laboratory. It is an effective means of capturing toxic, carcinogenic, offensive or flammable mists, vapors, fumes or dusts that would otherwise be released into the laboratory environment. Hoods can also provide a physical containment for laboratory operations.

Laboratory hoods should have a continuous monitoring device to allow convenient confirmation of adequate hood performance before use. Airflow into and within the hood should not be excessively turbulent; hood face velocity should be adequate (typically 80-100 linear feet per minute). Average face velocity will be measured annually in accordance with ASHRAE 110-1995. Fume hoods not meeting the required face velocity will be removed from service.

Laboratory hoods should not be used for chemical storage. Excessive loading of the bench significantly detracts from hood performance. Ventilated storage cabinets, canopy hoods, snorkels, etc. should be provided as needed. Allowing volatile chemicals to evaporate within the hood is an unacceptable means of disposal.

When necessary, equipment in hoods should be fitted with traps, condensers or filters to remove hazardous gases, vapors or dusts and prevent their release to the environment. Operations should be performed at least six inches from the face of the hood to prevent interference from cross drafts (a stripe on the bench surface is a good reminder). Place large objects in the hood up on blocks to allow air flow under them. When the hood is in use, the sash should be lowered as far as practical. The sash should not be raised above the 100 feet per minute (fpm) mark when hazardous substances are being used in the hood. The sash can protect workers from chemical splashes and sprays, as well as fires and minor explosions.

When a hood is found to be out of order, all hazardous chemicals should be capped or removed. Laboratory personnel should contact Facilities Management as soon as possible for repair. The hood should be clearly labeled as “Out of Order” until repaired.

Do not use perchloric acid in an ordinary laboratory fume hood. When perchloric acid is heated above ambient temperature, vapors may condense within the exhaust system and form explosive perchlorates. To use perchloric acid, a special perchloric acid hood with a dedicated exhaust and wash down system is required. Identify perchloric hoods with appropriate signage, and do not use them as general purpose fume hoods. Contact EHS for additional considerations, procedures and precautions for the selection and use of perchloric acid fume hoods.

4.0 Chemical Receiving, Distribution and Storage

4.1 Receiving

Before a substance is received, the individual who requisitioned the material must obtain information on proper handling, storage, and disposal. They must be aware of all hazardous properties of the material, and determine if the facilities where it will be used and the training of the personnel involved are adequate. Often the Safety Data Sheet (SDS) will provide the required information. An accessible copy of the SDS must be kept in the Laboratory/Department and one copy forwarded to EHS for entry into the MSDS Online system. Receiving personnel should be advised that the material has been ordered and should be familiar with the appropriate DOT shipping labels. No container will be accepted without an appropriate identifying label.

The label should contain the following information (as a minimum):

1. Name, address and telephone Number of the chemical manufacturer, importer or other responsible party
2. Product Identifier
3. Signal Word
4. Hazard Statement(s)
5. Precautionary Statement(s)
6. Pictogram(s)

4.2 Chemical Distribution

The method of transport of chemicals should reflect both the potential danger and the potential for facility disruption, posed by a specific substance. For example, for highly toxic or caustic materials, particular attention must be paid to the personal protection of the transporter.

When chemicals are hand carried, the container should be placed in an outside container or bucket. Freight-only elevators should be used when possible. Carts should be sturdy and have adequately sized wheels. Flammable liquids should only be transported in proper containers.

Compressed gas cylinders must be handled carefully. The valve cover must always be in place for transport. Cylinders should never be rolled or dragged. A handcart should be utilized with the cylinder strapped in place, even for short distances.

4.3 Chemical Storage

Due to the huge array of chemicals that are found in the academic laboratory, chemical storage at a university is a complex subject. Below are some general guidelines. Information on the storage of a specific chemical can be obtained from the Laboratory Chemical Storage Scheme Table (see Appendix J), the container label, the SDS, or by contacting EHS.

Chemicals that are highly toxic should be stored in unbreakable secondary containers. Stored chemicals should be examined periodically (at least annually) for deterioration and container integrity. It is recommended that more hazardous chemicals are stored below eye level. Stockrooms/storerooms should not be used as preparation or repackaging areas and should be controlled by one person.

Pyrophoric materials must be stored in tightly closed containers under an inert atmosphere or liquid. Pyrophoric materials are those that are capable of spontaneous combustion in the presence of air (see Appendix H). All transfers and manipulations of pyrophoric materials must also be carried out under an inert atmosphere or liquid.

Compressed gas cylinders must be stored in an upright position and securely restrained. Full cylinders not in use should have the valve cover in place. Full cylinders must be kept separate from empty cylinders. Cylinders with flammable contents should be separated from oxygen containing cylinders by at least 20 feet.

Amounts of chemicals stored within the laboratory itself should be as small as practical. Storage on bench tops and in hoods is inadvisable. Exposure to heat or direct sunlight should be avoided. Periodic inventories should be conducted, with unneeded items being discarded or returned to the storeroom/stockroom.

Stockroom personnel should be trained in the handling and spill remediation of the hazardous substances under their control.

1. Chemicals should be grouped according to the following groups (many have special storage requirements):
   Flammable (see Appendix A) liquids should be stored in flammable-liquid cabinets. If the laboratory contains ten or more gallons of flammable liquids, the use of a flammable-liquid cabinet is mandatory. Generally includes peroxide forming chemicals (also see Appendix A), which have the potential for explosion, and shall be stored in a cool, dark, dry location, with appropriate labels which include the date opened. These chemicals should be disposed of as hazardous waste within one year of opening.

2. Volatile toxics and poisons (see Appendix B) – Can be stored with flammables in a flammable storage cabinet if there are no other incompatible considerations. Alternative is any enclosed cabinet or shelf to protect from breakage below bench level. These are not to be stored with bases.

3. Oxidizing and non-oxidizing inorganic acids (see Appendix C) - should be stored in corrosives cabinets, separate from non-oxidizing inorganic acids, flammables, and each other by containment trays.

4. Organic Acids (See Appendix D) – should be stored in a vented cabinet under a fume hood. Do not store with with bases. Hydrofluoric Acid should be kept in separate storage. Acetic Acid should be stored in a flammable cabinet with other flammables.

5. Concentrated inorganic bases (Appendix E) should be stored separately from inorganic acids and halogenated organics (volatile toxics).

6. Oxidizing Liquids and Reactives, excluding oxidizing acids – (Appendix F) should be stored separately from all other chemicals as they are highly reactive. Never store these with flammables.

7. Non-volatile Toxics – (Appendix G) - may be stored in any storage area, according to its chemical properties. However, they should bear the appropriate warning label (when required).

8. Pyrophorics and Water Reactives – (Appendix H) – these products should always be isolated from other liquid chemicals and in double containment. They can be stored with dry chemicals if absolutely necessary.

9. Dry Solids (Appendix I) – This general grouping of chemicals should always be kept dry. Cabinets are the suggested means of storage. Always store above liquid chemicals, and keep the more toxic dry solids separate from non-toxics.

   See also Appendix Q for a list of general incompatibilities

4.4 Chemical Labeling

Chemical containers stored in the laboratory must meet minimum labeling requirements.

Manufacturer original chemical container labels must contain:
- Name, address and telephone number of manufacturer
- Product Identifier
- Signal Word
- Hazard Statement(s)
- Precautioinary Statement(s)
- Pictogram(s)

Secondary chemical container labels must contain:
- Product Identifier(s)

Note: Pictogram(s) or other symbol system can be used as best practice for labeling

In addition to manufacturers' container labels and secondary container labels, the following labels are available from the Environmental Health and Safety Office:
1) Hazardous Waste labels
2) Refrigerator no Flammables labels
3) Ethidium Bromide labels

5.0 Principles and Procedures for Working with Laboratory Chemicals

5.1 General

It is prudent to minimize all chemical exposures. Because few laboratory chemicals are without hazards, general precautions for handling all laboratory chemicals should be adopted, in addition to specific guidelines for particular types of chemicals. All potential skin contact with chemicals should be avoided.

Avoid underestimation of risk. Even for substances of no known significant hazard, exposure should be minimized; for work with substances that present special hazards, special precautions should be taken. One should assume that any mixture will be more

toxic than its most toxic components and that all substances of unknown toxicity are toxic. Care must be taken to avoid chemical incompatibilities (see Appendix Q) when planning experiments and operations.

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

Laboratory personnel chemical exposures shall be identified and managed to below established exposure guidelines. Two recognized exposure guidelines include:
OSHA Permissible Exposure Limits (PELs) (see Appendix P)
American Conference of Governmental Industrial Hygienists (ACGIH) Threshold Limit Values (TLVs). Contact EHS for assistance in identifying and measuring chemical exposure.

The Chemical Hygiene Plan requires that laboratory workers know and follow Plan rules and procedures. In addition to the general principles mentioned above, the following procedures and rules should be used for essentially all laboratory work with chemicals:

5.2 Avoidance of "routine" exposure

1. Develop and encourage safe habits.
2. Avoid unnecessary exposure to chemicals by any route.
3. Do not smell or taste chemicals.
4. Vent apparatus which may discharge toxic chemicals (vacuum pumps, distillation columns, etc.) into fume hoods.
5. Inspect gloves and test glove boxes before use.
6. Do not allow release of toxic substances in cold rooms and warm rooms, since these often have contained, recirculated atmospheres.
7. Use only those chemicals for which the available ventilation system is appropriate.

5.3 Equipment and glassware

1. Handle and store laboratory glassware with care to avoid damage; do not use glassware that is cracked, scratched, or showing other signs of wear or damage.
2. Use extra care with Dewar flasks and other evacuated glass apparatus; shield or wrap them to contain chemicals and fragments should implosion occur.
3. Use equipment only for its designed purpose.
4. In the event of breakage, clean broken glassware with a brush and dustpan. Always wear hand protection if it is necessary to handle broken glassware.
5. Never dispose of broken glass in the laboratory's general refuse container. Place all broken glassware in separate, dedicated puncture-proof box with a clear plastic liner.

5.4 Personal habits

1. Wash areas of exposed skin well before leaving the laboratory.
2. Avoid practical jokes or other behavior that might confuse, startle or distract another worker.
3. Do not use mouth suction for pipeting or starting a siphon.
4. Be alert to unsafe conditions and see that they are corrected when detected.
5. Do not eat, drink, smoke, chew gum, or apply cosmetics in laboratories or areas where laboratory chemicals are present.
6. Avoid storage, handling, or consumption of food or beverages in storage areas, refrigerators, glassware or utensils which are also used for laboratory operations.

5.5 Personal and protective apparel

1. Long hair should be confined.
2. Lab workers should not wear loose fitting or dangling clothing.
3. Clothing should cover as much of the worker's skin as possible.
4. Lab workers must wear close-toed shoes at all times in the laboratory - not sandals, perforated shoes, or canvas sneakers.
5. Protective apparel (lab coats, aprons, shoe covers etc.) with the required degree of protection for substances being handled should be available for each lab worker and visitor as appropriate.

5.6 Personal protective equipment

1. Assure that all persons, including visitors, where chemicals are stored or handled, wear appropriate eye protection. Wear appropriate gloves when the potential for contact with toxic materials exists; inspect the gloves before each use, wash them before removal, and replace them periodically (a table of resistance to chemicals of common glove materials is given in Appendix M).
2. Contact EHS for selection and use of respiratory protection. Refer to the UNC-Charlotte Respiratory Protection Program.
3. Use any other protective and emergency apparel and equipment as appropriate.
4. If contact lenses are worn in the laboratory, inform supervisor so special precautions can be taken.
5. Remove laboratory coats immediately when they become significantly contaminated.

5.7 Planning

1. Seek information and advice about hazards.
2. Plan appropriate protective procedures.
3. Plan the positioning of equipment before beginning any new operation.
4. Identify locations of safety equipment such as eyewash/shower stations, spill control equipment, and first-aid supplies.

5.8 Unattended operations

1. Leave the lights in the laboratory on.
2. Place an appropriate sign on the door.
3. Provide for containment of toxic substances in the event of failure of a utility service (such as cooling water).

5.9 Use of fume hood/s

1. Use the hood for operations that might result in release of toxic chemical vapors or dust.
2. As a rule of thumb, use a hood or other local ventilation device when working with any appreciably volatile substance with a Permissible Exposure Limit (PEL) of less than 50 ppm.
3. Confirm hood is performing adequately before using it by checking the EHS inspection sticker date, alarms (if applicable), and running the fume hood for a few minutes
4. Do not use Perchloric Acid, Hydroflouric Acid, or Radiation in a hood. Please contact EHS for approval.
5. Keep hood sash closed at all times, except when adjustments within the hood are being made.
6. Work at least 6 inches inside fume hood sash while wearing appropriate PPE. The general PPE requirement is lab coat, protective chemical resistant gloves, safety glasses and closed toed shoes.
7. Avoid creating air currents across the face of fume hood (e.g. pedestrian traffic, fans, keeping entrance door closed).
8. Keep materials stored in hoods to a minimum and do not allow them to block vents or airflow. Keep the work area and bottom baffles clear from clutter.
9. Remove any electrical units or spark sources from hood when using flammable liquids and/or gases.

10. Do not raise the hood above the 100 fpm mark when working with hazardous chemicals inside the hood.
11. Leave the hood "on" when it is not in active use if toxic substances are stored in it or if it is uncertain whether adequate general laboratory ventilation will be maintained when it is "off."
12. Do not modify the hood by adding unauthorized manufacture shelving, removing side panels, blocking air foil or any other manufacture unapproved modification.
13. Only use the fume hood for it is intended purpose. Do not use the fume hood for virology or bacteriology work. This work should be completed in a biosafety cabinet.

5.10 Working alone

1. Avoid working alone in a building.
2. Do not work alone in a laboratory if the procedures being conducted are hazardous.

5.11 Working with Allergens and Embryotoxins

1. Wear suitable gloves to prevent hand contact with allergens (examples: diazomethane, isocyanates, bichromates or substances of unknown allergenic activity).
2. If you are a woman of childbearing age, handle embryotoxic substances (examples: organomercurials, lead compounds, formamide) only in a hood in which satisfactory performance has been confirmed, using appropriate protective apparel (especially gloves) to prevent skin contact.
3. Review each use of these materials with the research supervisor and review continuing uses annually or whenever a procedural change is made.
4. Store these substances, properly labeled, in an adequately ventilated area in an unbreakable secondary container.
5. Notify supervisors of all incidents of exposure or spills; consult a qualified physician when appropriate.

5.12 Working with Particularly Hazardous Substances (including "Select Carcinogens")

The goal of the Chemical Hygiene Plan and program is to minimize exposure to highly hazardous chemicals, toxics and reactives (see Appendix N) using all reasonable precautions. Conduct all transfers and work with these substances in a "controlled area" (i.e. a restricted access hood, glove box, or portion of a lab designated for their use; for which all people with access are aware of the substances being used and necessary precautions). Assure that the controlled area is conspicuously marked and that all containers of these substances are appropriately labeled with identity and warning labels.

Before starting:

1. Prepare a plan for use and disposal of these materials and obtain the approval of the laboratory principle investigator.
2. Be prepared for accidents and spills. Assure that contingency plans, equipment, and materials to minimize exposures of people and property in case of accident are available.
3. Assure that at least 2 people are present at all times if a compound in use is highly toxic or of unknown toxicity.
4. Always use a fume hood or other containment device for procedures that may result in the generation of aerosols or vapors containing the substance. For a negative pressure glove box, ventilation rate must be at least 2-volume changes/hour and pressure at least 0.5 inches of water. For a positive pressure glove box, thoroughly

check for leaks before each use. When using any glove box, trap the exit gases or filter them through a HEPA filter or chemical scrubber before releasing them into the hood.

5. Cover work and storage surfaces with removable, absorbent, plastic backed paper.
6. Always avoid skin contact by use of gloves and long sleeves (and other protective apparel as appropriate).
7. Protect vacuum pumps against contamination by scrubbers or HEPA filters and vent them into the hood.
8. If use of toxicologically significant quantities of such a substance on a regular basis is anticipated, consult a qualified physician concerning desirability of regular medical surveillance.

While working:

1. Work and mount apparatus above chemically resistant trays.
2. If a major spill occurs outside the hood, evacuate the area and assure that cleanup personnel wear suitable protective apparel and equipment. Decontaminate the controlled area before normal work is resumed there. Use a wet mop or a vacuum cleaner equipped with a HEPA filter instead of dry sweeping if the toxic substance is a dry powder.

When the operation is complete:

Always wash hands and arms immediately after working with these materials.

1. Store containers of these chemicals only in a ventilated, limited access area in appropriately labeled, unbreakable, chemically resistant, secondary containers.
2. Thoroughly decontaminate contaminated clothing or shoes. Use chemical decontamination whenever possible; ensure that containers of contaminated waste (including washings from contaminated flasks) are transferred from the controlled area in a secondary container under the supervision of authorized personnel.
3. Store contaminated waste in closed, suitably labeled, impervious containers.
4. Decontaminate vacuum pumps or other contaminated equipment, including glassware, in the hood before removing them from the controlled area.

5.13 Hydrofluoric Acid Safety

Special precautions must be taken when working with hydrofluoric acid. Use the appropriate personal protective equipment as defined by the SDS. Make sure the integrity of your PPE is intact as a pinhole in a glove can have disastrous consequences. Although HF exposures can result in injury, quick response will minimize the damage. All exposures should be treated immediately even though burns may not be felt for hours. Affected personnel must receive immediate medical attention for all eye and inhalation exposures, and all but the most minor skin burns. A summary of first aid procedures is listed below:

Skin Contact – Immediately wash all affected areas with water. Be sure to remove any clothing or jewelry that could trap HF (remove goggles last). Flush skin for fifteen minutes or until medical attention is available. Flushing can be reduced to five minutes if calcium gluconate gel (2.5%) is immediately available. Apply calcium gluconate gel to the affected area (use rubber gloves) every fifteen minutes and massage continuously. Get medical attention. Calcium gluconate gel can be obtained from various vendors.

Eye Contact – Immediately flush eyes for at least fifteen minutes with water while holding eyelids open. Get medical attention. Flushing can be limited to five minutes if medical

personnel are immediately available to administer sterile calcium gluconate (1%) solution (via continuous drip).

Inhalation – Move to fresh air as soon as possible. Get medical attention. Medical personnel can administer pure oxygen and calcium gluconate (via nebulizer) to patient.

Laboratory personnel should only attempt to clean up small HF spills that do not involve personnel contamination and that are contained and under control. Be sure that good ventilation is available and that personal protective equipment is worn before attempting to clean up a HF spill.

Although accidents involving HF may not be totally eliminated, pre-planning will minimize the effects of such incidents. All laboratories that store or use HF should develop standard operating procedures that outline how to safely use HF, as well as how to respond to personnel contamination and HF spills. Please contact the Environmental Health and Safety Department for more information on HF, or for assistance in developing safe handling procedures.

5.14 Animal Work with Chemicals of High Chronic Toxicity

1. For large-scale studies, special facilities with restricted access are preferable.
2. When possible, administer the substance by injection or gavage, instead of in the diet.
3. If administering chemicals of high chronic toxicity in the diet, use a caging system under negative pressure or under laminar airflow directed toward HEPA filters.
4. Operations must utilize procedures that minimize formation and dispersal of contaminated aerosols, including those from food, urine, and feces (e.g., use HEPA filtered vacuum equipment for cleaning, moisten contaminated bedding before removal from the cage, mix diets in closed containers in a hood).
5. When working in the animal room, wear plastic or rubber gloves, fully buttoned laboratory coat or coveralls and, if needed, additional apparel and equipment such as shoe and head coverings, and respirators.
6. Dispose of contaminated animal tissues and excreta by incineration (as biohazard/medical waste).

6.0 Spills and Accidents

A written emergency plan should be established. It should include procedures for ventilation failure, evacuation, medical care, reporting, and drills. A spill control policy should be developed and should include consideration of prevention, containment, cleanup, and reporting. All accidents or near accidents should be carefully analyzed with the results distributed to all who might benefit.

6.1 Minor spills with human contamination

1. Be prepared, know where the nearest eyewash and safety shower are located.
2. Eye Contact: Promptly flush eyes with water for a prolonged period (15 minutes) while holding the eyes open (manually if necessary) and rotating the eyeballs; then seek medical attention.
3. Ingestion: Encourage the victim to drink large amounts of water. Do not induce vomiting, unless instructed to do so by the SDS or other credible source.
4. Skin Contact: Promptly flush the affected area with water (15 minutes) and remove any contaminated clothing or jewelry. When removing pullover shirts and sweaters, take care

not to contaminate the eyes. Wash affected areas with mild soap. If symptoms persist after washing, seek medical attention.
5. Consult the SDS for first-aid recommendations. Keep the SDS with the victim.
6. Promptly clean up spills, using appropriate protective apparel and equipment and dispose of all contaminated materials in accordance with the University Hazardous Waste Management Program.

6.2 Minor spills with no human contamination

1. Warn all nearby people of the spill and potential danger.
2. If the material is flammable (see Appendix A), turn off all possible sources of ignition such as Bunsen burners (DO NOT TURN OFF or ON electrical switches).
3. Evaluate the hazardous properties and size of the spill to determine if evacuation of the building or additional assistance are needed.
4. Wear appropriate personal protective equipment.
5. Absorb liquid spills using paper towels or commercially available spill absorption materials.
6. Dispose of all contaminated materials in accordance with the University Hazardous Waste Management program.

6.3 Major spills

On the UNC Charlotte campus, "large" spills of volatile hazardous materials, including chloroform, must be referred to the Campus Police by calling 911 from a campus phone or 704-687-2200 from any phone.

7.0 Personal and Environmental Monitoring

Regular measurement of airborne concentrations of hazardous chemicals is not usually justified or practical in laboratories, but may be appropriate when testing or redesigning fume hoods or other ventilation devices, or when a highly toxic substance is stored or used regularly. It is sometimes necessary to perform personal air sampling on an individual lab worker. EHS must be contacted if a lab worker believes they have received a significant chemical exposure or exhibits signs or symptoms of an overexposure to a chemical used in the lab. In addition, if there is any reason to believe that an employee's exposure approaches the OSHA action level or OSHA permissible exposure level (see Appendix P), EHS must be contacted.

EHS will evaluate exposure potential, perform personal or environmental sampling as appropriate or required, and make recommendations for reducing exposure. Lab workers will be notified in writing within one week of receipt of the results of air monitoring.

8.0 Medical Program

If a laboratory worker develops signs or symptoms associated with a hazardous chemical to which the lab worker may have been exposed, they shall be provided the opportunity to receive an appropriate medical examination. If exposure monitoring reveals an exposure level routinely above the action level (or in the absence of an action level, the PEL) for an OSHA regulated substance for which there are medical surveillance requirements, medical surveillance shall be established for the lab worker as prescribed by the particular standard. If an event takes place in the lab such as a spill, leak, explosion

or other occurrence resulting in the likelihood of a hazardous exposure, the affected lab workers shall be provided with the opportunity for a medical examination.
Anyone who believes they are exposed to, or whose work involves regular and frequent handling of, toxicologically significant quantities of a chemical should contact EHS for referral to a qualified physician to determine on an individual basis whether a regular schedule of medical surveillance is desirable.

9.0 Training Program

The goal of information dissemination and training is to assure that all individuals at risk are adequately informed about the nature of work in the laboratory, its risks, and what to do if an accident occurs. All personnel of the laboratory shall be trained in the proper use of protective/emergency equipment and procedures. Literature and consulting advice concerning chemical hygiene is readily available to laboratory personnel through EHS.

The principle investigator, instructor or lab manager shall ensure that lab workers receive the required training, and that their laboratory has a laboratory specific safety plan. EHS has developed a Laboratory Environment Training Checklist that will assist Principle Investigators with meeting basic safety training requirements as well as safety tools that can be used to compile a laboratory specific safety plan. Training shall be at the time of initial assignment to the laboratory and periodically thereafter as needed. Training must be documented (e.g. EHS Laboratory Environment training checklist, EHS training attendance form, etc.) and at a minimum cover the following requirements:

1. The contents of the OSHA Lab Standard and it's appendices;
2. The location, availability and applicable contents of the University Chemical Hygiene Plan;
3. The permissible exposure limits for OSHA regulated substances used in the lab; or, if the substance is not regulated by OSHA, the NIOSH recommended exposure limit or ACGIH threshold limit value;
4. Signs and symptoms associated with exposures to hazardous chemicals used in the laboratory;
5. The location and availability of known reference material on the hazards, safe handling, storage and disposal of hazardous chemicals found in the laboratory including, but not limited to SDSs received from the chemical supplier;
6. Methods and observations that may be used to detect the presence or release of a hazardous chemical (such as monitoring conducted by EHS, continuous monitoring devices, visual appearance or odor of hazardous chemicals being released, etc.)
7. The physical and health hazards of chemicals in the laboratory and the measures lab workers can take to protect themselves from these hazards, including specific procedures the University has implemented to protect lab workers from exposure to hazardous chemicals, such as appropriate work practices, emergency procedures, and personal protective equipment to be used.
8. EHS offers online general laboratory safety training tools (http://safety.uncc.edu/training)
9. A Laboratory Safety Plan including Chemical Guidance Documents provided by EHS that is pertinent to the individual laboratory. Some examples of these guidance documents include:
   - Chemical Storage Guidelines (post in lab)
   - Chemical Standard Operating Procedures, including but not limited to:
     - Diethyl Ether
     - Ethidium Bromide
     - Mercury

    - Hydrogen Peroxide
    - Nitric Acid
    - Chloroform
    - Formalin and Paraformaldehyde
    - Sulfuric Acid
    - Acrylamide
- Laboratory Fact Sheets
    - Cryogenic Materials
    - Hazardous Waste
    - Laboratory Fume Hoods
    - Lab Glassware Safety
    - Working Safely With Nanomaterials
    - Transporting Chemicals on Campus
- Experiment Standard Operating Procedures not provided on EHS website

10.0 Inspections

Formal safety and chemical hygiene inspections should be performed frequently by PI's or lab managers.. Eye wash fountains should be inspected monthly. Other safety equipment should be inspected regularly. (e.g., every 3-6 months).

Laboratory fume hoods will be inspected and certified by EHS at least annually. Hoods that do not meet the criteria for acceptable performance shall be labeled as such and arrangements made for their repair.

11.0 Waste Disposal Program

The goal of proper waste disposal is to assure that minimal harm to people, other organisms, and the environment will result from the disposal of laboratory chemicals. Hazardous waste disposal shall be in accordance with the University Hazardous Waste Management Program. The Hazardous Waste Management Program specifies how waste is to be segregated, stored, and transported. Transport from the institution must be in accordance with DOT regulations. Unlabeled containers of chemicals and solutions should undergo prompt disposal; if partially used, they should not be opened except by highly trained personnel using appropriate personal protective equipment.

Before a worker's employment in the laboratory ends, chemicals for which that person was responsible should be discarded or returned to storage. Waste should be removed from laboratories to a central waste storage area at least once per week and from the central waste storage area at regular intervals. Indiscriminate disposal by pouring waste chemicals down the drain or adding them to mixed refuse for landfill burial is unacceptable. Hoods should not be used as a means of disposal for volatile chemicals. Disposal by recycling or chemical decontamination should be used when possible.

12.0 Records

This section reviews the requirements for documenting the University's compliance with the Chemical Hygiene Laboratory Standard. The Laboratory Standard requires the following records be maintained for at least 30 years and that they be accessible to the laboratory workers or their representative.

- Air concentration monitoring results
- Exposure assessments
- Medical evaluations
- Medical examination

In additional to the above, training, complaint, equipment repair, inspection and incident records should be retained.

Appendix A Flammables/Combustibles and

Peroxide Formers

FLAMMABLES AND COMBUSTIBLES

2-MERCAPTOETHANOL
2-NITROPROPANE
ACETIC ACID, GLACIAL
ACETONE
BENZALDEHYDE
BENZENE BENZYL ALCOHOL
BROMOBENZENE
CARBON DISULFIDE
CAPROIC ACID
CHLOROBENZENE
COLLODION
CYCLOHEXANOL
DIMETHYL SULFIDE
EPICHLOROHYDRIN
ETHYL ACETATE
ETHYL ALCOHOL
ETHYLENE GLYCOL
ETHYLENE OXIDE
FORMIC ACID
GASOLINE
METHACRYLIC ACID
METHYL ALCOHOL
METHYL ETHYL KETONE
MORPHOLINE
N-HEXANE
NITROBENZENE
N-BUTANOL
PENTANE
PHENYL ETHER
PROPANE
PYRIDINE
STEARIC ACID
STODDARD SOLVENT
TEMED
TERT BUTYL ISOCYANATE
TOLUENE TRIETHYLAMINE
TURPENTINE
TERT BUTYL ISOCYANATE
XYLENE

Reference:
Safety data sheets (SDS)
National Fire Protection Agency document NFPA 321: *Classification of Flammable and Combustible Liquids*, 1991 Edition.

PEROXIDE FORMERS

1-PENTENE
1,3,5,7-CYCLOOCTATETRAENE
2-BUTANOL
2-PENTANOL
2-PROPANOL
4-METHYL-2-PENTANONE
ACETAL ACETALDEHYDE
BENZYL ALCOHOL
BUTADIENE
BUTYL ETHER
CROTONALDEHYDE
CUMENE
CYCLOHEXANE
CYCLOPENTENE
DECALIN(DECAHYDRONAPHTHALENE)
DIBUTYL ETHER DIETHYLENEGLYCOL
DIMETHYL ETHER DIETHYL ETHER
DIETHYLENE OXIDE
DIISOPROPYL ETHER
DIMETHYL ETHER
DIOXANE
DIVINYL ACETATE
DIVINYL ETHER
ETHER
ETHOXY ACETATE
ETHYL ETHER
ETHYLENE GLYCOL MONO ETHER
ETHYLENE GLYCOL DIMETHYL ETHER
FURAN
HEXONE
ISOPROPYL ETHER METHYL
ISOBUTYL KETONE
PERFLUOR ETHENE
POTASSIUM AMIDE SODIUM
AMIDE STYRENE
TETRAFLUOROETHYLENE
TETRAHYDROFURAN
TETRAHYDRO NAPHTHALINE
VINYL ACETATE
VINYL ACETYLENE
VINYL CHLORIDE
VINYL ETHERS
VINYLIDENE CHLORIDE

Appendix B

Volatile Toxins (Halogenated Solvents, Carcinogens,.Toxins)

ACETONITRILE CARBON
TETRACHLORIDE
CHLROFORM
DICHLOROMETHANE
DIMETHYL SULFATE
DIMETHYL SULFOXIDE
HALOGENATED ORGANICS
HALOMETHANE
HALOTHANE
MERCAPTOETHANOL
METHYLENE CHLORIDE
PERFLUOROHEXANE
PHENOL
TRITON X100

KNOWN CARCINOGENS

ACETALDEHYDE
AMINOBIPHENYL
ARSENIC
ASBESTOS
AZATHIOPRINE
BENZENE
BENZIDINE
BERYLLIUM COMPOUNDS
BIS(CHLOROMETHYL) ETHER
1,4-BUTANEDIOL DIMETHYL-SULFONATE
1,4-BUTANEDIOL DIMETHYL-SULFONATE
CHROMIUM / CHROMIUM COMPOUNDS
CYCLOPHOSPHAMIDE
ETHYLENE OXIDE
FORMALDEHYDE
SILICA DUST (AS QUARTZ/CRISTOBALITE)
VINYL CHLORIDE

Reference: National Toxicological Report KNOWN CARCINOGENS, 7th ANNUAL REPORT ON CARCINOGENS 199

Appendix C

Inorganic Acids

OXIDIZING

CHLORIC ACID
CHLOROSULFONIC ACID
CHROMIC ACID
FLOUROSULFONIC ACID
NITRIC ACID
NITROSULFONIC ACID
PERCHLORIC ACID
SELENIC ACID
SULFURIC ACID

NON-OXIDIZING

BORIC ACID
HYDROBROMIC ACID
HYDRIOTIC ACID
HYDROCHLORIC ACID
HYDROFLUORIC ACID
PHOSPHORIC ACID
SULFURYL ACID

Appendix D

Organic Acids

ACETIC ACID
ACRYLIC ACID
ACETIC ANHYDRIDE
BENZOYL BROMIDE
BENZOYL CHLORIDE
BENZYL BROMIDE
BENZYL CHLORIDE
BUTYRIC ACID
CHLOROACETIC ACID
DIMETHYL SULFATE
FORMIC ACID
GLACIAL ACETIC ACID
ISOBUTYRIC ACID LACTIC
ACID METHYL
CHLOROFORMATE PHENOL
PICRIC ACID
PROPIONIC ACID PROPIONYL
BROMIDE PROPIONYL
CHLORIDE SALICYLIC ACID
TRICHLOROACETIC ANHYDRIDE
TRIFLUOROACETIC ACID

Appendix E Inorganic

Bases / Alkaline

AMMONIUM HYDROXIDE
AMMONIUM SULFIDE
BARIUM HYDROXIDE
CALCIUM HYDRIDE
CALCIUM HYDROXIDE
CALCIUM OXIDE
HYDRAZINE
POTASSIUM HYDROXIDE
SODIUM CARBONATE
SODIUM HYDROXIDE
SODIUM HYDRIDE
STRONTIUM CARBONATE

Appendix F

Common Laboratory Oxidizers (Excluding Acids)

THE FOLLOWING CLASSES OF CHEMICALS ARE USUALLY CLASSIFIED AS OXIDIZERS:

BROMATES	CHLORATES	PERCHLORATES	CHLORITES
CHROMATES	HYPOCHLORITES	DICHROMATES	PEROXIDES
SUPEROXIDES	NITRATES	NITRITES	PERMANGANATES
PERSULFATES			

SOME SPECIFIC EXAMPLES:

AMMONIUM PERCHLORATE	AMMONIUM PERMANGANATE
BARIUM PEROXIDE	BROMINE
CALCIUM CHLORATE	CALCIUM HYPOCHLORITE
CHLORINE TRIFLUORIDE	CHROMIUM ANHYDRIDE
CHROMIC ACID	DIBENZOYL PEROXIDE
FLUORINE	HYDROGEN PEROXIDE (>30%)
LEAD DIOXIDE	MANGANESE DIOXIDE
MAGNESIUM PEROXIDE	NITROGEN TRIOXIDE
PERCHLORIC ACID	POTASSIUM BROMATE
POTASSIUM CHLORATE	POTASSIUM PEROXIDE
PROPYL NITRATE	SODIUM CHLORATE
SODIUM CHLORITE	SODIUM PERCHLORATE

References: CRC Handbook of Laboratory Safety, 3rd edition.

Appendix G

Non-Volatile Toxins

ACRYLAMIDE
BROMOPHENOL BLUE
ETHIDIUM BROMIDE
FORMAMIDE
IGEPAL
SODIUM DODECYL SULFATE
TRIETHANOLAMINE TRIZMA
BASE

Appendix H

PYROPHORIC AND WATER REACTIVE CHEMICALS

Pyrophoric Materials

Class of Pyrophoric Compounds	Examples
Finely divided metals	calcium, zirconium
Alkali metals	sodium, potassium
Metal hydrides or nonmetal hydrides	germane, diborane, sodium hydride, lithium aluminum hydride
Partially or fully alkylated derivatives of metal and nonmetal hydrides	diethylaluminum hydride, trimethylphosphine
Alkylated metal alkoxides or nonmetal halides	diethylethoxyaluminum, dichloromethylsilane
Metal carbonyls	pentacarbonyliron, octacarbonyldicobalt, nickel carbonyl
Used hydrogenation catalysts	Especially hazardous because of the adsorbed hydrogen
Phosphorus (white)	Grignard reagents

Water Reactive Materials

Aluminum Alkyl Halides	Ferrosilicon
Aluminum Alkyl Hydrides	Lithium
Aluminum Borohydride	Lithium Borohydride
Aluminum Carbide	Lithium Hydride
Aluminum Ferrosilicon	Lithium Nitride
Aluminum Hydride	Lithium Silicon
Aluminum Phosphide	Magnesium Alkyls
Barium	Magnesium Hydride
Calcium	Magnesium Phosphide
Calcium Carbide	Methyl Magnesium Bromide, in ethyl ether
Calcium Hydride	Potassium Alloys
Calcium Phosphide	Rubidium
Calcium Silicide	Sodium
Cesium	Sodium hydride
Diethyl, Demethyl Zinc	Trichlorsilane
Ethyldichlorisilane	Zinc powder

Reference: *Bretherick's Handbook of Reactive Chemical Hazards*.

Appendix I – Dry Solids

Common Dry Solids

The following are some common dry solids found at University of North Carolina-Charlotte

AGAROSE
ALBUMIN, FROM BOVINE SERUM
ALUMINA ALUMINUM CHLORIDE
ALUMINUM OXIDE AMMONIUM
ACETATE AMMONIUM
CARBONATE
AMMONIUM PERSULFATE
AMMONIUM SULFATE
BORIC ACID
BOVINE SERUM ALBUMIN
BROMOPHENOL BLUE
CALCIUM CARBONATE
CITRIC ACID
CUPRIC SULFATE
DODECYL SULFATE
EDTA
EGTA ETHYLENE
OXIDE GLYCINE
HYDRAZINE HYDRATE
HYDROXYLAMINE HYDROCHLORIDE
IMIDAZOLE
L-ASCORBIC ACID
MAGNESIUM SULFATE
METALS, VARIOUS
METHYL CELLULOSE
OXALIC ACID
PARAFORMALDEHYDE
PONCEAU S POTASSIUM
CARBONATE POTASSIUM
CHLORIDE
POTASISUM HYDROXIDE
POTASSIUM PHOSPHATE
SALICYLIC ACID
SODIUM ACETATE
SODIUM AZIDE SODIUM
BICARBONATE SODIUM
CHLORIDE SODIUM
HYDROXIDE SODIUM
THIOCYANATE
SUCCINIC ACID
SUCROSE
SULFANILAMIDE
TRIS BASE UREA

Appendix J

Laboratory Chemical Storage Scheme Table – UNC-Charlotte

Group	Properties	Important Notes	Storage	Examples
Group I **Flammables and Combustibles** 	Flammable liquids have a flashpoint (FP) below 100 F (38 C) Combustible liquids have a FP above 100 F FP is the lowest temperature at which a liquid gives adequate vapor to ignite	The SDS provides the flashpoint (FP) for flammable/combustible liquids Combustible liquids with FP>140 F do not require storage in flammable cabinets. Ignition sources include sparks from outlets and static electricity	Flashpoint(FP) < 140F, store in a metal flammable cabinet with no vents, slots, holes Never store in cold rooms or refrigerators that are not explosion proof Do not store with oxidizers or inorganic acids	All alcohols: butanol, isopropanol, methanol, etc. Acetone, acetaldehyde, acetonitrile, amyl acetate, benzene, cyclohexane, dioxane, ether, ethyl acetate, hexane, hydrazine, methyl butane, picolene, pyridine, tetrahydrofuran (THF), toluene, xylene, etc.
Peroxide-formers (Generally Group I) 	Highly flammable, low-power explosives are very sensitive to shock, sparks, light, strong oxidizers / reducers, friction, high temperatures.	Distillation, evaporation, or other concentration can present a high risk of explosion	Store with flammables. Date when received and opened. Dispose of as hazardous waste within 6 months.	Ether (diethyl and isopropyl), THF acetaldehyde, etc.
Group II (volatile) and VII (non-volatile) Toxics - poisons, halogenated solvents, carcinogens, mutagens, teratogens 	Chronic exposure is a health hazard. Avoid exposure to skin, inhalation. Many toxic solvents are highly volatile. Non-flammable (some combustible) Halogenated Organics	Chloroform stabilized with amylene can become unstable over time. Date chloroform bottle when it is received and discard as hazardous waste after one year. Commonly mistaken for a flammable liquid.	OK to store with flammables in flammable cabinet in unbreakable containers. Alternative: Any enclosed cabinet or shelf to protect from breakage below bench level. Do not store with bases.	Volatile toxics: carbon tetrachloride, chloroform, dimethyl sulfate, halothane, mercaptoethanol, methylene chloride, phenol. Non-volatile toxics: acrylamide solutions, ethidium bromide, triethanolamine
Group III (oxidizing acids and Inorganic/Mineral Acids) 	**Oxidizing acids are highly reactive and may react with each other.**	**Concentrated (>70%) perchloric acid reacts with wood and paper and may ignite. Never store on wood shelves.**	**Oxidizing acids should be separated from each other by use of plastic tubs. Oxidizing acids can be stored with mineral acids but not organic acids.**	**Oxidizing Inorganic Acids: Nitric, sulfuric, perchloric, chromic** **Non-oxidizing inorganic acids: hydrochloric, phosphoric, hydrofluoric**
Group IV (Organic Acids) 	**Corrosive burns to skin and eyes**	**Acid mist escapes from closed bottles and builds up inside unvented cabinets causing corrosion.**	**Store in a vented cabinet under fume hood.** **Do not store with bases. Keep Hydrofluoric in a separate tub or tray.**	**Organic Acids: acetic, acrylic, acetic anhydride, butyric, formic, glacial acetic, isobutyric, trichloroacetic anhydride, trifluoroacetic, etc.**

Group	Properties	Important Notes	Storage	Examples
Group V – Inorganic Liquid Bases / Alkaline 	Corrosive burns to skin and eyes	Avoid contact with any acids and volatile toxics	Store in separate cabinet below eye level. Alternative: Store with other chemicals and keep in separate tray. Do not store with inorganic acids or halogenated organics (volatile toxics).	Sodium hydroxide, ammonium hydroxide, calcium kydroxide, potassium hydroxide, aqueous ammonia
Group VI Oxidizing Liquids (Excluding Oxidizing Acids) 	**Provides oxygen that feeds fires and makes fires difficult to extinguish**	**The oxidizer symbol may be mistaken for the flammable symbol**	**Store on a separate shelf.** **If stored near any other chemicals, including oxidizers, keep in separate tub/tray.** **Do not store with flammables.**	**Perchlorates, Persulfates, Hydrogen Peroxide ≥30%**
Group VIII – Pyrophorics and Water Reactives 	**Ignite spontaneously in air. Water reactives can react with moisture in the air to produce a flammable gas.** **Metal hyrides react violently with water, some in the air.**	**These reactive chemicals require a standard operating procedure that includes storage practices and safe use**	**Waterproof double containment (shipping container may be appropriate second container).** **Isolate from other chemicals. OK to store with dry chemicals** **Do NOT store with liquid chemicals.**	**Pyrophorics: borane, diborane, lithium, phosphorus, 2-foraldehyde, diethyl aluminum chloride, trimethyl aluminum, etc.** **Water Reactives: aluminum chloride anhydrous, calcium carbide, acetyl chloride, chlorosulonic acid, sodium, potassium, calcium oxide, acid anhydrides, metal hydrides**
Group IX Dry solids	**Varies. May have different properties depending on the material.**	**Keep dry.** **Indicate where the more toxic materials are located.**	**Cabinets are suggested, but shelves are O.K. Store above liquids.**	**Benzidine, cyanogens, bromide, oxalic acid, potassium hydroxide**

Basic Rules

- Minimize chemicals purchased, especially flammables and reactives with limited shelf life
- Label all storage areas
- Consult manufacturer's recommendations and Safety Data Sheets for recommendations on:
  - Specific Storage Practices - This chart is a general guide and is not all encompassing
  - Personal Protective Equipment (PPE)
  - Accidental spill measures
- Ensure that SDS sheets are readily available at all times by laboratory members
- Do not store stock chemicals in a fume hood

****Note: These are general guidelines and not a substitute for referring to SDS sheets for storage guidance****

Appendix K

UNC Charlotte **EHS -- Chemical Inventory Form**		**Date:** **Department Primary Location:** **Person completing Inventory:** **Principal Investigator (if applicable):**				
Chemical / Product Name	Chemical / Product Manufacturer Name	Quantity	Unit of Measure (pound,gallon,pint, kilogram, milliliter, gram,etc)	CAS Number (If available)	Building	Room Location

Appendix L

ATTENTION

EMERGENCY CONTACT

The activities in this room/laboratory are under the supervision of:

NAME:_____

DEPARTMENT:_____

OFFICE ROOM NUMBER:

UNCC TELEPHONE NUMBER:

HOME/CELL TELEPHONE NUMBER:

DATE:_____

Please contact in case of an emergency or unusual event in the area. Also contact prior to any maintenance or repair work that may disturb the room set-up.

UNC CHARLOTTE

ATTENTION

EMERGENCY CONTACT

The activities in this room/laboratory are under the supervision of:

NAME:_____

DEPARTMENT:_____

OFFICE ROOM NUMBER:

UNCC TELEPHONE NUMBER:

HOME/CELL TELEPHONE NUMBER:

DATE:_____

Please contact in case of an emergency or unusual event in the area. Also contact prior to any maintenance or repair work that may disturb the room set-up.

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Appendix M

Glove Selection Charts

NR - Not Rated E – Excellent G – Good F – Fair P – Poor

Mineral Acids

Chemical	%	Neoprene	Nitrile	PVC	Natural Rubber	Butyl Rubber	Viton
Chromic*		F	F	F	NR	P	E
Hydrochloric(HCl)	10%	G	G	G	G	-	-
Hydrochloric(HCl)	36%	F	F	P	F	E	E
Hydrofluoric	10%	G	G	G	F	G	G
Muriatic (HCl)		G	G	G	G	E	-
Nitric*	10%	G	F	G	F	F	G
Nitric*	20%	F	F	F	P	F	G
Sulfuric*	10%	E	E	E	G	G	E
Sulfuric*	20%	E	E	E	F	G	E

*A known or suspected carcinogen

Organic Acids

Chemical	%	Neoprene	Nitrile	PVC	Natural Rubber	Butyl Rubber	Viton
Acetic	84%	F	F	E	G	G	P
Citric		G	G	G	G	E	E
Formic		G	F	G	G	E	F
Lactic	88%	G	E	E	E	E	E
Oxalic		G	G	G	G	E	E

Alcohols

Chemical	%	Neoprene	Nitrile	PVC	Natural Rubber	Butyl Rubber	Viton
Benzyl		G	G	G	F	G	E
Ethyl		E	E	E	G	E	G
Methyl		G	F	F	G	E	P

Aldehydes

Chemical	%	Neoprene	Nitrile	PVC	Natural Rubber	Butyl Rubber	Viton
Acetaldehyde*		G	F	G	F	E	P
Benzaldehyde		P	G	F	P	E	P
Formaldehyde*		G	G	E	G	E	P

*A known or suspected carcinogen

Aliphatic Solvents

Chemical	%	Neoprene	Nitrile	PVC	Natural Rubber	Butyl Rubber	Viton
Mineral Spirits		E	E	E	P	-	-

Alkalis

Chemical	%	Neoprene	Nitrile	PVC	Natural Rubber	Butyl Rubber	Viton
Ammonium Hydroxide	26%	G	E	E	G	E	G
Potassium Hydroxide (KOH)	45%	G	E	E	G	E	F
Sodium Hydroxide*(NaOH)	50%	G	E	G	G	E	G

*A known or suspected carcinogen

Aromatic Solvents

Chemical	%	Neoprene	Nitrile	PVC	Natural Rubber	Butyl Rubber	Viton
Benzene*		P	F	P	NR	P	G
Stoddards*		G	G	F	P	P	E
Toluene*		P	F	P	NR	P	E
Xylene*		P	E	F	NR	P	E

*A known or suspected carcinogen

Chlorinated Solvents

Chemical	%	Neoprene	Nitrile	PVC	Natural Rubber	Butyl Rubber	Viton
Carbon Tetrachloride*		F	F	P	NR	P	E
Chlorobenzene*		P	F	P	NR	P	E
Perchloroethylene*		P	P	P	NR	P	E
Trichloroethylene*		P	P	F	NR	P	E

Esters

Chemical	%	Neoprene	Nitrile	PVC	Natural Rubber	Butyl Rubber	Viton
Butyl Acetate*		F	F	P	P	G	P
Ethyl Acetate*		F	F	P	P	G	P

*A known or suspected carcinogen

Amines

Chemical	%	Neoprene	Nitrile	PVC	Natural Rubber	Butyl Rubber	Viton
Diethylamine		G	G	G	F	G	P
Methylamine		F	F	P	F	G	-

Ethers

Chemical	%	Neoprene	Nitrile	PVC	Natural Rubber	Butyl Rubber	Viton
Ethyl Ether*		G	G	P	F	G	P

*A known or suspected carcinogen

Oils and Fats

Chemical	%	Neoprene	Nitrile	PVC	Natural Rubber	Butyl Rubber	Viton
Airplane Hydaulic Oil (Texaco BB)		F	F	P	P	P	E
Animal Fats		G	G	G	P	G	E
Cutting Oil (Rigid)		F	G	E	F	F	E
Linseed Oil		F	G	F	P	G	E
Mineral Oil		G	G	F	P	P	E
Vegetable Oil		F	G	F	F	E	E

Oxides

Chemical	%	Neoprene	Nitrile	PVC	Natural Rubber	Butyl Rubber	Viton
Carbon Dioxide		G	G	G	G	-	-
Nitrous Oxide		F	F	G	F	-	-

Ketones

Chemical	%	Neoprene	Nitrile	PVC	Natural Rubber	Butyl Rubber	Viton
Acetone		F	P	P	G	E	P
Methyl Ethyl* (MEK)		P	NR	NR	G	E	P
Methyl Isobutyl		F	P	NR	G	G	P

*A known or suspected carcinogen

Inorganic Salts

Chemical	%	Neoprene	Nitrile	PVC	Natural Rubber	Butyl Rubber	Viton
Copper Sulfate		G	G	G	G	-	-

Reference: UC Davis

Appendix N

Resources for "Particularly Hazardous Substances"

The OSHA Laboratory Standard (1910.1450) defines particularly hazardous substances as:

> Carcinogens – A carcinogen is a substance capable of causing cancer. Carcinogens are chronically toxic substances; that is, they cause damage after repeated or long-duration exposure, and their effects may become evident only after a long latency period.
>
> A chemical is considered a carcinogen, for the purpose of the Laboratory Safety Manual, if it is included in any of the following carcinogen lists:
>
> - OSHA-regulated carcinogens as listed in Subpart Z of the OSHA standards. The current list of substances that OSHA regulates as carcinogens or potential carcinogens follows:

asbestos
4-Nitrobiphenyl
alpha-Naphthylamine
Methyl chloromethyl ether
3,3'-Dichlorobenzidine (and its salts)
bis-Chloromethyl ether
beta-Naphthylamine
Benzidine
4-Aminodiphenyl
Ethyleneimine
beta-Propiolactone
2-Acetylaminofluorene
4-Dimethylaminoazobenzene
N-Nitrosodimethylamine
Vinyl chloride
Inorganic arsenic
Cadmium
Benzene
Coke oven emissions
1,2-dibromo-3-chloropropane
Acrylonitrile
Ethylene oxide
Formaldehyde
Methylenedianiline
1,3-Butadiene
Methylene Chloride

OSHA CURRENT LIST: http://www.osha.gov/SLTC/carcinogens/index.html

> - Under the category "known to be carcinogens" in the *Annual Report of Carcinogens* published by the National Toxicology Program (NTP) latest edition

NTP CURRENT LIST: http://ntp.niehs.nih.gov/?objectid=03C9AF75-E1BF-FF40-DBA9EC0928DF8B15

> - Group 1 ("carcinogenic to humans") of the International Agency for Research on Cancer (IARC), latest edition. Chemicals listed in Group 2A or 2B ("reasonably anticipated to be carcinogens") that cause significant tumor incidence in experimental animals under specified conditions are also considered carcinogens under the OSHA Laboratory Standard.

IARC CURRENT LIST: http://monographs.iarc.fr/ENG/Classification/index.php

Reproductive Toxins – Reproductive toxins are substances that have adverse effects on various aspects of reproduction, including fertility, gestation, lactation, and general reproductive performance. When a pregnant woman is exposed to a chemical, the fetus may be exposed as well because the placenta is an extremely poor barrier to chemicals. Reproductive toxins can affect both men and women. Male reproductive toxins can in some cases lead to sterility.

Resources for information about reproductive toxins (Repro Tox, Repro Text, Teris, etc.) can be found through Micromedex.

Substances with a High Acute Toxicity – High acute toxicity includes any chemical that falls within any of the following OSHA-defined categories:

- A chemical with a median lethal dose (LD_{50}) of 50 mg or less per kg of body weight when administered orally to certain test populations.
- A chemical with an LD_{50} of 200 mg less per kg of body weight when administered by continuous contact for 24 hours to certain test populations.
- A chemical with a median lethal concentration (LC_{50}) in air of 200 parts per million (ppm) by volume or less of gas or vapor, or 2 mg per liter or less of mist, fume, or dust, when administered to certain test populations by continuous inhalation for one hour, provided such concentration and/or condition are likely to be encountered by humans when the chemical is used in any reasonably foreseeable manner.

Please refer to the list of Particularly Hazardous Substances as provided by OSHA

Appendix O

29 CFR 1910.1450
Occupational Exposure to Hazardous Chemicals in Laboratories

1910.1450(a)

Scope and application.

1910.1450(a)(1)

This section shall apply to all employers engaged in the laboratory use of hazardous chemicals as defined below.

1910.1450(a)(2)

Where this section applies, it shall supersede, for laboratories, the requirements of all other OSHA health standards in 29 CFR part 1910, subpart Z, except as follows:

1910.1450(a)(2)(i)

For any OSHA health standard, only the requirement to limit employee exposure to the specific permissible exposure limit shall apply for laboratories, unless that particular standard states otherwise or unless the conditions of paragraph (a)(2)(iii) of this section apply.

1910.1450(a)(2)(ii)

Prohibition of eye and skin contact where specified by any OSHA health standard shall be observed.

1910.1450(a)(2)(iii)

Where the action level (or in the absence of an action level, the permissible exposure limit) is routinely exceeded for an OSHA regulated substance with exposure monitoring and medical surveillance requirements paragraphs (d) and (g)(1)(ii) of this section shall apply.

1910.1450(a)(3)

This section shall not apply to:

1910.1450(a)(3)(i)

Uses of hazardous chemicals which do not meet the definition of laboratory use, and in such cases, the employer shall comply with the relevant standard in 29 CFR part 1910, subpart 2, even if such use occurs in a laboratory.

1910.1450(a)(3)(ii)

Laboratory uses of hazardous chemicals which provide no potential for employee exposure. Examples of such conditions might include:

1910.1450(a)(3)(ii)(A)

Procedures using chemically-impregnated test media such as Dip-and-Read tests where a reagent strip is dipped into the specimen to be tested and the results are interpreted by comparing the color reaction to a color chart supplied by the manufacturer of the test strip; and

1910.1450(a)(3)(ii)(B)

Commercially prepared kits such as those used in performing pregnancy tests in which all of the reagents needed to conduct the test are contained in the kit.

1910.1450(b)

Definitions -

"Action level" means a concentration designated in 29 CFR part 1910 for a specific substance, calculated as an eight (8)-hour time-weighted average, which initiates certain required activities such as exposure monitoring and medical surveillance.

"Assistant Secretary" means the Assistant Secretary of Labor for Occupational Safety and Health, U.S. Department of Labor, or designee.

"Carcinogen" (see "select carcinogen").

"Chemical Hygiene Officer" means an employee who is designated by the employer, and who is qualified by training or experience, to provide technical guidance in the development and implementation of the provisions of the Chemical Hygiene Plan. This definition is not intended to place limitations on the position description or job classification that the designated individual shall hold within the employer's organizational structure.

"Chemical Hygiene Plan" means a written program developed and implemented by the employer which sets forth procedures, equipment, personal protective equipment and work practices that (i) are capable of protecting employees from the health hazards presented by hazardous chemicals used in that particular workplace and (ii) meets the requirements of paragraph (e) of this section.

"Combustible liquid" means any liquid having a flashpoint at or above 100 deg. F (37.8 deg. C), but below 200 deg. F (93.3 deg. C), except any mixture having components with flashpoints of 200 deg. F (93.3 deg. C), or higher, the total volume of which make up 99 percent or more of the total volume of the mixture.

"Compressed gas" means:

(i) A gas or mixture of gases having, in a container, an absolute pressure exceeding 40 psi at 70 deg. F (21.1 deg. C); or

(ii) A gas or mixture of gases having, in a container, an absolute pressure exceeding 104 psi at 130 deg. F (54.4 deg C) regardless of the pressure at 70 deg. F (21.1 deg. C); or

(iii) A liquid having a vapor pressure exceeding 40 psi at 100 deg. F (37.8 C) as determined by ASTM D-323-72.

"Designated area" means 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.

"Emergency" means any occurrence such as, but not limited to, equipment failure, rupture of containers or failure of control equipment which results in an uncontrolled release of a hazardous chemical into the workplace.

"Employee" means an individual employed in a laboratory workplace who may be exposed to hazardous chemicals in the course of his or her assignments.

"Explosive" means a chemical that causes a sudden, almost instantaneous release of pressure, gas, and heat when subjected to sudden shock, pressure, or high temperature.

"Flammable" means a chemical that falls into one of the following categories:

(i) "Aerosol, flammable" means an aerosol that, when tested by the method described in 16 CFR 1500.45, yields a flame protection exceeding 18 inches at full valve opening, or a flashback (a flame extending back to the valve) at any degree of valve opening;

(ii) "Gas, flammable" means:

(A) A gas that, at ambient temperature and pressure, forms a flammable mixture with air at a concentration of 13 percent by volume or less; or

(B) A gas that, at ambient temperature and pressure, forms a range of flammable mixtures with air wider than 12 percent by volume, regardless of the lower limit.

(iii) "Liquid, flammable" means any liquid having a flashpoint below 100 deg F (37.8 deg. C), except any mixture having components with flashpoints of 100 deg. C) or higher, the total of which make up 99 percent or more of the total volume of the mixture.

(iv) "Solid, flammable" means a solid, other than a blasting agent or explosive as defined in 1910.109(a), that is liable to cause fire through friction, absorption of moisture, spontaneous chemical change, or retained heat from manufacturing or processing, or which can be ignited readily and when ignited burns so vigorously and persistently as to create a serious hazard. A chemical shall be considered to be a flammable solid if, when tested by the method described in 16 CFR 1500.44, it ignites and burns with a self-sustained flame at a rate greater than one-tenth of an inch per second along its major axis.

"Flashpoint" means the minimum temperature at which a liquid gives off a vapor in sufficient concentration to ignite when tested as follows:

(i) Tagliabue Closed Tester (See American National Standard Method of Test for Flash Point by Tag Closed Tester, Z11.24 - 1979 (ASTM D 56-79)) - for liquids with a viscosity of less than 45 Saybolt Universal Seconds (SUS) at 100 deg. F (37.8 deg. C), that do not contain suspended solids and do not have a tendency to form a surface film under test; or

(ii) Pensky-Martens Closed Tester (See American National Standard Method of Test for Flashpoint by Pensky-Martens Closed Tester, Z11.7 - 1979 (ASTM D 93-79)) - for liquids with a viscosity equal to or greater than 45 SUS at 100 deg. F (37.8 deg. C), or that contain suspended solids, or that have a tendency to form a surface film under test; or

(iii) Setaflash Closed Tester (see American National Standard Method of test for Flash Point by Setaflash Closed Tester (ASTM D 3278-78)).

Organic peroxides, which undergo autoaccelerating thermal decomposition, are excluded from any of the flashpoint determination methods specified above.

"Hazardous chemical" means 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.

Appendices A and B of the Hazard Communication Standard (29 CFR 1910.1200) provide further guidance in defining the scope of health hazards and determining whether or not a chemical is to be considered hazardous for purposes of this standard.

"Laboratory" means 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" means work with substances in which the containers used for reactions, transfers, and other handling of substances are designed to be easily and safety manipulated by one person. "Laboratory scale" excludes those workplaces whose function is to produce commercial quantities of materials.

"Laboratory-type hood" means a device located in a laboratory, enclosure on five sides with a movable sash or fixed partial enclosed on the remaining side; constructed and maintained to draw air from the laboratory and to prevent or minimize the escape of air contaminants into the laboratory; and allows chemical manipulations to be conducted in the enclosure without insertion of any portion of the employee's body other than hands and arms.

Walk-in hoods with adjustable sashes meet the above definition provided that the sashes are adjusted during use so that the airflow and the exhaust of air contaminants are not compromised and employees do not work inside the enclosure during the release of airborne hazardous chemicals.

"Laboratory use of hazardous chemicals" means handling or use of such chemicals in which all of the following conditions are met:

(i) Chemical manipulations are carried out on a "laboratory scale;"

(ii) Multiple chemical procedures or chemicals are used;

(iii) The procedures involved are not part of a production process, nor in any way simulate a production process; and

(iv) "Protective laboratory practices and equipment" are available and in common use to minimize the potential for employee exposure to hazardous chemicals.

"Medical consultation" means a consultation which takes place between an employee and a licensed physician for the purpose of determining what medical examinations or procedures, if any, are appropriate in cases where a significant exposure to a hazardous chemical may have taken place.

"Organic peroxide" means an organic compound that contains the bivalent -O-O- structure and which may be considered to be a structural derivative of hydrogen peroxide where one or both of the hydrogen atoms has been replaced by an organic radical.

"Oxidizer" means a chemical other than a blasting agent or explosive as defined in 1910.109(a), that initiates or promotes combustion in other materials, thereby causing fire either of itself or through the release of oxygen or other gases.

"Physical hazard" means a chemical for which there is scientifically valid evidence tat it is a combustible liquid, a compressed gas, explosive, flammable, an organic peroxide, an oxidizer pyrophoric, unstable (reactive) or water-reactive.

"Protective laboratory practices and equipment" means those laboratory procedures, practices and equipment accepted by laboratory health and safety experts as effective, or that the employer can show to be effective, in minimizing the potential for employee exposure to hazardous chemicals.

"Reproductive toxins" means chemicals which affect the reproductive chemicals which affect the reproductive capabilities including chromosomal damage (mutations) and effects on fetuses (teratogenesis).

"Select carcinogen" means any substance which meets one of the following criteria:

(i) It is regulated by OSHA as a carcinogen; or

(ii) 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

(iii) It is listed under Group 1 ("carcinogenic to humans") by the International Agency for research on Cancer Monographs (IARC)(latest editions); or

(iv) 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/m(3);

(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.

"Unstable (reactive)" means a chemical which is the pure state, or as produced or transported, will vigorously polymerize, decompose, condense, or will become self-reactive under conditions of shocks, pressure or temperature.

"Water-reactive" means a chemical that reacts with water to release a gas that is either flammable or presents a health hazard.

1910.1450(c)

Permissible exposure limits. For laboratory uses of OSHA regulated substances, the employer shall assure that laboratory employees' exposures to such substances do not exceed the permissible exposure limits specified in 29 CFR part 1910, subpart Z.

1910.1450(d)

Employee exposure determination -

1910.1450(d)(1)

Initial monitoring. The employer shall measure the employee's exposure to any substance regulated by a standard which requires monitoring if there is reason to believe that exposure levels for that substance routinely exceed the action level (or in the absence of an action level, the PEL).

1910.1450(d)(2) Periodic monitoring. If the initial monitoring prescribed by paragraph (d)(1) of this section discloses employee exposure over the action level (or in the absence of an action level, the PEL), the employer shall immediately comply with the exposure monitoring provisions of the relevant standard.

1910.1450(d)(3)

Termination of monitoring. Monitoring may be terminated in accordance with the relevant standard.

1910.1450(d)(4)

Employee notification of monitoring results. The employer shall, within 15 working days after the receipt of any monitoring results, notify the employee of these results in writing either individually or by posting results in an appropriate location that is accessible to employees.

1910.1450(e)

Chemical hygiene plan - General. (Appendix A of this section is non-mandatory but provides guidance to assist employers in the development of the Chemical Hygiene Plan).

1910.1450(e)(1) Where hazardous chemicals as defined by this standard are used in the workplace, the employer shall develop and carry out the provisions of a written Chemical Hygiene Plan which is:

1910.1450(e)(1)(i)

Capable of protecting employees from health hazards associated with hazardous chemicals in that laboratory and

1910.1450(e)(1)(ii)

Capable of keeping exposures below the limits specified in paragraph (c) of this section.

1910.1450(e)(2)

The Chemical Hygiene Plan shall be readily available to employees, employee representatives and, upon request, to the Assistant Secretary.

1910.1450(e)(3)

The Chemical Hygiene Plan shall include each of the following elements and shall indicate specific measures that the employer will take to ensure laboratory employee protection;

1910.1450(e)(3)(i)

Standard operating procedures relevant to safety and health considerations to be followed when laboratory work involves the use of hazardous chemicals;

1910.1450(e)(3)(ii)

Criteria that the employer will use to determine and implement control measures to reduce employee exposure to hazardous chemicals including engineering controls, the use of personal protective equipment and hygiene practices; particular attention shall be given to the selection of control measures for chemicals that are known to be extremely hazardous;

1910.1450(e)(3)(iii)

A requirement that fume hoods and other protective equipment are functioning properly and specific measures that shall be taken to ensure proper and adequate performance of such equipment;

1910.1450(e)(3)(iv)

Provisions for employee information and training as prescribed in paragraph (f) of this section;

1910.1450(e)(3)(v)

The circumstances under which a particular laboratory operation, procedure or activity shall require prior approval from the employer or the employer's designee before implementation;

1910.1450(e)(3)(vi)

Provisions for medical consultation and medical examinations in accordance with paragraph (g) of this section;

1910.1450(e)(3)(vii)

Designation of personnel responsible for implementation of the Chemical Hygiene Plan including the assignment of a Chemical Hygiene Officer, and, if appropriate, establishment of a Chemical Hygiene Committee; and

1910.1450(e)(3)(viii)

Provisions for additional employee protection for work with particularly hazardous substances. These include "select carcinogens," reproductive toxins and substances which have a high degree of acute toxicity. Specific consideration shall be given to the following provisions which shall be included where appropriate:

1910.1450(e)(3)(viii)(A)

Establishment of a designated area;

1910.1450(e)(3)(viii)(B)

Use of containment devices such as fume hoods or glove boxes;

1910.1450(e)(3)(viii)(C)

Procedures for safe removal of contaminated waste; and

1910.1450(e)(3)(viii)(D)

Decontamination procedures.

1910.1450(e)(4) The employer shall review and evaluate the effectiveness of the Chemical Hygiene Plan at least annually and update it as necessary.

1910.1450(f)

Employee information and training.

1910.1450(f)(1)

The employer shall provide employees with information and training to ensure that they are apprised of the hazards of chemicals present in their work area.

1910.1450(f)(2)

Such information shall be provided at the time of an employee's initial assignment to a work area where hazardous chemicals are present and prior to assignments involving new exposure situations. The frequency of refresher information and training shall be determined by the employer.

1910.1450(f)(3)

Information. Employees shall be informed of:

1910.1450(f)(3)(i)

The contents of this standard and its appendices which shall be made available to employees;

1910.1450(f)(3)(ii)

the location and availability of the employer's Chemical Hygiene Plan;

1910.1450(f)(3)(iii)

The permissible exposure limits for OSHA regulated substances or recommended exposure limits for other hazardous chemicals where there is no applicable OSHA standard;

1910.1450(f)(3)(iv)

Signs and symptoms associated with exposures to hazardous chemicals used in the laboratory; and

1910.1450(f)(3)(v)

The location and availability of known reference material on the hazards, safe handling, storage and disposal of hazardous chemicals found in the laboratory including, but not limited to, Safety data sheets (SDS) (SDS) received from the chemical supplier.

1910.1450(f)(4)

Training.

1910.1450(f)(4)(i)

Employee training shall include:

1910.1450(f)(4)(i)(A)

Methods and observations that may be used to detect the presence or release of a hazardous chemical (such as monitoring conducted by the employer, continuous monitoring devices, visual appearance or odor of hazardous chemicals when being released, etc.);

1910.1450(f)(4)(i)(B)

The physical and health hazards of chemicals in the work area; and

1910.1450(f)(4)(i)(C)

The measures employees can take to protect themselves from these hazards, including specific procedures the employer has implemented to protect employees from exposure to hazardous chemicals, such as appropriate work practices, emergency procedures, and personal protective equipment to be used.

1910.1450(f)(4)(ii)

The employee shall be trained on the applicable details of the employer's written Chemical Hygiene Plan.

1910.1450(g)

Medical consultation and medical examinations.

1910.1450(g)(1) The employer shall provide all employees who work with hazardous chemicals an opportunity to receive medical attention, including any follow-up examinations which the examining physician determines to be necessary, under the following circumstances:

1910.1450(g)(1)(i)

Whenever an employee develops signs or symptoms associated with a hazardous chemical to which the employee may have been exposed in the laboratory, the employee shall be provided an opportunity to receive an appropriate medical examination.

1910.1450(g)(1)(ii)

Where exposure monitoring reveals an exposure level routinely above the action level (or in the absence of an action level, the PEL) for an OSHA regulated substance for which there are exposure monitoring and medical surveillance requirements, medical surveillance shall be established for the affected employee as prescribed by the particular standard.

1910.1450(g)(1)(iii)

Whenever an event takes place in the work area such as a spill, leak, explosion or other occurrence resulting in the likelihood of a hazardous exposure, the affected employee shall be provided an opportunity for a medical consultation. Such consultation shall be for the purpose of determining the need for a medical examination.

1910.1450(g)(2)

All medical examinations and consultations shall be performed by or under the direct supervision of a licensed physician and shall be provided without cost to the employee, without loss of pay and at a reasonable time and place.

1910.1450(g)(3)

Information provided to the physician. The employer shall provide the following information to the physician:

1910.1450(g)(3)(i)

The identity of the hazardous chemical(s) to which the employee may have been exposed;

1910.1450(g)(3)(ii) A description of the conditions under which the exposure occurred including quantitative exposure data, if available; and

1910.1450(g)(3)(iii)

A description of the signs and symptoms of exposure that the employee is experiencing, if any.

1910.1450(g)(4)

Physician's written opinion.

1910.1450(g)(4)(i)

For examination or consultation required under this standard, the employer shall obtain a written opinion from the examining physician which shall include the following:

1910.1450(g)(4)(i)(A)

Any recommendation for further medical follow-up;

1910.1450(g)(4)(i)(B)

The results of the medical examination and any associated tests;

1910.1450(g)(4)(i)(C)

Any medical condition which may be revealed in the course of the examination which may place the employee at increased risk as a result of exposure to a hazardous workplace; and

1910.1450(g)(4)(i)(D)

A statement that the employee has been informed by the physician of the results of the consultation or medical examination and any medical condition that may require further examination or treatment.

1910.1450(g)(4)(ii)

The written opinion shall not reveal specific findings of diagnoses unrelated to occupational exposure.

1910.1450(h)

Hazard identification.

1910.1450(h)(1)

With respect to labels and safety data sheets (SDS) (SDS):

1910.1450(h)(1)(i)

Employers shall ensure that labels on incoming containers of hazardous chemicals are not removed or defaced.

1910.1450(h)(1)(ii)

Employers shall maintain any safety data sheets (SDS) that are received with incoming shipments of hazardous chemicals, and ensure that they are readily accessible to laboratory employees.

1910.1450(h)(2)

The following provisions shall apply to chemical substances developed in the laboratory:

1910.1450(h)(2)(i)

If the composition of the chemical substance which is produced exclusively for the laboratory's use is known, the employer shall determine if it is a hazardous chemical as defined in paragraph (b) of this section. If the chemical is determined to be hazardous, the employer shall provide appropriate training as required under paragraph (f) of this section.

1910.1450(h)(2)(ii)

If the chemical produced is a byproduct whose composition is not known, the employer shall assume that the substance is hazardous and shall implement paragraph (e) of this section.

1910.1450(h)(2)(iii)

If the chemical substance is produced for another user outside of the laboratory, the employer shall comply with the Hazard Communication Standard (29 CFR 1910.1200) including the requirements for preparation of safety data sheets (SDS) and labeling.

1910.1450(i)

Use of respirators. Where the use of respirators is necessary to maintain exposure below permissible exposure limits, the employer shall provide, at no cost to the employee, the proper respiratory equipment. Respirators shall be selected and used in accordance with the requirements of 29 CFR 1910.134.

1910.1450(j)

Recordkeeping.

1910.1450(j)(1)

The employer shall establish and maintain for each employee an accurate record of any measurements taken to monitor employee exposures and any medical consultation and examinations including tests or written opinions required by this standard.

1910.1450(j)(2)

The employer shall assure that such records are kept, transferred, and made available in accordance with 29 CFR 1910.1020.

1910.1450(k)

Dates -

1910.1450(k)(1)

Effective date. This section shall become effective May 1, 1990.

1910.1450(k)(2) Start-up dates.

1910.1450(k)(2)(i)

Employers shall have developed and implemented a written Chemical Hygiene Plan no later than January 31, 1991.

1910.1450(k)(2)(ii)

Paragraph (a)(2) of this section shall not take effect until the employer has developed and implemented a written Chemical Hygiene Plan.

1910.1450(l)

Appendices. The information contained in the appendices is not intended, by itself, to create any additional obligations not otherwise imposed or to detract from any existing obligation.

Appendix P

TABLE Z-1 Limits for Air Contaminants – 1910.1000

NOTE: Because of the length of the table, explanatory Footnotes applicable to all substances are given below as well as at the end of the table Footnotes specific only to a limited number of substances are also shown within the table

Footnote(1) The PELs are 8-hour TWAs unless otherwise noted; a (C) designation denotes a ceiling limit They are to be determined from breathing-zone air samples

Footnote(a) Parts of vapor or gas per million parts of contaminated air by volume at 25 degrees C and 760 torr

Footnote(b) Milligrams of substance per cubic meter of air When entry is in this column only, the value is exact; when listed with a ppm entry, it is approximate

Footnote(c) The CAS number is for information only. Enforcement is based on the substance name. For an entry covering more than one metal compound measured as the metal, the CAS number for the metal is given - not CAS numbers for the individual compounds

Footnote(d) The final benzene standard in 19101028 applies to all occupational exposures to benzene except in some circumstances the distribution and sale of fuels, sealed containers and pipelines, coke production, oil and gas drilling and production, natural gas processing, and the percentage exclusion for liquid mixtures; for the excepted subsegments, the benzene limits in Table Z-2 apply See 19101028 for specific circumstances

Footnote(e) This 8-hour TWA applies to respirable dust as measured by a vertical elutriator cotton dust sampler or equivalent instrument The time-weighted average applies to the cotton waste processing operations of waste recycling (sorting, blending, cleaning and willowing) and garnetting See also 19101043 for cotton dust limits applicable to other sectors

Footnote(f) All inert or nuisance dusts, whether mineral, inorganic, or organic, not listed specifically by substance name are covered by the Particulates Not Otherwise Regulated (PNOR) limit which is the same as the inert or nuisance dust limit of Table Z-3

Footnote(2) See Table Z-2

Footnote(3) See Table Z-3

Footnote(4) Varies with compound

TABLE 1
LIMITS FOR AIR CONTAMINANTS

Substance	CAS No. (C)	ppm (a) (1)	mg/m ^{3} (b) (1)	Skin designation
Acetaldehyde	75 - 07 - 0	200	360	
Acetic acid	64 - 19 - 7	10	25	
Acetic anhydride	108 -24 - 7	5	20	
Acetone	67 - 64 - 1	1000	2400	
Acetonitrile	75 - 05 - 8	40	70	
2-Acetylaminofluorene;				
see 1910.1014	53 - 96 - 3			
Acetylene dichloride; see				
1,2-Dichloroethylene.				
Acetylene tetrabromide.	79 -27 - 6	1	14	
Acrolein	107 - 02 - 8	0.1	0.25	
Acrylamide	79 - 06 - 1		0.3	X
Acrylonitrile;				
see 1910.1045	107 - 13 - 1			
Aldrin	309 - 00 -2		0.25	X
Allyl alcohol	107 - 18 - 6	2	5	X
Allyl chloride	107 - 05 - 1	1	3	
Allyl glycidyl ether				
(AGE)	106 - 92 - 3	(C) 10	(C) 45	
Allyl propyl disulfide.	2179 - 59 - 1	2	12	
alpha-Alumina	1344 -28 - 1			
Total dust			15	
Respirable fraction..			5	
Aluminum Metal (as Al).	7429 - 90 - 5			
Total dust			15	
Respirable fraction			5	
4-Aminodiphenyl				
see 1910.1011	92-67-1			
2-Aminoethanol				
see Ethanolamine				
2-Aminopyridine	504-29-0	0.5	2	
Ammonia	7664-41-7	50	35	
Ammonium sulfamate	7773-06-0			
Total dust			15	
Respirable fraction			5	
n-Amyl acetate	628-63-7	100	525	
sec-Amyl acetate	626-38-0	125	650	
Aniline and homologs	62-53-3	5	19	X
Anisidine				X
(o-,p-isomers)	29191-52-4			
Antimony and compounds				
(as Sb)	7440-36-0		0.5	

ANTU (alpha				
Naphthylthiourea)	86-88-4		0.3	
Arsenic, inorganic				
compounds (as As);				
see 1910.1018	7440-38-2			
Arsenic, organic				
compounds (as As)	7440-38-2		0.5	
Arsine	7784-42-1	0.05	0.2	
Asbestos;				
see 1910.1001	(4)			
Azinphos-methyl	86-50-0		0.2	X
Barium, soluble				
compounds (as Ba)	7440-39-3		0.5	
Barium sulfate	7727-43-7			
Total dust			15	
Respirable fraction			5	
Benomyl	17804-35-2			
Total dust			15	
Benzene; See 1910.1028	71-43-2			
See Table Z-2 for the				
limits applicable in the				
operations or sectors				
excluded in 1910.1028				
(d)				
Benzidine;				
See 1910.1010	92-87-5			
p-Benzoquinone;				
see Quinone.				
Benzo(a)pyrene; see				
Coal tar pitch volatiles				
Benzoyl peroxide	94-36-0		5	
Benzyl chloride	100-44-7	1	5	
Beryllium and				
beryllium compounds				
(as Be)	7440-41-7		(2)	
Biphenyl; see Diphenyl.1		I		
Bismuth telluride,				
Undoped	1304-82-1			
Total dust			15	
Respirable fraction			5	
Boron oxide	1303-86-2			
Total dust			15	
Boron trifluoride	7637-07-2	(C)l	(C)3	
Bromine	7726-95-6	0.1	0.7	
Bromoform	75-25-2	0.5	5	X
Butadiene				
1,3-Butadiene); See				

29 CFR 1910.1051;	106-99-0	1 ppm/5		
29 CFR 1910.19(l)		ppm STEL		
Butanethiol;				
see Butyl mercaptan.				
2-Butanone				
(Methyl ethyl ketone)	78-93-3	200	590	
2-Butoxyethanol	111-76-2	50	240	X
n-Butyl-acetate	123-86-4	150	710	
sec-Butyl acetate	105-46-4	200	950	
tert-Butyl-acetate	540-88-5	200	950	
n-Butyl alcohol	71-36-3	100	300	
sec-Butyl alcohol	78-92-2	150	450	
tert-Butyl alcohol	75-65-0	100	300	
Butylamine	109-73-9	(C)5	(C)15	X
tert-Butyl chromate				
(as Cro(3))	1189-85-1		(C) 0.l	X
n-Butyl glycidyl ether				
(BGE)	2426-08-6	50	270	
Butyl mercaptan	109-79-5	10	35	
p-tert-Butyltoluene	98-51-1	10	60	
Cadmium (as Cd);				
see 1910.1027	7440-43-9			
Calcium Carbonate	1317-65-3			
Total dust			15	
Respirable fraction			5	
Calcium hydroxide	1305-62-0			
Total dust			15	
Respirable fraction			5	
Calcium oxide	1305-78-8		5	
Calcium silicate	1344-95-2			
Total dust			15	
Respirable fraction			5	
Calcium sulfate	7778-18-9			
Total dust			15	
Respirable fraction			5	
Camphor, synthetic	76-22-2		2	
Carbaryl (Sevin)	63-25-2		5	
Carbon black	1333-86-4		3.5	
Carbon dioxide	124-38-9	5000	9000	
Carbon disulfide	75-15-0		(2)	
Carbon monoxide	630-08-0	50	55	
Carbon tetrachloride	56-23-5		(2)	
Cellulose	9004-34-6			
Total dust			15	
Respirable fraction			5	
Chlordane	57-74-9		0.5	X
Chlorinated camphene	8001-35-2		0.5	X
Chlorinated diphenyl				
oxide	55720-99-5		0.5	

Chlorine	7782-50-5	(C) l	(C) 3	
Chlorine dioxide	10049-04-4	0.1	0.3	
Chlorine trifluoride	7790-91-2	(C) 0.l	(C) 0.4	
Chloroacetaldehyde	107-20-0	(C) l	(C) 3	
a-Chloroacetophenone				
(Phenacyl chloride)	532-27-4	0.05	0.3	
Chlorobenzene	108-90-7	75	350	
o-Chlorobenzylidene				
malononitrile	2698-41-1	0.05	0.4	
Chlorobromomethane	74-97-5	200	1050	
2-Chloro-1,3-butadiene				
See beta-Chloroprene				
Chlorodiphenyl				
(42%- Chlorine)(PCB)	53469-21-9		1	X
Chlorodiphenyl				
(54% Chlorine)(PCB)	11097-69-1		0.5	X
1-Chloro-2				
3-epoxypropane				
See Epichlorohydrin				
2-Chloroethanol; See				
Ethylene chlorohydrinj				
Chloroethylene				
See Vinyl chloride				
Chloroform				
(Trichloromethane)	67-66-3	(C) 50	(C) 240	
bis(Chloromethyl)				
ether; see 1910.1008.	542-88-1			
Chloromethyl methyl				
ether; see 1910.1006.	107-30-2			
1-Chloro-l-nitropropane	600-25-9	20	100	
Chloropicrin	76-06-2	0.1	0.7	
beta-Chloroprene	126-99-8	25	90	X
2-Chloro-6				
(trichloromethyl)				
pyridine	1929-82-4			
Total dust			15	
Respirable fraction			5	
Chromic acid and				
chromates (as Cro (3))	(4)		(2)	
Chromium (II) compounds				
(as Cr)	7440-47-3		0.5	
Chromium (III)				
compounds (as Cr)	7440-47-3		0.5	
Chromium metal and				
insol. salts (as Cr)				
	7440-47-3		1	
Chrysene; see Coal tar				
pitch volatiles				
Clopidol	2971-90-6			

Total dust			15	
Respirable fraction			5	
Coal dust (less than				
5% SiO(2))				
respirable fraction			(3)	
Coal dust (greater than				
or equal to 5%				
Sio(2)), respirable				
fraction			(3)	
Coal tar pitch				
volatiles (benzene				
soluble fraction)				
anthracene, BaP				
phenanthrene				
acridine, chrysene				
pyrene	65966-93-2		0.2	
Cobalt metal, dust,				
and fume (as Co)	7440-48-4		0.1	
Coke oven emissions				
see 1910.1029				
Copper	7440-50-8			
Fume (as Cu)			0.1	
Dusts and mists			1	
(as Cu)				
Cotton dust (e)				
see 1910.1043			1	
Crag herbicide(Sesone)	136-78-7			
Total dust			15	
Respirable fraction			5	
Cresol, all isomers	1319-77-3	5	22	X
Crotonaldehyde	123-73-9	2	6	
	4170-30-3			
Cumene	98-82-8	50	245	X
Cyanides (as CN)	(4)		5	X
Cyclohexane	110-82-7	300	1050	
Cyclohexanol	108-93-0	50	200	
Cyclohexanone	108-94-1	50	200	
Cyclohexene	110-83-8	300	1015	
Cyclopentadiene	542-92-7	75	200	
2,4-D (Dichlorophen-				
oxyacetic acid)	94-75-7		10	
Decaborane	17702-41-9	0.05	0.3	X
Demeton (Systox)	8065-48-3		0.1	X
Diacetone alcohol				
(4-Hydroxy-4-methyl-				
2-pentanone)	123-42-2	50	240	
1,2-Diaminoethane;				
see Ethylenediamine				
Diazomethane	334-88-3	0.2	0.4	

Diborane	19287-45-7	0.1	0.1	
1,2-Dibromo-3-				
chloropropane (DBCP)				
see 1910.1044	96-12-8			
1,2-Dibromoethane; see				
Ethylene dibromide				
Dibutyl phosphate	107-66-4	1	5	
Dibutyl phthalate	84-74-2		5	
o-Dichlorobenzene	95-50-1	(C) 50	(C) 300	
p-Dichlorobenzene	106-46-7	75	450	
3,3 '-Dichlorobenzidine;				
see 1910.1007	91-94-1			
Dichlorodifluoromethane	75-71-8	1000	4950	
1,3-Dichloro-S,				
5-dimethyl hydantoin	118-52-5		0.2	
Dichlorodiphenyltri				
chloroethane (DDT)	50-29-3		1	X
1,1-Dichloroethane	75-34-3	100	400	
1,2-Dichloroethane; see				
Ethylene dichloride				
1,2-Dichloroethylene	540-59-0	200	790	
Dichloroethyl ether	111-44-4	(C) 15	(C) 90	X
Dichloromethane; see				
Methylene chloride				
Dichloromonofluoro-				
methane	75-43-4	1000	4200	
1,1-Dichloro-l-				
nitroethane	594-72-9	(C) 10	(C) 60	
1,2-Dichloropropane				
see				
Propylene dichloride				
Dichlorotetrafluoro-				
ethane	76-14-2	1000	7000	
Dichlorvos (DDVP)	62-73-7		1	X
Dicyclopentadienyl iron	102-54-5			
Total dust			15	
Respirable fraction			5	
Dieldrin	60-57-1		0.25	X
Diethylamine	109-89-7	25	75	
2-Diethylaminoethanol	100-37-8	10	50	X
Diethyl ether;				
see Ethyl ether				
Difluorodibromomethane	75-61-6	100	860	
Diglycidyl ether (DGE)	2238-07-5	(C) 0.5	(C) 2.8	
Dihydroxybenzene;				
see Hydroquinone				
Diisobutyl ketone	108-83-8	50	290	
Diisopropylamine	108-18-9	5	20	X
4-Dimethylaminoazo-				

benzene;				
see 1910.1015	60-11-7			
Dimethoxymethane;				
see Methylal				
Dimethyl acetamide	127-19-5	10	35	X
Dimethylamine	124-40-3	10	18	
Dimethylaminobenzene;				
see xylidine				
Dimethylaniline				
(N,N-Dimethylaniline)	121-69-7	5	25	X
Dimethylbenzene;				
see Xylene				
Dimethyl-1,2-dibromo-2,1				
2-dichloroethyl				
phosphate	300-76-5		3	
Dimethylformamide	68-12-2	10	30	X
2,6-Dimethyl-4-				
heptanone; see				
Diisobutyl ketone				
1,1-Dimethylhydrazine	57-14-7	0.5	1	X
Dimethylphthalate	131-11-3		5	
Dimethyl sulfate	77-78-1	1	5	X
Dinitrobenzene				
(all isomers)			1	X
(ortho)	528-29-0			
(meta)	99-65-0			
(para)	100-25-4			
Dinitro-o-cresol	534-52-1		0.2	X
Dinitrotoluene	25321-14-6		1.5	X
Dioxane				
(Diethylene dioxide)	123-91-1	100	360	X
Diphenyl (Biphenyl)	92-52-4	0.2	1	
Diphenylmethane				
diisocyanate; see				
Methylene bisphenyl				
isocyanate				
Dipropylene glycol				
methyl ether	34590-94-8	100	600	X
Di-sec octyl phthalate				
(Di-(2-ethylhexyl)				
phthalate)	117-81-7		5	
Emery	12415-34-8			
Total dust			1.5	
Respirable fraction			5	
Endrin	72-20-8		0.1	X
Epichlorohydrin	106-89-8	5	19	X
EPN	2104-64-5		0.5	X
1,2-Epoxypropane; see				
Propylene oxide				

2,3-Epoxy-l-propanol;				

see Glycidol				
Ethanethiol; see				
Ethyl mercaptan				
Ethanolamine	141-43-5	3	6	
2-Ethoxyethanol				
(Cellosolve)	110-80-5	200	740	X
2-Ethoxyethyl acetate				
(Cellosolve acetate)	111-15-9	100	540	X
Ethyl acetate	141-78-6	400	1400	
Ethyl acrylate	140-88-5	25	100	X
Ethyl alcohol (Ethanol)	64-17-5	1000	1900	
Ethylamine	75-04-7	10	18	
Ethyl amyl ketone				
(5-Methyl-3-				
heptanone)	541-85-5	25	130	
Ethyl benzene	100-41-4	100	435	
Ethyl bromide	74-96-4	200	890	
Ethyl butyl ketone				
(3-Heptanone)	106-35-4	50	230	
Ethyl chloride	75-00-3	1000	2600	
Ethyl ether	60-29-7	400	1200	
Ethyl formate	109-94-4	100	300	
Ethyl mercaptan	75-08-1	(C) 10	(C) 2.5	
Ethyl silicate	78-10-4	100	8.50	
Ethylene chlorohydrin	107-07-3	5	16	X
Ethylenediamine	107-15-3	10	25	
Ethylene dibromide	106-93-4		(2)	
Ethylene dichloride				
(1,2-Dichloroethane)	107-06-2		(2)	
Ethylene glycol				
dinitrate	628-96-6	(C)0.2	(C)l	X
Ethylene glycol methyl				
acetate; see Methyl				
cellosolve acetate				
Ethyleneimine;				
see 1910.1012	151-56-4			
Ethylene oxide;				
see 1910.1047	75-21-8			
Ethylidene chloride;				
see 1,1-Dichlorethane				
N-Ethylmorpholine	100-74-3	20	94	X
Ferbam	14484-64-1			
Total dust			15	
Ferrovanadium dust	12604-58-9		1	
Fluorides (as F)		(4)	2.5	

Fluorine	7782-41-4	0.1	0.2	
Fluorotrichloromethane				
(Trichloro-				
fluoromethane)	75-69-4	1000	5600	
Formaldehyde;				
see 1910.1048	50-00-0			
Formic acid	64-18-6	5	9	
Furfural	98-01-1	5	20	X
Furfuryl alcohol	98-00-0	50	200	
Grain dust (oat, wheat				
barley)			10	
Glycerin (mist)	56-81-5			
Total dust			15	
Respirable fraction			5	
Glycidol	556-52-5	50	150	
Glycol monoethyl ether;				
see 2-Ethoxyethanol				
Graphite, natural				
respirable dust	7782-42-5		(3)	
Graphite, synthetic				
Total dust			1-5	
Respirable Fraction			5	
Guthion;				
see Azinphos methyl				
Gypsum	13397-24-5			
Total dust			15	
Respirable fraction.			5	
Hafnium	7440-58-6		0.5	
Heptachlor	76-44-8		0.5	X
Heptane (n-Heptane)	142-82-5	500	2000	
Hexachloroethane	67-72-1	1	10	X
Hexachloronaphthalene	1335-87-1		0.2	X
n-Hexane	110-54-3	500	1800	
2-Hexanone (Methyl				
n-butyl ketone)	591-78-6	100	410	
Hexone (methyl				
isobutyl ketone)	108-10-1	100	410	
sec-Hexyl acetate	108-84-9	50	300	
Hydrazine	302-01-2	1	1.3	X
Hydrogen bromide	10035-10-6	3	10	
Hydrogen chloride	7647-01-0	(C)5	(C)7	
Hydrogen cyanide	74-90-8	10	11	X
Hydrogen fluoride				
(as F)	7664-39-3		(2)	
Hydrogen peroxide	7722-84-1	1	1.4	
Hydrogen selenide				
(as Se)	7783-07-5	0.05	0.2	
Hydrogen sulfide	7783-06-4		(2)	
Hydroquinone	123-31-9			2

Iodine	7553-56-2	(C) O.l	(C) l	
Iron oxide fume	1309-37-1		10	
Is,omyl acetate	123-92-2	100	525	
Isomyl alcohol				
(primary and				
secondary)	123-51-3	100	360	
Isobutyl acetate	110-19-0	150	700	
Isobutyl alcohol	78-83-1	100	300	
Isophorone	78-59-1	25	140	
Isopropyl acetate	108-21-4	250	950	
Isopropyl alcohol	67-63-0	400	980	
Isopropylamine	75-31-0	5	12	
Isopropyl ether	108-20-3	500	2100	
Isopropyl glycidyl				
ether (IGE)	4016-14-2	50	240	
Kaolin	1332-58-7			
Total dust			15	
Respirable fraction			5	
Ketene	463-51-4	0.5	0.9	
Lead inorganic (as Pb);				
see 1910.1025	7439-92-1			
Limestone	1317-65-3			
Total dust			15	
Respirable fraction			5	
Lindane	58-89-9		0.5	X
Lithium hydride	7580-67-8		0.025	
L.P.G. (Liquified				
petroleum gas)	68476-85-7	1000	1800	
Magnesite	546-93-0			
Total dust			15	
Respirable fraction			5	
Magnesium oxide fume	1309-48-4			
Total Particulate			15	
Malathion	121-75-5			
Total dust			15	X
Maleic anhydride	108-31-6	0.25	1	
Manganese compounds				
(as Mn)	7439-96-5		(C) 5	
Manganese fume (as Mn)	7439-96-5		(C) 5	
Marble	1317-65-3			
Total dust			15	
Respirable fraction			5	
Mercury (aryl and				
inorganic)(as Hg)	7439-97-6		(2)	
Mercury (organo) alkyl				
compounds (as Hg)	7439-97-6		(2)	
Mercury (vapor) (as Hg)	7439-97-6		(2)	
Mesityl oxide	141-79-7	25	100	
Methanethioll-				

see Methyl mercaptan.				
Methoxychlor	72-43-5			
Total dust			15	
2-Methoxyethanol				
(methyl cellosolve)	109-86-4	25	80	X
2-Methoxyethyl acetate				
(methyl cellosolve				
acetate)	110-49-6	25	120	X
Methyl acetate	79-20-9	200	610	
Methyl acetylene				
(Propyne)	74-99-7	1000	1650	
Methyl acetylene				
propadiene mixture				
(MAPP)		1000	1800	
Methyl acrylate	96-33-3	10	35	X
Methylal				
(Dimethoxy-methane)	109-87-5	1000	3100	
Methyl alcohol	67-56-1	200	260	
Methylamine	74-89-5	10	12	
Methyl amyl alcohol;				
see Methyl Isobutyl				
carbinol				
Methyl n-amyl ketone	110-43-0	100	465	
Methyl bromide	74-83-9	(C) 20	(C) 80	
Methyl butyl ketone;				
see 2-Hexanone				
Methyl cellosolve				
see 2-Methoxyethanol				
Methyl cellosolve				
acetate;				
see 2-Methoxyethyl				
acetate				
methyl chloride	74-87-3		(2)	
Methyl chloroform				
(1,1,1-Trichloro-				
ethane)	71-55-6	350	1900	
Methylcyclohexane	108-87-2	500	2000	
Methylcyclohexanol	25639-42-3	100	470	
o-Methylcyclohexanone	583-60-8	100	460	X
Methylene chloride	75-09-2		(2)	
Methyl ethyl ketone				
(MEK); see 2-Butanone				
Methyl formate	107-31-3	100	250	
Methyl hydrazine				
(Monomethyl				
hydrazine)	60-34-4	(C) 0.2	(C) 0.35	X
Methyl iodide	74-88-4	5	28	X
Methyl isoamyl ketone	110-12-3	100	475	
Methyl isobutyl				

carbinol	108-11-2	25	100	X
Methyl isobutyl ketone;				
see Hexone				
Methyl isocyanate	624-83-9	0.02	0.05	X
Methyl mercaptan	74-93-1	(C)10	(C)20	
Methyl methacrylate	80-62-6	100	410	
Methyl propyl ketone;				
see 2-Pentanone				
alpha-Methyl styrene	98-83-9	(C)100	(C)480	
Methylene bisphenyl				
isocyanate (MDI)	101-68-8	(C)0.02	(C)0.2	
Mica; see Silicates				
Molybdenum (as Mo)	7439-98-7			
Soluble compounds			5	
Insoluble Compounds				
Total dust			15	
Monomethyl aniline	100-61-8	2	9	X
Monomethyl hydrazine;				
see Methyl hydrazine.				
Morpholine	110--91-8	20	70	X
Naphtha (Coal tar)	8030-30-6	100	400	
Naphthalene	91-20-3	10	50	
alpha-Naphthylamine;				
see 1910.1004	134-32-7			
beta-Naphthylamine;				
see 1910.1009	91-59-8			
Nickel carbonyl (as Ni)	13463-39-3	0.001	0.007	
Nickel, metal and				
insoluble compounds				
(as Ni)	7440-02-0		1	
Nickel, soluble				
compounds (as Ni)	7440-02-0		1	
Nicotine	54-11-5		0.5	X
Nitric acid	7697-37-2	2	5	
Nitric oxide	10102-43-9	25	30	
p-Nitroaniline	100-01-6	1	6	X
Nitrobenzene	98-95-3	1	5	X
p-Nitrochlorobenzene	100-00-5		1	X
4-Nitrodiphenyl;				
see 1910.1003	92-93-3			
Nitroethane	79-24-3	100	310	
Nitrogen dioxide	10102-44-0	(C)5	(C)9	
Nitrogen trifluoride	7783-54-2	10	29	
Nitroglycerin	55-63-0	(C)0.2	(C)2	X
Nitromethane	75-52-5	100	250	
1-Nitropropane	108-03-2	25	90	
2-Nitropropane	79-46-9	25	90	
N-Nitrosodimethylamine;				
see 1910.1016				

Nitrotoluene				
(all isomers)		5	30	X
o-isomer	88-72-2			
m-isomer	99-08-1			
p-isomer	99-99-0			
Nitrotrichloromethane;				
see Chloropicrin				
Octachloronaphthalene	2234-13-1		0.1	X
Octane	111-65-9	500	22350	
Oil mist, mineral	8012-95-1		5	
Osmium tetroxide				
(as Os)	20816-12-0		0.002	
Oxalic acid	144-62-7		1	
Oxygen difluoride	7783-41-7	0.05	0.1	
Ozone	10028-15-6	0.1	0.2	
Paraquat, respirable				
dust	4685-14-7		0.5	X
	1910-42-5			
	2074-50-2			
Parathion	56-38-2		0.1	X
Particulates not				
otherwise regulated				
PNOR)(f)				
Total dust			15	
Respirable fraction			5	
PCB; see Chlorodiphenyl				
(42% and 54%				
chlorine)				
Pentaborane	19624-22-7	0.005	0.01	X
Pentachloronaphthalene	1321-64-8		0.5	X
Pentachlorophenol	87-86-5		0.5	X
Pentaerythritol	115-77-5			
Total dust			15	
Respirable fraction			5	
Pentane	109-66-0	1000	2950	
2-Pentanone (Methyl				
propyl ketone)	107-87-9	200	700	
Perchloroethylene				
(Tetrachloroethylene)	127-18-4		(2)	
Perchloromethyl				
mercaptan	594-42-3	0.1	0.8	
Perchloryl fluoride	7616-94-6	3	13.5	
Petroleum distillates				
(Naphtha)(Rubber				
Solvent)		500	2000	
Phenol	108-95-2	5	19	X
p-Phenylene diamine	106-50-3		0.1	X
Phenyl ether, vapor	101-84-8	1	7	
Phenyl ether-biphenyl				

mixture, vapor		1	7	
Phenylethylene;				
see Styrene				

Phenyl glycidyl ether				
(PGE)	122-60-1	10	60	
Phenylhydrazine	100-63-0	5	22	X
Phosdrin (Mevinphos)	7786-34-7		0.1	X
Phosgene (Carbonyl				
chloride)	75-44-5	0.1	0.4	
Phosphine	7803-51-2	0.3	0.4	
Phosphoric acid	7664-38-2		1	
Phosphorus (yellow)	7723-14-0		0.1	
Phosphorus				
pentachloride	10026-13-8		1	
Phosphorus pentasulfidel	1314-80-3		1	
Phosphorus trichloride	7719-12-2	0.5	3	
Phthalic anhydride	85-44-9	2	12	
Picloram	1918-02-1			
Total dust			15	
Respirable fraction			5	
Picric acid	88-89-1		0.1	X
Pindone (2-Pivalyl-1,				
3-indandione)	83-26-1		0.1	
Plaster of paris	26499-65-0			
Total dust			15	
Respirable fraction			5	
Platinum (as Pt)	7440-06-4			
Metal				
Soluble Salts			0.002	
Portland cement	65997-15-1			
Total dust			15	
Respirable fraction			5	
Propane	74-98-6	1000	1800	
beta-Propriolactone;				
see 1910.1013	57-57-8			
n-Propyl acetate	109-60-4	200	840	
n-Propyl alcohol	71-23-8	200	500	
n-Propyl nitrate	627-13-4	25	110	
Propylene dichloride	78-87-5	75	350	
Propylene imine	75-55-8	2	5	X
Propylene oxide	75-56-9	100	240	
Propyne; see Methyl				
acetylene				
Pyrethrum	8003-34-7		5	
Pyridine	110-86-1	5	15	
Quinone	106-51-4	0.1	0.4	

RDX: see Cyclonite				
Rhodium (as Rh), metal				
fume and insoluble				
compounds	7440-16-6		0.1	
Rhodium (as Rh),				
soluble compounds	7440-16-6		0.001	
Ronnel	299-84-3		15	
Rotenone	83-79-4		5	
Rouge				
Total dust			15	
Respirable fraction			5	
Selenium compounds				
(as Se)	7782-49-2		0.2	
Selenium hexafluoride				
(as Se)	7783-79-1	0.05	0.4	
Silica, amorphous				
precipitated and gel.	1112926-00-8		(3)	
Silica, amorphous,				
diatomaceous earth,				
containing less than				
1% crystalline silical	61790-53-2		(3)	
Silica, crystalline				
cristobalite,				
respirable dust	14464-46-1		(3)	
Silica, crystalline				
quartz, respirable				
dust	14808-60-7		(3)	
Silica, crystalline				
tripoli (as quartz),				
respirable dust	1317-95-9		(3)	
Silica, crystalline				
tridymite				
respirable dust	15468-32-3		(3)	
Silica, fused,				
respirable dust	60676-86-0		(3)	
Silicates (less than 1%1				
crystalline silica)				
Mica (respirable				
dust)	12001-26-2		(3)	
Soapstone, total dust			(3)	
Soapstone, respirable				
dust			(3)	
Talc (containing				
asbestos): use				
asbestos limit: see				
29 CFR 1910.1001			(3)	
Talc (containing no				
asbestos),				
respirable dust	14807-96-6		(3)	

Tremolite,				
asbestiform; see				
1910.1001				
Silicon	7440-21-3			
Total dust			15	
Respirable fraction			5	
Silicon carbide	409-21-2			
Total dust			15	
Respirable fraction			5	
Silver, metal and				
soluble compounds				
(as Ag)	7440-22-4		0.01	
Soapstone;				
see Silicates				
Sodium fluoroacetate	62-74-8		0.05	X
Sodium hydroxide	1310-73-2		2	
Starch	9005-25-8			
Total dust			15	
Respirable fraction			5	
Stibine	7803-52-3	0.1	0.5	
Stoddard solvent	8052-41-3	500	2900	
Strychnine	57-24-9		0.15	
Styrene	100-42-5		(2)	
Sucrose	57-50-1			
Total dust			15	
Respirable fraction			5	
Sulfur dioxide	7446-09-5	5	13	
Sulfur hexafluoride	2551-62-4	1000	6000	
Sulfuric acid	7664-93-9		1	
Sulfur monochloride	10025-67-9	1	6	
Sulfur pentafluoride	5714-22-7	0.025	0.25	
Sulfuryl fluoride	2699-79-8	5	20	
Systox; see Demeton				
2,4,5-T (2,4,5-tri-				
chlorophenoxyacetic				
acid)	93-76-5		10	
Talc; see Silicates				
Tantalum, metal and				
oxide dust	7440-25-7		5	
TEDP (Sulfotep)	3689-24-5		0.2	X
Tellurium and				
compounds (as Te)	13494-80-9		0.1	
Tellurium hexafluoride				
(as Te)	7783-80-4	0.02	0.2	
Temephos	3383-96-8			
Total dust			15	
Respirable fraction			5	
TEPP (Tetraethyl				
pyrophosphaate)	107-49-3		0.05	X

Terphenylis	26140-60-3	(C)l	(C)9	
1,1,1,2-Tetrachloro-2,				
2-difluoroethane	76-11-9	500	4170	
1,1,2,2-Tetrachloro-1,				
2-difluoroethane	76-12-0	500	4170	
1,1,2,2-Tetrachloro-				
ethane	79-34-5	5	35	X
Tetrachoroethylene;				
see Perchloroethylene				
Tetrachloromethane; see				
Carbon tetrachloride				
Tetrachloronaphthalene	1335-88-2		2	X
Tetraethyl lead (as Pb)	78-00-2		0.075	X
Tetrahydrofuizan	109-99-9	200	590	
Tetramethyl lead,				
(as Pb)	75-74-1		0.075	X
Tetramethyl				
succinonitrile	3333-52-6	0.5	3	X
Tetranitromethane	509-14-8	1	8	
Tetryl (2,4,6-Trinitro-				
Phenylmethyl-				
nitramine)	479-45-8		1.5	X
Thallium, soluble				
compounds (as Tl)	7440-28-0		0.1	X
4,41-Thiobis(6-tert,				
Butyl-m-cresol)	96-69-5			
Total dust			15	
Respirable fraction			5	
Thiram	137-26-8		5	
Tin, inorganic				
compounds (except				
oxides) (as Sn)	7440-31-5		2	
Tin, organic compounds				
(as Sn)	7440-31-5		0.1	
Titanium dioxide	13463-67-7			
Total dust			15	
Toluene	108-88-3		(2)	
Toluene-2,				
4-diisocyanate (TDI).	584-84-9	(C)0.02	(C)0.14	
o-Toluidine	95-53-4	5	22	X
Toxaphene; see				
Chlorinated camphene				
Tremolite;				
see Silicates				
Tributyl phosphate	126-73-8		5	
1,1,1-Trichloroethane				
see Methyl chloroform				
1,1,2-Trichloroethane	79-00-5	10	45	X
Trichloroethylene	79-01-6		(2)	

Trichloromethane;				
see Chloroform				
Trichloronaphthalene	1321-65-9		5	X
1,2,3-Trichloropropane	96-18-4	50	300	
1,1,2-Trichloro-1,2,				
2-trifluoroethane	76-13-1	1000	7600	
Triethylamine	121-44-8	25	100	
Trifluorobromomethane	75-63-8	1000	6100	
2,4,6-Trinitrophenol;				
see Picric acid				
2,4,6-Trinitrophenyl-				
methyl nitramine;				
see Tetryl				
2,4,6-Trinitrotoluene				
(TNT)	118-96-7		1.5	X
Triorthocresyl				
phosphate	78-30-8		0.1	
Triphenyl phosphate	115-86-6		3	
Turpentine	8006-64-2	100	560	
Uranium (as U)	7440-61-1			
Soluble compounds			0.05	
Insoluble compounds			0.25	
Vanadium	1314-62-1			
Respirable dust				
(as V(2)0(5))			(C)0.5	
Fume (as V (2) 0 (5))			(C)0.1	
Vegetable oil mist				
Total dust			15	
Respirable fraction			5	
Vinyl benzene;				
see Styrene				
Vinyl chloride;				
see 1910.1017	75-01-4			
Vinyl cyanide;				
see Acrylonitrile				
Vinyl toluene	25013-15-4	100	480	
Warfarin	81-81-2		0.1	
Xylenes				
(o-, m-, p-isomers)..	1330-20-7	100	435	
Xylidine	1300-73-8	5	25	X
Yttrium	7440-65-5		1	
Zinc chloride fume	7646-85-7		1	
Zinc oxide fume	1314-13-2		5	
Zinc oxide	1314-13-2			
Total dust			15	
Respirable fraction			5	
Zinc stearate	557-05-1			
Total dust			15	
Respirable fraction			5	

Zirconium compounds				
(as Zr)	7440-67-7		5	

Reference: Occupational Safety and Health Administration. *Limits for Air Contaminants*. [On-line]

Appendix Q

Incompatible Chemicals

The following are examples of chemical incompatibilities. This list should not be considered complete and persons unsure as to the status of a particular chemical are advised to refer to the manufacturer and SDS.

Chemical	Incompatibilities
Acetic acid	Chromic acid, nitric acid, hydroxyl compounds, ethylene glycol, perchloric acid, peroxides, permanganates
Acetylene	Chlorine, bromine, copper, fluorine, silver, mercury
Acetone	Concentrated nitric and sulfuric acid mixtures
Alkali and alkaline earth metals (such as powdered aluminum or magnesium, calcium, lithium, sodium, potassium)	Water, carbon tetrachloride or other chlorinated hydrocarbons, carbon dioxide, halogens
Ammonia (anhydrous)	Mercury (in manometers, for example), chlorine, calcium hypochlorite, iodine, bromine, hydrofluoric acid (anhydrous)
Ammonium nitrate	Acids, powdered metals, flammable liquids, chlorates, nitrites, sulfur, finely divided organic combustible materials
Aniline	Nitric acid, hydrogen peroxide
Arsenical materials	Any reducing agent
Azides	Acids
Bromine	See chlorine
Calcium oxide	Water
Carbon (activated)	Calcium hypochlorite, all oxidizing agents
Carbon tetrachloride	Sodium
Chlorates	Ammonium salts, acids, powdered metals, sulfur, finely divided organic or combustible materials
Chromic acid and chromium	Acetic acid, naphthalene, camphor, glycerol, alcohol, flammable liquids in general
Chlorine	Ammonia, acetylene, butadiene, butane, methane, propane (or other petroleum gases), hydrogen, sodium carbide, benzene, finely divided metals, turpentine
Chlorine dioxide	Ammonia, methane, phosphine, hydrogen sulfide
Copper	Acetylene, hydrogen peroxide
Cumene hydroperoxide	Acids (organic or inorganic)
Cyanides	Acids
Flammable liquids	Ammonium nitrate, chromic acid, hydrogen peroxide, nitric acid, sodium peroxide, halogens
Fluorine	All other chemicals
Hydrocarbons (such as butane, propane, benzene)	Fluorine, chlorine, bromine, chromic acid, sodium peroxide
Hydrocyanic acid	Nitric acid, alkali

Hydrofluoric acid (anhydrous)	Ammonia (aqueous or anhydrous)
Hydrogen peroxide	Copper, chromium, iron, most metals or their salts, alcohols, acetone, organic materials, aniline, nitromethane, combustible materials
Hydrogen sulfide	Fuming nitric acid, oxidizing gases
Hypochlorites	Acids, activated carbon
Iodine	Acetylene, ammonia (aqueous or anhydrous), hydrogen
Mercury	Acetylene, fulminic acid, ammonia
Nitrates	Sulfuric acid
Nitric acid (concentrated)	Acetic acid, aniline, chromic acid, hydrocyanic acid, hydrogen sulfide, flammable liquids, flammable gases, copper, brass, any heavy metals
Nitrites	Acids
Nitroparaffins	inorganic bases, amines
Oxalic acid	Silver, mercury
Oxygen	Oils, grease, hydrogen: flammable liquids, solids or gases
Perchloric acid	Acetic anhydride, bismuth and its alloys, alcohol, paper, wood, gease, oils
Peroxides, organic	Acids (organic or mineral), avoid friction, store cold
Phosphorus (white)	Air, oxygen, alkalies, reducing agents
Potassium	Carbon tetrachloride, carbon dioxide, water
Potassium chlorate	Sulfuric and other acids
Potassium perchlorate (see also chlorates)	Sulfuric and other acids
Potassium permanganate	Glycerol, ethylene glycol, benzaldehyde, sulfuric acid
Selenides	Reducing agents
Silver	Acetylene, oxalic acid, tartartic acid, ammonium compounds, fulminic acid
Sodium	Carbon tetrachloride, carbon dioxide, water
Sodium nitrite	Ammonium nitrate and other ammonium salts
Sodium peroxide	Ethyl or methyl alcohol, glacial acetic acid, acetic anhydride, benzaldehyde, carbon disulfide, glycerin, ethylene glycol, ethyl acetate, methyl acetate, furfural
Sulfides	Acids
Sulfuric acid	Potassium chlorate, potassium perchlorate, potassium permanganate (similar compounds of light metals, such as sodium, lithium)
Tellurides	Reducing agents