

LABORATORY SAFETY MANUAL

1.0 INTRODUCTION

1.1 LABORATORY STANDARD

1.1.1 Background

On January 31, 1990, the Occupational Safety and Health Administration (OSHA) issued a safety and health standard entitled "Occupational Exposure to Hazardous Chemicals in Laboratories" (29 CFR 1910.1450). The basis for this standard was a determination by OSHA that laboratories are different from industry, with respect to the usage and handling of hazardous chemicals. OSHA issued this standard because there was general consensus that an approach different from OSHA's substance specific health hazards was required to protect laboratory personnel. The standard became effective in May 1990 and a compliance date of January 31, 1991 was set.

1.1.2 Purpose

The purpose of the standard and this manual is to ensure that the hazards of all substances used and stored in laboratories at Florida International University are evaluated, effectively controlled, and conveyed to the personnel involved.

This manual serves as the Chemical Hygiene Plan (CHP) for Florida International University. It is designed to alert laboratory personnel of potential workplace hazards and to provide guidance on how to avoid exposure to hazardous chemicals through adherence to safe work practices and procedures.

1.2 APPLICABILITY

The Laboratory Standard applies to all facilities at Florida International University engaged in the use of hazardous chemicals in laboratories where:

- * chemical operations are carried out on a laboratory scale as opposed to operations whose objective is to produce commercial quantities of materials.
- * operations are designed to be easily and safely operated by one person.
- * multiple chemicals or multiple processes are used.

- * procedures involved are not part of a manufacturing process and do not simulate a production process.
- * standard laboratory procedures and equipment are commonly used to minimize potential employee exposure.

1.3 IMPLEMENTATION

Each department is responsible to assure that their laboratories conform to the minimum requirements of this Chemical Hygiene Plan. Training will be provided on a regular basis. Refer to Section 12.0 TRAINING AND INFORMATION.

1.4 ELEMENTS

The Florida International University CHP provides information for laboratory personnel on the following:

1. Standard operating procedures to be followed to protect safety and health when laboratory work involves the use of hazardous chemicals.
2. Criteria for the implementation of control measures (engineering controls, personal protective equipment, and hygiene practices) to reduce employee exposure to hazardous substances.
3. Measures to be taken to ensure proper performance of fume hoods and other protective equipment.
4. Available information and training resources.
5. Circumstances and criteria for evaluating a particular laboratory procedure or activity prior to the implementation of this procedure or activity.
6. Availability of medical examination and consultation when signs or symptoms of exposure to hazardous chemicals are evident; when routine monitoring reveals an exposure above the action level or Permissible Exposure Limit (PEL), or when a spill, leak, or other event occurs and creates the likelihood of a hazardous exposure.
7. Designated personnel responsible for implementing the Chemical Hygiene Plan, including the Chemical Hygiene Officer.
8. Steps to be taken to provide additional protection of laboratory personnel when working with particularly hazardous substances. These would

include establishing designated work areas, using containment devices such as fume hoods, implementing procedures for safe removal of contaminated waste, and the use of decontamination procedures.

2.0 RESPONSIBILITIES

The responsibility for health and safety rests with each and every member of the University community. Refer to Appendix A University Safety Policy.

2.1 ADMINISTRATION

The Director of Environmental Health and Safety, on behalf of the Vice President of Business and Finance serves as the custodian for the Chemical Hygiene Plan at Florida International University. The Director shall manage the ongoing health and safety program that provides for chemical hygiene and shall administer the resources to evaluate laboratory safety practices and facilities.

2.2 CHEMICAL HYGIENE OFFICER

The EH&S Environmental Compliance Manager shall serve as FIU Chemical Hygiene Officer with direct report to the Director of Environmental Health & Safety. The Chemical Hygiene Officer is responsible for assisting Department Heads and Principal Investigators or Laboratory Managers in the implementation of their responsibilities for laboratory safety. The duties of the Chemical Hygiene Officer shall include:

- * Experiment hazard assessment and recommendation of engineering process controls.
- * Recommendation of protective equipment for laboratory personnel.
- * Monitoring of laboratory personnel for potential exposure to hazardous chemicals.
- * Explanation of process control and handling requirements for regulated substances.
- * Providing guidance for handling and ultimate disposal of hazardous wastes generated in the laboratory.
- * Assessing Florida International University laboratory chemical hygiene procedures to recommend ways to improve those procedures.
- * Training laboratory personnel on acceptable methods for performing surveillance and testing of laboratory safety systems.
- * Inspecting laboratories and following up on corrective actions.

2.3 LABORATORY PERSONNEL

The Principal Investigator or Laboratory Manager shall serve as the supervisor of the laboratory and shall be responsible and accountable for the following:

- * Ensuring that laboratory personnel and students know and follow chemical hygiene and safety practices, that protective equipment is available and in working order, and that the required training for the type of work being conducted has been provided.
- * Providing regular chemical hygiene and housekeeping inspections to maintain the laboratory in a safe working condition.
- * Maintaining a chemical inventory on site and supplying copy of the chemical inventory to the Department of Environmental Health & Safety on an annual basis. Refer to Appendix Q Chemical Inventory Form and Appendix R Chemical Inventory Term Explanation.
- * Demonstrating an understanding of the current legal requirements associated with the use of regulated substances in the laboratory.
- * Determining the required levels of personal protective equipment.
- * Ensuring that facilities and training for use or planned use of any hazardous material are appropriate.
- * Identifying maintenance problems with safety showers, eye wash stations, emergency first aid equipment, fire blankets, fume hoods and similar type emergency response equipment and supplies.
- * Notify the Department of Environmental Health & Safety of process, procedural or facility related changes within their area of operation.

2.4 STUDENTS

Students are responsible for planning and conducting laboratory activities in accordance with instructions received from instructors or laboratory managers and appropriate chemical hygiene habits.

2.5 CONTRACTORS

Contractors performing work on a temporary or permanent basis on FIU premises are responsible for conducting their activities in accordance with established hygiene and safety procedures as obtained from FIU Facilities Management, project managers, FIU

Chemical Hygiene Officer, principal investigators, laboratory managers or area managers, and for assuring a safe environment for their employees and FIU staff, students and visitors.

2.6 VISITORS

Visitors to FIU campuses shall abide by the recommendations included in this CHP. It is the responsibility of staff and students to alert visitors of the required protective measures appropriate for their protection.

3.0 BASIC RULES AND PROCEDURES

3.1 ADMINISTRATIVE PROCEDURES

3.1.1 Procurement

Before any substance is ordered, information on proper handling, storage and disposal shall be obtained by the user. New substances known or suspected to be hazardous shall not be received unless proper handling procedures are available and disseminated to all the personnel involved in the handling, storage and use of the substance.

A copy of the requisition for procurement of new chemicals shall be submitted to the Chemical Hygiene Officer in order that relevant information may be obtained from the vendor prior to delivery. No laboratory chemical shall be accepted without a label that identifies the chemical's name. Personnel who receive chemical shipments shall be knowledgeable of the proper procedures for receipt and handling. Copies of MSDSs shall be retained on site at each laboratory and copies shall be forwarded to the Department of Environmental Health & Safety (EH&S).

3.1.2 Purchasing

To prevent storage of excess quantities of hazardous chemicals only the amounts projected for use shall be ordered. Check existing inventories. Regardless of projection no chemical shall be ordered in quantities which can not be safely stored. Excess chemicals become a storage nuisance and a safety hazard. Whenever possible use the Interdepartmental Chemical Exchange Program (ICEP).

3.1.3 Smoking

Smoking is prohibited in all Florida International University buildings, or sections thereof, owned, leased or operated by the University. Refer to Appendix B for the FIU Smoking Policy.

3.1.4 Food

Food storage, preparation and/or consumption is not to be permitted in laboratories, storage rooms or any other facilities where laboratory type chemicals or hazardous substances are stored, handled or used for research, educational or any other purpose. Glassware or any other apparatus used in laboratories shall not be used for storage, preparation and/or consumption of food. Likewise, refrigerators used for the storage of laboratory supplies shall not be used to store foods to be consumed.

3.1.5 Cosmetics

The application of cosmetics, nor the insertion of contact lenses, are recommended in laboratories, storage rooms or any other facilities where chemicals or hazardous substances are stored, handled or used for research, educational, or any other purpose.

3.2 GENERAL SAFETY

3.2.1 Equipment and Glassware

Do not use damaged glassware. Use equipment only for its designed purpose. Laboratory equipment and glassware must be handled with care to avoid breakage and potential injury. Use extra care with evacuated glass apparatus; consider shielding or wrapping to contain chemicals and fragments in case implosion occurs. Broken glassware shall be disposed of.

3.2.2 Personal Hygiene

Wash areas of exposed skin promptly and thoroughly if contact with chemicals or hazardous substances is suspected. Remove clothing or apparel if contact is suspected or apparent. Decontaminate clothing and apparel at the end of all work procedures and before reusing. At the end of all work procedures wash hands thoroughly with soap and water. Refer to Appendix C for appropriate hand washing techniques.

3.2.3 Personal Apparel

Do not wear loose fitting clothes or jewelry, which may become caught in moving parts or clothing which may inadvertently dip into chemicals. Shoes must be worn at all times in laboratories; the wearing of sandals, perforated or open-toe shoes should be avoided because of the limited protection they provide in case of a spill.

3.2.4 Personal Protection

Eye protection must be worn by all persons, including visitors, where chemicals or hazardous substances are stored, handled or use and the potential for eye injury exists. Eye protection must be approved [ANSI Z.87.1] for the type exposure anticipated.

Wear appropriate gloves when the potential for contact with toxic materials exists. The style of glove and the type material from which the glove is made should be selected based on type of chemicals or substances handled, quantities to be used, potential for contact, permeation of the chemical through the glove and degradation of the material. EH&S can assist in the selection of suitable gloves. Refer to Appendix D, Gloves, for a list of different types of gloves and the protection provided.

Gloves that will be reused must be washed with soap and water before removal. Gloves should be inspected for tears and pinholes before each use. New gloves should also be inspected before initial use. Under no circumstances should a student or employee leave a chemical use area with contaminated gloves. Remove and/or replace gloves as required prior to leaving work area. Gloves should be removed when picking up a telephone or using equipment others touch barehanded.

Apparel should be selected considering the possibility of chemical or hazardous substances contact. Wear clothing which provides maximum skin coverage. Do not wear light fabrics since rapid chemical penetration can occur.

Refer to FIU University Safety Compliance Guide for information on appropriate personal protective equipment.

3.2.5 Horseplay

Avoid practical jokes or any other behavior which may distract or potentially cause physical harm to others. Do not run or jump in laboratories or where chemicals or hazardous substances are being handled or stored. Playing with laboratory equipment is strictly forbidden.

3.2.6 Skin Contact

Skin contact with chemicals or hazardous substances should be avoided under all circumstances. In case of skin contact, wash with plenty of soap and water. If redness or itching develops, consult a physician immediately.

3.2.7 Eye Contact

Eye contact with chemicals or hazardous substances should be avoided under all circumstances. Wear approved safety eyewear when the potential for eye injury exists. In case of eye contact with chemicals, flush eyes with plenty of water for a minimum of 15 minutes. Consult physician if necessary.

3.2.8 Housekeeping

Keep the work area clean and uncluttered. Label all chemicals and hazardous substances and equipment. Glassware and other apparatus should be cleaned at the end of the day or work session and store properly. Halls and passageways must be dry and free of tripping hazards. Inappropriate storage of materials in hallways, exit routes and in such a manner that emergency equipment may be obstructed is strictly prohibited.

3.2.9 Unattended Operations

A thorough hazard analysis shall be conducted for any experiment/project which is likely to be unattended for a period of time. Unattended operations that could be hazardous should be avoided. When such operations must be necessarily conducted the need for the following precautions must be considered; leave lights on; place an appropriate sign at the door that includes the name(s) and phone number(s) of personnel that can be contacted in an emergency; and provide for containment of toxic substances in the event of failure of a utility service or equipment (such as cooling water, ventilation, electrical power, etc.).

3.2.10 Children

Prudent laboratory safety practices as well as appropriate work place ethics must be followed at all times. These practices prohibit the presence of young children and babies in areas that have a potential for exposure to radioactive materials, toxic or hazardous chemicals, infectious agents, or where the children are exposed to possible injury from a laboratory or other type of accident.

3.2.11 Vacuum and Pressure Operations

Proper and safe procedures for the operation of vacuum and pressure equipment including but not limited to explosion shields and face masks is essential in the laboratory. The pressure differential created when laboratory apparatus is used at pressures above or below that of the atmosphere creates several potential hazards. The hazards of high-pressure systems arise largely from failures caused by leaks, pulsation, vibration, and over exposure. Pressure gauges should be checked and recalibrated on a regular basis.

In an evacuated system, the higher pressure is on the outside, rather than on the inside, so that a break causes an implosion rather than an explosion. The resulting hazards consist of flying glass, spattered chemicals, and possibly fire. An explosion shield and a face mask should be used to protect the person performing the experiments.

Water, solvents, or corrosive gases should not be allowed to be drawn into a building vacuum system. When the potential for such a problem exists, a water aspirator should be used as the vacuum source.

Mechanical vacuum pumps should be protected by using cold traps, and their exhausts should be vented to an exhaust hood or to the outside of the building.

3.3 SPECIAL SAFETY CONSIDERATIONS

Some substances and equipment, because of their specific characteristics, require special care when handling in order to prevent accidents or injuries to laboratory personnel. The substances and equipment discussed in this section are included in this category.

3.3.1 Corrosive Substances

Biological corrosives attack human tissue and cause irritation, chemical burns, and in severe cases, tissue destruction. In case of skin or eye contact with corrosives, prompt treatment with a physiologically correct buffered saline is important. Safety showers and eye wash stations are provided in case of contact and are readily available to all laboratory personnel. After thorough washing, if indication of tissue damage exists, obtain medical attention as soon as possible.

Nose, throat and lung injury may be caused by inhaling corrosive gases, vapors or aerosols. The irritant nature of most airborne corrosives usually provide a warning. However any indication of respiratory exposure to corrosive substance must be brought to the attention of a qualified health professional. Except in cases of sheer stupidity and carelessness ingestion of corrosives is less likely to occur in a laboratory; but if it does, seek immediate medical attention.

However any indication of suspecting exposure to corrosive substances must be brought to the attention of a qualified health professional. Except in cases of shared stupidity and carelessness ingestion of corrosives is less likely to occur in a laboratory; but if it does, seek immediate medical attention. Refer to Appendix E, Common Laboratory Corrosives, for a list of corrosive substances commonly used in the laboratory.

3.3.2 Oxidizers

Oxidizers are compounds (solid, liquid, gas) that produce oxygen or are electron acceptors either at room temperature or upon slight heating. Oxidizers can react vigorously at ambient temperatures when they contact organic materials or reducing substances. In addition to their corrosive properties, powerful oxidizing agents such as perchloric and chromic acids (sometimes used as cleaning solution), present fire and explosion hazards on contact with organic compounds and other oxidizable substances. Strong oxidizing agents should be stored and used in glass or other inert containers (preferably unbreakable), and corks and rubber stoppers should not be used. Reaction vessels containing significant quantities of these reagents should be heated by using fiberglass mantles or sand baths rather than oil baths. Refer to Appendix F, Common Laboratory Oxidizers, for a list of oxidizing substances commonly used in the laboratory.

3.3.3 Air and Moisture Sensitive Compounds

Many chemical compounds deteriorate when exposed to air. For most this exposure only causes a decrease in purity. But for a few, extreme reactivity with oxygen (from air) leads

to other effects. Another group of compounds react with atmospheric moisture and causes the release of toxic or flammable gases or vapors or the generation of enough heat to cause fires and explosions. For example, potassium and sodium metals and many metal hydrides react on contact with water to produce hydrogen, and these reactions evolve sufficient heat to ignite the hydrogen with explosive violence. Certain polymerization catalysts, such as aluminum alkyls, react and burn violently on contact with water.

3.3.4 Pyrophoric Compounds

Pyrophorics are a special sub-group of air sensitive compounds. These substances are so reactive that they undergo air oxidation and spontaneously ignite in air, they do not require an external ignition source. All such chemicals should be stored in tightly closed containers and, when being transferred, should be kept under an inert atmosphere or liquid. Among these substances are alkali metals; calcium and magnesium; metal alkyls and aryls; metal carbonyls; powders of aluminum, cobalt iron and manganese; metal hydrides; boranes and arsines; and white phosphorous. Failure to store and handle these chemicals properly can lead to severe and unexpected fires.

3.3.5 Peroxide-Forming Compounds

Some organic compounds are usually susceptible to atmospheric oxidation. These compounds invariably contain an autoxidizable hydrogen atom that is activated by adjacent structural features and/or the presence of actinic radiation (sensitivity to ultra violet radiation), so that it reacts slowly under ambient conditions with atmospheric molecular oxygen, initially to form a peroxide. Once formed, peroxides are thermally unstable and may also be shock sensitive.

The general precautions proposed for these compounds are all aimed at preventing peroxide formation as far as possible, and include storage in opaque containers under a nitrogen atmosphere. The exceptions are some monomers that contain inhibitors which need some amount of air in order to effectively retard the rate of peroxide formation. Refer to the Appendix G, Peroxidizable Chemicals, for a list of peroxidizable compounds and to Appendix H, Peroxide Detection and Removal.

Inorganic peroxides should also be handled with care and respect for their hazardous potential. Barium, sodium and potassium peroxides when mixed with combustible materials form explosives that ignite easily.

3.3.6 Explosive and Shock-Sensitive Compounds

Shock-sensitive and/or explosive compounds present obvious safety concerns even for laboratory-scale quantities. The first step in safe operations with such substances is a recognition of the potential for personal injury and property damage.

It is possible to reach meaningful conclusions on the likely level of stability of individual compounds in many cases by examining their empirical molecular formulas. If there is an

unusually high proportion of nitrogen and N-N bonds in the compound, instability should be suspected (hydrogen azide, 97.6% N, and hydrazine, 87.4% N, are both explosively unstable; ammonia, 82.2% is not).

The concept of oxygen balance is also important. The oxygen balance of a compound is the difference between the oxygen content of a compound and that required to oxidize fully all the other elements present. If there is a deficiency of oxygen, the balance is negative, and if there is a surplus, the balance is positive. Compounds of positive balance have been mixed with fuels to give powerful explosives, such compounds must be stringently segregated from any combustible materials.

Oxygen balance is not, however, the sole criterion in assessing potential hazard; the question of the energy of activation of the decomposition reaction is also of significance in determining the margin between potential and actual hazard of explosive decomposition. Refer to Appendix I, Shock Sensitive and Explosive Chemicals, for a list of explosive and shock sensitive compounds.

3.3.7 Flammable Materials

General prudent practices include minimizing the amount of flammable materials used in the laboratory, storing chemicals properly, keeping appropriate fire extinguishing equipment readily available, physically separating flammable materials from sources of ignition, properly grounding static sources of ignition, and using the least hazardous alternative available.

Some basic precautions for the safe handling of flammable materials include the following:

- Handle flammable substances only in areas free of ignition sources.
- Never heat flammable substances with an open flame.
- Ventilate by diluting the vapors until they are no longer flammable.
- Keep containers of flammable substances tightly closed at all times when not in use.
- Use only refrigeration equipment certified for storage of flammable materials.
- Use the smallest quantities of flammable substances possible.

While all flammable substances should be handled prudently, the extreme flammability of some materials require extreme care. Refer to Appendix T Flammable and Combustible Materials.

3.3.8 Radioactive Materials

The FIU Manual of the Radiation Protection Program available from the Radiation Safety Officer provides specific purchasing, handling, storage and disposal procedures for these materials. Refer to the Manual for information.

3.3.9 Bloodborne Pathogens

Bloodborne pathogens are pathogenic microorganisms that are present in the blood and body of human beings and can cause disease in humans. These pathogens include, but are not limited to, hepatitis B virus (HBV) and human immunodeficiency virus (HIV). A Bloodborne Pathogen Exposure Control plan is available to staff and students. The objective of the Plan is to protect employees from exposure to bloodborne pathogens and to provide for appropriate prophylaxis, response, treatment and counseling.

Infectious materials include semen, vaginal secretions, cerebrospinal fluid, pleural fluid, pericardial fluid, peritoneal fluid, amniotic fluid, saliva in dental procedures, any body fluid visibly contaminated with blood and all body fluids in situations where it is difficult or impossible to differentiate between body fluids. They also include any unfixed tissue or organ other than intact skin from a human (living or dead), human immunodeficiency virus (HIV)-containing cell or tissue cultures, organ cultures, and HIV or hepatitis B (HBV)-containing culture medium or other solutions as well as blood, organs or other tissues from experimental animals infected with HIV or HBV.

Security and general facility safety requires all researchers to conduct a thorough evaluation of hazards and appropriate control procedures prior to the initiation of any activities involving the use of any hazardous material/agent listed or described.

3.3.10 Microbiological and biomedical laboratories

Microbiological and biomedical laboratories are special, often unique, work environments that may pose infectious disease risk to persons in or near them. Security and general facility safety requires all researchers to conduct a thorough evaluation of hazards and appropriate control procedures prior to the initiation of any activity involving the use of any hazardous material/agent.

“Containment” is the recognized method used to manage infectious agents in the laboratory environment where they are being handled or stored. The purpose of containment is to prevent, reduce or eliminate exposure of laboratory workers, building occupants and the outside environment of potentially hazardous infectious agents.

Primary containment addresses the protection of personnel and the immediate laboratory

environment from exposure to infectious agents. Primary containment is achieved through the application of good microbiological techniques and the use of appropriate safety equipment.

The use of appropriate vaccines may provide an increased level of personnel protection.

Secondary containment addresses the protection of the environment external to the laboratory. Secondary containment seeks to prevent the release of infectious materials. This is achieved through a combination of facility design and operational practices.

Therefore, the three elements of containment include laboratory practice and technique, safety equipment, and facility design. A risk assessment of the work to be done with a specific agent will determine the appropriate combination of these elements.

The most important element of containment is strict adherence to good standards of microbiological practices and techniques. Persons working with infectious agents or potentially infected materials must be aware of potential hazards, and must be trained and proficient in the practices and techniques required for handling such material safely.

Safety equipment is considered a primary barrier intended to minimize exposures to hazardous biological materials. Safety equipment includes biological safety cabinets (BSCs), enclosed containers, and engineering controls. The biological safety cabinet (BSC) is the primary device used to provide containment on infectious splashes or aerosols generated by many microbiological procedures. There are three types of biological safety cabinets (Class I, II, and III) used in microbiological laboratories.

Open-fronted Class I and II biological safety cabinets offer significant levels of protection to laboratory personnel and to the environment when properly maintained and used with good microbiological techniques. The Class II biological safety cabinet also provides protection from contamination of materials (e.g., cell cultures, microbiological stocks) being manipulated inside the cabinet. The gas-tight Class III biological safety cabinet provides the highest attainable level of protection to personnel and the environment. Refer to the Appendix for a comparison of biological safety cabinets.

The facility design provides a secondary level of protection for persons working inside and outside of the laboratory, and for the protection of persons and animals in the community from infectious agents which are used in the laboratory.

3.3.10.1 Biosafety Levels

Four biosafety levels (BSLs) are described as follows. These consist of combinations of laboratory practices and techniques, safety equipment, and laboratory facilities. Each combination is specifically appropriate for the operations performed, the documented or suspected routes of transmission of the infectious agents, and for the laboratory function or activity to be carried out.

Biosafety Level 1: These practices, safety equipment, and facilities are appropriate for undergraduate and secondary educational training and teaching laboratories, and for other facilities in which work is done with defined and characterized strains of viable microorganisms not known to cause disease in healthy adult humans.

Biosafety Level 2: These practices, safety equipment, and facilities are applicable to clinical, diagnostic, teaching, and other facilities in which work is done with the broad spectrum of indigenous moderate-risk agents present in the community and associated with human disease or varying severity. With good microbiological techniques, these agents can be used safely in activities conducted on the open bench, provided the potential for producing splashes or aerosols is low or specifically controlled.

Biosafety Level 3: These practices, safety equipment, and facilities are applicable to clinical, diagnostic, teaching, research, or production facilities in which work is done with indigenous or exotic agents with a potential for respiratory transmission, and which may cause serious and potentially lethal infection. Purchase or acquisition of these materials requires signature acknowledgement from the Chemical Hygiene Officer.

Biosafety Level 4: These practices, safety equipment, and facilities are applicable for work with dangerous and exotic agents which pose a high individual risk of life-threatening disease, which may be transmitted via the aerosol route, and for which there is no available vaccine or therapy. Purchase or acquisition of these materials requires signature authorization from the Chair of the Biosafety Committee and the Chemical Hygiene Officer.

3.3.11 Carcinogens

There are numerous chemicals classified as carcinogenic. It is the responsibility of the principal investigator to assure control of carcinogens. It is important to designate appropriate areas for the storage and use of these chemicals. Special consideration should be given to protective equipment and handling practices including posting signs and restricting access to the areas where these chemicals are stored and handled. Refer to Appendix J, Carcinogens, for a list of carcinogenic chemicals current as of the publication of this manual. Always refer to the MSDS for current information. Information regarding the potential carcinogenicity may be obtained from the MSDS for the chemical under consideration

3.3.12 Reproductive Hazards

A very limited number of chemicals are currently suspected as being human mutagens or teratogens and exposure may result in DNA changes some of which are likely to affect the developing fetus. The risk may be related to the level of exposure. Infrequent low-level exposures are clearly less of a risk than frequent exposures to higher concentration in poorly ventilated areas. The risk is also greater during early stages of pregnancy.

In the typical working environment exposure by inhalation is the most common route. Working in a fume hood* or in some other properly ventilated enclosure prevents exposure by inhalation. Skin absorption and ingestion are rarely significant routes of exposure, provided safe work practices are observed. Refer to Appendix K, Reproductive Hazards, for a list of these chemicals.

*Specific procedures apply to the safe use of fume hoods.

3.3.13 Lasers

Lasers produce non-ionizing radiation capable of causing eye injury. Lasers operating outside of the visible light region (ultraviolet or infrared) are especially hazardous. Laser protective eyewear shall be made available and shall be worn by all personnel within the Nominal Hazard Zone (NHZ) of Class 3 b and Class 4 lasers where the exposures above the Maximum Permissible Exposure (MPE) can occur. All laser protective eyewear shall be clearly labeled with the optical density and the wavelength for which protection is afforded. Refer to Appendix L, Laser Classification.

4.0 LOGISTICS

Good chemical management and safety practices begin with the decision to purchase chemicals. Personnel must be knowledgeable to assure appropriate inventory control, labeling, storage and distribution. A good understanding of the hazards of each chemical is required in order to make the most judicious decision regarding the need for, subsequent use and ultimate disposal of each chemical purchased.

4.1 PROCUREMENT

The following procedures will assist with the purchasing of chemicals.

- 1) Evaluate the need for the particular chemical and determine if a substitute less hazardous is available.
- 2) Determine the minimum quantity required to meet specific demand.
- 3) Determine the specific safety procedure and design elements required to assure protection of personnel and property (e.g. Storage cabinets, respiratory protection, control ventilation).
- 4) Check to determine if unused quantities can be returned to the manufacturer.
- 5) Determine if adequate ventilation is available for each chemical ordered.
- 6) Inventory the personal protective equipment necessary to handle the chemical is available and in good shape. If the personal protective equipment is not available, make sure it is ordered and the delivery date is prior to the chemical arrival.
- 7) Order chemicals in the smallest quantity necessary for the laboratory needs. Excess amount of a chemical must be disposed representing a double expense.
- 8) Request Material Safety Data Sheets (MSDS) for all chemicals ordered. Make sure MSDSs are received and forwarded to the Environmental Health & Safety office at CP 183.
- 9) Prepare the area for the arrival of the chemical. Check to determine if outside container is in good shape. Make sure package is not damaged. Open the package carefully and determine if the chemical container is labeled and sound.

4.2 STORAGE

Information from the MSDSs and the container labels must be read before attempting to store chemicals in a chemical storage area. Proper storage of chemicals is not complicated but does require some thinking. Chemicals must not be stored alphabetically since incompatibles may fall close to each other simply because of their names. The following general guidelines will help with the proper storage of chemicals.

- 1) Make sure containers are in good condition, capped and properly labeled. DO NOT store unlabelled chemical containers.
- 2) Store incompatible chemicals separately. Segregate chemicals according to hazard class. Refer to Appendix S Chemical Incompatibility.
- 3) Ensure storage areas are dry, adequately ventilated and properly lighted.
- 4) Store highly reactive or corrosive liquids on spill trays.
- 5) Whenever chemicals are transferred from one container to another observe manufacturer's recommendation for storage and labeling condition.
- 6) Store gas cylinders away from heat sources. Make sure cylinder is not leaking and label is in good readable condition. Check cylinders for stamped hydrostatic test date (testing should have been done within the past 5 years). Cylinders must be securely strapped in an upright position.

Refer to Appendix M, Chemical Compatibility Storage Guidelines.

4.3 DISTRIBUTION

In order to complete a safe arrival of the chemical proper distribution to the final user is a key factor.

- 1) Observe all warnings on the package.
- 2) Open the package carefully and determine if the chemical is properly labeled.
- 3) Review documentation on the safe handling and storage of the chemical.
- 4) Do not transport open chemical containers. Lids must be tightly secured before moving the chemical.
- 5) Carts for transporting chemicals and hazardous substances must have secondary containment and wheels large enough to negotiate uneven surfaces.

- 6) Transport only compatible chemicals together.
- 7) Hand deliveries must be in shock-resistant carrying containers and buckets.
- 8) Transport chemicals on freight-only elevators whenever these are available.
- 9) Avoid transporting chemicals during periods of high student traffic.
- 10) Transport gas cylinders using the appropriate hand truck and strap the cylinder down. Leave the valve cover cap on until the cylinder is located in its area of intended use. Make sure cylinders are properly chained when awaiting to be used and when being used.
- 11) Do not leave carts with chemicals unattended in hallways or walkways.
- 12) Do not stack boxed chemicals beyond two levels on a delivery cart.

5.0 ENVIRONMENTAL MONITORING

In order to provide a safe environment for students, staffs and visitors Florida International University has established programs to address environmental concerns and to control air quality within educational and research laboratories as well as areas of access to the general public.

5.1 INDOOR AIR QUALITY

The quality of indoor air and its potential to affect human health is a concern among building occupants at Florida International University. Indoor air quality has been implicated as the cause of occupant health conditions, and symptoms that run the gamut of those frequently associated with poor indoor air quality.

Investigations of indoor air quality complaints have identified a variety of sources as causative or synergistic agents. Some of these agents include human metabolic activity, second hand smoke, dust, structural components of buildings, biological contaminants, building systems, office and mechanical equipment, pesticides, cleaning agents and outside contamination brought into the building.

5.1.1 Indoor Air Quality Management Program

In recognition of the importance of acceptable indoor air quality to building occupants, the Vice President, Division of Business and Finance, has established the Indoor Air Quality Management Program to assure maintenance of the best achievable quality of indoor air within University facilities, and to provide timely and effective management of all complaints brought to the attention of the Department of Environmental Health & Safety and/or the Physical Plant Department. Implementation of the Indoor Air Quality Program has been assigned to the Indoor Air Quality Taskforce.

5.1.2 Indoor Air Quality Taskforce

The Indoor Air Quality Taskforce will address all indoor air quality concerns originating in University facilities. The Taskforce is comprised of professionals with the expertise necessary to address likely indoor air quality concerns. The Taskforce will serve to assure that indoor air quality concerns arising within University facilities are managed in a timely and effective manner. Taskforce activities will be coordinated by the Director of the Department of Environmental Health & Safety.

5.1.3 Air contaminants

Exposure to any substance listed in Tables Z-1, Z-2 and Z-3 (Refer to Appendixes N, O and P) of 29 CFR part 1910 subpart Z shall be limited in accordance with the following:

5.1.3.1 Table Z-1

1) Substances with limits preceded by “C” – Ceiling values.

Exposure to any substance in Table Z-1, the exposure limit of which is preceded by a “C”, shall at no time exceed the exposure limit given for that substance. If instantaneous monitoring is not feasible, then the ceiling shall be assessed as a 15-minute time weighted average exposure which shall not be exceeded at any time during the working day.

2) Other substances – 8-hour Time Weighted Averages.

Exposure to any substance in Table Z-1, the exposure limit of which is not preceded by a “C”, shall not exceed the 8-hour time weighted average given for that substance in any 8-hour work shift of a 40-hour work week.

5.1.3.2 Table Z-2

1) 8-hour Time Weighted Averages.

Exposure to any substance listed in Table Z-2, in any 8-hour work shift of a 40-hour workweek, shall not exceed the 8-hour time weighted average limit given for that substance in Table Z-2.

2) Acceptable ceiling concentrations.

Exposure to a substance listed in Table Z-2 shall not exceed at any time during an 8-hour shift the acceptable ceiling concentration limit given for the substance in the table, except for a time period, and up to a concentration not exceeding the maximum duration and concentration allowed in the column under “acceptable maximum peak above the acceptable ceiling concentration for an 8-hour shift”.

5.1.3.3 Table Z-3

Exposure to any substance listed in Table Z-3, in any 8-hour work shift of a 40-hour workweek, shall not exceed the 8-hour time weighted average limit given for that substance in the table.

5.1.3.4 Computation formulae

The computation formula which shall apply to employee exposure to more than one substance for which 8-hour time weighted averages are listed in subpart Z of 29 CFR part 1910 in order to determine whether an employee is exposed over the regulatory limit is as follows:

$$E = (C_a T_a + C_b T_b + \dots C_n T_n) / 8$$

Where:

E is the equivalent exposure for the working shift.

C is the concentration during any period of time T where the concentration remains constant.

T is the duration in hours of the exposure at the concentration C.

The value of E shall not exceed the 8-hour time weighted average specified in subpart Z of 29 CFR part 1910 for the substance involved.

In case of a mixture of air contaminants the equivalent exposure shall be computed as follows:

$$E_m = (C_1/L_1 + C_2/L_2) + \dots (C_n/L_n)$$

Where:

E_m is the equivalent exposure for this mixture.

C is the concentration of a particular contaminant.

L is the exposure limit for that for that substance specified in subpart Z of 29 CFR part 1910.

The value of E_m shall not exceed unity (1).

5.2 SMOKING

In order to protect the public health, comfort, and the environment, by maintaining University facilities free from tobacco smoke, and under authority from Section 386.201-211, Florida Statutes, the “Florida Clean Indoor Air Act”, the University has established the smoking policy. Refer to the Appendix B for FIU Smoking Policy.

5.3 FUME HOODS

Work that involves hazards and noxious materials which are toxic, odoriferous, volatile or harmful shall be conducted within a laboratory hood. The primary purpose of the hood is to keep toxic or irritating vapors and fumes out of the general laboratory circulation.

5.3.1 Operating Guidelines

A fume hood is a ventilated enclosure in which gases, vapors and fumes are contained and enclosed and evacuated. Ductwork connects the hood to a fan which pulls contaminants away from the lab and ejects them outside. Caution should be used to ensure that continuous air flow is maintained in a direction away from the user. The following guidelines will help ensure safe use of a fume hood:

- * Verify that exhaust fans are working.

- * Keep the sash as low as possible while performing your work.
- * Work must be conducted at least 6 inches in from the edge. A stripe on the bench surface is a good remainder
- * Only place in the hood the materials necessary to perform your work.
- * Never put your head inside the hood.
- * All electrical devices should be connected to plugs outside the hood. Permanent electrical receptacles are not permitted in the hood.
- * Remove working materials and clean the hood at the conclusion of your work.
- * Do not store chemicals in a fume hood unless storage is the sole use of the hood.
- * Never use hood evaporation as a means of chemical disposal.
- * Avoid cross drafts at the face of the hood.
Walking rapidly past the work opening can create a cross draft that may disturb the direction of the airflow and cause turbulence.
- * Ensure that equipment or materials do not block the baffle vents in the back of the hood.
- * Large equipment shall be placed on blocks to allow air flow beneath it.

5.3.2 Fume Hood Inspection Program

A fume hood shall provide an average face velocity of 100 +/- 10 linear feet per minute in order to provide the necessary protection when performing work. Higher face velocities cause turbulence that may bring the contaminants back into the user's breathing zone. Slower face velocities will not eliminate all the contaminants.

In order to assure the protection of staff and students by maintaining the fume hoods in a good working condition, the Department of Environmental Health & Safety at Florida International University has established a Fume Hood Inspection Program. The purpose of the Program is to evaluate the performance of the fume hoods on a periodic basis and to initiate the necessary work required to correct deficiencies and malfunctions discovered during the inspections. The Program covers all University campuses.

The inspections involve the use of a properly calibrated anemometer and smoke tube tests as well as checks of light switches, gauges, pilot lights, lightning, general physical condition and housekeeping.

6.0 LABORATORY

6.1 HOUSEKEEPING

Good housekeeping in laboratories is essential in order to reduce risks of accidents and injuries and to protection of the integrity of experiments. Routine housekeeping* should be relied upon to assure work areas free of significant sources of contamination.

Laboratory personnel are responsible for cleaning laboratory benches, equipment and any area that may require specialized technical knowledge. Additional housekeeping concerns include:

- Access to emergency equipment, safety showers, eyewash fountains and exits must never be blocked.
- All aisles, hallways, and stairs (egress paths) must be kept clear of obstruction and storage of any chemicals as required by fire codes and the State Fire Marshall's Office.
- Attention must be paid to electrical safety, especially as it relates to the use of extension cords, proper grounding of equipment, overloading electrical circuits and avoidance of the creation of electrical hazards in wet areas.
- Original labels on containers must be protected so that the identity of the contents and the hazards of those contents present are known.
- Containers into which chemicals have been transferred from an original container must be labeled with the chemical name and the hazard(s).
- All chemicals must be placed in their assigned storage prior to leaving the area at the end of each workday/schedule.
- All working areas and floor must be cleaned regularly, kept dry and free of tripping hazards.
- DO NOT use laboratory floors and bench tops for storage of equipment and materials not in use.
- Properly secure all gas cylinders.
- Never use fume hoods for storage of chemicals or other materials.

- Maintain laboratories free of excess, unused and old chemicals by periodically submitting the “Request for Hazardous Waste Pick-Up for Disposal” form to the Department of Environmental Health & Safety.
- Surfaces should be clean and free of infrequently used chemicals, glassware and equipment.

*Housekeeping refers to the clean and orderly maintenance of the area and it is not limited to tasks performed by building maintenance/services personnel.

6.2 MAINTENANCE

6.2.1 Safety Showers

It is the responsibility of each laboratory worker and student to identify and learn the location and route to the safety shower in their work area so that they will be able to use these in an emergency.

Showers are capable of drenching the subject immediately and are provided with a quick-opening valve to provide continuous water flow. The quick-opening valve requires manual closing to stop the flow of water.

Safety showers are provided in areas where chemicals are handled and areas where the potential for an exposure to a hazardous situation may require immediate first aid treatment. Every employee and student should learn the location of safety showers so that it can be found with eyes closed, if necessary.

Safety showers are inspected and tested biannually by the Environmental Health & Safety personnel. Safety showers are checked for valve operability, water flow, accessibility and surrounding area housekeeping. Inspection dates are recorded in the safety shower inspection tag attached to each individual safety shower. More frequent tests by potential users are recommended to ensure that the valve is operable and to remove any debris in the system.

6.2.2 Eyewash Fountains

It is the responsibility of each laboratory worker and student to identify and learn the location and route to the eyewash station in their work area so that they will be able to use these in an emergency.

Eyewash fountains are required if the substance in use presents a corrosive hazard to the eye or in research or instructional laboratories where unknown hazards may be encountered. Eyewash fountains should provide a soft stream or spray of aerated water for an extended period, at least 15 minutes.

Eyewash fountains are tested biannually by Environmental Health & Safety personnel. Eyewash fountains are checked in conjunction with safety showers at dual installation locations. Eyewash stations are checked for valve operability, water flow, flow alignment, accessibility and general surrounding area housekeeping. Weekly routine tests to be performed by potential users are recommended to ensure operability and to remove debris.

6.2.3 Fume Hoods

Fume hoods are inspected annually to check operability and safety aspects. Refer to Section 5.3 Fume Hoods.

6.3 LABORATORY INSPECTIONS

Laboratory safety inspections are conducted by the Department of Environmental Health & Safety at all University campuses to assure a safe environment for all employees and students and to determine if laboratories are in compliance with safety rules and regulations. Laboratories are inspected annually by Environmental Health & Safety personnel as per the frequency established by the Laboratory Safety Program for general housekeeping, ventilation, compressed gases storage, hazardous waste disposal, chemical storage, signage, egress facilities, electrical equipment and radiation safety. Safety violations found during routine inspections are recorded on the Laboratory Safety Inspection Checklist and reported to the Laboratory Manager for corrective action. The Laboratory Safety Program evaluates laboratories on a case by case basis in order to determine an appropriate inspection frequency based on the degree of hazard and the compliance history of each location. Refer to Appendix C, Laboratory Safety Inspection Checklist.

6.4 LABORATORY CLOSE-OUT PROCEDURE

Whenever a principal investigator or laboratory supervisor leaves the university or is transferred to a different location, proper disposition of hazardous materials is required. This includes faculty, staff, graduate students, or any person performing work with hazardous materials in the laboratory.

6.4.1. Vacating Procedure

The following procedure should be completed before the responsible individual leaves the university or transfers to a different location on campus:

- Assure that all containers of chemicals are labeled with the name of the chemical. All containers must be securely closed. All laboratory glassware must be emptied and cleaned.

- Hazardous chemical wastes must be collected and labeled for disposal. Contact the Department of Environmental Health & Safety for pick up at least two weeks prior to vacating the laboratory.
- Check refrigerators, freezers, ovens, fume hoods, storage cabinets and bench tops for hazardous materials and thoroughly clean these locations.
- Assure all electrical equipment is turned off and the cord unplugged from the outlet.
- Chemicals still usable must be removed, or the responsibility for the chemical must be transferred to another principal investigator or laboratory manager willing to take charge.
- Gas cylinders must have the regulator removed and the cap secured in place. Return cylinders to the supplier, or transferred the responsibility as required for chemicals.
- Submit laboratory keys to laboratory manager.

6.4.2 Vacating Inspection

The Department of Environmental Health & Safety shall be notified at least two weeks prior to vacating a laboratory. At this time, an exit inspection will be scheduled with the current principal investigator or laboratory supervisor to ensure chemical and physical hazards are identified and addressed and the Chemical Hygiene Plan is turned over to the Chemical Hygiene Officer or laboratory manager.

The Chemical Hygiene Officer shall be responsible to submit inspection findings report to the department representative and to follow-up on required corrective actions.

7.0 LABORATORY MEDICAL MONITORING PROGRAM

It is the responsibility of each principal investigator and/or instructor to identify in the planning stages of each research undertaking or experiment the need to implement/request medical monitoring for any and all laboratory workers whose work will involve regular and frequent handling of toxicological significant quantities of material known or suspected to be acutely or chronically toxic.

Additionally the department of Environmental Health & Safety recommends baseline medical evaluations for all persons who will be working with particularly hazardous substances prior to the commencement of the project or experiment.

Medical supervision of laboratory workers is provided to assist employees and students in case of chemical exposure. Various aspects of the medical program are described in this section.

7.1 MEDICAL MONITORING

Medical examinations and consultations must be performed by a licensed and qualified physician or under a physician's direct supervision at such frequencies as determined to be necessary. Frequencies shall be determined on a case by case basis.

Each principal investigator and/or instructor shall consider the following in making the determination to implement or request medical monitoring for employees or students who will be involved in the research undertaking or experiment:

- The identity of the hazardous chemicals to which the employee or student may have been exposed.
- The potential health effect of the chemical to be used.
- An evaluation of the conditions under which the exposure may occur.
- A description of the signs and symptoms of exposure that the employee or student may exhibit.

7.2 FIRST AID

The following guidelines must be followed when using first aid kits and applying first aid to employees or students:

- * Assure First Aid Kits are visible, accessible and appropriately stocked.

- * Do not dispense or administer any medication, including common pain relievers.
- * Do not put any ointments or creams on wounds or burns. Use ice, a cold pack or cold water.
- * Consult the MSDS for first aid information.
- * Student (or employees) requiring first aid may be treated at the Student Health Center.
- * FIU Police Officers are trained and certified in the administration of first aid.

7.3 MEDICAL SURVEILLANCE

Employees and students who work with hazardous chemicals are required to be provided with the opportunity to contact/consult with a licensed qualified physician under the following circumstances:

- Whenever an employee or student develops signs or symptoms associated with a chemical to which the employee may have been exposed.
- When a routine monitoring of the work area reveals an exposure above applicable personal exposure limits.
- When an event takes place in the work area such as a spill or leak, explosion or other occurrences resulting in the likelihood of an acute exposure to a hazardous agent.
- When their determination is made that OSHA requires medical surveillance.
- When the Chemical Hygiene Officer determines that an individual assessment should be made with respect to specific hazardous substances or specific experiments.

7.4 RECORD KEEPING

The results of any laboratory tests, biological monitoring, physical examinations, and diagnosis where appropriate shall be kept on record. A written medical opinion to the administrator of the medical shall include the following:

- * Any recommendation for further medical follow-up including periodic biological testing.

- * A description of the results of the examination and any associated tests.
- * Any medical condition that is revealed in the course of the examination that may place the employee at increased risk, if exposed to a hazardous substance in the workplace.
- * A statement that the employee has been informed by the physician of the results of the examination and any medical condition which may require further evaluation or treatment.

Specific diagnosis unrelated to occupational exposure shall not be revealed to anyone except the employee. All records related to employee medical status shall be maintained absolutely confidential.

8.0 PERSONAL PROTECTION

It is the responsibility of the principal investigator to identify the need for personal protective equipment. Personal protective equipment serves to create a barrier between the individual and the laboratory hazard. Personal protective equipment does not substitute for good engineering or administrative controls or good work practices and should be used in conjunction with these controls to ensure the safety and health of employees and students.

Among the engineering and administrative controls which may reduce the need for personal protective equipment and eliminate exposures to hazardous chemical include, but are not limited to:

- * Substitution of a less hazardous substance
- * Substitution of a less hazardous equipment or process
- * Isolation of the operator or the process
- * Local and/or general ventilation
- * Hazard education
- * Limit exposure rotation

The use of personal protective equipment is required whenever it is determined that the implementation of engineering and administrative controls is not sufficient to protect the individuals from injury and/or illness.

8.1 EYE PROTECTION

Prevention of eye injuries requires that all persons who may be potentially exposed to hazards to the eye wear protective eyewear. This includes employees, students, visitors, researchers, contractors, or others passing through an identified eye hazard area.

Suitable protectors shall be used when individuals are exposed to hazards from flying particles, molten metal, acids or caustic liquids, chemical liquids, gases or vapors, bioaerosols, or potentially injurious light radiation.

Standard eye protection include:

- * safety glasses
- * safety goggles

- * face shields

Other eye and face protection equipment may be necessary under specific circumstances.

8.1.1 Safety Glasses

Standard safety glasses look very much like normal glasses, but are designed to protect against flying particles. Safety glasses have lenses that are impact resistant and frames that are stronger than regular glasses. Safety glasses must meet the standards of the American National Standards Institute (ANSI). Safety glasses are also available in prescription form for those persons who need corrective lenses. Safety glasses can be equipped with side shields, cups, or tinted lenses to offer additional protection.

8.1.2 Safety Goggles

Like safety glasses, goggles are impact resistant and are available in tinted lenses. Goggles provide a secure shield around the entire eye area to protect against hazards coming from many directions.

8.1.3 Face shields

Face shields are not in themselves protective eye wear. However, they are frequently used in conjunction with eye protectors to provide additional protection. Full-face shields are often used when you are exposed to chemicals or heat or glare hazards.

8.1.4 Eyewear Selection Guidelines

When selecting protective eyewear consider the following guidelines:

- * Wearers of contact lenses must also wear appropriate eye and face protection devices in a hazardous environment.
- * Side protectors shall be used when there is a hazard from flying objects.
- * Goggles and face shields shall be used when there is a hazard from chemical splash.
- * Face shields shall only be worn over primary eye protection (safety glasses or goggles).
- * For wearers of prescription lenses, eye protectors shall either incorporate the prescription in the design or fit properly over the prescription lenses.
- * Protectors shall be marked to assure they are approved for type usage.

- * Equipment fitted with appropriate filter lenses shall be used to protect against light radiation. Tinted and shaded lenses are not filter lenses unless they are marked and identified as such.

8.2 RESPIRATORY PROTECTION

Respirators are used to prevent inhalation of air contaminants such as dusts, fumes, mists, vapors, and gases. Positive pressure types can also supply breathable air in oxygen-deficient atmospheres.

Standard respiratory protective equipment include:

- * Particle-removing air purifying respirators
- * Gas and vapor-removing air purifying respirators.
- * Atmosphere supplying respirators.

Respirators should be carefully selected to insure proper protection. Individuals required to use respirators must be trained on the proper use and fit tested to make sure the necessary protection is provided. Contact the Department of Environmental Health & Safety for additional information on respiratory protection.

8.2.1 Air Purifying Respirators

Mechanical filter respirators are used for particulate matter. Chemical cartridge respirators are used for gaseous contaminants. In addition, a special subcategory of air purifying respirators is the Powered Air Purifying type. PAPRs are positive pressure devices that use a blower to force contaminated air through a filter or cartridge. PAPRs are powered by portable rechargeable battery packs.

8.2.2 Air Supplied Respirators

Air supplied respirators provide uncontaminated air from a source independent of the surrounding atmosphere, via an air line. Air supplied respirators can be fed from air tanks carried by the user or from a piped air line specially dedicated for this purpose.

8.3 SKIN PROTECTION

Attire should be selected carefully to provide protection which covers areas of the skin which may be exposed to hazardous substances. Gloves, laboratory coats and proper attire provide skin protection.

8.3.1 Gloves

Skin contact is a potential route of exposure to toxic materials, it is important that the necessary steps be taken to prevent such contact. Most accidents involving hands and arms can be classified under four main hazard categories: chemicals, abrasions, cutting, and heat. Various types of gloves are available that can protect workers from each of these hazards or any combination thereof.

Gloves should be replaced periodically, depending on frequency of use and permeability to the substance(s) handled. Gloves overtly contaminated should be rinsed and then carefully removed after use.

In addition to the typical hazards of the chemical and research laboratories gloves should also be worn whenever it is necessary to handle rough sharp-edged objects, and very hot or very cold materials. The type of glove materials to be used in these situations include leather, welder's gloves, aluminum-backed gloves, and other types of insulated glove materials.

Careful attention must be given to protecting your hands when working with tools and machinery. Power tools and machinery must have guards installed or incorporated into their design that prevent the hands from contacting the point of operation, power train, or other moving parts. To protect hands from injury due to contact with moving parts, it is important to:

- * Ensure that guards are always in place and used.
- * Always lock-out machines or tools and disconnect the power before making repairs.
- * Treat a machine without a guard as inoperative
- * Do not wear gloves around moving machinery, such as drill presses, mills, lathes, and grinders.

The following is a guide to the most common types of protective work gloves and the types of hazards they can guard against:

Disposable Gloves	Disposable gloves, usually made of lightweight plastic against mild irritants.
Fabric Gloves	Made of cotton or fabric blends are generally used to improve grip when handling slippery objects. They also help insulate hands from mild heat or cold.

Leather Gloves	These gloves are used to guard against injuries from sparks or scraping against rough surfaces. They are also used in combination with an insulated liner when working with electricity.
Metal Mesh Gloves	These gloves are used to protect hands from accidental cuts and scratches. They are used most commonly by persons working with cutting tools or other sharp instruments.
Aluminized Gloves	Gloves made of aluminized fabric are designed to insulate hands from intense heat. These gloves are most commonly used by persons working with molten materials.
Chemical Resistance Gloves	These gloves may be made of rubber, neoprene, polyvinyl alcohol or vinyl. The gloves protect hands from corrosives, oils, and solvents.

Refer to the Appendix for a table provided as a guide for the selection of different types of gloves and the chemicals against which they provide protection. When selecting chemical resistance gloves, be sure to consult the manufacturer's recommendations, especially if the gloved hand will be immersed in the chemical. Refer to Appendix D, Gloves.

8.3.2 Laboratory Coats

The laboratory coat can be used to protect street clothing against biological or chemical spills as well as to provide additional body protection. The specific hazard(s) and the degree of protection required must be known before selecting coats for laboratory personnel.

8.3.3 Clothing

Long sleeve shirts are recommended. Shorts or other type clothing which leave skin exposed to chemical contact shall not be worn. Sandals or any type of shoe that partially expose the feet shall not be worn in the laboratories. Any clothing item that becomes contaminated with chemicals must be decontaminated before reuse, or must be disposed as recommended in the chemical's material safety data sheet. If clothing becomes contaminated with more than one chemical, the item must be disposed according to the instructions applicable to the most hazardous chemical.

8.3.4 Manufacturer's Recommendations

In all cases the use of personal protective equipment shall be consistent with manufacturer's recommendations, industry practice, proper hygiene and specific task safety considerations.

8.4 EQUIPMENT

Several pieces of equipment play an important part in the protection of students and employees while conducting instructional and research activities.

Safety shower and eyewash stations provide the washing conditions necessary in case of chemical splashes and other emergencies. See Section 6.2

8.4.1 Fire Extinguishers

Fire extinguishers are provided for each laboratory. At the request of laboratory managers or principal investigators additional ones may be made available. As a general rule laboratories are provided with ABC fire extinguishers unless specific laboratory conditions required another type of extinguisher. In addition, fire extinguishers are strategically located in laboratory hallways and other locations throughout the University following NFPA guidelines. Fire extinguisher inspection requirement dictates monthly verification. See Appendix for guidelines on inspection of fire extinguishers.

EH&S discourage staff access to laboratories where principal investigators and laboratory managers may not be present, therefore EH&S shall rely on principal investigators and laboratory managers to assure fire extinguishers are operational as recommended in Appendix.

8.4.2 Fire Alarms

Fire alarms pull stations and sirens are located in hallways and other locations throughout the University following NFPA guidelines. Do not block fire alarm pull stations. Advise students and visiting researchers when and how to activate alarms.

8.4.3. Emergency Telephones

All teaching and research laboratories shall be provided with telephones or similar type communication devices for emergency used. Laboratories are required to maintain an emergency contact list posted by the exit door. This list shall include telephone numbers of principal investigator, laboratory manager, Public Safety, Department of Environmental Health & Safety, and any other contacts useful in case of an emergency.

9.0 RECORDS

9.1 ACCIDENTS

All accidents/occurrences resulting in significant property damage and/or injury to any person must be immediately reported to the Public Safety department. Timely notification shall be provided to the Department of Environmental Health & Safety. The office of Human Resources shall be notified for all injuries involving University employees. Laboratory managers shall assure that witness statements are taken and made available to the Department of Environmental Health & Safety as appropriate.

Each laboratory shall be appropriately equipped with first aid supplies, spill kits and fire extinguishers. First aid and CPR training is available for all laboratory personnel through the Department of Environmental Health & Safety.

9.2 CHEMICAL HYGIENE PLAN

Numbered copies of the FIU Chemical Hygiene Plan shall be distributed to Laboratory managers and each research laboratory location. Upon vacating a laboratory the principal investigator shall comply with the requirements of Section 6.4 "Laboratory Close-Out Procedure" and shall return the numbered copy of the Chemical Hygiene Plan to the Chemical Hygiene Officer or laboratory manager. The FIU Chemical Hygiene Plan shall be updated annually to reflect any changes in regulations, University standard operating procedures or state-of-the-art. It is the responsibility of each laboratory manager and principal investigator to assure that updates are made to their copy of the Chemical Hygiene Plan as distributed by the Chemical Hygiene Officer.

9.3 CHEMICAL INVENTORY

Nothing is more important to laboratory safety than the identification of potentially hazardous materials used at that location. The maintenance of a chemical inventory is the heart of this process. It is the responsibility of each laboratory manager and principal investigator to assure the following:

1. Compile a list of each chemical present at the laboratory.
2. Maintain inventory current by adding each purchase and deleting used or disposed materials.

Chemical inventory procedure include periodic inspection of storage conditions and containers to check for:

1. Shelf life
2. Inappropriate storage
3. Damaged labels
4. Damaged containers

Inventories shall be maintained immediately accessible and shall be made available to the Chemical Hygiene Officer, Fire Prevention Officer, Fire Marshall and emergency response personnel as appropriate. Refer to Appendix Q Chemical Inventory Form and Appendix R Chemical Inventory Term Explanation.

10.0 SIGNS AND LABELS

The standardization of signs and labels displayed at Florida International University is necessary to display the necessary information to employees and students.

10.1 SIGNS

Laboratories shall display a sign, which provides information to visitors and non-research support personnel on the hazards in the laboratory. The principal investigator or laboratory manager is responsible to assure that all signs meet the specifications for accident prevention signs and tags as specified in 29 CFR 1910.145. Color coding for signage as “recommended” by 29 CFR 1910.145(f) shall be as follows:

“DANGER”	Red, or predominantly red, with lettering or symbols in a contrasting color.
“CAUTION”	Yellow, or predominantly yellow, with lettering or symbols in a contrasting color.
“WARNING”	Orange, or predominantly orange, with lettering or symbols in a contrasting color.
“BIOLOGICAL HAZARD”	Fluorescent orange or orange-red, or predominantly so, with lettering or symbols in a contrasting color.

EH&S will provide the sign and assure that appropriate warning information is included.

Signs shall be posted at eye level on the outer side of the laboratory entrance door. If there is more than one entrance to the laboratory similar signs must be posted on the outside of each door.

10.2 LABELS

A label is any written, printed, or graphic material displayed on, or affixed to, containers of chemicals. Labels or other forms of hazard warnings, such as tags or placards, provide immediate warning of potential danger.

Each container of chemical where in the contents shall be kept for more than a single use on the same workday by the same person or group of persons shall be clearly labeled. Damaged labels shall be replaced as necessary. Refer to Section 3.1.6

The Occupational Safety and Health Administration’s Hazard Communication Standard established the minimum labeling requirements for most chemical containers in the

workplace. All chemical containers at Florida International University shall be labeled according to these OSHA requirements. The containers shall be labeled as follows:

- Common and scientific name of the chemical. Chemical formulas and structural formulas alone are not acceptable except for small quantities of compounds synthesized in the laboratory.
- Date container opened.
- Physical and health hazards
- Appropriate handling precautions

Existing labels on new containers of chemicals or containers in storage shall not be removed or defaced. Containers shall display original labels from manufacturer; distributors are required to also bear the name and address of the manufacturer.

Employees and students should not work with any chemical from an unlabeled container. However portable containers intended for immediate use, by the employee or student, performing the transfer, do not need to be labeled. This labeling requirement also does not apply to students assigned unknown chemicals for analysis. However, hazard information should be provided with all unlabeled chemicals distributed for analysis in student laboratories. Any portions remaining after the class or the experiment is concluded shall be labeled or appropriately discarded. Unlabeled chemical containers shall not be left unattended at the conclusion of classes or experiments.

All containers that hold carcinogens, reproductive hazards or acutely toxic reagents must be properly labeled concerning the health hazard posed by the chemical. Most new reagent containers will have the chemical hazards clearly displayed on the label. However the laboratory worker must properly label older reagents.

MSDS provide additional information on each chemical. Laboratory personnel must become familiar with information on labels and MSDSs.. Several University departments maintain copies of the MSDSs for the chemicals in use at those departments. No new chemical shall be ordered, used or stored unless consideration is given to associated health and safety hazards.

Chemical manufacturers and distributors are required by the Hazard Communication Standard to provide the purchasers of chemicals with MSDS for each hazardous chemical or product purchased. If an MSDS is not provided with the shipment of a hazardous chemical, one should be requested from the manufacturer or distributor. The Department of Environmental Health & Safety maintains hard copies of MSDSs. Each laboratory manager/principal investigator should maintain copies of MSDSs immediately accessible or shall develop written posted procedures for accessing MSDSs whether on line or otherwise. Chemicals must not be handled unless thorough information on the chemical characteristics is known.

10.3 FOOD AND DRINK

Eating, drinking and the application of cosmetics in laboratories are an unsafe practice which should be strongly discouraged by laboratory managers and principal investigators. It is the responsibility of each laboratory manager/principal investigator to assure compliance with this recommendation. The use of signage and written procedures to seek compliance will be evaluated by the Chemical Hygiene Officer during periodic laboratory inspections.

11. SPILLS AND ACCIDENTS

11.1 SPILLS

11.1.1 Prevention

The first and best method of spill control is prevention. By using the proper equipment and handling techniques, spills and leaks can be prevented in almost all cases. Some specific suggestions for preventing leaks and spills are:

- Provide a physical arrangement that permits easy manipulations and material transfers.
- Leak-test the system before introducing flammable or toxics.
- Make practice runs with inert or non-flammable materials as a final check.

A thorough hazard evaluation including potential spill assessment should be conducted prior to starting new experiment or project.

11.1.2 Containment

Provide for containment of spills as a backup to the preventive steps described above. Trays or catch-pans under apparatus where leaks or spills may occur greatly simplify the clean-up problem. Container should be large enough to contain the maximum possible spill.

In laboratory settings, it is mandatory that appropriate equipment be available for responding to and containing spills. Recommended materials for containing spills include a smothering and damming material, neutralizing agents and an absorbent. Each laboratory must secure and maintain these laboratory spill control items. Commercially available spill kits contain materials adequate to contain and clean specific spills.

11.1.3 Control and Clean-up

Small chemical spills should be promptly cleaned up when appropriate expertise, protective apparel, equipment and proper disposal resources are available to safely accomplish the task. Consult the MSDS on file in the area for the chemical spilled if the hazards of the chemical are unknown, and determine if the spill can be contained using the spill kit.

If the spill can be contained using the spill kit, immediately put on appropriate gloves, goggles and any other protective equipment specified in the MSDS. Pour the absorbant around the perimeter of the spill to prevent the spill from spreading. Use the plastic scoop and brush to work the absorbant into the spilled material. Add more absorbant as

needed to contain the spill. Use the scoop and brush to collect the contaminated absorbant and place it into an adequate container. Assure the container is compatible with the spilled material. Place any other contaminated items such as glass, gloves, etc. in the container. Seal and label the container. Contact EH&S for proper disposal.

If it is determined that the amount and/or hazardous nature of a spill is beyond the ability to respond safely, vacate the area immediately. Contact Public Safety and advise the operator what type of chemical(s) was spilled, amount spilled, exact location (building, room number) of the spill. All spills must also be reported to EH&S.

11.2 INJURIES & ILLNESSES

For minor cuts, burns, etc. follow first-aid procedures. If necessary, follow up with a visit to the Health Clinic. For major injury or medical emergencies, contact Public Safety. If appropriate administer aide which may include washing under a safety shower, removing contaminated clothing, irrigating the eye at an eyewash station. Notify personnel in adjacent areas of any potential hazard.

12.0 TRAINING AND INFORMATION

Florida International University offers a comprehensive and thorough training program addressed to comply and exceed regulatory agency requirements. Special attention is given to laboratory personnel and students because of the continuous handling of chemicals. Dissemination of information on the hazards of chemicals and the handling of laboratory equipment is an integral part of the program.

12.1 TRAINING VIDEOS

The Department of Environmental Health & Safety has over 70 professionally filmed safety training videos in 17 categories. Videos and CDs are available for loan to faculty, staff and students. At the time of publication of this Plan the following related videos are available. Contact EH&S for comprehensive list.

0200 Biohazards

- 0201 Bacteria & Disease Control (09:00)
- 0202 DNA Thermal Cycler (42:00)
- 0203 Containing HIV & HBV
- 0204 Bloodborne Pathogens (08:00)
- 0205 Controlling Exposure to Bloodborne Pathogens (19:00)

0300 Chemicals

- 0301 Chemicals on Campus (120:00)
- 0302 Chemical Storage Hazards (11:00)
- 0303 Corrosives (06:16)
- 0304 Toxics (06:39)

0400 Electrical Safety

- 0401 Electrical Safety – Qualified Employees (05:48)
- 0402 Electrical Safety – Safe Work Practices (05:06)
- 0403 Hazards of Electricity (05:33)

0600 Emergency Evacuation Assistance

- 0601 Evacu-Trac: Operator Training

0700 Fire Safety

- 0701 Fire Extinguishers (05:59)
- 0702 Fire Extinguishers: Use and Procedures (12:00)

0800 General Safety

- 0801 Airborne Standards (06:42)
- 0802 Gas Cylinders (06:51)
- 0803 Health Factors in Welding Operations (28:00)

0804 Heat Stress (05:00)
0805 Housekeeping (06:07)

0900 Hazard Communications / Right-to-Know

0901 Hazard Communications (10:00)
0902 Hazard Communications for Custodians (10:00)
0903 Hazard Communications – Labels & MSDS (16:41)
0904 Mammalian Cell Culture Hazard/X-Ray Diffraction/
Assessing Risks of Toxic Chemicals

1000 Lab Safety

1001 Centrifugation Hazards (09:00)
1002 Glassware Washing Hazards (10:00)

1100 Machine Safety

1103 Lockout/Tagout – Affected Employees (05:03)
1104 Lockout/Tagout Procedure (06:13)
1105 Machine Guarding (06:23)
1106 Pressure Valves (05:00)

1200 Miscellaneous

1201 Train the Trainer

1400 Personal Protective Equipment

1401 Air Purifying Respirators (05:00)
1402 Equipped for Safety (09:00)
1403 Personal Protective Equipment (05:44)
1404 Respirator Training (13:00)

1500 Personnel Safety

1502 Employee Safety Orientation (12:00)
1504 Safety Attitude (05:46)
1505 Unsafe Acts – Human Behavior (12:00)
1506 You're the One (21:00)

1600 Physical Health

1603 Eye Safety (05:00)
1604 Hand safety (05:00)
1605 Hearing Safety (05:00)
1702 Ergonomics

1900 Radiation

1901 Introduction (15:00)
1902 Laboratory Techniques (15:28)
1903 Emergency Procedures (10:53)

- 1904 Decontamination Procedures Pt. 1
- 1905 Decontamination Procedures Pt. 2
- 1906 Decontamination Procedures Pt. 3

12.2 MATERIAL SAFETY DATA SHEETS (MSDS)

The workplaces of the world are loaded with chemicals that have properties that can cause illnesses, injury, and even, death to people who are exposed to them in quantities in excess of accepted threshold. In an attempt to protect employees who are exposed to these chemicals in the workplace, the federal Hazard Communication standard, adopted by the State of Florida under the authority of Chapter 42, Florida Statutes, as the Florida Right-to-Know law which requires that all firms manufacturing and/or distributing chemicals for use in the United States prepare material safety data sheets (MSDS) for those chemicals and distribute them to their customers.

The law further requires that employers provide their employees with an MSDS for every hazardous chemical that is present in their workplace. Employers must also provide employees with the information and training necessary to read and understand MSDSs so that those employees can do what is necessary to protect themselves from the hazards associated with exposure to these chemicals.

The objective of the MSDS is to concisely inform about the hazards of the materials you work with so that you can protect yourself and respond to emergency situations. The law states that you must have access to MSDSs and be taught to read and understand them.

The American National Standards Institute (ANSI) recommends for the MSDS to contain 16 sections. These sections are as follows:

- Section 1 Chemical Product & Company Information
- Section 2 Composition/Information on Ingredients
- Section 3 Hazards Identification
- Section 4 First Aid Measures
- Section 5 Fire Fighting Measures
- Section 6 Accidental Release Measures
- Section 7 Handling and Storage
- Section 8 Exposure Controls/Personal Protection
- Section 9 Physical and Chemical Properties
- Section 10 Stability and Reactivity
- Section 11 Toxicological Information
- Section 12 Ecological Information
- Section 13 Disposal Considerations
- Section 14 Transport Information
- Section 15 Regulatory Information
- Section 16 Other Information

The Department of Environmental Health & Safety at Florida International University is the repository for the MSDSs of all chemical products used at the University campuses. Several University departments maintain copies of the MSDSs for the chemicals in use at those departments.

Each department is encouraged to develop a written Hazard Communication Program in accordance with the guidelines in the University Safety Compliance Guide.

13.0 CHEMICAL WASTE MANAGEMENT

The following guidelines are to be used to handle hazardous chemical waste at Florida International University. However these guidelines do not apply to radioactive wastes which must be managed in accordance with the FIU Radiation Safety Manual. For detailed information regarding the management and disposal see the University Safety Compliance Guide: Hazardous Waste Management Program.

13.1 CHEMICAL WASTE MANAGEMENT GUIDELINES

The responsibility for chemical waste identification, labeling and packaging rest with the principal investigator or laboratory manager. The principal investigator and the laboratory manager shall follow all the procedures as provided in the Hazardous Waste Management Program in the guidelines and shall provide proper training to personnel under their supervision.

13.1.1 Storage

Chemical waste shall not be held in storage for more than 3 months awaiting disposal. Prompt disposal is necessary to prevent unnecessary exposure to laboratory employees and students and to assure the University complies with federal, state and local regulations.

- 1) Chemical wastes shall be held in storage in accordance with chemical classification conditions.
- 2) Excess chemicals should not allow to accumulate in any location to create an unsafe working environment for laboratory employees and students.
- 3) Unknown chemicals should not be held in storage for an indefinite period. Personnel responsible for the area where unknowns are found are expected to identify these chemicals through communications and/or chemical analysis. EH&S shall not assume costs for disposal of unknowns.
- 4) The laboratory manager or principal investigator shall conduct periodic chemical inventories at least once per semester to determine if any chemicals shall be selected for disposal.
- 5) Once a chemical has been selected for disposal personnel responsible shall fill the "Request for Hazardous Waste Pick up for Disposal" and immediately contact EH&S to schedule pick up.

13.1.2 Labeling

Prior to pick up by EH&S the laboratory manager or principal investigator must assure that all chemical waste containers are accurately labeled with the chemical name and the hazards. Type or print legibly on the label. Do not use chemical symbols. Use percentages if there are multiple chemicals in the container. Do not use abbreviations, acronyms or trade names. Containers with labels that are in deteriorated condition preventing the complete chemical identification will not be accepted for pick up. EH&S will not pick up unlabeled chemical containers.

13.1.3 Collection

Once the "Request for Hazardous Waste Pick-up for Disposal" is filled out and submitted to EH&S, pick up will be scheduled. EH&S will make every efforts to pick up waste on scheduled date. While waiting for pick up, chemicals must be stored in secondary containers away from routine laboratory traffic. Chemicals will be picked up by EH&S in their secondary containers. An EH&S representative will sign and date the form and leave the yellow copy at the place of pick up. Under no circumstance shall chemical waste be left in corridor or general access areas to await pick up.

13.1.4 Disposal

Chemical wastes picked up from the generating laboratories will be transported by EH&S personnel to the Hazardous Waste Storage Facility. Chemicals are kept at this facility until collected by a hazardous waste disposal firm contracted by FIU to provide these services. All hazardous waste pick-up and disposals services for the University are consolidated under one contract to assure overall compliance and to realize economy of scale.