University of Southern Mississippi

LABORATORY SAFETY HANDBOOK

USM

LABORATORY SAFETY HANDBOOK

Department of EHS
Walker Science Building Room 240

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I. INTRODUCTION

In January, 1990, the Occupational Safety and Health Administration (OSHA) enacted the regulation entitled *Occupational Exposure to Hazardous Chemicals in Laboratories* (29CFR1910.1450 - commonly called "The Lab Standard"). This standard deals specifically with hazardous chemical recognition, safe use, storage, and disposal.
There are many hazards present in laboratories besides hazardous chemicals. Non-chemical lab hazards include compressed gases, cryogenic fluids, biohazards, electrical hazards, mechanical hazards, radiation, and radioisotopes. Non-chemical hazards are discussed in the latter part of this publication.
This handbook provides basic information for many important topics concerning laboratory safety. It is neither a complete nor comprehensive presentation of lab safety. Additional information may be obtained by calling the Department of EHS at 266-6912.

II. PUBLICATIONS

The Department of EHS has produced several publications that are directly or indirectly related to lab safety. A description of each publication follows.

Laboratory Management Plan - **To be proposed** to respond to the OSHA Lab Standard involving hazardous chemicals.

Waste Disposal Guidelines - Information concerning retention, treatment, and acceptable disposal of chemical waste is provided in this publication. Each department will be provided with a copy of these guidelines.

Bloodborne Pathogens-Exposure Control Plan - This publication will respond to the OSHA Regulation involving exposure to human blood and body fluids. Each department will be provided with a copy of these guidelines.

Biosafety Manual - This publication contains guidelines for the safe use of biological agents in the laboratory. Areas covered include biological agent summaries and classification, biowaste decontamination and disposal, spill response, bio-afety cabinets and biohazard shipments.

Emergency Procedures Handbook - This publication provides actions to take and telephone numbers to call in case of emergencies such as fire, chemical spill, or injury. Presented in a handy flip-chart format, these are posted inside each laboratory.

III. COMMITTEES

The University has organized committees to deal with safety issues relative to government regulations and guidelines, and prudent practices. Following are the committees that are involved with laboratory safety issues.

Laboratory Safety Committee - A campus-wide committee that is responsible for all laboratory safety issues not covered by other specific committees. This committee formally reports to the EHS Department for action on policy recommendations.

Institutional Biosafety Committee - This committee is responsible for review and approval of research activities and proposals involving recombinant DNA according to federal guidelines.

Biohazard Committee - All issues and research studies that involve non-recombinant DNA biological agents are reviewed by this committee.

Animal Care and Use Committee - The College of Science and Technology has a committee to review and approve activities and proposals for experimental animal use in compliance with federal regulations.

Radiation Safety Committee - The radiation safety committee is responsible for review and approval of radiation source and use activities in compliance with federal regulations.

Departmental Laboratory Safety Coordinators - Although not a formal committee, each department with laboratories has appointed a safety coordinator. This person is responsible for providing appropriate safety information to staff in his department and coordinating safety improvements recommended for the department.

IV. LABORATORY SAFETY SURVEYS

The department of EHS conducts inspections of all campus labs on an annual or more frequent basis. Results of the inspections are provided to the department in writing, usually through the department lab safety coordinator. The following general categories are examined relative to required or recommended practices.

- Emergency Procedures Posting
- Emergency Equipment - eyewash, shower, etc.
- Fume Hood/Biological Safety Cabinet
- Personal Protective Equipment
- Housekeeping and Hygiene
- Chemical/Biological Storage
- Chemical and Biohazardous Waste
- Labeling
- Electrical
- Compressed Gas/Cryogenic Liquids
- Equipment Guarding
- Lab User Knowledge of Safety Materials
- Fire Safety
- Hazard/Safety Signage

V. USM LABORATORY SAFETY POLICIES

Policy on Eye and Face Protection in Laboratory

Eye and face protection shall be used according to the laboratory classification system. Each department shall determine the hazard class of each laboratory. These requirements should be posted outside each laboratory door. Protective equipment will be provided to employees at no charge. Each department will be responsible for enforcement of this approved policy. If the recommended policy does not apply to a particular situation, departments must provide an alternative policy for approval by the Laboratory Safety Committee. These requirements apply to all persons entering the laboratory. If a procedure creates a greater hazard than the laboratory classification would indicate, eye and face protection appropriate for the hazard shall be worn. Guidance for the selection of eye and face protection is given in the "American National Standard for Occupational and Educational Eye and Face Protection" (ANSI Z87.1). EHS will assist in determining the appropriate eye and face protection for specific laboratory hazards and will provide vendor information for securing equipment.

LABORATORY CLASSIFICATION SYSTEM

CLASS 1 - EYE/FACE PROTECTION NOT REQUIRED
Laboratories that do not use chemicals, biologicals or physically hazardous materials.
Example: computer laboratory

CLASS 2 - EYE/FACE PROTECTION REQUIRED WHEN HAZARD EXISTS
Laboratories that use chemicals, biological or physically hazardous materials on an occasional basis.
Example: laser laboratory, some biological labs

CLASS 3 - EYE/FACE PROTECTION REQUIRED AT ALL TIMES
Laboratories that routinely use chemicals, biologicals, or machinery
Example: most research laboratories

Policy on Eating, Drinking, and Related Activities in Laboratories

Hazardous materials can be accidentally ingested when eating, drinking, gum chewing, or related activities are not permitted within workplace and teaching laboratories. To eliminate this potential route of exposure, OSHA has developed guidelines which prohibit these activities in areas where laboratory chemicals are present. In addition, OSHA recommends hand washing before these activities are conducted.

Eating, drinking, gum chewing, the application of cosmetics, and the storage of food and beverages are not permitted in laboratories containing hazardous materials. These activities may take place in a separate area which is a room with floor to ceiling walls and a door separating the area from the laboratory space in which hazardous materials are used, stored, or transported.

Chemical/Spill Reporting Policy

All chemical spills should be reported to EHS immediately.

VI. CHEMICAL HAZARD CLASSES

Laboratory chemicals may be catagorized according to the type of hazard that they present. Following are major hazard classes and examples of chemicals belonging to each class.

Toxic - Materials causing immediate (acute) or longterm/delayed (chronic) health effects. Exposure limits for many chemicals have been established according to the toxicity of the material. Examples: f**ormaldehyde, methylene chloride, phenol.**

Flammable - Material that can burn or explode when exposed to heat, sparks or open flames. Examples: **ethanol, hexane, xylene.**

Oxidizers - Materials that provide oxygen or other oxidizing elements that can cause fires in contact with flammables or can cause significant burns/ irritation to the skin. Examples: **hydrogen peroxide, perchloric acid, potassium dichromate.**

Corrosive - Substances that can damage exposed body tissue, including acids and bases. Examples: **acids - hydrochloric, sulfuric; bases - sodium hydroxide, ammonia (ammonium hydroxide).**

Peroxide formers - Chemicals that produce explosive peroxides when concentrated or exposed to oxygen (air). Examples: **ethyl ether, dioxane, THF.**

VII. TYPES OF EXPOSURES AND CONTROL METHODS

Chemicals can cause illness according to the type of exposure experienced. Following are the routes of entry for chemical exposure.

♦ Inhalation

♦ Ingestion

♦ Absorption (skin or eye contact)

♦ Injection

Prevention of illness caused by chemical exposure relies on preventing the chemical contacts listed above. One or more of the following control measures should be employed when hazardous chemicals are involved in any lab procedure.

♦ **Engineering** - substitution, isolation, enclosure, ventilation.

♦ **Administrative** - scheduling, training, medical monitoring.

♦ **Personal Protective Equipment (PPE)** - gloves, safety glasses, lab coats, face shields.

VIII. PARTICULARLY HAZARDOUS SUBSTANCES

Although care must be taken with all chemicals, certain chemical classes require special attention due to their potential to cause significant health effects. Specific precautions must be taken according to the **Standard Safety Operating Procedures (SSOPs)** developed for the chemical to be used. SSOPs should be developed by the department or lab using the chemical in conjunction with EHS.

Types

- **Carcinogens** – Materials known to cause cancer
- **Reproductive Toxins** - Mutagens (cause genetic mutations) and teratogens (cause birth defects)
- **Acute Toxics** (HMIS rated 3 or 4)
- **Chemicals of Unknown Toxicity**

IX. STANDARD SAFETY OPERATING PROCEDURES

The OSHA Laboratory Standard, which requires the preparation of a Chemical Hygiene Plan (USM Laboratory Management Plan) also requires written standard safety operating procedures (SSOPs) to be followed when laboratory work involves the use of hazardous chemicals. A separate SSOP must be completed for every hazardous material and procedure that has characteristics different from other materials and procedures used. Hazardous materials with the same safety procedures may be grouped together in the same SSOP. Written SSOPs should be kept in an accessible location with other safety information (such as MSDSs) so that lab users can check safety procedures prior to their use of a new chemical or procedure. The following are key issues to consider for preparing SSOPs:

♦ Personal protective equipment (eye, face, hand protection, etc.)

♦ Procedures to minimize chemical exposure (splashing and aerosol minimization)

♦ Location for use (designated area such a fume hood)

♦ Labeling information (hazard information on the container)

♦ Methods of measuring and transferring materials (weighing and dispensing equipment)

♦ Decontamination procedures (materials used for routine or spill cleanups)

♦ Locations for storage (flammable, refrigerated, or other storage requirements)

♦ Waste disposal (containers, labeling, segregation, and storage)

♦ Transportation of hazardous materials outside of the lab

X. CHEMICAL HAZARD INFORMATION RESOURCES

Determining the hazards presented by chemicals in use is the first step in preventing adverse health effects. The following information resources will provide the type and relative severity of chemical hazards and control measures to prevent overexposure.

- **Container labels**
- **Chem Tracker database and the internet**
- **Material Safety Data Sheets (MSDSs)**

XI. CHEMICAL PROCUREMENT

When purchasing chemicals for lab use, there are several considerations that should be taken.

- Investigate the use of less hazardous materials.
- Plan for containment, storage, disposal, and personal protective equipment.
- Order appropriate (minimal) amount - limit storage space and disposal costs.
- Date chemicals when received and opened.
- Insure that all manufacturer's chemical bottles and secondary containers are properly labeled.

Note: All procured chemicals are received in the chemical storeroom. A Chem Tracker barcode is affixed to the container. When the container is empty, the barcode must be removed and returned to EHS.

XII. CHEMICAL STORAGE

Proper storage of chemicals helps eliminate breakage, chemical spills and inadvertent mixing of noncompatible materials. The following are precautions that should be taken.

- Store chemicals by hazard class and segregate each class in a separate area. A **Chemical Incompatibility Chart** is provided in this document. A list of the minimum number and type of hazard classes follows.
    - Flammables
    - Acids
    - Bases
    - Oxidizers
    - No hazard
    - Chemical bottles should not be stored on the floor or above eye level.
    - Store over 10 gallons of flammable materials in an approved flammable storage cabinet.
    - Only chemicals in current use should be on the lab bench or in the fume hood.

XIII. PRIOR APPROVAL

Certain activities may create special hazardous situations and require prior approval. The OSHA Lab Standard requires each employer to assess activities and determine which will require prior approval. Prior approval policies and procedures are initiated by each department according to their needs. Examples of activities that may require prior approval follow.

- Sole occupancy of a laboratory or building
- Hazardous operations, equipment and/or chemicals
- New procedures or new chemical use
- Unattended operations

XIV. SAFETY AND EMERGENCY EQUIPMENT AND PROCEDURES

In order to be prepared before an emergency incident occurs, knowledge of safety equipment use/location, and appropriate room layout are necessary. All lab workers should be aware of the following for the lab that they work in.

Know:

- Location of Emergency Procedures Handbook.
- Location of nearest eyewash and shower.
- Location and use (if trained) of fire extinguisher.
- Location of nearest fire alarm pull station.
- Two ways to exit the building.

Avoid:

- Blocking emergency equipment - fire extinguishers, emergency showers, eyewashes, and electrical panels.
- Storing materials on floors, in aisles, and in exits.

XV. PERSONAL PROTECTIVE EQUIPMENT (PPE)

Personal protective equipment includes clothing and devices that are worn by the lab worker to protect him/her from hazards. Following are PPE equipment categories and recommendations.

Eye protection - In addition to the safety glasses requirements stated in the USM Policy, goggles (and a face shield in certain cases) are required for the use of liquids that could damage eyes if splashing occurs. Eye protection equipment should be stored in its original container or a sealed plastic bag.

Gloves - Gloves appropriate for the material handled should be worn when there is potential for chemical exposure, injury or irritation (see Section MSDS for the material being used for glove selection criteria).

Body protection - Street clothing should be covered with a lab coat or other protective clothing when working with chemicals in the lab. Waterproof clothing or a rubber apron may be needed to prevent soak through or caustic burns. Shorts and sandals should not be worn in labs. Long hair and baggy clothing should be properly confined.

Note: PPE should remain in the lab when exiting.

XVI. FUME HOODS

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;

Chemical fume hoods should tested annually for acceptable airflow. Following are recommendations to help maintain a safe atmosphere for the fume hood operator.

Confirm airflow - Use a hood monitor, flow indicator, or strip of tissue taped to the bottom of the hood sash for airflow confirmation.

Sash position - Maintain bottom of hood sash at indicated level (arrows) or lower, as shown on the hood certification sticker.

Work position - Position equipment and chemicals at least six inches inside the face of the hood or sash.

Avoid - Blocking face or back baffle with large equipment (elevate equipment about two inches) and using hood as a chemical storage area.

XVII. BIOLOGICAL SAFETY CABINETS (BSC)

Biological safety cabinets (also known as laminar flow hoods) are different than fume hoods in that they capture microbiological materials using a High Efficiency Particulate Air (HEPA) filter. Most BSCs are not vented to the outside of the building. Recommendations for the safe use of BSCs follow.

Flammable material use - This is usually prohibited because of the potential for an explosive mixture to develop due to the recirculation of air within the cabinet.

Volatile toxic material use - Gases are not removed by the HEPA filter and are therefore released to the lab unless the BSC is vented to the outside of the building.

Air intake grill - Avoid blocking this grill at the front of the cabinet as this can affect product and personnel safety.

UV light - A UV lamp is often used inside BSCs to disinfect the inside surfaces of the cabinet. This type of disinfection should only be done when no one is using the BSC.

Clean benches - These provide HEPA-filtered air from the back of the cabinet, across the work surface, and out the face of the cabinet. Clean benches do not provide personal protection from materials used in them.

XVIII. MEDICAL CONSULTATION

Incidents or conditions that cause a significant health effect require medical attention in person. For minor exposures with no symptoms, a telephone call to Office of EHS may be adequate followup. Following are instances when a medical consultation is necessary. Information on how and when to report an incident is also provided.

Cases requiring medical consultation

- If a chemical exposure occurs, including 1) skin or eye contact with hazardous materials, 2) exposure during a chemical spill, or 3) health symptoms (such as headache or rash) develop while working with chemicals.
- When air sampling indicates exposure above OSHA's action level or permissible exposure level.
- For any “on the job” injury.

Reporting procedures for medical consultation.

- Complete Occupational Illness/Injury Report.
- Report to Student Employee Health Service during normal work hours.
- Call University of Southern Mississippi security at 6911 for transportation to emergency center for evening and weekend accidents.

XIX. WASTE SEGREGATION AND DISPOSAL

Laboratory waste must be segregated into the waste streams listed below for safe storage and disposal. Information about each waste stream disposal follows.

Chemical waste

- Follow all provisions of the **Waste Disposal Guidelines.**
- Segregate chemical wastes into separate containers. Certain similar chemical groups, such as flammable solvents, can be consolidated in the same bottle.
- Label waste containers using a "Waste Chemical Label". Stock chemical wastes in their original container with original label do not need to be relabeled.
- Recap chemical waste containers when not adding waste to them.
- Store chemical waste in closed containers.
- Store waste containers in an appropriate location prior to pickup.
- EHS will pickup chemical wastes in a timely manner.
- It is imperative to remove the Chem Tracker barcode and return to EHS prior to disposal of the container

Biological waste

Segregate biological waste into sharp and non-sharp categories.

- Sharp biohazards, including syringes, needles, , must be placed in a “sharps container” (i.e. red plastic container with “biohazard” symbol).
- Non-sharp biohazards including contaminated glass, rigid plastic pipets, and Petri dishes must be placed in a autoclavable bag marked with the "biohazard" symbol.

Disposal of biological waste may be accomplished in two ways.

- Autoclave in department, mark container “treated,” and dispose as ordinary trash.
- Call EHS at 266-6912 for pickup.

Glass

All uncontaminated or broken uncontaminated glass to be disposed should be placed in a cardboard box marked “glass for disposal”. When two-thirds full, the box should be taped shut and placed with ordinary trash.

Radioactive and mixed wastes

All wastes with radioisotope content should be referred to the Radiation Safety Office for disposal.

XX. COMPRESSED GASES AND CRYOGENIC LIQUIDS

Potential hazards encountered with these materials include explosion, overexposure, crushed feet, a broken-off valve, and frostbite. The following are measures that will limit or eliminate injury when working with compressed gases and cryogenic liquids.

- Wear safety glasses when working with compressed gas cylinders.
- Wear goggles and a face shield when using cryogenic liquids.
- Secure gas cylinders in the upright position using appropriate restraints.
- Keep valve cover on cylinder except when regulator is attached.
- Open main valve slowly.
- Leak-test all connections, especially when using hazardous gases.
- Use a hand truck to move gas cylinders.
- Wear loose-fitting thermal gloves when working with cryogenic liquids.
- Insure that cylinders remain labeled during their entire life in the lab.
- Store gas cylinders in a non-corrosive environment.

XXI. ELECTRICAL SAFETY

Following are recommendations for safe use of electrical equipment.

- All equipment with substantial current requirements must be grounded.
- Outlet expanders (3:1) and grounded-to ungrounded converters (cheater plugs) are not allowed.
- Extension cords should have overload breaker protection and be used only as temporary wiring.
- Damaged electrical cords must be replaced (not repaired).
- Ground fault circuit interrupts (GFCI) outlets or equipment should be used within 5 feet of water sources.
- All sources of harmful electrical energy must be isolated to prevent electrical shock by contact.

XXII. BIOLOGICAL SAFETY

Biohazards are operationally divided into three categories. Recombinant DNA experimentation is reviewed and approved by the Institutional Biosafety Committee according to National Institutes of Health (NIH) Guidelines. Human blood and body fluid exposure is controlled by the OSHA Bloodborne Pathogens (BBP) regulation. Among other requirements, the BBP standard requires an annual training program for preventing transmission of infectious agents when exposed to human blood and body fluids. Precautions for use of all other biohazards are recommended in the CDC/NIH publication *Biosafety in Microbiological and Biomedical Laboratories*. Biohazards are divided into biosafety levels 1 to 4, with 4 being the most significant health hazards. Practices for safe use of biological agents at each level are provided in this publication. The Campus Biohazard Committee reviews and approves protocols involving non-recombinant DNA experimentation.

XXIII. ELECTROMAGNETIC RADIATION HAZARDS

Equipment commonly used in laboratories can produce hazardous amounts of electromagnetic radiation. Information on the radiation types, sources, and means of personal protection follow.

Ultraviolet Light (UV)

Depending on the wavelength and intensity, overexposure to ultraviolet light can result in injury to the skin and/or eyes. Several measures can be taken to avoid this.

- Enclose or shield the UV source - acrylic plastic material, such as plexiglass, is an effective absorber of UV light.
- Protect eyes with UV-rated safety glasses or goggles.
- Protect exposed skin with face shields, long sleeves, and long pants.

Lasers

Lasers can result in skin and/or eye injuries depending on the type and intensity of the source. Laser safety guidelines have been developed by the American National Standards Institute. Lasers are classified from 1 to 4 according to their power, with 1 being the least powerful and 4 the most powerful. Safety measures to be followed during laser use are as follows.

- Completely enclose the laser system.
- Use non-reflective and fire resistant background materials.
- Provide warning signs at the room entry for Class 3 and 4 lasers.
- Provide interlock device or “laser in use” light for Class 4 lasers.
- Protect eyes with source and wavelength - specific safety glasses/goggles.

X-Ray Radiation

X-Rays and electron beams are produced by laboratory instruments such as diffractometers, gauging systems, and electron microscopes. X-Ray radiation safety services are provided by the Radiation Safety Office.

XXIV. Chemical Incompatibility Chart

Chemical Incompatibilities

Chemical	Incompatibilities
Acetic Acid	Chromic acid, nitric acid, hydroxyl compounds, ethylene glycol, perchoric acid, peroxides, permanganates
Acetylene	Chlorine, bromine, copper, fluorine, silver, mercury
Alkali/alkaline earth metals (e.g. potassium, sodium, powdered magnesium)	Water, chlorinated hydrocarbons, carbon dioxide, halogens
Ammonia (anhydrous)	Mercury, chlorine, iodine, bromine, HF
Carbon tetrachloride	Sodium, potassium
Chromic acid, chromium	Acetic acid, maphthalene, glycerol, alcohol, flammable liquids, camphor
Chlorine (also bromine)	Ammonia, acetylene, butadiene, butane, methane, propane, hydrogen, sodium carbide, finely divided metals, turpentine, benzene
Cyanides	Acids
Flammable liquids	Ammonium nitrate, chromic acid, hydrogen peroxide, nitric acid, halogens
Hydrofluoric acid (anhyd)	Ammonia (aqueous or anhydrous)
Hydrogen peroxide	Copper, chromium, iron, most metals or their salts, alcohols, organic and combustible matls.
Iodine	Acetylene, hydrogen, ammonia (aq or anh)
Mercury	Acetylene, ammonia, fulminic acid
Nitric Acid (concentrated)	Acetic acid, aniline, chromic acid, hydrogen sulfide, flammables, any heavy metals (brass)
Nitrites	Acids
Oxygen	Oils, grease, flammables, hydrogen
Perchloric acid	Acetic anhydride, alcohol, paper, wood, grease, oils, bismuth and its alloys
Peroxides (organic)	Acids (organic or mineral), friction, heat
Phosphorous Pentoxide	Water, halogenated agents
Sulfuric acid	Potassium chlorate, potassium perchlorate potassium permanganate, (similar compounds of light metals such as sodium and lithium

TELEPHONE NUMBERS

Department of EHS

Director 266-6912
Environmental Manager (Hazardous and
Infectious Wastes) 266-6912
Biosafety Officer 266-6912
Radiation Safety Officer.....266-6912

Other Safety/Health Areas

Radiation Safety Office 266-6912

Emergencies

Police 911or 6911
Fire .....911 or 6911
Emergency Medical Service ..... 911 or 6911
Utilities 266-4414
MS Poison Control Center 1-800-222-1222