FAU
FLORIDA ATLANTIC UNIVERSITY

Division of Administrative Affairs

Environmental Health and Safety
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Chemical Hygiene Plan

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Cover page for FAU Chemical Hygiene Plan

2. CONTENTS:

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Approved and issued by order of:

Wendy Ash Graves
Director, Environmental Health and Safety

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POLICY MAINTENANCE SECTION

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FLORIDA ATLANTIC UNIVERSITY

ENVIRONMENTAL HEALTH AND SAFETY

Chemical Hygiene Plan

Florida Atlantic University

Office of Environmental Health and Safety

November 2022

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List of Acronyms

ACGIH – American Congress of Governmental Industrial Hygienists

ANSI – American National Standards Institute

BSC – Biological Safety Cabinet

BSL – Biological Safety Level

CDC – Centers for Disease Control and Prevention

CFR – Code of Federal Regulations

CHO – Chemical Hygiene Officer

CHP – Chemical Hygiene Plan

DNA – Deoxyribonucleic Acid

DOT – Department of Transportation

EH&S – Environmental Health and Safety

FAC – Florida Administrative Code

FAU -- Florida Atlantic University

HEPA –High Efficiency Particulate Air

IACUC – Institutional Animal Care and Use Committee

LFPM – Linear Feet per Minute

LSM – Laboratory Safety Manual

LSO – Laboratory Safety Officer

LSO – Laser Safety Officer

NFPA – National Fire Protection Association

OSHA – Occupational Safety and Health Administration

PEL – Permissible Exposure Limit

PI – Principle Investigator

PPE – Personal Protective Equipment

RSO – Radiation Safety Officer

SDS – Safety Data Sheet

SOP – Standard Operating Procedure

1 Introduction

As a research and educational institution, Florida Atlantic University (FAU) is morally and legally obligated to provide a safe working environment for all its employees and students. Since FAU employs workers engaged in the laboratory use of hazardous chemicals, the University will comply with the provisions of the Occupational Safety and Health Administration (OSHA) standard: "**29 CFR§1910.1450, Occupational Exposure to Hazardous Chemicals in Laboratories."** This standard is commonly referred to as "**The OSHA Lab Standard**." It was developed to provide increased protection to laboratory employees beyond that which is provided in the General Industry Standards. The OSHA Lab Standard is also a "performance-oriented standard." This means OSHA establishes the minimum requirements, but the methods for achieving these requirements are left up to the employer. The backbone of the Lab Standard is its requirement for employers to develop and carry out the provisions of a written **Chemical Hygiene Plan (CHP)**, which requires development of **standard operating procedures (SOPs)** for work with hazardous chemicals in laboratories.

With the great diversity of lab activities on campus, it is impossible for any one person to develop SOPs for every activity in every laboratory. However, the performance-oriented nature of this standard makes it possible to construct a general framework that can be used by individual laboratories to meet the requirements of the OSHA Lab Standard.

This document constitutes the FAU CHP. It details laboratory safety policies, procedures, and standards at FAU. Implementation of the guidelines in this document depends on the cooperation of department chairpersons, faculty, laboratory staff, students, Environmental Health and Safety (**EH&S**) staff and members of safety committees. Although Principal Investigators bear the ultimate responsibility for safe conditions and procedures in their laboratories, each member of a laboratory group is responsible for complying with standards put forth in this document with the common goal of promoting a healthy and safe working environment for employees and students.

There may be some situations in which proper facilities and equipment are not available for conducting project requirements. When this is the case, faculty members should consult **EH&S** for assistance in evaluating hazards and finding ways to conduct activities properly. This document should not be considered a comprehensive review of all potential hazards. Individuals with more specific questions should contact **EH&S** directly.

2 Implementation and Responsibilities

The Chemical Hygiene Plan will be implemented and administered by the Chemical Hygiene Officer who is a member of the Department of Environmental Health and Safety. The Chemical Hygiene Officer is responsible for developing, implementing, and reviewing the written Chemical Hygiene Plan, which will be reviewed annually and updated as needed.

Although the Chemical Hygiene Officer is responsible for the development and implementation of the Chemical Hygiene Plan, it is important to realize that the responsibility for chemical hygiene rests at all levels of the University.

Responsibilities under the Chemical Hygiene Plan (CHP) are outlined as follows:

1. **The President of the University**, as the chief executive, has ultimate responsibility within the institution, and along with other administrators, provides continuing support for the CHP. Responsibility for the administration of the University's environmental health and safety program is delegated to the **Director of Environmental Health and Safety** and implemented through operations of the Office of Environmental Health and Safety ("EH&S").

2. **Vice-Presidents**, **Deans**, **Department Heads**, and **Principal Investigators** are responsible for compliance with the CHP within their areas. This includes ensuring that all employees, guests, and visiting scientists working within their areas are informed of, and adhere to, chemical hygiene practices as outlined in the FAU CHP. Vice-Presidents, Deans, Department Heads, and Principal Investigators must also provide appropriate personal protective equipment to those under their direct supervision.

3. **The University Laboratory Safety Officer** is responsible for developing, implementing, and updating the CHP on behalf of the University President, or Director of Environmental Health and Safety. The LSO will assist departments and individual laboratories in implementing and complying with the CHP. The LSO must also institute appropriate audit methods to ensure compliance.

4. **The LSO is** responsible for ensuring Principal Investigators and Laboratory Managers develop and implement standard operating procedures and training programs specific to their laboratories.

5. **Principal Investigators** and **Laboratory Managers** have overall responsibility for chemical hygiene in their laboratories. Each will develop and implement standard operating procedures (see Appendix A: Standard Operating Procedures) and training programs specific to the work being carried out in their laboratories. They must also maintain current inventories for all chemicals stored in their laboratories and/or in other storage areas and have (Material) Safety Data Sheets - (M)SDSs readily accessible for all hazardous chemicals stored in their laboratories. Principal Investigators and Laboratory Managers must ensure that lab personnel understand and follow the CHP and attended required training.

6. **Laboratory Employees** are ultimately responsible for developing and applying good chemical hygiene practices as outlined in the CHP. They must always use the appropriate personal protective equipment provided. Laboratory Employees are required to report all accidents, injuries, and illnesses to their supervisors. (see also Appendix G).

3 Definitions

The definitions listed below are taken directly from the OSHA Lab Standard (29 CFR§1910.1450(b)).

Chemical Hygiene Plan: A written program developed and implemented by an employer which sets forth procedures, materials, personal protective equipment and work practices that (i) are capable of protecting employees from the health hazards presented by hazardous chemicals used in that particular workplace and (ii) meet the requirements of paragraph (e) of the Lab Standard.

Emergency: Any occurrence such as, but not limited to, equipment failure, rupture of containers or failure of control equipment that results in an uncontrolled release of hazardous chemicals in the workplace.

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

Hazardous chemical: A chemical for which there is statistically significant evidence based on at least one study conducted in accordance with established scientific principles that acute or chronic health effects may occur in exposed employees.

Health hazard: A term that includes chemicals which are carcinogens, toxic or highly toxic agents, reproductive toxins, irritants, corrosives, sensitizers, hepatotoxins, nephrotoxins, neurotoxins, agents which act on the hematopoietic systems, and agents which damage the lungs, skin, eyes, or mucous membranes.

Laboratory: A facility where the "laboratory use of hazardous materials, equipment or research with animals" occurs. It is a workplace where relatively small quantities of hazardous chemicals are used on a non-production basis. This includes but is not limited to engineering and arts workspaces.

Academic Laboratory: A facility where curriculum-based experiments for study in science is conducted.

Research Laboratory: A facility where scientific research and investigations is conducted

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

Laboratory-type hood: A device located in a laboratory that is enclosed on five sides with a movable sash or fixed partial enclosure on the remaining side. It is designed to prevent or minimize the escape of air contaminants into the laboratory and to keep the breathing zone of the operator uncontaminated. Walk-in hoods with adjustable sashes meet this definition provided that the sashes are adjusted during use so that the airflow and the exhaust of air contaminants are not compromised, and employees do not work inside the enclosure during the release of airborne hazardous chemicals.

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

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

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

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

Based on these definitions, the CHP will apply to all areas engaged in the laboratory use of hazardous chemicals.

4 Administrative Details

Copies of the Chemical Hygiene Plan will be maintained in either a 3-ring binder or as a link on the laboratory computer(s) desktop, and kept readily accessible in the following locations:*

1. Environmental Health and Safety.

2. Each laboratory covered by this CHP.

* Alternatively, the CHP can be accessed directly on the **EH&S** web site at www.fau.edu/ehs. Having the CHP available in these locations will most effectively ensure that employees have access to pertinent safety information. It will also provide a template for new investigators or lab managers to use when new laboratories are brought on-line.

In addition to complying with the CHP, laboratories using radioactive materials and radiation producing devices (X-ray diffractors, electron microscopes, etc.) must follow the policies and procedures outlined in the FAU Radiation Safety Manual. Laboratories using Lasers designated Class II or above must also contact the Laser Safety Officer (See Laser Safety Manual) . Laboratories where work involving human/primate tissues, recombinant DNA, or pathogenic agents is conducted must comply with Centers for Disease Control and National Institutes of Health guidelines. Contact **EH&S** for details.

5 Components of a Chemical Hygiene Plan

The OSHA Lab Standard specifies that eight elements be addressed in order to ensure the protection of laboratory employees. These eight elements, summarized below, are fully detailed in 29 CFR§ 1910.1450(e)(3) of the regulation.

1. Basic safety practices for handling toxic chemicals.
2. Control measures to reduce worker exposures.
3. Fume hood performance.
4. Employee information and training (including emergency procedures).
5. Requirements for prior approval of laboratory activities.
6. Medical consultation and medical examinations.
7. Chemical hygiene responsibilities.
8. Special precautions for work with particularly hazardous substances.

Responsibilities under the Chemical Hygiene Plan (element #7 above) have already been discussed. The remaining elements will be addressed in the pages that follow. This portion of the CHP is generalized, and individual lab managers and principal investigators are responsible for tailoring this CHP to the specific needs of their areas. Contact **EH&S** with questions about adapting this CHP to a laboratory area. See also Appendix A: Standard Operating Procedures for more information.

6 Basic Safety Practices

There are many excellent publications containing guidelines for the safe conduct of laboratory work; such as Safety in Academic Chemistry Laboratories, published by the American Chemical Society, and Prudent Practices in the

Laboratory: Handling and Disposal of Chemicals, published by National Research Council. These publications are concise, readable, and oriented toward academic laboratories. They are recommended reading for all laboratory personnel. Consulting other safety information resources is encouraged, review the references in Appendix F: References or contact the Chemical Hygiene Officer for additional sources.

The following basic safety practices apply to all laboratories[1]. Each laboratory must include any specific practices pertaining to Standard Operating Procedures used in that particular lab (see Appendix A: Standard Operating Procedures).

6.1 Accidents and Spills

Eye Contact: Immediately flush eyes with water for a minimum of 15 minutes while holding eyelids open. In the event that only one eye has been affected, keep the other eye closed while flushing to minimize the probability of contamination spreading to the unaffected eye during flushing. As soon as flushing begins, contact emergency medical personnel who can provide further evaluation, assistance and treatment to avoid lasting eye injury and/or blindness.

Ingestion: Consult Safety Data Sheet (SDS) and call the Poison Control Information Center at 1-800-222-1222 for emergency response information for the specific compound ingested. Seek medical attention immediately. The (M)SDS should accompany the patient to the medical treatment facility.

Skin Contact: Promptly flush the affected area with water, using safety shower if necessary, (minimum of 15 minutes). Remove any contaminated clothing while flushing with water, using care not to spread chemical contamination to other parts of the body. If clothing is usually removed by pulling overhead, cut the clothing off instead, using the safety scissors provided in first aid kits. If symptoms persist after washing, seek medical attention.

NOTE: In case of skin contact involving hydrofluoric acid (HF), thoroughly flush the affected area of the body and then curtain flushing. Immediately apply calcium gluconate gel or a 10% $^{W}/_{V}$ calcium gluconate solution to the affected area and seek medical attention. Application of the calcium gluconate antidote is imperative to minimize the risk of serious, lasting injury or fatality. On arrival, inform emergency medical personnel that a hydrofluoric acid exposure has occurred.

Inhalation: Immediately move the patient to fresh air and seek medical attention. In the event the patient is overcome, evaluate the area for your own personal safety prior to attempting to retrieve the victim. Do NOT attempt a rescue in an unsafe atmosphere. Contact 911 immediately if a rescue is required. Well-intentioned rescuers have often become a victim as well in these situations.

Reporting: Should an accident occur, follow procedures outlined in Appendix G: Hazardous Materials Emergencies and Spills. Report all accidents to your supervisor.

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[1] Adapted from the National Research Council's, "Prudent Practices in the Laboratory: Handling and Disposal of Chemicals," National Academy Press, Washington, DC, 1995.

Clean-up: Promptly clean up all small spills using appropriate personal protective equipment and properly containerize and label the resulting waste. Contact EH&S for pick up and disposal. Consult (M)SDSs and other safety information sources for specific clean-up recommendations. Contact EH&S to clean up large chemical spills or spills of highly toxic chemicals. For detailed information on procedures for accidents, spills and emergencies see Appendix G.

6.2 Avoidance of "Routine" Exposure

Develop and encourage safe work practices. Avoid unnecessary exposure to chemicals by any route and encourage proper personal hygiene (i.e. remove gloves and wash hands prior to leaving laboratory area). Do not smell or taste chemicals. Vent any apparatus that may discharge toxic chemicals (vacuum pumps, distillation columns, ovens, etc.) into local exhaust devices. Inspect gloves and test glove boxes before use. Do not allow release of toxic substances in cold rooms or warm rooms, since these contain recirculated atmospheres.

6.3 Choice of Chemicals\Waste Minimization

Strive to substitute less hazardous chemicals in place of more hazardous chemicals whenever practical. Use micro-scale lab techniques as often as possible. Share surplus chemicals with colleagues or allow **EH&S** to remove surplus chemicals for later redistribution. Limit inventory on hand to chemicals and quantities necessary for laboratory activities. Inspect chemical inventories periodically and dispose of outdated chemicals in accordance with the FAU Hazardous Waste Policies and Procedures (see Hazardous Materials Manual).

6.4 Shipping and Receiving Hazardous Materials

Shipping and receiving hazardous materials shall be done in accordance with Hazardous Materials Shipping/Receiving Guide (LSM Section 12.6). Hazardous materials packages must be inspected at the time of their arrival to ensure that they are not damaged or leaking. Do not accept damaged or leaking packages from delivery companies, and notify EH&S at ehs@fau.edu if damaged or leaking packages are discovered.

Do not accept hazardous materials packages that are not properly labeled in accordance with Department of Transportation (DOT) regulations. Principal Investigators/Lab Managers should date chemical containers, and enter them into the lab inventory upon receipt, and date them again when first opened.

Gifts or donations of chemicals from off-campus sources must be approved by **EH&S** before acceptance.

6.5 Compressed Gas Cylinders

Compressed gas cylinders may present both physical and health hazards. Gases may be oxidizers, flammable, reactive, corrosive, or toxic and these properties must be considered when developing experimental procedures and designing apparatus. Compressed gases, when handled incorrectly, can be very dangerous with a high potential for explosion. Only cylinders designed, constructed, tested, and maintained in accordance with US Department of Transpiration (DOT) specifications and regulations shall be permitted to be used. The use of non-DOT conforming cylinders must be evaluated and approved by EH&S on a case-by-case basis. (See LSM Section 12.4)

6.6 General Laboratory Safety Guidelines

Observe the following basic safety guidelines when working in a laboratory.

6.6.1 Eating, Smoking, etc.

Do not eat, drink, use tobacco products (smoke, chew, dip), chew gum, use cell phones or apply cosmetics in areas where laboratory hazards (eg. chemical, physical, biological, equipment) are present; remove gloves, wash hands and leave the area before conducting these activities. Do not store food or beverages in refrigerators or glassware that have been used for laboratory operations. Food and beverages are not permitted in the laboratories, without regard for the type of hazard(s).

6.6.2 General Housekeeping and Apparel

Keep the work area clean and uncluttered, with chemicals and equipment properly labeled and stored; clean up the work area upon completion of an operation or at the end of each day. Confine long hair and loose clothing and remove jewelry. Wear appropriate closed toed shoes at all times in the laboratory. The wearing of shorts, open-toed shoes or sandals in laboratories is prohibited. Wear appropriate PPE where necessary.

Minimum apparel for laboratories includes lab coats or appropriate protective clothing, closed toed shoes, and eye protection. See Section 7.3 Protective Personal Equipment

6.6.3 Handling Equipment and Glassware

Handle and store laboratory glassware with care to avoid damage, and never use damaged glassware. Use extra care with Dewar flasks and other evacuated glass apparatus. Shield or wrap them to contain chemicals and fragments should an implosion occur. Use equipment only for its designed purpose. Decontaminate and properly dispose of damaged/unwanted glassware according to any chemical, biological or radiological hazards that may be present.

6.6.4 Unattended Operations

Leave lights on, place an appropriate sign on the door, include your name and telephone number as well as that of Principal Investigator. Provide for containment of toxic substances in the event of failure of a utility service to an unattended operation. All unattended operations must be provided with automatic shutoffs to prevent accidents, fires, or explosions.

6.6.5 Working Alone

Avoid working alone in a building. Prior approval from the Principal Investigator is required before working alone in a laboratory as well as informing the University Police upon entering and leaving the building. Working alone in a laboratory is prohibited when working with a compound of high or unknown toxicity. Working alone in a lab must be approved in writing by the Principal Investigator or Lab Manager.

6.6.6 Children Prohibited

Minor children (under 18 years of age) are not allowed into any chemical, biological or radioactive materials laboratory at FAU unless the minor child is participating in a program of study at FAU and working in the laboratory is required as part of the course, or the minor child is participating in a supervised program officially sponsored by FAU, such as a building tour or field trip. Permission slips/waivers of liability may be required. Refer to the FAU policy on Minors in Research Laboratories or Animal Facilities for additional information. The University's General Counsel may also be contacted for further details.

6.7 Planning Operations

The following best practices should be observed during the planning stage for all laboratory operations:

1. Develop Standard Operating Procedures (see Appendix A).
2. Seek information and advice about hazards.
3. Review all applicable (M)SDSs before handling chemicals.
4. Plan appropriate safety procedures.
5. Plan positioning of equipment before beginning any new operation.
6. Locate emergency supplies and exits.
7. Ensure that aisles are clear and kept clear during laboratory operations.

Principal Investigators or Lab Managers must approve all new experimental protocols or any significant changes to existing protocols.

6.8 Waste Disposal

Standard Operating Procedures (see Appendix A) for each laboratory must include procedures for waste disposal. Each laboratory generating hazardous waste must have at least one lab manager responsible for ensuring that all waste generators within the lab receive Hazard Communication, Hazardous Waste Generator and Hazardous Material Handling and Disposal Training. Hazardous waste must be properly containerized, labeled and stored. Contact EH&S for pick up and disposal of hazardous wastes. Hazardous Waste Disposal Procedures for the University are outlined in the **Hazardous Materials Manual**.

6.9 Laboratory Contact Information

Each laboratory must have laboratory contact and emergency procedure information posted on the entrance to the lab and by lab telephones, when present. (See LSM Appendix H – Forms and Checklists for recommended form.) Additional laboratory signage is required for work with biological and radiological materials. (See also, Animal Research Health and Safety Plan, Biological Safety and Radiation Safety Manuals.)

6.10 Laboratory Security

When authorized laboratory personnel are not present, each laboratory must be kept locked, even if it is only for a short period of time. Depending on the type of work performed in a particular laboratory, it may be prudent to keep that laboratory locked at all times. Laboratory personnel must immediately, and politely, engage unknown individuals discovered in a lab to determine their reason for being there. A simple, "May I help you?" should get the dialog started. Immediately report suspicious individuals to University Police.

7 Exposure Control Measures

Safe work with hazardous chemicals can only be accomplished using proper control measures. Proper control measures include the use of engineering controls, appropriate storage and handling of chemicals, the use of personal protective equipment, and proper use and maintenance of safety equipment. Carefully implemented control measures can reduce or eliminate the risk of employee exposure to hazardous chemicals.

7.1 Exposure Determination

The Chemical Hygiene Officer or Industrial Hygienist shall initiate air monitoring for any regulated substance if there is reason to believe that the exposure levels for that substance exceed the action level or, in absence of the action level, the OSHA permissible exposure limit (PEL). The PEL is the eight-hour time weighted average concentration of contaminant in air to which a healthy person can be repeatedly exposed without reasonable expectation of adverse health effects. PELs for many chemicals can be found in (M)SDSs, OSHA's "Z Tables" (29 CFR 1910.1000), and in the NIOSH Pocket Guide to Chemical Hazards.

7.2 Engineering Controls

Engineering controls include proper laboratory design, adequate ventilation, and the use of other safety devices (mechanical pipettes, safety centrifuge cups, etc.). Ventilation is the most common and most important form of engineering control used to reduce exposures to hazardous chemicals. There are two types of ventilation: general ventilation, and local exhaust.

7.2.1 General Ventilation

General ventilation for laboratory operations should be designed such that the laboratory is under a slightly negative pressure relative to other parts of the building. This prevents odors and vapors from leaving the lab. Lab ventilation should be verified by professional engineering analysis. Proper design of laboratory ventilation systems minimizes the possibility of chemical vapors accumulating.

7.2.2 Local Exhaust

Local exhaust ventilation systems are intended to capture an emitted contaminant at or near its source, before the contaminant has the opportunity to disperse into the workplace air. In laboratories, chemical fume hoods are

local exhaust devices recommended for use to reduce exposure to hazardous dusts, mists, fumes, fibers, and vapors. As a rule, the hood shall be used for all chemical procedures involving substances that are volatile and/or have a PEL less than 50 ppm. The hood sash should be closed or lowered to an appropriate working level to provide protection from chemical splashes and fires and to allow for optimal hood operating efficiency.

Fume hoods are certified annually for proper operation by EH&S. A sticker located above the sash contains the proper sash height, hood face velocity (generally recommended to fall within 100 – 140 linear feet per minute of air), date of inspection and the inspector's initials. The proper sash height is also indicated by a sticker on the side of the fume hood opening. If there are problems with a hood, the Utilities Department and EH&S should be notified. A hood is not designed to withstand explosions nor as a means of disposal for volatile chemicals. When using a fume hood, always keep your work at least 6 inches inside the hood face. This simple step can reduce vapor concentrations at the face of the hood by as much as 90 percent. See the section entitled Fume Hood Performance for more on hood usage.

Biological safety cabinets, glove boxes, and isolation rooms also provide local exhaust ventilation. These are usually very specialized pieces of equipment. Biological safety cabinets must be certified for use annually by trained and certified individuals such as manufacturer or distributor representatives. Glove boxes should be pressure tested periodically to ensure they are functioning properly.

7.3 Personal Protective Equipment

The laboratory environment contains many potential hazards. Most hazards can be reduced or eliminated by substitution and/or engineering controls. Substitution is the reduction or elimination of a hazard by replacing a high hazard material or procedure with a less hazardous one. When hazards cannot be adequately controlled using substitution and/or the implementation of engineering controls, personal protective equipment (PPE) may be required.

PPE issued to laboratory personnel must be appropriate for the task and will depend upon the proper hazard identification and assessment made by the Principal Investigator (PI). Laboratory personnel must understand the use and limitations of the PPE. PPE includes, but is not limited to, laboratory coats and aprons, eye protection (safety glasses, face shields, etc.), and gloves. Laboratory personnel must wear proper PPE when it is required. (See LSM Section 9)

7.4 Proper Storage and Handling of Chemicals

Proper storage of chemicals is important to prevent chemical reactions that may result in fires, explosions or other safety/health hazards. Chemicals must be stored according to chemical group, not simple alphabetical order. Store chemicals of similar hazards and reactivity together. Many chemical companies provide storage codes for their products in order to assist customers with the proper storage of chemicals. ***Laboratory Safety Manual Appendix D: Storing Chemicals Safely*** provides additional information regarding storage time limits and chemical incompatibilities. Here are some general rules for safe chemical storage:

1. Store chemicals only in secure, well-ventilated areas.

2. Chemicals should be stored properly in cabinets or on shelves. Do not store chemicals on the floor or in fume hoods. Make sure all chemicals are securely capped when not in immediate use.

3. Shelving units must be stable and secured to the wall (island units must be braced across the top). Shelves should have lips to prevent items from sliding off.

4. Keep chemicals pushed back on shelves to prevent them from falling off in the event of accidental tipping. A good rule of thumb is to set bottles back from the edge a distance equal to the height of the bottle when in an upright position.

5. Reactive chemicals should be stored on low shelving, preferably in secondary containment in case of leakage.

6. Dispose of expired, no longer used and/or bad chemicals. Contact **EH&S** at ehs@fau.edu or submit a chemical waste pick request in BioRAFT to dispose of outdated chemicals.

7. Always keep chemicals properly labeled – relabel if a label is becoming faded or has been damaged.

8. Make sure labels include the full name of the chemical, clearly written out in English and the proper GHS Pictograms. Do not rely on abbreviations, acronyms, chemical formulas, and chemical structural diagrams as the sole source of information on container labels.

9. Store large quantities of flammable chemicals in an approved flammable storage cabinet.

Laboratory personnel must always wear proper PPE when handling chemicals, and secondary containment must always be used when transporting chemicals from one location to another to prevent accidental chemical releases.

For more information see the FAU Laboratory Safety Manual

7.5 Safety Equipment

In most cases, the following safety items should be readily available in laboratories: fire extinguishers, eyewash/safety showers, spill kits/absorbents, first aid kits, and a telephone with emergency numbers posted on it. Consult EH&S for assistance in determining safety equipment needs for a particular laboratory.

Annual maintenance inspections on fire extinguishers are performed by a licensed fire extinguisher service contractor. Discharged, overcharged, or missing fire extinguishers need to be reported immediately to EH&S. Eyewash/safety showers should be flushed weekly by laboratory personnel. In order to verify operation and accessibility, laboratory personnel should check all other safety equipment at least once a week as well. Fume hoods are inspected annually by EH&S (see the section on Fume Hood Performance).

Malfunctioning eyewash/safety showers and fume hoods should be reported immediately to Physical Plant. If the safety equipment is not repaired promptly, please call EH&S. Laboratory operations should be restricted until safety equipment is repaired; no chemical work is to be performed in a malfunctioning fume hood.

Spill Kits and First Aid Kits are to be maintained by individual laboratories or departments. Minimum equipment requirements for spill kits can be found in Appendix D: Hazardous Materials Emergencies and Spills. Emergency contact numbers can also be found in Appendix G.

8 Fume Hoods

The fume hood is one of the primary safety engineering controls in the laboratory. **EH&S** will (1) be responsible for the annual inspection and certification of fume hoods, (2) monitor the preventive maintenance program for the fume hoods and (3) coordinate the approval and placement of new (or used) fume hoods in the laboratory. The purpose of the fume hood is to remove toxic fumes or contaminants from the breathing zone of the user. There are two basic categories of fume hoods: *General Purpose* and *Special Purpose*. Diagrams outlining the general characteristics of fume hoods can be found in LSM Section 15.4

Under this plan, Ductless Fume Hoods are prohibited because of the potential for employee exposure through a "breakthrough" and/or desorption of vapors from the hood's filters. (See EH&S P&P 29 Chemical Fume Hoods)

9 Laminar Flow Hoods

9.1 Laminar Flow Hoods

The term "laminar flow" describes the air purifying action of these hoods because they provide a directed, non-mixing air stream through a HEPA filter. They can also be called "clean benches" because they provide a near-sterile work area. **However, these hoods do not provide protection to the user from contamination and, in fact, can expose the worker to aerosols of allergenic or infectious materials**. Researchers therefore must not confuse these hoods with biological safety cabinets. These hoods must not be used for microbiological work with potential pathogens.

Please consult Appendix F for diagrams of the basic components of laminar flow hoods. (See LSM Section 15.6)

9.2 Materials, Designs and Construction

All materials, designs and construction of laminar flow hoods shall abide by the **National Sanitation Foundation (NSF) Standard 49**.

9.3 Performance, Inspection and Certification

Since laminar flow hoods are not used to provide protection to the user, these devices should be certified annually to prevent product contamination. A list of licensed certification companies is available on the **EH&S** web site under the "Biological Safety" link.

10 Local Exhaust Enclosures and Snorkels

Local exhaust enclosures and snorkels are only appropriate for use with low-hazard materials. These devices are not an appropriate substitute for fume hoods or biosafety cabinets, which have significantly higher capture efficiencies. **Use of local exhaust enclosures or snorkels with moderate- to high-hazard materials can result in serious injury or death**.

Local exhaust enclosures and snorkels may be used to help an already-effective general ventilation system achieve the following:

- Control of nuisance-level dust, fume, and vapor in labs and other workspaces

- Enhanced removal of low-hazard airborne contaminants
- Increased worker comfort

Contact EH&S if you require assistance in determining the suitability of local exhaust enclosures or snorkels for your specific application.

11 Employee Information and Training

An essential component of the Chemical Hygiene Plan (CHP) is providing information and training to all laboratory workers. This information and training will ensure that laboratory workers are aware of the hazards posed by chemicals in their work areas and how to protect themselves from these hazards.

All employees will be informed and trained about the hazards in the work area at the time of initial assignment and prior to work involving new exposure situations. Refresher training will occur annually.

11.1 Employee Information

Laboratory workers are informed of, and provided access to the below by access to the CHP and On the Job Training.

1. Contents and appendices of the "OSHA Lab Standard" (29 CFR§1910.1450).

2. Contents and appendices of the CHP.

3. Mandatory and recommended exposure limits for hazardous chemicals.

4. The signs and symptoms associated with exposures to hazardous chemicals.

5. The location and availability of safety reference materials, including (M)SDSs, for hazardous chemicals.

11.2 Employee Training

At a minimum, employee training will include:

1. Methods used to detect the presence or release of hazardous chemicals.

2. Physical and health hazards of chemicals in the work area.

3. Protective measures used to reduce hazards or exposures.

4. Applicable details of the CHP.

11.3 Information and Training Responsibilities

To satisfy the information and training requirements outlined above; laboratory workers must receive Laboratory Safety, Fire Safety and Prevention, Portable Fire Extinguisher, Hazard Communication, Hazard Material Handling and Storage and Hazardous Waste Generator Training. The training is assigned through the training platform Percipio. The link to training can be found on the EH&S website here: https://www.fau.edu/ehs/training/. EH&S will document and maintain records of such training and assist departments in tracking their refresher training needs.

Departments must identify laboratory workers who require training and ensure workers attend training sessions, including refresher training. Principal investigators and lab managers must also provide on-the-job, lab specific safety training to laboratory workers.

12 Activities Requiring Prior Approval

In order to protect the health and safety of laboratory employees, building occupants and the community at large, certain laboratory activities will require prior approval from the designated approval body. *Table III* provides a summary of activities and the bodies within the University responsible for granting approvals for those activities.

Table I Activities and Approving Bodies

Activity	Approving Body
Research grant proposals involving: hazardous chemicals[A], biological materials, radioisotopes, lasers, high risk procedures	Environmental Health & Safety
Research involving: human/primate blood, tissues, human, animal and plant pathogens, and recombinant DNA.[A]	Institutional Biological Safety Committee, Institutional Review Board
The use of laboratory animals[B]	Institutional Animal Care and Use Committee (IACUC)
New experimental protocol procedures	Principal Investigator, Lab Manager
Change(s) to existing protocol procedures	Principal investigator, Lab Manager
Unattended operations	Principal investigator, Lab Manager
Working alone in the laboratory[C]	Principal investigator, Lab Manager

[A]Research grant proposals will be used to receive notice of these activities.
[B]Animal Care and Use Committee reviews work when the Principal Investigator applies.
[C]Prohibited activity: A laboratory worker may not work alone in a laboratory while working with substances of unknown or high toxicity.

13 Post-Exposure Medical Consultations/Examinations

Employees should contact **EH&S** whenever there is a suspected exposure to a hazardous chemical in the laboratory. All accidents, injuries, or incidents must be reported to the supervisor or other person in charge. Accidents and injuries resulting in the need for first aid, medical attention, or lost work-time must be documented. Persons responsible for the affected individual(s) must complete the appropriate report. (See University Accident Reporting Procedures.)

If in the course of an exposure investigation by **EH&S**, monitoring reveals an exposure level routinely above the action level (or permissible exposure level, "PEL"), as prescribed by the 29 CFR 1910 standard that applies to the substance being investigated, then medical surveillance will be established for the affected employee.

Employees will also be provided the opportunity for a medical consultation in the event of a spill, leak, or other potential hazardous exposure occurrence. Such consultation will be used to determine the need for a medical examination. Some of the chemicals used in the laboratory are OSHA regulated and have exposure monitoring and medical surveillance requirements. These requirements are activated when the concentrations of these chemicals meet or exceed exposure levels determined by OSHA.

All consultations/examinations will be conducted or supervised by a licensed physician. These consultations and/or examinations will be provided to the employee at no cost. The employee will be directed to an appropriate medical facility by the University's Managed Care Provider as required by State Worker's Compensation requirements.

In cases where laboratory employees seek medical attention for possible overexposure to hazardous chemicals, the Principal Investigator, supervisor, or lab manager must provide the following information to the attending physician:

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

2. A description of the conditions under which the exposure occurred including quantitative exposure data, if available; and

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

If at all possible, a copy of the (Material) Safety Data Sheet(s) for the chemical(s) involved should also be given to the physician. All incidents of overexposure must be fully documented (see University Accident Reporting Procedures).

For any consultation/examination provided under this program, the person responsible for the employee must ensure that the attending physician provides a written opinion regarding the case to **EH&S**. These medical documents shall be stored in a locked file cabinet in a room that is also locked when unoccupied. The written opinion must include the following:

1. Any recommendations for further medical follow-up;

2. The results of the medical examination and any associated tests;

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

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

The written opinion must not reveal specific findings or diagnoses that are unrelated to the occupational exposure.

Any written opinion from a physician will be treated as confidential medical records and will not be released to third parties without the prior written consent of the employee. Any releases will be logged for tracking purposes. The log will indicate where health records were sent, even if a copy is released to the employee by **EH&S**.

14 Particularly Hazardous Substances

Additional protective measures must be implemented in areas where OSHA "select carcinogens," reproductive toxins, and substances with a high degree of acute toxicity are used. **The Principal Investigator (PI) bears the ultimate responsibility for the safe use of particularly hazardous chemicals in the laboratory.** Researchers must create a *Designated Area* (see definition in the Appendix E: Glossary) in the laboratory that is physically separated and visually labeled with appropriate warnings. Access to the Designated Area must be strictly controlled. Engineering controls (such as fume hoods and biosafety cabinets) must also be located in this Area. Some additional measures to be followed include:

1. Abiding by good industrial/chemical hygiene practices (i.e., no eating drinking or tobacco products, wash hands, use of proper PPE, etc.).

2. Properly handling and storing waste.

3. Using appropriate procedures for decontamination.

The PI using particularly hazardous substances will be responsible for submitting a Standard Operating Procedure (SOP) to **EH&S** for review and approval before the "Designated Area" may become active. The SOP must outline the methods that will be used, the proper handling of chemicals in the "Designated Area" and access restrictions to the area. Researchers should consult the SOP information described in Appendix A of this document to complete their SOPs. Contact **EH&S** with additional questions or concerns.

14.1 Guidelines for Handling Some Specific Hazardous Chemicals

The guidelines that follow, taken from Appendix A of the OSHA Lab Standard (29 CFR§1910.1450), should be adhered to when working with hazardous chemicals of a specific nature. For additional information on the handling, storage or disposal of any of these chemicals, contact **EH&S**. (See LSM Section 13)

Appendix A: Standard Operating Procedures

Each laboratory must write specific standard operating procedures (SOPs) for work involving the use of hazardous chemicals. See the definition of "Hazardous Chemical" in the Definitions section of this document. In most cases, more than one SOP will be required. All hazardous chemicals used in the laboratory must be covered by an SOP, and these SOPs must be maintained with the Chemical Hygiene Plan in the laboratory.

There are three methods that can be used to write SOPs:

1. By process (distillation, synthesis, chromatography, etc.).
2. By individual hazardous chemical (arsenic, benzene, hydrochloric acid, etc.).
3. By hazardous chemical class (flammables, corrosives, oxidizers, etc.).

These methods may be used alone or in combination. Two forms are provided (an example and a blank) in this appendix to assist in the preparation of SOPs. The blank form consists of eleven sections and should contain the information listed below. Sample SOPs for some common laboratory chemicals can be found on the EH&S web site under the "Chemical Safety Program" link. Contact **EH&S** for assistance in developing appropriate SOPs.

SOP Format

Sect. 1. Describe Process, Hazardous Chemical, or Hazard Class.

Process - Describe the process, which involves hazardous chemicals. List all chemicals used in the process.

Hazardous Chemical - Name the hazardous chemical for which the SOP is being developed. Include International Union of Pure and Applied Chemistry (IUPAC), common name, and any abbreviation(s) used for the chemical.

Hazard Class - Describe the hazard associated with a particular group of similar chemicals and list the chemicals used in the laboratory.

Sect. 2. Potential Hazards - Describe the potential hazards for each process, hazardous chemical or hazard class in detail. Include physical and health hazards. Consult SDS and other chemical literature.

Sect. 3. Personal Protective Equipment (PPE) - Identify the required level of PPE and hygiene practices needed for each process, hazardous chemical or hazard class. PPE includes: gloves, aprons, lab coats, safety glasses, goggles, face-shields, and respirators. **Note: Before using respirators, all employees must**

comply with the University's Respiratory Protection Program. Email EH&S (ehs@fau.edu) for more information.

Sect. 4. Engineering Controls - Describe engineering controls that will be used to minimize or eliminate employee exposure to hazardous chemicals during the process. This includes ventilation devices such as fume hoods, gloveboxes, blast shields, etc.

Sect. 5. Special Handling & Storage Requirements - List storage requirements for the hazardous chemicals involved with the SOP, including specific storage areas, temperatures, and policies regarding access to chemicals. Special procedures such as dating peroxide formers and testing them before distillation are appropriate here.

Sect. 6. Spill and Accident Procedures - Indicate how spills or accidental releases will be handled and by whom. List the location of appropriate emergency equipment (spill kits, showers, eyewashes, and fire equipment). Any special requirements for personnel exposure should also be identified in this section. Identify the location of emergency response phone numbers.

Sect. 7. Decontamination Procedures - Specify decontamination procedures to be used for equipment, glassware and clothing: include equipment such as glove boxes, hoods, lab benches, and designated areas within the laboratory.

Sect. 8. Waste Disposal Procedures - Indicate how wastes will be disposed. Include the name of the person responsible for managing laboratory waste. See ***FAU Hazardous Material Manual.***

Sect. 9. Safety Data Sheet Location - Indicate the location of SDSs for each hazardous chemical used. Also, indicate the location of other pertinent safety information, i.e. equipment manuals, chemical references, etc.

Sect. 10. Principal Investigator/Lab Manager Approval – Sign and date to indicate the SOP has been approved.

Sample Standard Operating Procedure

Title: SOP for X

Location: _____ Principal Investigator: _____ Date: _____

Section 1. Describe Hazard Class- Concentrated inorganic acid solutions. Examples are hydrochloric and sulfuric acids

Section 2. Potential Hazards- Corrosive material, Inhalation of vapor is harmful, could damage lungs. Ingestion may be fatal. Liquid can cause severe damage to skin and eyes. Strong inorganic acid mists containing Sulfuric acid can cause cancer.

Section 3. Personal Protective Equipment- When working with small amounts use chemical safety glasses and butyl or neoprene gloves. Must have proper exhaust ventilation in room or use a fume hood. When pouring large amounts, use safety goggles a face shield, long gloves and a chemical resistant apron.

Section 4. Engineering Controls- When possible, dispense chemical in a fume hood. The room where the chemical is being used should be equipped with proper exhaust ventilation to keep the airborne concentration below the allowable exposure limit. Eye wash station and a safety shower must be accessible within a 10 second travel time and not require passage through more than one door.

Section 5. Special Handling and Storage Requirements- Store in a cool, dry, ventilated area with other compatible substances. Keep away from strong bases, oxidizers, cyanides, organic materials and metals such as zinc and mercury. Do not store in metal containers. When diluting, always add the acid into water slowly, never the other way around. Containers of this product are hazardous when empty until neutralized with a mild Sodium Bicarbonate solution.

Section 6. Spill and Accident Procedures-

Inhalation: Remove to fresh air. If not breathing, give artificial respiration. Get medical attention immediately.

Ingestion: DO NOT INDUCE VOMITING. Give large quantities of water or milk. Never give anything by mouth to an unconscious person. Get medical attention immediately.

Skin Contact: Immediately flush skin with copious amounts of water for at least 15 minutes while removing any contaminated clothing. Get medical attention immediately. Never use neutralizers on skin.

Eye Contact: Immediately flush eyes with copious amounts of water for at least 15 minutes. Get medical attention immediately.

Small Spills (One Liter or less): Ventilate the area and use proper personal protective equipment. Neutralize with alkaline material such as Soda Ash or Sodium Bicarbonate. Absorb the material with an inert absorbent such as vermiculite or sand and place in a suitable container for disposal and notify EH&S for pickup.

Large Spills (More than a Liter): Notify those affected by the spill and turn off all ignition sources. Evacuate the area and call Environmental Health and Safety at 561-297-3129 or campus police at 561-297-3500. Restrict people from entering the affected area until cleanup is completed.

Section 7. Decontamination Procedures- To decontaminate, wipe areas with a mild solution of Sodium Bicarbonate. Place all material in a container labeled with the words "Hazardous Waste" and the contents, and notify EH&S for pickup.

Section 8. Waste Disposal Procedures- Place waste in an appropriate and compatible container. Container must be closed and labeled with the words "Hazardous Waste" and with the main constituents. Place waste in waste collection area and submit Waste Pick-up form to EH&S in BioRAFT by submitting a request or call EH&S at 561-297-3129.

Section 9. Safety Data Sheets Locations- (Material) Safety Data Sheets are kept in a binder labeled (M)SDS in room___, or may be found on the web at either www.siri.org or https://fau.bioraft.com.

Section 10. Principal Investigator/ Lab Manager Approval: Signature: _____

Date: _____

Standard Operating Procedure

Title: SOP for X

Location: _____ Principal Investigator: _____ Date: _____

Section 1. Describe Process, Hazardous Chemical, or Hazard Class.

Section 2. Potential Hazards

Section 3. Personal Protective Equipment

Section 4. Engineering Controls

Section 5. Special Handling and Storage Requirements

Section 6. Spill and Accident Procedures

Section 7. Decontamination Procedures

Section 8. Waste Disposal Procedures

Section 9. Material Safety Data Sheet Locations

Section 10. Principal Investigator/Lab Manager Approval:

Signature: _____

Date: _____

Appendix B: Glove Selection Chart

The following guide was developed from information in several sources.* Many factors affect the breakthrough times of glove materials including, but not limited to, the thickness of glove material, concentration of the chemical, amount of chemical the glove comes in contact with, length of time the glove is exposed to the chemical, the temperature and abrasion or puncture.

B-1 General Safety Procedures

This information is provided as a guide to proper glove material selection. Glove performance varies between manufacturers, so before working with any highly toxic chemical always consult the manufacturer to make sure that the correct gloves are used for the application. Generally, **Nitrile** is recommended as a good all-purpose glove for non-toxic chemicals. Silver Shield or Laminate Film are the best gloves for more toxic or unknown hazards, BUT, always check with the manufacturer before using with any toxic or unknown substance. When using gloves follow these safety procedures:

- Make sure the glove material is resistant and compatible with the substances in use.
- Inspect gloves for holes and tears before each use.
- Wash gloves appropriately before removing them.
- In order to prevent the unintentional spread of hazardous substances, remove gloves before handling objects such as doorknobs, telephones, pens etc. and before leaving the laboratory.
- Replace gloves periodically, depending on their permeation and degradation characteristics.

Selection Key:

4 = Excellent, breakthrough times generally greater than 8 hours.

3 = Good, breakthrough times generally greater than 4 hours.

2 = Fair, breakthrough times generally greater than 1 hour.

1 = Not Recommended, breakthrough times generally less than 1 hour.

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* Sources:

ILC Dover Chemical Compatibility Chart.

Glove Resistance Ratings, James North & Sons, Inc.

Quick Selection Guide to Chemical Protective Clothing,

2nd Edition, Forsberg & Mansdorf.

? = Not Tested or No Information, check other references.

TABLE II Glove Selection Guide

Chemical	Natural Rubber	Neoprene	Butyl	PVC	Nitrile	Viton ®
Alcohols						
Allyl alcohol	1	1	4	1	4	3
Butyl alcohol	1	3	4	2	3	4
Ethyl alcohol	1	2	4	1	3	4
Isopropyl alcohol	1	3	4	2	4	4
Methyl alcohol	1	1	4	1	1	4
14.1.1.1.1 Aldehydes						
Acetaldehyde	1	1	4	1	1	1
Acrolein	1	1	4	1	1	1
Benzaldehyde	1	1	4	1	1	3
Butyraldehyde	1	1	4	1	1	1
Formaldehyde	1	2	4	2	4	4
Glutaraldehyde	?	4	4	2	?	4
Alphatic Hydrocarbons						
Diesel Fuel	1	2	1	2	3	4
Hexanes	1	1	1	1	4	4

Chemical	Natural Rubber	Neoprene	Butyl	PVC	Nitrile	Viton ®
Kerosene	1	3	1	3	4	4
Naphtha	1	2	1	3	4	4
Pentane	1	1	1	1	3	4
Petroleum Ether	1	1	1	2	3	4
Turpentine	1	1	1	1	2	4
Alkalis						
Ammonium Hydroxide up to 70%	1	3	4	2	3	?
Potassium Hydroxide up to 70 %	4	4	4	4	4	4
Sodium Hydroxide 70 + %	4	4	4	4	3	3
Amines						
Aniline	1	1	1	1	2	1
Ethanolamine	2	4	4	3	4	4
Ethylamine	1	2	4	1	1	1
Methylamine	1	3	4	2	4	4
Triethanolamine	1	1	4	1	4	4
Aromatic Hydrocarbons						
Benzene	1	1	1	1	1	3
Gasoline	1	1	1	1	4	4
Naphthalene	1	1	1	1	4	4
Toluene	1	1	1	1	1	4

Chemical	Natural Rubber	Neoprene	Butyl	PVC	Nitrile	Viton ®
Xylene	1	1	1	1	1	4
Elements						
Bromine	1	2	1	?	1	4
Chlorine aqueous	?	1	2	?	1	4
Iodine	?	1	3	?	3	4
Mercury	?	4	4	?	4	4
Esters						
Ethyl acetate	1	1	3	1	1	1
Butyl acetate	1	1	2	1	1	1
Methyl acetate	1	1	4	1	1	1
Isobutyl acrylate	1	1	4	1	1	1
Ethers/Glycols						
Diethyl ether	1	2	1	1	2	1
Ethylene glycol	1	2	4	1	2	4
Isopropyl ether	1	2	1	1	3	1
Propylene glycol	?	3	3	2	2	?
Tetrahydrofuran	1	1	2	1	1	1

Chemical	Natural Rubber	Neoprene	Butyl	PVC	Nitrile	Viton ®

14.1.1.1.2 Halogenated Hydrocarbons

Carbon Tetrachloride	1	1	1	1	1	4
Chloroform	1	1	1	1	1	4
Methylene Chloride	1	1	1	1	2	3
Polychlorinated Biphenyls(PCB's)	1	4	4	?	2	4
Perchloroethylene	1	1	1	1	2	4
Trichloroethylene	1	1	1	1	1	4

Inorganic Acids

Chromic acid up to 70%	1	1	4	3	3	4
Hydrochloric acid up to 37%	3	3	4	3	3	3
Hydrofluoric acid up to 70%	2	2	3	1	1	?
Nitric acid 70+ %	?	1	2	?	1	4
Perchloric acid up to 70%	4	4	3	4	4	4
Phosphoric acid 70+ %	4	4	4	4	4	4
Sulfuric acid 70+ %	1	2	4	2	1	2

Ketones

Acetone	1	1	4	1	1	1
Diisobutyl ketone	1	1	2	1	1	2
Methyl ethyl ketone	1	1	4	1	1	1

Chemical	Natural Rubber	Neoprene	Butyl	PVC	Nitrile	Viton ®

14.1.1.1.3 Miscellaneous

Acetic anhydride	1	2	4	1	1	1
Acetonitrile	1	1	4	1	1	1
Acrylamide	1	1	3	1	2	3
Carbon disulfide	1	1	1	1	1	4
Cresols	1	3	4	?	2	4
Cutting fluid	?	2	?	2	3	?
Dimethyl sulfoxide	1	4	4	1	1	1
Hydraulic oil	?	?	1	2	3	?
Hydrazine	2	4	4	4	4	1
Hydrogen Peroxide	4	2	4	3	4	4
Lubricating oil	3	3	?	?	4	3
Malathion	?	3	1	?	3	?
Nitrobenzene	1	1	4	1	1	4
Phenol	1	3	2	1	1	4
Photo solutions	3	4	?	3	4	?
Picric acid	1	2	3	1	2	4

Chemical	Natural Rubber	Neoprene	Butyl	PVC	Nitrile	Viton ®
Pyridine	1	1	4	1	1	1

Organic Acids

Acetic acid	2	3	4	2	1	4
Formic acid	2	3	4	3	2	2
Lactic Acid	4	4	4	3	4	4
Maleic acid	3	3	2	3	3	4
Oxalic Acid	4	4	4	4	4	4

Salt Solutions

Ammonium nitrate	4	4	4	4	4	4
Calcium hypochlorite	1	3	4	4	3	4
Ferric chloride	4	4	4	4	4	4
Mercuric chloride	3	3	4	3	3	4
Potassium cyanide	4	4	4	4	4	4
Potassium dichromate	4	4	4	4	4	4
Potassium permanganate	4	4	?	4	4	?
Sodium cyanide	4	4	4	4	4	4

Chemical	Natural Rubber	Neoprene	Butyl	PVC	Nitrile	Viton ®
Sodium thiosulfate	4	4	4	4	4	4

Appendix C: References & Acknowledgements

The following sources were consulted during the development of the FAU Chemical Hygiene Plan:

- Hazard Communication Standard (OSHA) 29 CFR 1910.1200, Chapter 442, F.S., Rule 38I-20.003 F.A.C.
- Hazardous Waste Management (EPA) 40 CFR§260-299, Rule 62-730, F.A.C.
- Occupational Exposure to Hazardous Chemicals in Laboratories (OSHA) 29 CFR§1910.1450, Rule 38I- 20.003 F.A.C.
- "Safety in Academic Chemistry Laboratories"; American Chemical Society, Washington D.C., 1994.
- Prudent Practices in Laboratories, Handling and Disposal of Chemicals; National Academy of Sciences, Washington D.C., 1995.
- "Flammable and Combustible Liquids Code"; NFPA Standard 30, National Fire Protection Association, Quincy, MA, 1993.
- Boca Raton, Florida, Municipal Code Ch. 17, Art. IV § 17-103 (2010).
- “Managing Spent Fluorescent and High Intensity Discharge (HID) Lamps, A Fact Sheet For Florida Businesses and Government Facilities”; Florida Department of Environmental Protection, Tallahassee FL, 2008.
- Universal Pharmaceutical Waste, Rule 62-730.186, F.A.C.
- Used Oil Management, Rule 62-710, F.A.C.
- "Lists of Carcinogens and Reproductive Toxins," Seventh Annual Report on Carcinogens, Summary 1994, U.S. Dept. of Public Health Services.
- Johns Hopkins University Safety Manual.
- The Florida State University Chemical Hygiene Plan
- The Harvard University, Longwood Area, Chemical Hygiene Plan.
- The University of Southern California Laboratory Safety Program.
- The University of West Florida Chemical Hygiene Plan.
- The University of Miami Laboratory Safety Manual.
- Boca Raton, Florida, Municipal Code Ch. 17, Art. IV § 17-103 (2010).

- “Managing Spent Fluorescent and High Intensity Discharge (HID) Lamps, A Fact Sheet For Florida Businesses and Government Facilities”; Florida Department of Environmental Protection, Tallahassee FL, 2008.
- Universal Pharmaceutical Waste, Rule 62-730.186, F.A.C.
- Used Oil Management, Rule 62-710, F.A.C.

Appendix D: Hazardous Material Emergencies and Spills

The following guidelines and procedures are to be used in case of chemical emergencies or spills. For more detailed information on any of these subjects, contact **EH&S.**

D-1 Chemical Exposures

Inhalation: Remove to fresh air. If not breathing, give artificial respiration. Seek medical attention immediately.

Eye Contact: If a chemical has been splashed into the eyes, immediately wash the eye and inner surface of the eyelids with copious amounts of water for 15 minutes, lifting upper and lower eyelids occasionally. Check for and remove any contact lenses at once. Seek medical attention immediately.

Ingestion: Consult SDS, and/or call the Poison Control Information Center at 1-800-222-1222. Follow directions and seek medical attention immediately.

Minor Skin Contact: Promptly flush the affected area with water and remove any contaminated clothing. If symptoms persist after washing, seek medical attention.

Major Skin Contact: If chemicals have been spilled over a large area of the body, quickly remove all contaminated clothing while using the safety shower. Repeat if pain returns. Wash off chemicals by using a mild detergent or soap and water. Do not neutralize chemicals or apply salves or bandages. Leave affected area clean and open to the air. Seek medical attention immediately.

Remember that for some chemicals, such as hydrofluoric acid, effects resulting from exposure may not become apparent until hours or days later. Consult the SDS for any chemical to which someone has been exposed, even if no immediate injury is apparent.

If clothing is on fire, help the individual to the floor and roll that person around to smother the flames. If a safety shower is immediately available, douse the person with water; running to a remote shower will only fan the flame.

Report instances of chemical exposure to EH&S after medical attention has been received.

D-2 Accident Reporting & Workers Compensation Procedures

All accidents, injuries, or incidents must be reported to the supervisor or other person in charge. Accidents and injuries resulting in the need for first aid, medical attention, or lost work-time must be documented. Persons responsible for the affected individual(s) must complete the appropriate report. (See University Accident Reporting Procedures.)

D-3 Emergencies

All laboratory personnel must know what to do in case of an emergency. Laboratory work must not be undertaken without knowledge of the following points:

- How to report a fire, injury, chemical spill, or other emergency.
- The location of emergency equipment such as safety showers and eyewash fountains.
- The location of fire extinguishers and spill control equipment.
- The locations of all available exits for evacuation from the laboratory.
- The location of your emergency evacuation meeting area.

The Principal Investigator must ensure that all laboratory personnel are familiar with this information.

Laboratory personnel should be aware of their level of expertise with respect to the use of fire extinguishers and emergency equipment, response to chemical spills, and ability to treat injuries. They should not take actions outside the limits of their expertise, but instead, should call on trained personnel for assistance.

Post emergency telephone numbers and the telephone numbers of individuals responsible for the laboratory by the laboratory telephone and on signage at the laboratory entrance.

D-3.1 Emergency Procedures:

- Call 911 immediately for all fires and any accidents or spills with injuries that require urgent medical attention.
- Contact EH&S at **ehs@fau.edu** during normal business hours for accidents or spills without injuries or with injuries that **do not require** urgent medical attention. After normal business hours and on weekends and holidays call FAU Campus Police at **561-297-3500**.
- Emergencies involving radiation or radioactive materials must also be reported to the FAU Radiation Safety Officer at **561-297-0028**. After normal business hours and on weekends and holidays call FAU Campus Police at **561-297-3500**.

Table III General Emergency Procedures

Type of Emergency	Who to Call
All Fires Accidents or Spills with injuries that require urgent medical attention	At Any Time Campus Police or Local Emergency Responders 911
Accidents or spills without injuries or with injuries that do not require urgent medical attention (i.e. on-site first aid only)	During Normal Business Hours Environmental Health and Safety 561-297-3129 Outside Normal Business Hours, Weekends, Holidays Campus Police 561-297-3500
Emergencies involving radiation or radioactive materials	During Normal Business Hours Radiation Safety Officer 561-297-0028 Outside Normal Business Hours, Weekends, Holidays Campus Police 561-297-3500

D-4 Management of Spills

Hazardous chemical, biological or radiological spills can be handled effectively when a plan of action has been developed. To respond to any type of spill, lab personnel must be adequately trained. Contact **EH&S** for training assistance. Spill awareness and/or procedures include the following:

1. The potential location of spills.
2. The quantities of material that might be released.
3. Chemical, physical and hazardous properties of the material. This information may be obtained from the (Material) Safety Data Sheet or label.
4. The types of personal protection equipment that is needed for cleanup.
5. Location and contents of spill kits that should be made available where possible.

Table IV presents a list of *suggested* materials for spill control kits.

Note: Not all the materials on this list are required to complete a spill control kit, only those which apply to a particular laboratory.

Table IV Suggested Items For Laboratory Spill Control KitsCOMPONENTS	QTY[1]	PURPOSE
Plastic Tote	1 each	hold kit contents below
Clay Absorbent (i.e. Oil-Dry, Kitty Litter)	5 lbs.	absorbent for organic solvents, oil spills
Sodium Bicarbonate	5 lbs.	neutralizes acid (base) spills
Magic Sorb®	5 lbs.	all purpose (except Hydrofluoric Acid)
Sodium Hypochlorite (bleach)	1 gal.	disinfectant for biohazardous spills
Absorbent pads/ paper	6 units	absorb radioactive/biohazardous spills
Sulfur	1 lb.	reactant for mercury spills
Mercury "sniffer" bottle	1 each	pick-up mercury droplets
Silver Shield, Nitrile or neoprene coated gloves	2 pairs	PPE
Disposable gloves	1 box	PPE
Safety Goggles	2 pairs	PPE
Whisk broom or bench brush	2 each	collect spill waste
Dustpan (non-sparking)	2 each	collect spill waste

Table IV Suggested Items For Laboratory Spill Control KitsCOMPONENTS	QTY[1]	PURPOSE
Polyethylene bags	6 each	collect and dispose waste
Impermeable red biomedical waste bags	6 units	dispose biomedical waste
Tongs or forceps	1 each	picking up sharps/syringes
Duct tape	1 roll	seal spill waste in bag
Other (as needed)		

[1]These quantities are suggested amounts per laboratory. Items may be added to or deleted from the spill kit depending on the variety and quantity of chemicals used in a laboratory. Additional items can include absorbent towels, spill pillows, mops, Radiacwash, etc.

D-4.1 Simple Chemical Releases

A simple chemical release is generally small in quantity, gradual in dispersion, and easy to contain. Simple releases may be managed with a laboratory spill control kit. The Principal Investigator or the laboratory supervisor must be informed when this type of release occurs. The following are some routine procedures to use with a simple chemical spill:

1. *Neutralize acids and bases whenever possible*. Use baking soda (sodium bicarbonate) or some other appropriate neutralizer. (Never neutralize a spill on skin, use water.)

2. *Control and absorb liquid releases*. Use absorbent materials (Speedi Dri, oil dry, spill socks, pads, etc.) to dike the contaminated areas and prevent the spread of a liquid release.

3. *Store waste absorbent materials properly*. After cleaning the release area, place waste products in a properly labeled container and contact **EH&S** for disposal.

4. *Decontaminate the area and affected equipment*. Increase ventilation to the area by using fans or opening windows if available. Contact **EH&S** for an indoor air quality assessment if necessary.

When dealing with a simple release, make sure to properly label all disposal bags with the names of the spilled chemicals and the approximate amounts. Also include on the label "contains broken glass," where appropriate. Always restock the spill control kit after use.

D-4.2 Complex Chemical Releases

Complex chemical releases require outside assistance from properly trained individuals. These involve the release of large amounts of chemicals or chemicals of high toxicity. Evacuate the area, contact the

Campus or Local Police and **EH&S**, and have all personnel involved wait in a predetermined evacuation area.

D-4.3 Guidelines for Mercury Handling, Storage, and Spill Cleanup

This guideline, specifically written for mercury, was developed because of the toxicity of the element, and because it is so widely used on the FAU campuses. Mercury is a chronic toxin and particularly insidious due to its long latency period. It is similar to benzene or lead since it is a cumulative poison that produces body damage through exposure to small concentrations over a long period of time.

Elemental mercury can be absorbed through the skin, inhaled as a gas, or ingested. Although it is a liquid at room temperature, it is constantly emitting vapors that are colorless, odorless, and tasteless. Mercury poisoning causes emotional disturbances, unsteadiness, inflammation of the mouth and gums, fatigue, memory loss, and possibly kidney damage.

Handling - All work with mercury should be performed in a properly functioning fume hood. At a minimum, a lab coat and at least one pair of disposable gloves should be worn. Secondary containment should be utilized when transporting or working with mercury.

Storage - Containers of mercury should be kept closed and stored in secondary containers in a well-ventilated room. The secondary container for storage or use, should be enameled or plastic for easy cleaning and large enough to hold the volume of mercury in use.

Spills - Notify everyone in the area that a spill occurred, call **EH&S**.

- Isolate the area to prevent spreading.
- A mercury spill kit must be used, and proper procedures followed.
- At a minimum, wear gloves, lab coat, and shoe covers.
- Place mercury and mercury device in a bottle or zip lock bag and label.
- Wash thoroughly after the cleanup is complete.
- Place bags in the Designated Waste Area and call EH&S for a pickup and a survey.
- For large spills (barometers, manometers) call EH&S immediately.

The preferred mercury spill cleanup method is to immediately call EH&S for cleanup.

D-4.4 Accidental Release of Biohazardous Agents

Laboratories in which biohazardous agents are used must have the ability to contain and control accidental releases of these agents. The laboratory spill kit must incorporate the appropriate items to accomplish containment including, but not be limited to, the following: an appropriate disinfectant/decontaminate, proper PPE (gloves, goggles, etc.), and **RED** biomedical waste disposal bags.

Laboratory procedures and biohazardous agents present in a specific laboratory will determine what additional items may be necessary.

For more information concerning the use and disposal of biohazardous agents, see the *FAU Biological Waste Program*.

D-4.5 Spills of Radioactive Substances

The accidental release of radioactive substances falls into two primary categories:

- *Minor incidents* – Incidents involving the release or spillage of less than 10 uCi of a radionuclide in a non-volatile form.
- *Major incidents* – Incidents involving the release or spillage of greater than 10 uCi of a radionuclide or any amount of a radionuclide in a volatile form.

Minor Incident Procedure:

1. **Notify** all other persons in the area immediately.
2. **Prevent** the spread of contamination by placing absorbent paper on the spill.
3. **Clean** up the spill working from the outside of the spill inward.
4. **Survey** the area, record the results.
5. **Dispose** of all materials as radioactive waste.
6. **Survey** clothes, hands, and feet.
7. **Notify** the laboratory supervisor.
8. **Notify** EH&S and the RSO at 561-297-3129.

Major Incident Procedure:

1. **Clear** the area of all personnel.
2. **Notify** the RSO immediately at 561-297-3129.
3. **Notify** the laboratory supervisor.
4. **Close** and lock the lab.
5. **Post** warning signs.
6. **Survey** personnel and area, record results.
7. **Wait** for assistance from RSO before decontaminating area.

Surveys of the area for residual contamination are also required as well as reporting all accidental releases to the Radiation Safety Officer. See the FAU Radiation Safety Manual for more information on managing accidental releases of radioactive materials.

Appendix E: Glossary

Laboratory employees should become familiar with the following terms and concepts. Many of these terms are commonly used in Safety Data Sheets (SDSs). Some are also found in this Chemical Hygiene Plan.

ACGIH. **A**merican **C**onference of **G**overnmental **I**ndustrial **H**ygienists. An organization of professionals in government agencies and educational institutions engaged in occupational safety and health programs.

aqueous. Describes a water-based solution or suspension. Frequently describes a gaseous compound dissolved in water.

anhydride. Any compound formed by the removal of the elements of water (hydrogen and oxygen).

anhydrous. "Without water". A substance in which no water molecules are present either in the form of a hydrate or as water of crystallization.

ANSI. American **N**ational **S**tandards **I**nstitute. A privately funded, voluntary organization which develops and coordinates national consensus standards. Many ANSI standards relate to safe design/performance of equipment and safe practices or procedures. ANSI standards are widely recognized and accepted as "State of the Art" knowledge regarding acceptable safety practices.

asphyxia. The loss of consciousness as a result of too little oxygen and too much carbon dioxide in the blood.

asphyxiant. A vapor or gas that can cause unconsciousness or death by suffocation. Most *simple asphyxiants* are harmful to the body only when they become so concentrated that they reduce the available oxygen in the air (normally about 21 %) to dangerous levels (18 % or lower); e.g., CO_2, N_2, H_2 and He. Others are *chemical asphyxiants* like carbon monoxide (CO) or hydrogen cyanide (HCN) which reduce the blood's ability to carry oxygen.

autoignition temperature. The minimum temperature to which a substance must be heated without application of a flame or spark to cause that substance to ignite. Materials should not be heated to greater than 80% of this temperature.

base. A substance that can do at least one of the following: (1) liberate hydroxide anions (OH^-) when dissolved in water, (2) receive a hydrogen ion from a strong acid to form a weaker acid, and/or (3) give up two electrons to an acid. Bases have a pH > 7 and turn litmus paper blue. They may be corrosive to human tissue and should be handled with care.

biodegradable. The capability of being readily decomposed by biological means, especially by microorganisms.

biomedical waste. Any solid or liquid waste which may present a threat of infection to humans.

biomedical waste disposal bags (red bags). These are the only approved biomedical waste disposal bags used at FAU to be in compliance with FAC 64E-16. All other types are illegal in the state of Florida. Supplies of these bags can be obtained from private distributors or through **EH&S**.

Bloodborne Pathogens Policy and Procedures. The University's Exposure Control Plan, designed to eliminate or minimize occupational exposure of employees to bloodborne pathogens and other potentially infectious materials in compliance with OSHA's Bloodborne Pathogens Standard 29 CFR 1910.1030.

boiling point, BP. The temperature at which the vapor pressure of a liquid is equal to the surrounding atmospheric pressure so that the liquid becomes a vapor. Flammable materials with low BP's generally present special fire hazards. e.g., butane, BP = 31 ^{o}F; gasoline, BP = 100 ^{o}F.

BTU. British **t**hermal **u**nit. The quantity of heat required to raise the temperature of 1 lb of H_2O by 1 ^{o}F at 39.2 ^{o}F, its temperature of maximum density.

buffer. A substance that reduces the change in hydrogen ion concentration (pH) that otherwise would be produced by adding acids or bases to a solution.

carcinogen. Substances that can cause cancer in humans or animals. A material is considered to be a carcinogen if (1) it has been evaluated and listed by the International Agency for Research on Cancer (IARC), (2) it is listed as a carcinogen or suspected carcinogen in the Annual Report on Carcinogens published by the National Toxicology Program (NTP), (3) it is regulated by OSHA as a carcinogen, or (4) it meets the EPA criteria for a carcinogen or suspected carcinogen.

CAS Registration Number. Chemical **A**bstract **S**ervice registration number is the number assigned to identify a substance. CAS numbers identify *specific* chemicals and are assigned sequentially. The numbers have no chemical significance.

CFR. Code of Federal Regulations. The annual accumulation of executive agency regulations that contains the general body of regulatory laws governing practices and procedures performed by federal administrative groups.

combustible. A term used by NFPA, DOT, and others to classify, on the basis of flash point, certain liquids that will burn.

corrosive. A chemical that causes visible destruction or irreversible alterations in living tissue through chemical action at the site of contact.

cryogenic. Relating to extremely low temperature such as in refrigerated gases.

DEP. The **D**epartment of **E**nvironmental **P**rotection of the State of Florida. A state agency with environmental protection, regulatory, and enforcement authority.

dermal toxicity. Adverse effects resulting from skin exposure to a material. Ordinarily used to denote effects on experimental animals.

DOT. U.S. **D**epartment **O**f **T**ransportation. Regulates transportation of materials. DOT addresses issues in labeling, weight, classification of hazards, placarding of vehicles, etc. DOT regulations are intended to protect the public as well as fire rescue, EMTs and other emergency-response personnel.

Designated Area. A separate and distinct portion of a laboratory designed to deal with extremely hazardous chemicals and other substances that require special needs. The Designated Area must have the necessary engineering controls (fume hoods, biosafety cabinets, etc.) and the appropriate warning labels. Access must also

be strictly controlled. A Standard Operating Procedure detailing the methods, responsible individuals, materials and handling of substances in the Designated Area must be completed by the Principal Investigator, and approved by **EH&S**.

electrolyte. Any substance which in solution or in a liquid form is capable of conducting an electric current by the movement of its disassociated positive and negative ions to the electrodes.

EPA. U.S. **E**nvironmental **P**rotection **A**gency. The federal agency with environmental protection, regulatory, and enforcement authority.

evaporation rate. The rate at which a material will vaporize from the liquid or solid state. The evaporation rate can be useful in evaluating the health and fire hazards of a material.

exposure limits. The boundaries for quantities of chemicals to which employees can be exposed.

flammable. Describes any solid, liquid, vapor or gas that will readily catch fire and burn in air.

flash point. The lowest temperature at which a liquid has a sufficient vapor pressure to form an ignitable mixture with air near the surface of the liquid.

freezing point. The temperature at which a material changes its physical state from liquid to solid.

hazardous material. Any substance or mixture of substances having which has properties capable of producing adverse effects on the health or safety of a human. These substances also display the characteristics stated in 40 CFR 261.3, Subpart D, of ignitability, corrosivity, reactivity and EPA Toxicity or are listed in 40 CFR 261.31-33.

HEPA. Acronym for **H**igh-**E**fficiency **P**articulate **A**ir-purifying filter equipment, used for removing airborne materials. Often used for the removal of infectious microbes (e.g., TB) from the air.

incompatible. Describes materials that can cause dangerous conditions when mixed together or stored in close proximity.

irritant. A non-corrosive material which causes a reversible inflammatory effect on living tissue at the site of contact. The severity of the reaction is a function of concentration and duration of exposure.

LEL. Lower **E**xplosive **L**imit refers to the minimum concentration (by percent volume) of a fuel (vapor) in air at which a flame is propagated when an ignition source is present.

melting point. The temperature at which a solid changes to liquid.

(M)SDS. (**M**aterial **S**afety **D**ata **S**heet. These sheets contain descriptive safety information concerning the use and handling of chemicals. OSHA has established guidelines for these forms (OSHA form 174) and requires those who produce, distribute, and use hazardous materials to make the MSDS available to their employees. *In 2012, the acronym 'MSDS' was simplified to 'SDS', which stands for Safety Data Sheet – see the definition of SDS for more information.*

mutagen. A material that induces genetic changes (mutations) in the DNA of chromosomes.

nanomaterial. Engineered nanoscale materials or nanomaterials are materials that have been purposefully manufactured, synthesized, or manipulated to have a size with at least one dimension in the range of approximately 1 to 100 nanometers and that exhibit unique properties determined by their size.

nanoparticle. An ultrafine particle with lengths in two or three dimensions greater than 0.001 micrometer (1 nanometer) and smaller than about 0.1 micrometer (100 nanometers) and which may or may not exhibit a size-related intensive property.

NFPA. National **F**ire **P**rotection **A**ssociation. A national organization with the purpose of establishing programs, standards and safeguards against loss of life and property by fire. The NFPA develops the National Fire Codes that are the laws that govern fire prevention and protection.

NIOSH. National **I**nstitute of **O**ccupational **S**afety and **H**ealth. The agency of the Public Health Service that tests and certifies respiratory and air sampling devices. It recommends exposure limits for substances and assists OSHA in investigations and research.

odor threshold. The lowest concentration of a gas in air that can be detected by smell.

OSHA. The **O**ccupational **S**afety and **H**ealth **A**dministration. Part of the U.S. Department of Labor. The regulatory and enforcement agency responsible for safety and health in most U.S. industrial sectors.

oxidation. A reaction in which a substance combines with oxygen provided by an oxidizer or oxidizing agent. Also the process by which electrons are removed from atoms or ions.

oxidizer. A substance that yields oxygen readily to stimulate the combustion (oxidation) of organic matter.

pH. The value that represents the acidity or alkalinity of an aqueous solution. The number represents the base 10 logarithm of the reciprocal of the hydrogen ion concentration of a solution.

physical state. The condition of a material; i.e., solid, liquid, or gas, at a given temperature.

reducing agent. A chemical or substance that (1) has oxygen removed or (2) gains electrons from an oxidation-reduction reaction.

REL. Recommended **E**xposure **L**imit. The NIOSH, REL, is the highest allowable airborne concentration that is not expected to injure a worker. It may be expressed as a ceiling limit or as a time-weighted average for 10-hr work shifts.

SDS. Safety **D**ata **S**heet. The information contained in the SDS is largely the same as the MSDS, except now the SDSs are required to be presented in a consistent user-friendly, 16-section format. The SDS must be in English (although it may be in other languages as well). In addition, OSHA requires that SDS preparers provide specific minimum information as detailed in Appendix D of 29 CFR 1910.1200.

sensitizer. A material to which there is little or no physiological response on first exposure in humans or test animals. However, repeated exposures may cause a marked response not necessarily limited to the contact site. The skin and respiratory tracts are the most commonly affected areas in the body by chemical sensitizers.

sharps container. A rigid, puncture-resistant container designed primarily for containment of needles, syringes, lancets, razor blades, etc. All sharps containers must be labeled with international biohazard symbol. All sharps containers must be approved by **EH&S**.

Standard Operating Procedure (SOP). Procedures which outline the methods, responsible individuals, materials and handling of hazardous and toxic substances in a specialized area in the laboratory. An SOP is specifically required when using extremely hazardous chemicals and/or some types of infectious agents.

specific gravity. The ratio of the mass of a body to the mass of an equal volume of water at 4^{o}C or other specified temperature.

target organs. Organs within the body which are specifically affected by different types of chemicals. The most common of these include the liver, kidneys, nervous system, skin, and eyes.

TC_{Lo}. Toxic **C**oncentration **L**ow. The lowest concentration of a substance in air to which humans or animals have been exposed for any given period of time that has produced (1) toxicity, (2) tumorigenesis, or (3) reproductive changes.

TLV. Threshold **L**imit **V**alue. A term used by ACGIH to express the daily exposure limit for workers to the airborne concentrations of specified materials without adverse effects. ACGIH expresses TLV's in three ways: (1) **TLV-TWA**, the allowable **T**ime-**W**eighted **A**verage concentration for a normal 8-hour workday or 40-hour week; (2) **TLV-STEL**, the **S**hort **T**erm **E**xposure **L**imit or maximum concentration for a continuous exposure period of 15 minutes (with a maximum of four such periods per day, and provided that daily TLV-TWA is not exceeded); and (3) **TLV-C**, **C**eiling, the concentration that should not be exceeded at any time.

toxic. Describes the ability of a material to injure biological tissue.

UEL. Upper **E**xplosive **L**imit refers to the highest concentration (by percent volume) of a fuel (vapor) in air at which a flame is propagated when an ignition source is present.

vapor pressure. The pressure at any given temperature of a vapor in equilibrium with its solid or liquid form. Vapor pressures are useful (with evaporation rates) to determine how quickly a material becomes airborne and thus how quickly a worker can be exposed to it.

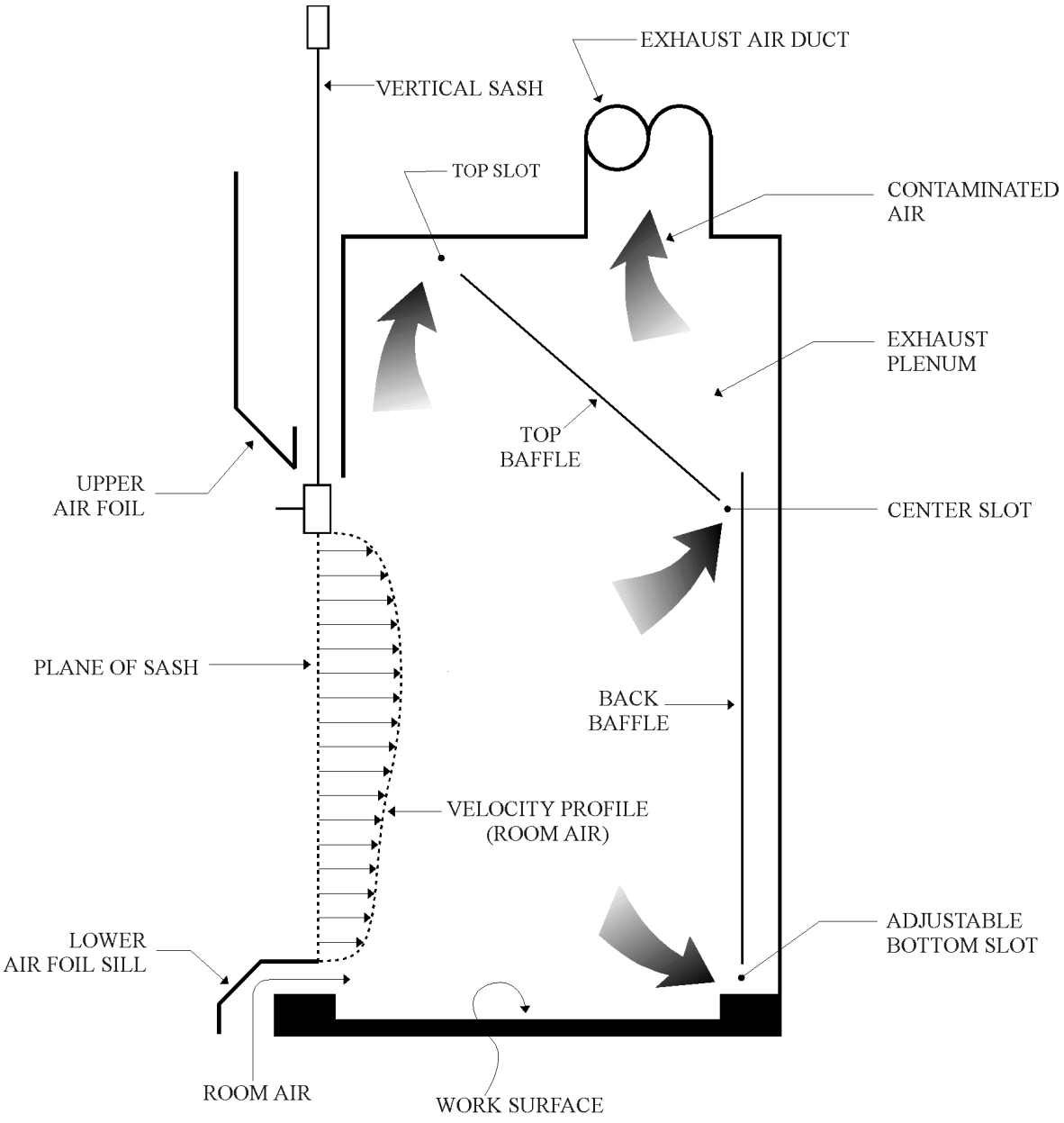
volatility. Measure of a material's tendency to vaporize or evaporate at ambient conditions.

water reactivity. Ability of a material to react with water and release a gas that is either flammable or presents a health hazard.

Appendix F: Diagrams of Local Exhaust Devices

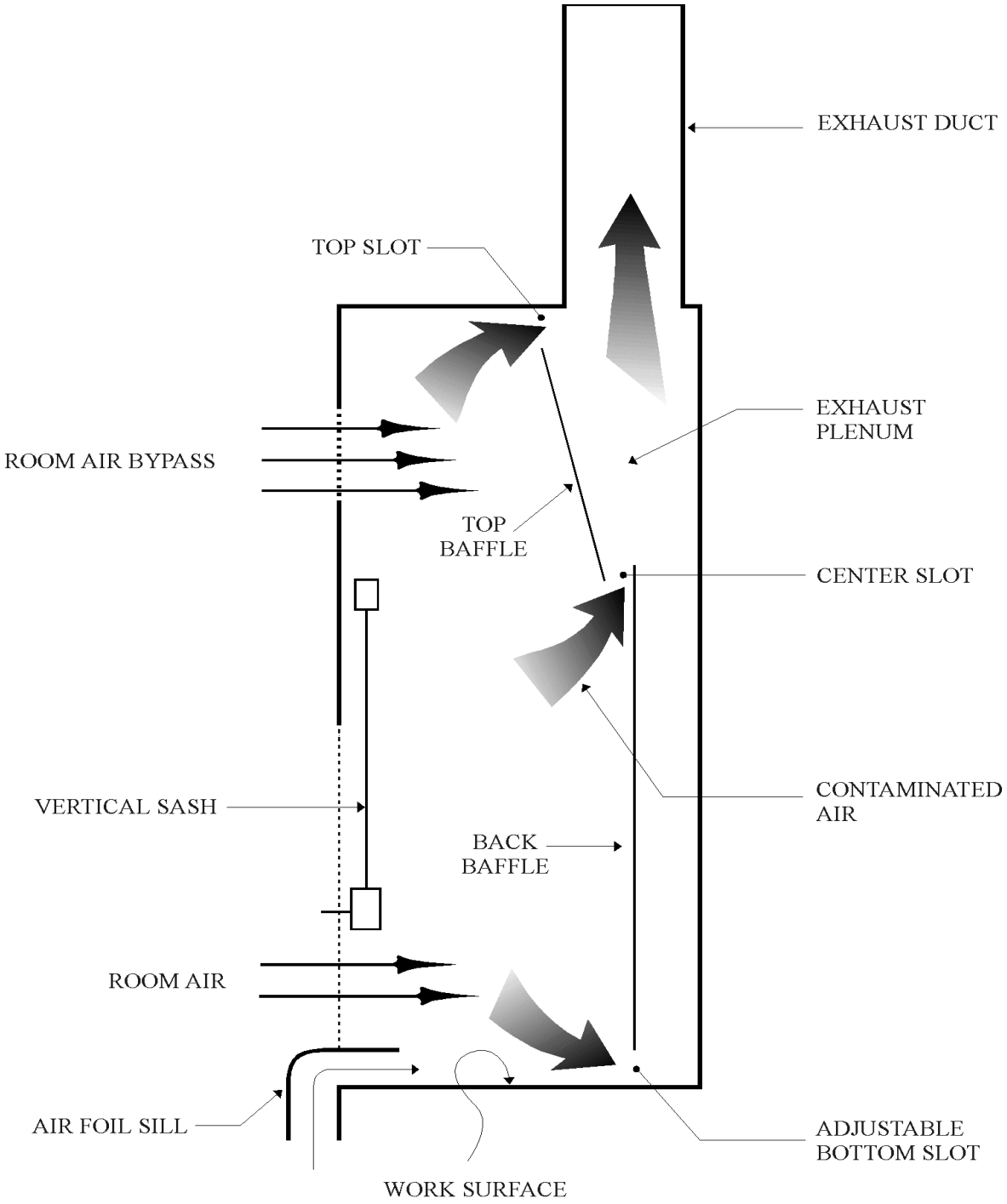
Chemical Fume Hoods

F-1 Conventional Fume Hood



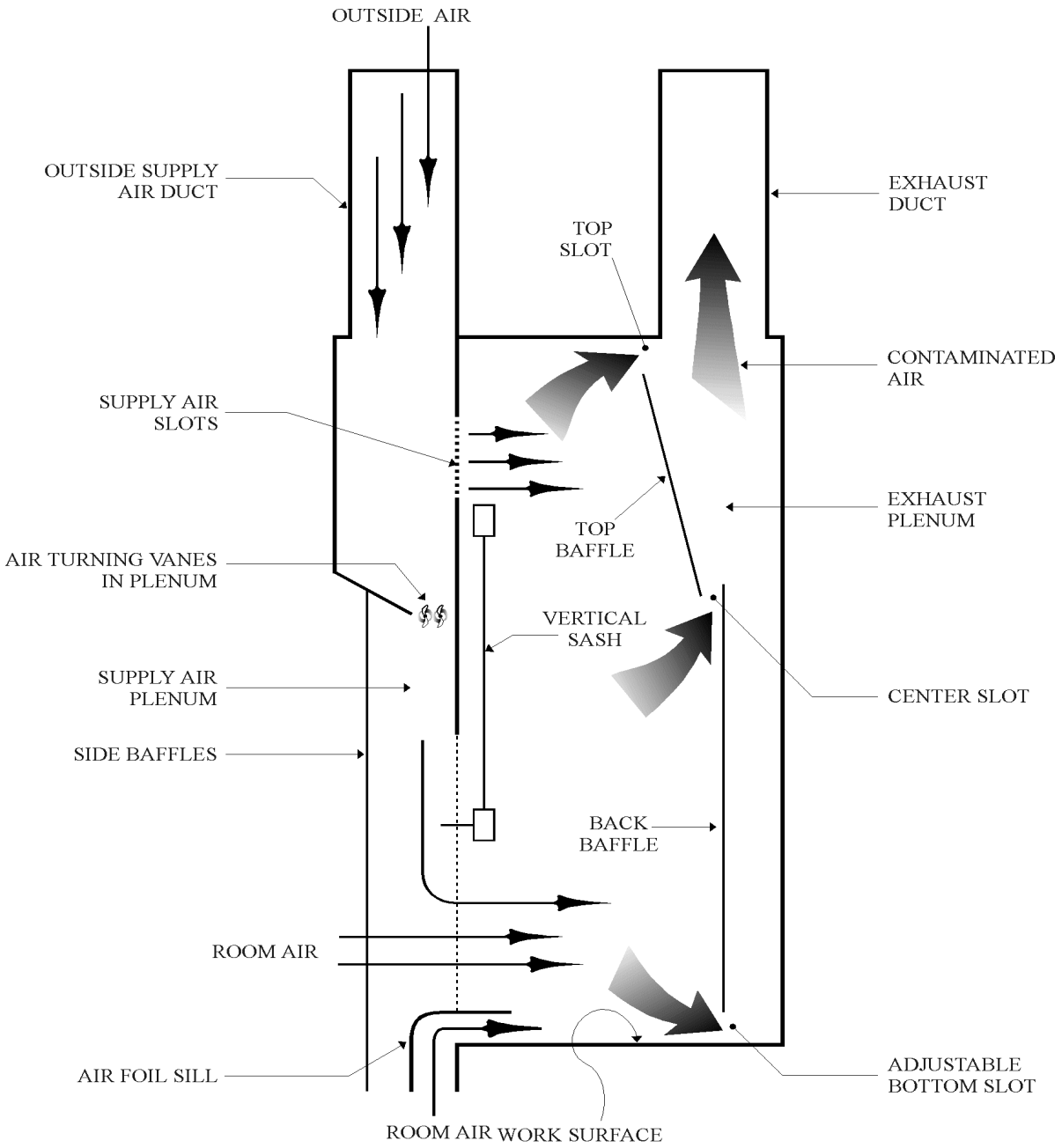
This is the basic fume hood model. Room air is drawn into the hood through the plane of the sash and exhausted through ductwork outside the building. The vertical sash determines the air velocity measured in lfpm (linear feet per minute). The air is exhausted through three (or more) slots (top, center, and bottom) to accommodate a variety of research activities.

F-2 Bypass Fume Hood



This type of fume hood is designed to minimize the excessive air velocities which occur when the vertical sash opening is low (6 in. or less). Airflow can be diverted through the room-air bypass at low sash openings which decreases the turbulence created by the increased velocities without effecting the efficiency of the fume hood. These hoods are generally used with experiments involving delicate procedures and/or sensitive equipment.

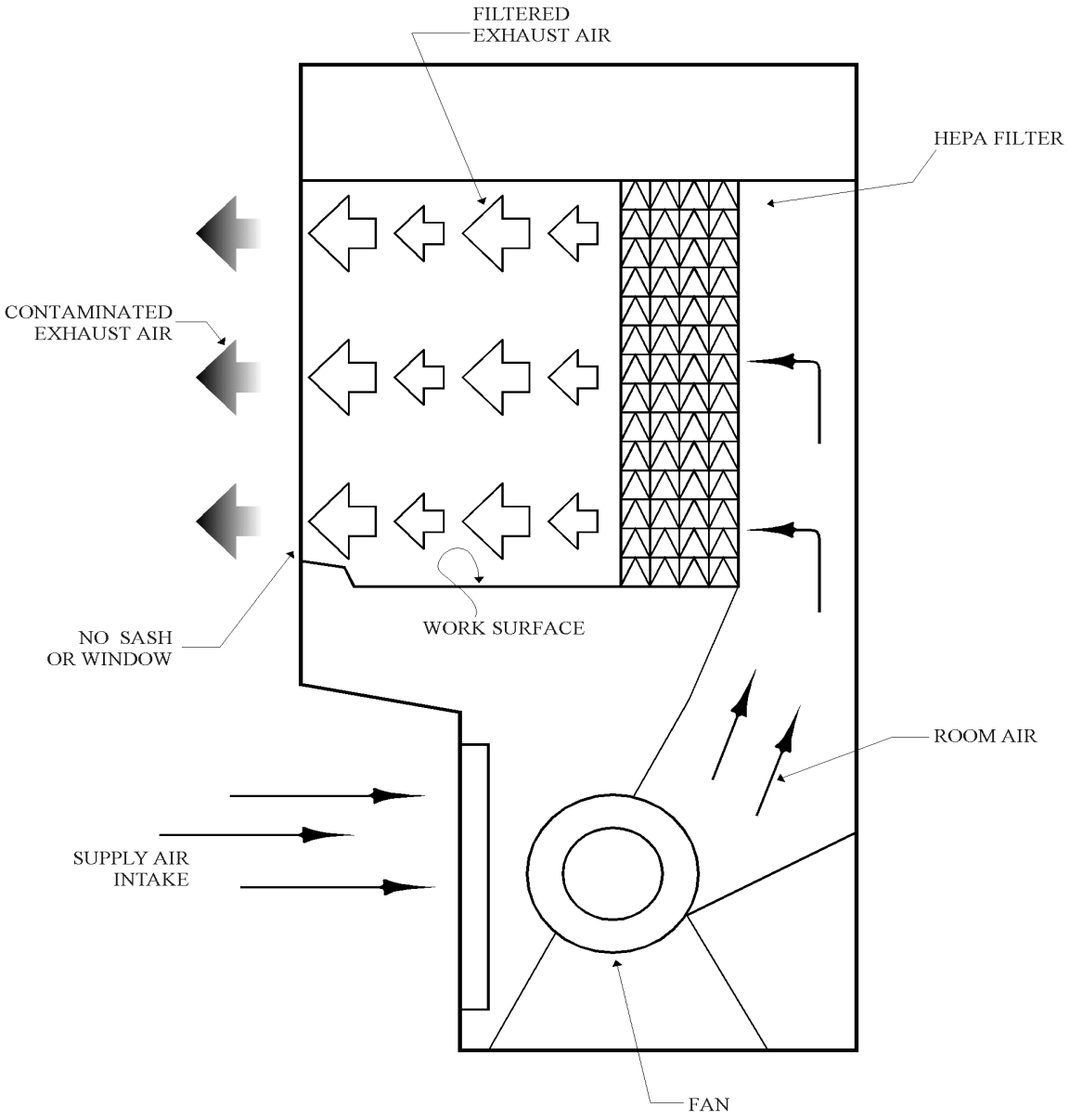
F-3 Auxiliary-Air Fume Hood



This type of fume hood is similar to the bypass chemical fume hood except that a major portion of the air exhausted is provided from a supply-air plenum attached to the hood just above the face. The purpose of an auxiliary-air fume hood is to reduce the demand for fully conditioned make-up air for hood service. Since the plenum provides streams of minimally conditioned outside air across the face of the hood, users sometimes mistake these airflows as problems with the exhaust of the hood.

Laminar Flow Hoods

F-10 Horizontal Laminar Flow Hood



These devices are termed “laminar flow” because they provide a uniform non-mixing air stream through a HEPA filter. They can also be called “clean benches” because they provide a near sterile work area. Since users will be directly exposed to non-purified air during operation**, these hoods must not be used with toxic, allergenic, or infectious materials**. Laminar flow hoods are designed to protect the product or sample from contamination, not the operator.

F-11 Snorkels

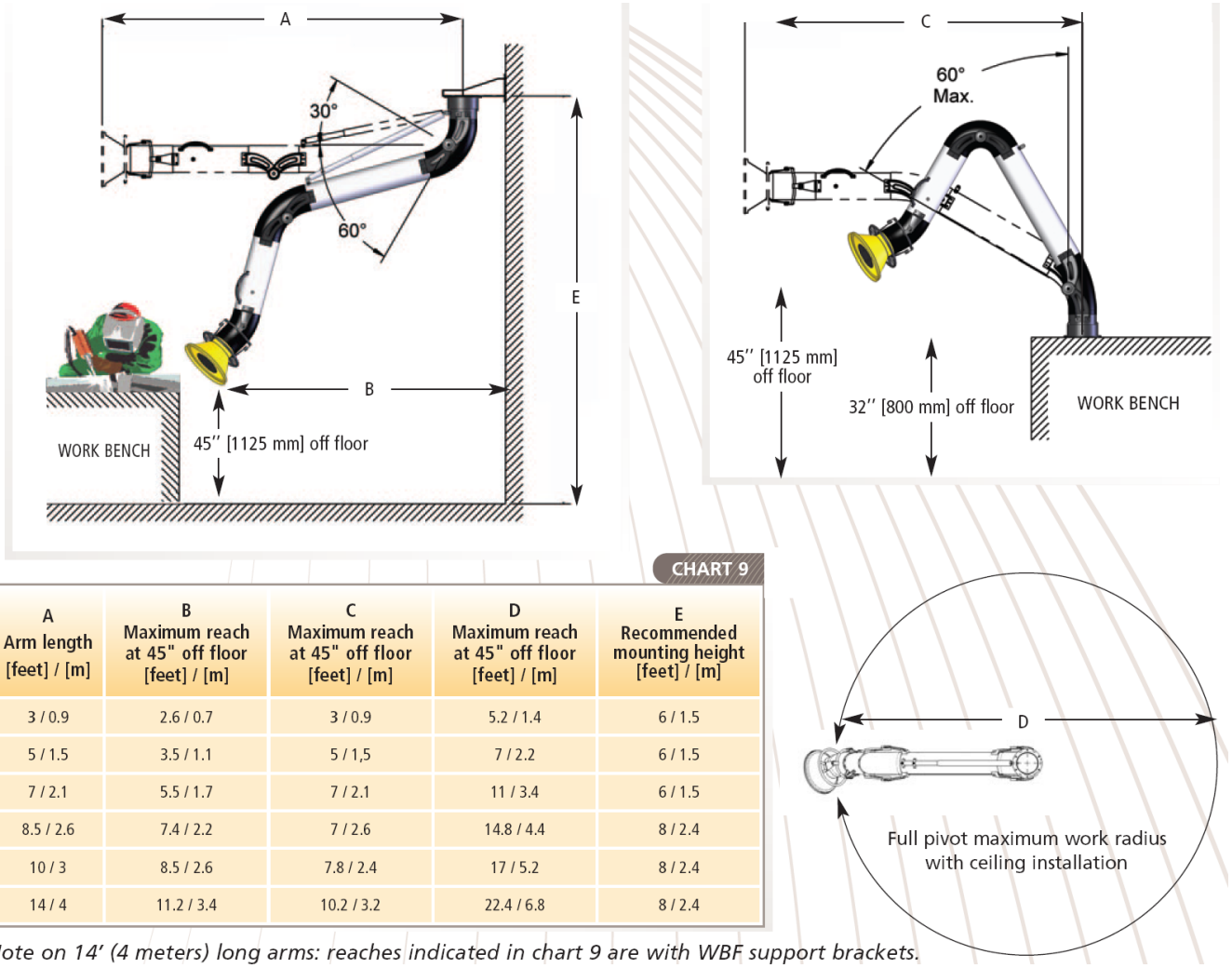


CHART 9

A Arm length [feet] / [m]	B Maximum reach at 45" off floor [feet] / [m]	C Maximum reach at 45" off floor [feet] / [m]	D Maximum reach at 45" off floor [feet] / [m]	E Recommended mounting height [feet] / [m]
3 / 0.9	2.6 / 0.7	3 / 0.9	5.2 / 1.4	6 / 1.5
5 / 1.5	3.5 / 1.1	5 / 1,5	7 / 2.2	6 / 1.5
7 / 2.1	5.5 / 1.7	7 / 2.1	11 / 3.4	6 / 1.5
8.5 / 2.6	7.4 / 2.2	7 / 2.6	14.8 / 4.4	8 / 2.4
10 / 3	8.5 / 2.6	7.8 / 2.4	17 / 5.2	8 / 2.4
14 / 4	11.2 / 3.4	10.2 / 3.2	22.4 / 6.8	8 / 2.4

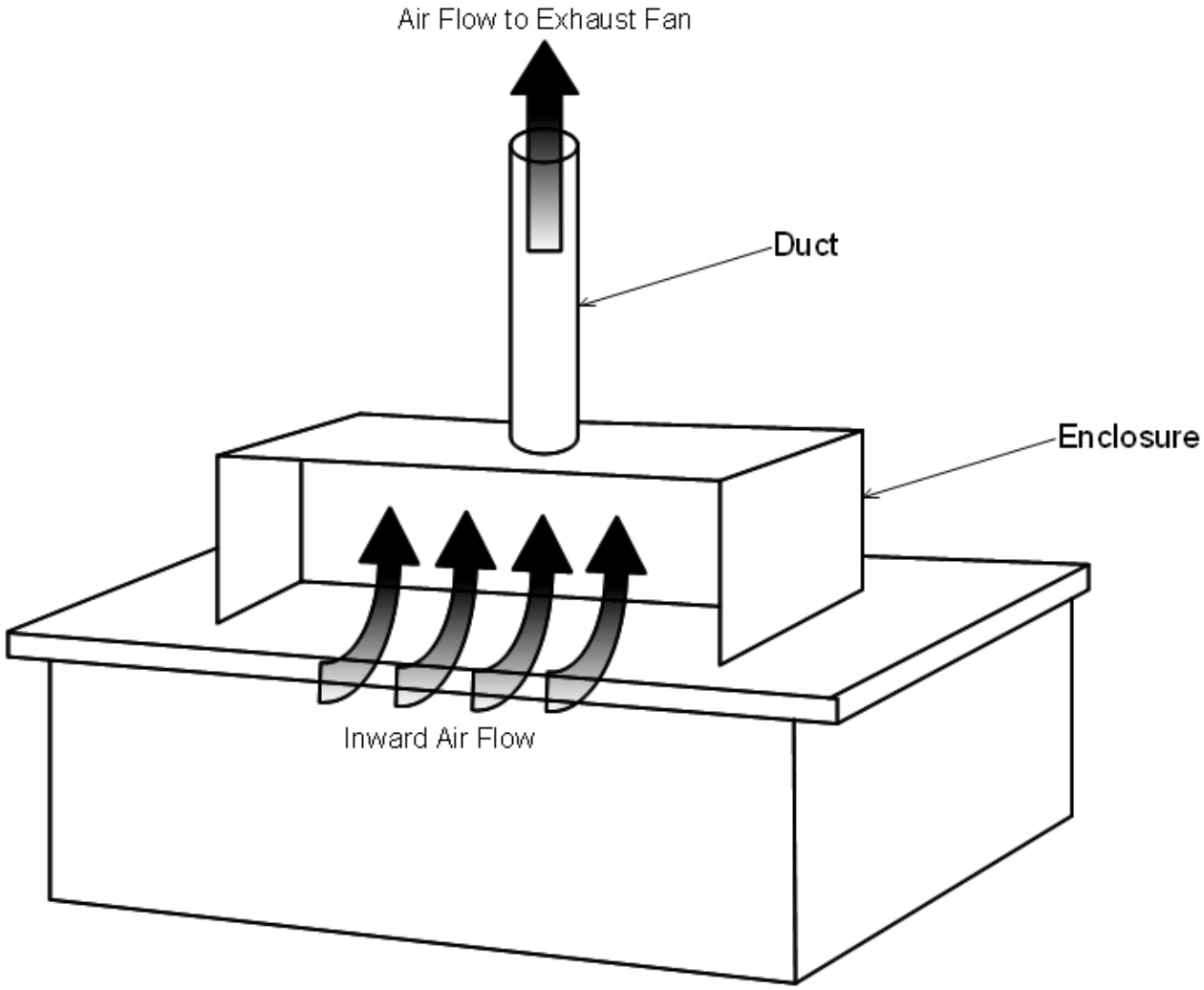
Note on 14' (4 meters) long arms: reaches indicated in chart 9 are with WBF support brackets.

Standard snorkel tubes are usually made of steel with external cast aluminum joints, which may include adjustable friction discs. The arms typically have a handle attached to the hood to facilitate positioning. Aluminum hood diameters can vary from a few inches to more than a foot in diameter. Hood diverters, which increase capture velocity, might also be installed on some models. The effective capture radius for snorkels is generally equal to one hood diameter from the edge of the hood, with efficiency falling rapidly as distance from the hood increases.

This type of local exhaust device is only appropriate for use with low-hazard materials and is not an adequate substitute for higher-efficiency control devices that must be used when working with moderate- to high-hazard materials.

Note: The diagram provided above is for a MAXAIR "Fume Arm" and is typical of the type of laboratory snorkels in use at FAU.

F-12 Local Exhaust Enclosures



Local Exhaust Enclosure

At FAU, these enclosures can be found primarily in chemistry laboratories. They are custom made and of metal construction. They have one central pickup area in the center of the enclosure that corresponds to the location where the ductwork penetrates the enclosure box. The efficiency of these control devices drops off rapidly as distance from the pickup area increases. Capture efficiency outside the enclosure is negligible.

The efficiency of these local exhaust enclosures can be adversely affected by small changes in air flow in the local area where installed. **As in the case of snorkels, these local exhaust enclosures are only appropriate for use with low-hazard materials and are not an adequate substitute for higher-efficiency control devices that must be used when working with moderate- to high-hazard materials.**