Chemical Hygiene Plan

Florida Institute of Technology
Environmental Health and Safety
150 W University Blvd
Melbourne, FL 32901
Email: ehs@fit.edu
Web: https://www.fit.edu/office-of-environmental-health-and-safety/

Revision History

Revision Number	Revision Date	Revised By	Description of Change
00	8/12/19	Selvin McLean	Initial creation and implementation.
01	3/17/2020	Selvin McLean	Numbering changes. Telephone number updates. Emergency contact word changes. Update to links. Update to chemical hazards information.
02	1/19/2021	Selvin McLean	Title/responsibility updates.
03	2/4/2021	Selvin McLean	Document review; review against the federal register for updates.
04	4/18/2022	Selvin McLean	Updates to Shipping/Receiving Hazardous Material; updates to Compressed gas cylinder information; BSC updates; Melbourne Prohibited Discharge list updates; Security update.
05	7/18/2022	Selvin McLean	Link to Florida Tech Ethics Policy embedded into document.
06	6/8/2023	Selvin McLean	Updates to document information, policy removal; telephone number removal etc.

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1 Introduction

Florida Institute of Technology (Florida Tech) is legally and ethically required to provide a safe working environment for all its employees and students under the Occupational Safety and Health Administration (OSHA) General Duty Clause, Section 5(a)(1) of the Occupational Safety and Health Act of 1970, employers are required to provide their employees with a place of employment that is 'free from recognized hazards that are causing or are likely to cause death or serious physical harm.' Since Florida Tech employs workers engaged in the use of hazardous chemicals, Florida Tech will comply with the provisions of the OSHA standard: "**29 CFR§1910.1450, Occupational Exposure to Hazardous Chemicals in Laboratories."** This standard is commonly referred to as "**the Laboratory Standard**." It was developed to provide increased protection to laboratory employees beyond that which is provided in the General Industry Standards (**29 CFR§1910**). '**The Laboratory 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 Laboratory 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/shops.

This document constitutes Florida Tech's CHP. It details laboratory safety policies, procedures, and standards at Florida Tech. 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 as set forth in Florida Tech' Safety Policy.

There may be some situations in which proper facilities and equipment are not available for conducting project requirements. When this is the case, faculty/staff members should consult **EH&S** for assistance in evaluating hazards and finding ways to safely mitigated the hazard(s). This document should not be considered a sole review of all potential hazards. Individuals with more specific questions should contact **EH&S or the Chemical Hygiene Officer: Carolyn Martinsen (cmartin2003@fit.edu / (321) 674-7562)** directly.

2 Implementation

The Chemical Hygiene Plan will be implemented and administered by the Department of Environmental Health and Safety (EH&S). EH&S is responsible for developing, implementing, and reviewing the written Chemical Hygiene Plan, which will be **reviewed annually** and updated as needed by **EH&S**.

Although EH&S 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 Institution.

3 Responsibilities

a. The President of the Florida Tech, as the chief executive officer, has ultimate responsibility within the institution, and along with other administrators, provides continuing support for the CHP.

b. 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 Florida Tech CHP. Vice-Presidents, Deans, Department Heads, and Principal Investigators shall provide appropriate personal protective equipment to those under their direct supervision (29CFR1910.132 Personal Protective Equipment).

c. Chemical Hygiene Officer (CHO) / Department of Environmental Health and Safety (EH&S) is responsible for developing, implementing, and updating the CHP on behalf of the Institute President, or designated representative. CHO/EH&S will assist departments and individual laboratories in implementing and complying with the CHP. EH&S will also institute appropriate audit methods to ensure compliance.

d. Department Safety Representatives are responsible for ensuring Principal Investigators and Laboratory Managers develop and implement standard operating procedures and training programs specific to their laboratories. Department Safety Representatives will maintain an up to-date copy of the CHP, and act as a liaison to EH&S.

e. Principal Investigators and **Laboratory Managers** have overall responsibility for chemical hygiene in their laboratories. Each will develop and implement standard operating procedures (Appendix C 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 Safety Data Sheets (SDS) 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.

f. 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 I).

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:

- Environmental Health and Safety;
- Departmental Representative's Office;
- Each laboratory covered by this CHP.

Alternatively, the CHP can be accessed directly on the **EH&S** web site at https://www.fit.edu/office-of-environmental-health-and-safety/. 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 Florida Tech's Radiation Safety Plan. Laboratories using Lasers designated Class II or above must also contact the Radiation Safety Officer. 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 and may be subject to specific committee approval. Contact **EH&S** for details.

5 Components of a Chemical Hygiene Plan

'The Laboratory Standard' specifies that eight elements be addressed 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. Standard operating procedures and practices;
2. Control measures to reduce worker exposures against hazardous chemicals;
3. Fume hoods and other protective equipment are functioning properly and adequately;
4. Employee information and training (including emergency procedures) are provided;
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.

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 **CHO/EH&S** with questions about adapting this CHP to a laboratory area. See also Appendix C Standard Operating Procedures for more information.

6 Basic Safety Practices

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 C Standard Operating Procedures).

a. Accidents and Spills

Eye Contact: Immediately flush eyes with water for a minimum of 15 minutes while holding eyelids open. If 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 National Capital Poison Center at 1-800-222-1222 for emergency response information for the specific compound ingested. Seek medical attention immediately. The 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 discontinue 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 without proper PPE and emergency response training. Well-intentioned rescuers have often become a victim as well in these situations.

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

[1] Adapted from the National Research Council's, "Prudent Practices in the Laboratory: Handling and Disposal of Chemicals," National Academy Press, Washington, DC, 2011.

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 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 I.

b. 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.

c. 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 (see the https://www.fit.edu/office-of-environmental-health-and-safety/ under Waste Minimization Plan. 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 Florida Tech Hazardous Waste Procedures (see Appendix D Hazardous Materials Manual).

d. Shipping and Receiving Hazardous Materials

Shipping and receiving hazardous materials shall be done in accordance with Appendix F Hazardous Materials Shipping/Receiving Guide. 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 321-674-7715 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.

e. 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.

OSHA's general requirements for compressed gas cylinders can be found in 29 CFR 1910.101, which incorporates by reference the Compressed Gas Association's Pamphlets C-6-1968, C-8-1962, and P-11965. These pamphlets describe the procedures for inspecting, handling, storing, and using compressed gas cylinders. The National Fire Protection Association also provides guidance on the management of cylinders in **NFPA 55**: Compressed Gases and Cryogenic Fluids Code, which is incorporated by reference into the Uniform Fire Code. Safety procedures that must be followed when handling, storing, and transporting compressed gas cylinders are summarized below:

- Cylinders must be clearly labeled with their contents.
- Regulators must be compatible with the cylinder contents and valve.
- Cylinders must be secured in an upright position by corralling them and securing them to a cart, framework, or other *fixed object* by use of a restraint.
- Cylinders must be stored in a cool, well-ventilated area away from ignition and/or heat sources.
- When not in use, cylinders must always be capped.
- Cylinder carts must be used to transport cylinders, and cylinders must be capped and properly secured during transport.
- Cylinders containing flammable gases must not be stored near oxidizers (minimum 20 ft. separation).
- Cylinders must not be stored near corrosives.
- Cylinders must be stored away from doors and exits.

All cylinders (new, used, or empty) must be secured at all times. Chains or belts must be used with properly tightened clamps or wall mounts to secure cylinders that are not otherwise secured on carts, or in cylinder cages. Restraints must be kept tight at all times, with no appreciable amount of slack. Do not store gas cylinders in the hallway.

The use of disposable or lecture size cylinders is strongly discouraged. If special circumstances warrant the use of these types of cylinders, the Principal Investigator/Lab Manager is responsible for contacting **EH&S** for disposal of these types of cylinders.

Although cryogenic liquefied gases (e.g. liquid nitrogen) are generally not stored under pressure, laboratory personnel must become familiar with the special hazards associated with the use of these gases. Contact **EH&S** for additional information.

f. General Laboratory Safety Guidelines

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

(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 chemicals 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.

(2) General Housekeeping and Apparel

Keep the work area clean and uncluttered, with chemicals and equipment being 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. Always wear appropriate closed toed shoes in the laboratory.

(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.

(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.

(5) Working Alone

Avoid working alone in a building or off-site. Prior approval from the Principal Investigator is required before working alone in a laboratory as well as informing the Florida Tech Security 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) Children Prohibited

Minor children (under 18 years of age) are not allowed into any chemical, biological or radioactive materials laboratory at Florida Tech unless the minor child is participating in a program of study at Florida Tech 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 Florida Tech, such as a building tour or field trip.

g. Planning Operations

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

- Develop Standard Operating Procedures (see Appendix C).
- Seek information and advice about hazards.
- Review all applicable SDSs before handling chemicals.
- Plan appropriate safety procedures.
- Plan positioning of equipment before beginning any new operation.
- Locate emergency supplies and exits.
- 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.

h. Waste Disposal

Standard Operating Procedures (see Appendix C) 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 annual Hazardous Waste Management Training. Hazardous wastes must be properly containerized, labeled and stored. Contact EH&S for pick up and disposal of hazardous wastes. Hazardous Waste Disposal Procedures for the Florida Tech are outlined in the **Hazardous Materials Manual** (found in Appendix D).

i. 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 Appendix J – Forms and Checklists for recommended form.)

j. Security

Florida Tech is an open campus – which means anyone can walk-in off the public street and into a laboratory space: When authorized laboratory personnel are not present, each laboratory must be kept locked with doors closed, even if it is only for a short period of time. Depending on the type of work performed in a laboratory, it may always be prudent to keep that laboratory locked. 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 by 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.

a. Exposure Determination

The EH&S 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 SDSs, OSHA's "Z Tables" (29 CFR 1910.1000), and in the NIOSH Pocket Guide to Chemical Hazards.

b. 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.

(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.

(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, fumes 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 Facilities 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.

c. 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 through the use of 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.

Please look at the following location for assistance under Plans tab to the right of the webpage: Florida Tech Personal Protective Equipment & Florida Tech Personal Protective Equipment Guidelines.

(3) **Eye/Face Protection**

The PI has many responsibilities in regard to eye and face protection, including:

- Assessing the potential for eye/face injuries due to exposure to eye or face hazards from flying particles, molten metal, p-listed chemicals, acids or caustic liquids, chemical gases or vapors, or potentially injurious light radiation
- Training employees on the uses and limitations of PPE
- Providing the appropriate type of protection required
- Ensuring that the appropriate eye/face PPE is available and used by laboratory personnel.

All eye/face protection devices must meet the requirements set forth in the **ANSI Z87 standard**. Note: Additional eye/face protection standards should be consulted for welding operations (29 CFR 1910.133(a)(5)) and for laser use (**ANSI Z136**).

When evaluating the appropriate type of eye protection to use, it is important to note that more than one type of protection may be appropriate. Also, multiple layers of eye and face protection may be warranted for higher-hazard operations. During the PPE selection process, the PI should consider the following:

- Safety glasses should be upgraded to splash-resistant chemical goggles whenever pouring liquid chemicals. Chemical goggles offer a much higher degree of eye protection.

- Face shields are not to be worn alone. They must only be used as a secondary means of eye and face protection, with the appropriate primary eye protection worn underneath. For example, chemical goggles should be worn under a face shield while pouring acids.

- Goggles come in many varieties. The right type of goggle must be selected to ensure the appropriate level of eye protection is achieved. For example, vented goggles protect the wearer from flying chips and are appropriate for cutting operations; however, the vents make them less effective as splash protection.

Contact **EH&S** for additional information on the assessment of hazards, and the selection, and use of eye/face protection equipment.

(4) **Gloves**

Gloves play an important role in the safe handling of laboratory materials. Gloves must be comfortable, sufficient in length, and made of material that has the appropriate level of chemical resistance for the task to provide adequate protection. Depending on its intended use, a glove may be designed to provide dexterity, strength, low permeability, resistance to penetration by sharp objects, or protection from temperature changes. Specific information on the properties of glove materials can be found in the manufacturer's permeation guide. See Appendix G Glove Selection Chart for additional information.

(5) **Respirators**

The selection and use of respirators must be done in accordance with 29 CFR§1910.134 and Florida Tech's Respiratory Protection Plan. Respirators can only be used when it is not possible to minimize or eliminate exposure to a contaminant through other means. All individuals issued respirators must meet the criteria established in the OSHA standard and Institute Policy. These criteria include medical screening, training and fit testing. For further information, contact EH&S**.**

(6) **Lab Coats & Aprons**

The following general directions apply to both disposable and reusable lab coats and aprons, used for chemical, biological, and/or radiological protection. All laboratory clothing shall be stored in a sanitary manner in a contamination-free area of the lab. Lab coats and aprons are not to be worn while eating or drinking and should not be worn outside the laboratory except when transporting hazardous materials or moving between labs. The wearing of lab coats, aprons, or

other potentially contaminated personal protective equipment into break areas or lunch rooms is strictly prohibited.

Lab coats and aprons that are contaminated must be handled as little as possible. They must be evaluated by laboratory personnel for laundering or disposal, depending on the nature of the contamination, and bagged or containerized at the location of use. If coats or aprons are visibly wet, they should also be placed in secondary containment to prevent the spread of contamination should the plastic bag or container leak or be otherwise compromised during storage or transport. Lab coats and aprons must not be sorted or rinsed in the location of use since the process can result in the spread of contamination and/or the uncontrolled release of contaminants down the drain. Note: Rinsing areas in labs may also be unsanitary or inadequate for laundering purposes.

(5) **Disposable Lab Coats and Aprons**

Use of disposable lab coats and aprons whenever practical is strongly encouraged as these coats are low-cost and can be replaced once contaminated or otherwise soiled. Disposable, single-use coats and aprons can be placed in the trash if they have not been contaminated with chemicals, pathogens, or radionuclides.

If contaminated, lab coats and aprons shall be placed in a sealed, leak-proof, labeled plastic bag and segregated by contaminant type – chemical, radiological, or biological. Contact EH&S for pickup and disposal of contaminated, disposable lab coats, as you would with any other hazardous waste. Note: Disposable lab coats and aprons shall not be cleaned since the cleaning process can severely degrade the materials of construction, potentially allowing contamination to pass through onto clothing on reuse.

(6) **Reusable Lab Coats and Aprons Contaminated with Chemicals**

Lab coats and aprons that become contaminated with chemicals must be evaluated on a case-by-case basis. Those that are contaminated with acutely hazardous chemicals or waste shall be considered hazardous waste and must not be laundered or reused. Lab coats and aprons that have been grossly contaminated with non-acutely hazardous waste may also be designated for disposal rather than laundering, depending on the chemical nature of the contaminant(s), since laundering may spread contamination and/or result in discharge of effluent that exceeds local limits. All **lab coats and aprons** that are designated for management as hazardous waste shall be placed in a sealed, leak-proof, labeled plastic bag, placed in the lab's waste storage area, and picked up by EH&S.

Lab coats and aprons that have been contaminated due to incidental contact with non-acutely hazardous chemicals or that have become dirty from regular use can be laundered by a commercial vendor that has expertise in cleaning lab coats. Note: When a department's contaminated laundry is transported off site; the department must ensure compliance with all applicable federal, state, and municipal regulations, including labeling.

FR (Flame Resistant or Flame Retardant) Lab coats must be worn when handling Pyrophoric or extremely flammable (flashpoint <73°F) substances. These Lab coats must be cleaned by a qualified commercial vendor in order to retain the FR properties.

(7) **Reusable Lab Coats and Aprons Contaminated with Pathogens**

Universal Precautions should be observed for all lab coats and aprons that are contaminated or potentially contaminated with pathogens. Contaminated lab coats and aprons can be disposed of as biological waste; sent to a commercial vendor that has expertise in cleaning lab coats; or autoclaved, evaluated for reuse, and laundered onsite. Note: Depending on the materials of construction, the coat or apron may not be able to withstand the high temperatures of an autoclave. Also, coats or aprons that also have chemical or radiological contamination should never be autoclaved.

All **lab coats and aprons** that are designated for management as biological waste shall be placed in a sealed, leak-proof, labeled plastic biological waste bag, placed in the lab's waste storage area, and picked up by EH&S.

When staging contaminated lab coats or aprons for pickup by an outside commercial laundering service, the use of alternatively labeled or color-coded containers is required. Employees must be able to readily recognize the containers as requiring compliance with Universal Precautions. Departments must ensure that employees are provided with proper, color-coded containers that are designated for exclusive use in the transport of contaminated laundry. As with the case of chemicals, when a department's contaminated laundry is transported off site; the department must ensure compliance with all applicable federal, state, and municipal regulations, including labeling.

Biological laboratory lab coats and aprons that are dirty from regular use but otherwise noncontaminated, or those that have undergone successful autoclaving can be laundered at an approved site facility.

(8) **Reusable Lab Coats and Aprons Contaminated with Radionuclides**

As with the case of chemicals, lab coats and aprons that become contaminated with radionuclides must be evaluated on a case-by-case basis. Lab coats and aprons that become contaminated with long-lived radioisotopes (^{3}H, ^{14}C, ^{22}Na, ^{51}Cr, ^{45}Ca) shall be placed in designated, dry solids, radioactive waste containers for management as radioactive waste. Lab coats and aprons contaminated with short-lived radioisotopes (^{32}P, ^{33}P, ^{35}S, ^{125}I) shall be segregated from other radioactive waste. Contact the Radiation Safety Officer (321-674-8889) for storage of these items in designated, separate, radioactive material containers where the lab coats will be kept until the radioisotopes have been fully decayed. Once fully decayed, the lab coats can be removed and evaluated for reuse. Note: Never autoclave lab coats that are contaminated or potentially contaminated with radioactive material.

Lab coats and aprons from a laboratory that uses radioactive materials that are not contaminated, including those that have been fully decayed, surveyed, cleared and deemed reusable may be laundered by a commercial service with expertise in laundering laboratory clothing.

Departments and/or laboratories that have their own laundering facilities must ensure that the use of these facilities does not (1) result in the spread of contamination, (2) result in the uncontrolled release of chemical, biological, or radiological contamination to the environment while lab coats or aprons are being transported, or (3) send contamination down the drain that exceeds the City of Melbourne's Prohibited Discharge Standards & Local Limits. Refer to the City of Melbourne's Prohibited Discharge Standards & Local Limits provided in Appendix D and contact EH&S for additional information or clarification.

d. 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. Appendix F Chemical Storage provides additional information regarding storage time limits and chemical incompatibilities. Here are some general rules for safe chemical storage:

- Store chemicals only in secure, well-ventilated areas.
- 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.
- 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.
- 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.
- Reactive chemicals should be stored on low shelving, preferably in secondary containment in case of leakage.
- Dispose of outdated chemicals. Contact **EH&S** at hazwaste@fit.edu to dispose of outdated chemicals. An inventory of the outdated/expired chemicals should be submitted at the time of the request.
- Always keep chemicals properly labeled – relabel if a label is becoming faded or has been damaged.

- 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.

- 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.

(7) **Flammable Chemical Storage**

Flammable liquids generate vapors that can readily ignite and burn in air. The rate at which different liquids produce flammable vapors depends on their vapor pressures and temperatures. These substances should be stored separately from oxidizers and corrosive materials and in a flammable storage cabinet. Storage of flammable liquids (including waste) outside approved flammable storage cabinets and safety cans must not exceed 10 gallons per 100 square feet of laboratory space. See *Table I* for storage limitations imposed by OSHA and NFPA.

Table I Flammable and Combustible Liquid Storage Limits for Laboratories[1]

Laboratory Unit Class	Flammable or Combustible Liquid Class	*Excluding* Quantities in Storage Cabinets[2] or Safety Cans	*Including* Quantities in Storage Cabinets[3] or Safety Cans
		Maximum Quantity[3] per 100 sq. ft of Laboratory Unit	Maximum Quantity[3] per 100 sq. ft of Laboratory Unit
A[4]	I	10 gallons	20 gallons
(High Hazard)	I, II, and IIIA	20 gallons	40 gallons
B	I	5 gallons	10 gallons
(Intermediate Hazard)	I, II, and IIIA	10 gallons	20 gallons
C	I	2 gallons	4 gallons
(Low Hazard)	I, II, IIIA	4 gallons	8 gallons

[1]The information in this table was taken from the NFPA 45 standard on *Fire Protection for Laboratories Using Chemicals,* 1996.
[2]Only *Approved Storage Cabinets* as defined by NFPA 45 are allowed by **EH&S**.
[3]The maximum quantities of flammable and combustible liquids in Class B and Class C instructional laboratory units shall be 50 percent of those listed.
[4]Class A laboratory units shall not be used as instructional laboratory units.

(8) Corrosive Liquid Storage

Corrosive chemicals include strong acids and bases, dehydrating agents, and oxidizing agents. Inhalation of vapors or mists from these substances can cause severe bronchial irritation. These chemicals also erode the skin and respiratory epithelium and are particularly damaging to the eyes. Corrosive chemicals should be stored in corrosion resistant cabinets and separated from other reagents. Acids should be stored separately from bases and both should be stored separately from flammables and combustibles. Nitric acid should be stored by itself away from other chemicals whenever possible. **Never store Nitric acid with organic acids** (i.e. Glacial Acetic Acid).

(9) Oxidizing Agents

Oxidizing agents, in addition to their corrosive properties, can present fire and explosion hazards on contact with organic compounds or other oxidizable substances. Strong oxidizing agents (see *Table II*) should be stored and used in glass or other inert containers. Cork and rubber stoppers should not be used with these substances.

Table II Examples of Oxidizing Agents[1]

Gases:	Fluorine, Chlorine, Ozone, Nitrous Oxide
Liquids:	Hydrogen Peroxide, Nitric Acid, Perchloric Acid, Bromine, Sulfuric Acid
Solids:	Nitrites, Nitrates, Perchlorates, Peroxides, Chromates, Dichromates, Picrates, Permanganates, Hypochlorites, Bromates, Iodates, Chlorites, Chlorates

[1]The information in this table was taken from *Prudent Practices in the Laboratory: Handling and Disposal of Chemicals.* National Academy Press 1995.

(10) **Peroxidizable Compounds**

Peroxidizable compounds (including ethers) are a group of chemicals which become shock sensitive when they form organic peroxides. This reaction is catalyzed by changes in sunlight, temperature, and pressure. Store these compounds airtight and in their original containers, ideally with an inert gas such as nitrogen in the headspace (the area above the liquid in the bottle). Isolate these chemicals from combustible and oxidizable materials, preferably in a flammable storage cabinet. Always date peroxidizable compounds upon receipt and upon opening. See Appendix D for more information on the handling, disposal, labeling and storage time limits for peroxidizable compounds.

(11) **Highly Reactive (Shock Sensitive) Chemicals**

Highly reactive chemicals are inherently unstable and can react in an uncontrolled manner liberating heat and toxic gases, which can lead to explosion. These include shock sensitive chemicals, high-energy oxidizers, and peroxide formers. Before using these materials, safety information should be reviewed to evaluate proper storage and handling procedures. Always date highly reactive/shock sensitive chemicals upon receipt and upon opening.

The following additional procedures are recommended for handling reactive chemicals:

- Secure reaction equipment properly.
- Use impact protection (shields and guards) in addition to chemical splash protection (eye protection, gloves, laboratory coat, etc.).
- Handle shock-sensitive chemicals gently to avoid friction, grinding, and impact.

Review Appendix E for specific examples of shock sensitive chemicals as well as additional safety information.

(12) **Toxic Chemical Storage**

Toxic chemicals should be stored in accordance with general chemical compatibility guidelines. Highly toxic chemicals that can pose immediate danger to life and health upon container opening should be stored under lock-and-key. Some examples of these compounds include, but are not limited to, dimethyl mercury ($(CH_3)_2Hg$), thallium (III) oxide (Tl_2O_3), and hydrofluoric acid (HF).

(13) **Crossover Properties**

Many chemicals found in the laboratory exhibit properties common to more than one of the previously mentioned groups (for example, ether). For each chemical, one should simultaneously follow the safety guidelines for all applicable hazard groups. Contact **CHO/EH&S** for additional information about the storage of specific chemicals.

(14) **Storage of Chemicals in Refrigerators**

All refrigerators located in laboratory areas must be clearly marked as to their contents. An inventory list should be posted on the outside of the refrigerator. Refrigerators used for chemical storage must be marked **"Chemical Storage Only! No Food!"** Flammable chemicals are not to be stored in a refrigerator unless the refrigerator is specifically designed and approved for flammable storage. Refrigerators located in break rooms or lunchrooms, and which are located in the vicinity of laboratories, should be marked **"Food Storage Only! No Chemicals!"** *Refrigerators in laboratory work areas must not be used for food storage.*

(15) **Labeling**

All containers (including beakers, vials, flasks, etc.) must be labeled with their chemical content(s) and other relevant information. This includes dilute as well as stock solutions. Whenever possible, chemicals should remain in their original containers with the original labels intact. If a chemical is transferred from its original container, the new container must have the full name of the chemical, written out in English, and appropriate GHS Pictogram. Damaged or faded labels must be replaced before becoming illegible. Additional information on labeling requirements can be found in the Florida Tech Hazard Communication Plan.

e. Moving Chemicals on Campus

Whenever chemicals are moved between labs or storage rooms in the same building, between buildings, or even across campus, the use of secondary containment or overpacking is required as an added safety precaution. Both secondary containment and overpacking help mitigate the adverse effects of a spill or an in-transit container failure by reducing the likelihood of environmental releases and the probability and severity of exposure to harmful chemicals. For those chemicals which are immediately dangerous to life and health (IDLH) when spilled, overpacking is required. When practical, additional secondary containment may also be used in conjunction with overpacking to provide an added level of protection.

Note: For the purposes of this section, secondary containment refers to open top bins, pails, containers, trays, etc. that are moved in an upright position. Overpacking refers to closed top/encapsulating packaging that can hold its contents even if tipped over.

(16) **Secondary Containment**

The form of secondary containment that is most widely used at the University consists of durable plastic bins. This baseline level of containment is required when moving liquid chemicals and is strongly recommended when moving solid chemicals as well. Solid chemicals may also be moved in cardboard boxes of rigid construction that have completely closed and properly sealed bottoms. For compressed gases contained in lecture bottles, plastic pails serve as an adequate baseline level of containment. Secondary containment is not used for large DOT-approved compressed gas cylinders. Guidance for transporting DOT cylinders can be found in the Compressed Gas Cylinder Section of this CHP.

In all cases, the secondary containment selected must be constructed of material that is compatible with the chemical(s) being moved. The secondary containment must also be strong enough to hold all containers without excessive flexure and must have enough volume to hold the contents of all containers without overflowing in the event of container failure. As needed, spill pads, cardboard inserts, or bubble wrap can be used to prevent bottles from bumping together while being moved. This practice helps minimize the potential for bottle breakage.

(17) **Overpacking**

Overpacking is the practice of placing a chemical container within a larger, often padded, sealable container to increase the level of protection in the event of a spill or container failure while being moved. The original DOT-compliant packaging, used to ship the chemical on initial purchase, can always be used as an overpack as long as the outer packaging is in good condition and includes all original inner packaging materials, such as plastic liners, absorbent materials, foam padding, etc. A basic overpack consisting of a larger sealable container, of construction compatible with the chemical being moved, and packed with spill pads, is easily made and effective for most chemicals when the original vendor packaging is unavailable, incomplete, or damaged.

In order to better understand when overpacking is required, the degree of severity of the hazard posed while moving a chemical must be fully understood. The degree of severity of a hazard is a function of a chemical's hazard classification, amount being moved, and relative concentration in mixtures or solutions. Note: Consideration must also be given to the route traveled, weather conditions (if moving chemicals outdoors between buildings), and potential for the presence of other people along your chosen path. Since these three factors are situation and location-specific, they are left to the responsible individual, tasked with moving chemicals, to evaluate on a case-by-case basis.

A decision tree has been included as Appendix L of this CHP. This tool can be used to determine the specific type of overpacking needed for the different hazard categories. If you have any questions or require further assistance, contact CHO/EH&S at hazwaste@fit.edu.

(18) **Hazard Classification**

The safety data sheet (SDS) for a chemical can be a valuable tool in evaluating the need for overpacking. Section 2, "Hazards Identification," of GHS-compliant SDSs provides the GHS hazard classifications and category numbers for all pertinent chemical(s) of concern. Under the GHS system,

the lower the hazard category number, the higher the hazard. As a general rule of thumb, as the GHS hazard number decreases, the need for additional care while moving chemicals and the necessity for overpacking both increases. Any chemical that is IDLH: explosive/shock sensitive, pyrophoric, water reactive or a strong lachrymator requires overpacking. Those chemicals that have a GHS hazard category of 1 for the following hazard classifications are also considered IDLH and require overpacking:

- Acute toxicity (any route – inhalation, skin absorption, ingestion, or injection)
- Skin corrosion
- Serious Eye Damage

For those chemicals that are GHS hazard category of 2 or 3, overpacking may be appropriate as an added level of protection beyond the baseline practice of using secondary containment. This determination needs to be made on a case-by-case basis and depends on the amount being moved and concentration. GHS hazard category 4 or 5 chemicals do not typically require overpacking; however, they can be overpacked, for added protection, at the discretion of the responsible decision maker, principal investigator, or lab manager.

(19) **Amount Being Moved**

The amount of chemical being moved can also have an impact on the need for overpacking. Generally, moderate hazard chemicals (with a GHS hazard category of 2 or 3) will not require overpacking if moved in limited quantities, as long as secondary containment is used. If larger amounts of chemicals are to be moved, overpacking should be considered to increase the overall level of protection.

A good example in considering amount as a deciding factor can be found with a chemical such as hexane. Hexane has a hazard category of 2 or 3 for all relevant GHS hazard classifications. When a small bottle of hexane is to be moved, secondary containment is usually adequate. When several 4-liter bottles of hexane are to be moved, overpacking is strongly recommended. In this case, the shipper's original packaging, or a liquid tight container(s) padded with spill pads would both be appropriate.

(20) **Concentration**

The concentration of a chemical in a solution also plays a significant role in determining the need for overpacking. For those chemicals with a GHS hazard category of 1 that are in solution, concentration is almost directly proportional with the need for overpacking, *i.e.* as concentration increases, so does the necessity of overpacking prior to moving chemicals from place-to-place.

A classic example of how concentration affects the need for overpacking can be found with a chemical such as hydrochloric acid (HCl). Fuming HCl (>37% by volume) has a hazard category of 1 for both serious eye damage and skin corrosion. When the concentration is decreased to 0.1M, the skin corrosion hazard significantly decreases and the hazard category of 1 only remains for serious eye damage. When HCl concentration is further reduced to 0.01M, HCl no longer has a hazard category of 1 for any hazard classification. Fuming HCl should always be overpacked, in

the shipper's original packaging or wrapped in spill pads and placed in a larger sealable jar of compatible construction, when moved. The dilute 0.01M HCl solution would require no overpacking and can be moved like any other low- to moderate-hazard liquid in a plastic secondary containment bin.

The chart below is provided as a general guide to better understand when secondary containment and overpacking should be used. Contact CHO/EH&S at hazwaste@fit.edu if further assistance is required.

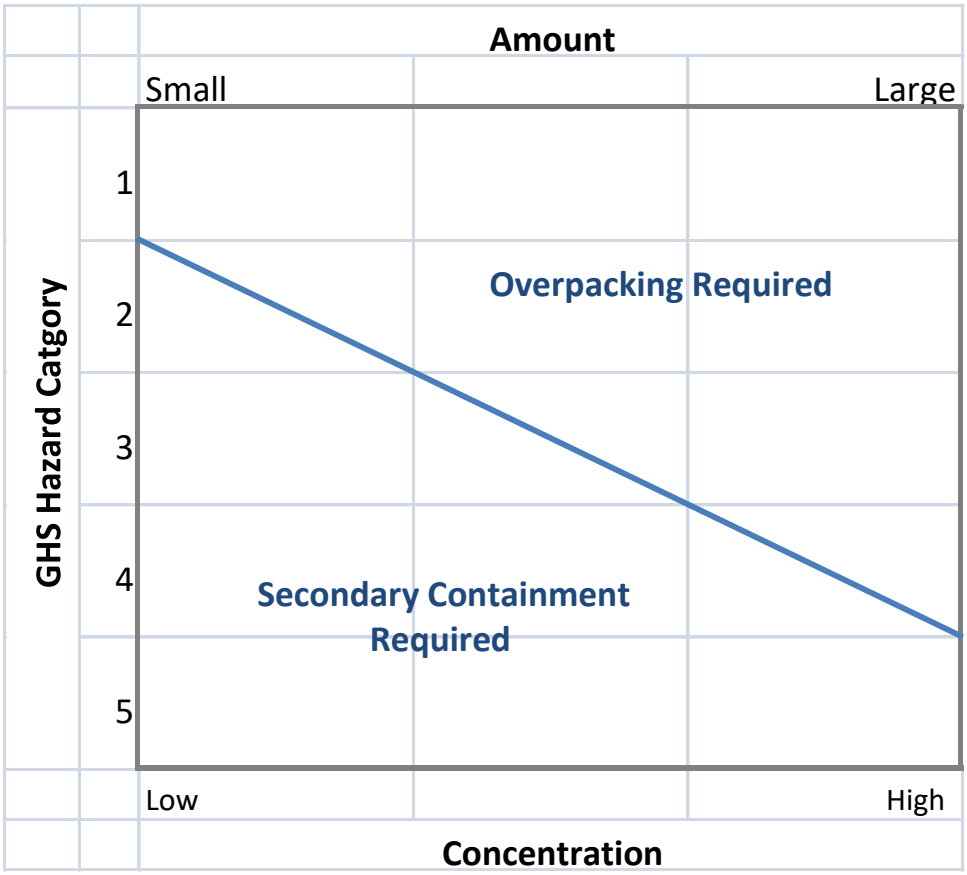


Chart I: Secondary Containment v. Overpacking

f. Shipping of Hazardous Materials

To assure the safe transport of hazardous materials, the Florida Tech *must* comply with the United States DOT Hazardous Materials Regulations (49 CFR §171-180). These regulations cover the shipping and transport of hazardous materials such as infectious substances, toxins, flammables, and explosives. They also contain specific packaging and labeling requirements and require that all individuals who ship hazardous materials be trained in the proper packaging, labeling, and shipping of such goods.

Hazardous Materials are defined as, "substances or materials that are capable of posing a significant risk to health, safety, or property when transported." Florida Tech employees may not be involved

in the shipping of hazardous materials, *unless* they have received training, which enables them to properly pack and label hazardous materials and to correctly complete the required shipping papers. Laboratories shipping hazardous chemicals must also provide a Safety Data Sheet to outside entities who will receive the hazardous chemicals. Contact EH&S for assistance in shipping hazardous materials off campus, or to obtain the required training (See Appendix E Hazardous Materials Shipping/Receiving Guide).

g. 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 Facilities. 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 under 7. Fume hood).

Fire suppression systems such as those located in a spray booth require semi-annual inspection and certification from a licensed service contractor. This normally done by a company that specializing in fire system support or fire extinguisher inspections and maintenance.

Malfunctioning eyewash/safety showers and fume hoods should be reported immediately to Facilities. If the safety equipment is not repaired promptly, please contact 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 I Hazardous Materials Emergencies and Spills. Emergency contact numbers can also be found in Appendix I.

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 Appendix K: Diagrams of Local Exhaust Devices.

a. General Purpose Hoods

These hoods are used for laboratory work with materials that do not require special handling procedures. A general-purpose fume hood can be one of four types: (1) Conventional Hood, the basic hood with a movable sash and baffle. This hood is generally the least expensive and its performance depends mainly on the position of the sash. (2) By-Pass Hood designed to allow some exhaust air to "by-pass" the face of the hood even when the sash is closed. It is designed for use with sensitive and fragile apparatus and/or instruments. (3) Auxiliary Air Hood designed to introduce outside air into the hood and limit the amount of room air that is exhausted. (4) Variable Air Volume (VAV) Hood, designed to regulate the hood exhaust and keep the air velocity at a predetermined level.

b. Special Purpose Hoods

Certain research activities involve the use of substances that can create dangerous conditions or have clearly defined health hazards. These activities will require specially designed fume hoods to deal with these unique conditions. The most common special purpose fume hoods are perchloric acid and radioisotope fume hoods.

(1) **Perchloric Acid Fume Hoods**

Procedures with perchloric acid must never be done in a regular fume hood. Special perchloric acid hoods must be used, except in the case of the infrequent use of small quantities of perchloric acid. In this case, a regular fume hood may be used; however, perchloric acid vapor must be trapped and scrubbed prior to release.

Perchloric acid hoods are generally made of non-corrosive materials (stainless steel) and are equipped with a water wash down mechanism in the ductwork. Perchloric acid fume hoods must be clearly labeled and used only for perchloric acid or other mineral acids, such as nitric, hydrochloric, and hydrofluoric. **No organic solvents should be stored or used in these hoods**. When perchloric acid is heated above ambient temperature, vapor is formed which can condense in the ductwork and form explosive perchlorates. After each use, the fume hood operator shall wash down the hood and ductwork with water.

(2) **Radioisotope Fume Hoods**

Any research activity involving volatile radionuclides must be done in a fume hood appropriate for such activities and must meet the requirements set forth by the Florida Tech Radiation Safety Officer (RSO). These requirements include, but are not limited to, the following:

- Certification before procedures begin and at routine intervals thereafter, not to exceed one year
- Establishment of a minimum flow rate of 100 linear feet per minute (lfpm) across the sash opening of the fume hood with a minimum face area of four-square feet.
- Operation twenty-four hours per day, 365 days per year for those hoods used with tritium or radioiodine.

- Thyroid bioassays are required for individuals working with volatile I125 in quantities greater than 1mCi.

Maintenance of a Use Log for each radioisotope fume hood is required to assure that the established release limits are not exceeded.

c. General Safety Practices for Fume Hoods

- Fume hoods are *not* designed for storage. Items (equipment, chemicals, etc.) within the fume hood should be minimized as they can reduce fume hood performance. Remove all items not required for procedures in progress.

- Fume hoods should be equipped with "Magnehelic" gauges or flow meters with low flow alarms to ensure that the hoods are functioning properly. In the absence of gauges or meters, a convenient test method is to use a tissue paper streamer attached to the bottom of the sash.

- All work should be at least six inches behind the plane of the face (sash opening) of a fume hood.

- Any items within a hood must not obstruct the baffle openings or impede airflow at the face of the fume hood.

- Fume hoods should be operated with sashes lowered whenever possible.

- Fume hood baffles are set to exhaust equally from the top, middle, and bottom zones of the hood. Baffle adjustments should only be made after consultation with EH&S.
- Fume hoods may fail for a variety of reasons. Lab personnel should have a contingency plan for hood failure to prevent development of hazardous conditions, and to avoid interruptions in laboratory use.

9 Biosafety Cabinets and Laminar Flow Hoods

a. Biosafety Cabinets

The Biological Safety Cabinet (BSC) is another primary engineering control in the laboratory. It is commonly used as a containment and protection device in laboratories working with biological agents. The major functional element of a BSC is its ability to create a near-sterile environment through the use of High Efficiency Particulate Air (HEPA) filters. The size, location, and placement of these filters will determine the class and function of a biological safety cabinet.

There are three different classes of BSCs which are not directly related to the Biological Safety Levels (BSLs) required for the microbiological agent being used. Generally, Class I and Class II cabinets can be used for work at BSLs 1 to 3. Class III cabinets are usually reserved for work at BSL4, although a Class II cabinet can be used at this level if the appropriate personal protective equipment is used.

(1) **Class I Biosafety Cabinet**

A ventilated cabinet for personnel and environmental protection, with non-recirculated inward airflow away from the user. The cabinet exhaust air is HEPA filtered before it is discharged to the outside atmosphere. This cabinet resembles a chemical fume hood with a filtered exhaust and is suitable for work with low and moderate risk biological agents where no product protection is required.

(2) **Class II Biosafety Cabinet**

A ventilated cabinet for personnel, product and environmental protection having (1) an open front with inward airflow for user protection, (2) downward HEPA-filtered; laminar airflow for product protection, and (3) HEPA- filtered exhausted air for environmental protection. Class II cabinets are suitable for low- and moderate-risk biological agents.

There are four recognized types of Class II biosafety cabinets that are widely used. These are Class II types: A1, B1, B2, and B3. The nature of the particular research operation, the characteristics of a laboratory's exhaust system, and the mandated regulations will determine which type of Class II cabinet can be used. Contact **EH&S** for more specific information.

(3) **Class III Biosafety Cabinet**

A totally enclosed ventilated cabinet of gas-tight construction. Operations in the cabinet are conducted through attached rubber gloves. The cabinet is maintained under negative air pressure of at least 0.5 inches (12.7 mm) water gauge. Supply air is drawn into the cabinet through HEPA filters. The exhaust air is treated by double HEPA filtration. Class III cabinets are suitable for high-risk biological agents and are accompanied by auxiliary safety equipment.

b. Laminar Flow Hoods

The term "laminar flow" describes the air purifying action of these hoods because they provide a directed, nonmixing 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.

c. Materials, Designs and Construction

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

d. Performance, Inspection and Certification

Every new BSC must be performance tested by the manufacturer according to the requirements listed in the **NSF Standard**. BSCs convertible from one type to another should

be performance tested in each mode. Field certification by authorized individuals or companies should include, but not be limited to, the following testing procedures (described in **NSF Standard 49**):

- Soap Bubble/Halogen Leak
- HEPA Filter Leak
- Velocity Profile
- Vibration sensitivity
- Noise level
- Airflow Smoke Patterns

In addition, each BSC must have a certificate of inspection that should include, but not be limited to, the date of certification, the name of the person who performed the inspection, and the date for the next inspection. **Certification of biosafety cabinets must be done annually, whenever relocated, or if a problem is suspected.**

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.

All federal (OSHA; EPA; NRC etc.) required Florida Administrative Code safety training must be done.

a. Employee Information

Laboratory workers will be informed of, and provided access to the following:

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 SDSs, for hazardous chemicals.

b. 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.

c. Information and Training Responsibilities

To satisfy the information and training requirements outlined above; laboratory workers must receive Laboratory Safety and Hazardous Waste Management training at a minimum. CHO/EH&S will provide these trainings to departments upon request and as otherwise scheduled. 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. All risk must be properly mitigated.

Table III Activities and Approving Bodies

Activity	Approving Body
Research grant proposals involving hazardous chemicals[A], radioisotopes, lasers	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 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 worktime must be documented. Persons responsible for the affected individual(s) must complete the appropriate report. (See Florida Tech 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 Florida Tech'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 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 Florida Tech's 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 N: 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:

- Abiding by good industrial/chemical hygiene practices (i.e., no eating, drinking, or tobacco products, wash hands, use of proper PPE, etc.).
- Properly handling and storing waste.
- 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 C of this document to complete their SOPs. Contact **EH&S** with additional questions or concerns.

a. Guidelines for Handling Some Specific Hazardous Chemicals

The guidelines that follow, taken from Appendix C of '**the Laboratory 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**.

(1) **Allergens and Embryotoxins**

Allergens (diazomethane, isocyanates, and dichromate's) can produce varying degrees of symptoms in the body depending upon individual susceptibility. Lab workers should wear suitable PPE (gloves, lab coats, safety glasses, respirators, etc.) to prevent hand contact with allergens or substances of unknown allergenic activity.

Embryotoxins (organomercurials, lead compounds, formamide) can have degenerative and toxic effects on developing embryos. Women of childbearing age must handle these substances only in a glove box or hood with satisfactory performance. They must also use appropriate protective apparel (gloves, lab coats, etc.) to prevent skin contact.

In addition to these guidelines, the following practices should be instituted when working with allergens and embryotoxins:

- Review the use of these materials with the research supervisor. Review procedures annually or whenever a procedural change is made.
- Store these substances in an unbreakable secondary container, properly labeled, and in an area that is secured (capable of being locked) and adequately ventilated.
- Notify supervisors of all incidents of exposure or spills. Consult a qualified physician when appropriate.

(2) Chemicals of Moderate Chronic or High Acute Toxicity

Certain chemicals have been identified as causing acute and/or chronic health effects. Substances of high acute toxicity cause *immediate* health effects at very low concentrations. Some examples of chemicals with high acute toxicity include the gases hydrogen cyanide, phosgene, and arsine. Substances that have moderate chronic toxicity may cause adverse health effects after repeated exposure over a period of time. These may include carcinogens, teratogens, mutagens, and sensitizers. These supplemental rules should be followed in addition to those for allergens and embryotoxins:

- *Aim*: To minimize exposure to these toxic substances by any route using all reasonable precautions.

- *Applicability*: These precautions are appropriate for substances with moderate chronic or high acute toxicity.

- *Location*: Use and store these substances only in areas of restricted access with special warning signs.

- *Containment*: Always use a hood (previously evaluated to confirm adequate performance with a face velocity of at least 100 linear feet per minute) or other containment device for procedures which may result in the generation of aerosols or vapors. Trap released vapors to prevent their discharge.

- *Personal protection*: Avoid skin contact by use of gloves and long sleeves (and other protective apparel as identified in the SDS or other safety document). Always wash hands and arms immediately after working with these materials.

- *Records*: Maintain records of the amounts of these materials on hand, amounts used, and the names of the workers involved.

- *Prevention of spills and accidents*: Be prepared for accidents and spills. Assure that at least two people are present at all times if a compound in use is highly toxic or of unknown toxicity. Store breakable containers of these substances in chemical resistant trays. Work (including instrumentation areas) and storage areas should be covered with removable, absorbent, plastic backed paper.

    - If a major spill occurs outside the hood, evacuate the area. Contact **EH&S** as soon as possible. Cleanup personnel must wear suitable protective apparel and equipment.

- *Waste*: Thoroughly decontaminate/dispose of containers, labware, and contaminated clothing or shoes in accordance with directions from **EH&S**. Store contaminated waste in closed, properly labeled, impervious containers. Ensure that absorbent material is used to prevent breaking of containers and to absorb any leakage. All materials used must be compatible with the chemicals in the container.

(3) **Chemicals of High Chronic Toxicity**

These chemicals can produce severe chronic effects in very low doses. Some examples include dimethylmercury and nickel carbonyl, benzo-a-pyrene, and N-nitrosodiethylamine.

Further supplemental rules to be followed, in addition to all those mentioned above, for work with substances of known high chronic toxicity (in quantities above a few milligrams to a few grams, depending on the substance as identified in an SDS or other safety document, include the following:

- *Access*: Conduct all transfers and work with these substances in a "Designated Area." A Designated Area is a restricted access hood, glove box, or portion of a lab, designated for use of highly toxic substances. Make sure all people with access are aware of the substances being used and of the necessary precautions.

- *Approvals*: Prepare a plan for the use and disposal of these materials and obtain **EH&S** approval.

- *Non-contamination/Decontamination*: Protect vacuum pumps against contamination by scrubbers or HEPA filters and vent them into the hood. Decontaminate vacuum pumps or other contaminated equipment, including glassware, in the hood before removing them from the Designated Area.

    - Decontaminate the Designated Area before normal work is resumed there, based on guidance from **EH&S**, SDS, and/or other sources of information.

- *Exiting*: On leaving a Designated Area, remove any protective apparel (placing it in an appropriate, labeled container) and thoroughly wash hands, forearms, face, and neck.

- *Housekeeping*: Use a wet mop or a vacuum cleaner equipped with a HEPA filter. Avoid dry sweeping powder if the substance was toxic.

- *Medical surveillance*: If using toxicologically significant quantities (as identified by SDS or other source of safety information) on a regular basis (e.g. 3 times per week), consult a qualified physician concerning regular medical surveillance. If medical surveillance is recommended, consult with **EH&S**.

- *Records*: Keep accurate records of the amounts of these substances stored and used, the dates of use, names of users, and disposal records.

- *Signs and labels*: Assure that the Designated Area is conspicuously marked with warning and restricted access signs. Keep all containers appropriately labeled with chemical name and hazard, i.e. "Toxic or Poison."

- *Spills*: Assure that contingency plans, equipment, and materials to minimize exposures of people and property in case of accident are available.

- *Storage*: Store containers of these chemicals only in a ventilated, limited access area in appropriately labeled, unbreakable, chemically resistant, secondary containers.

- *Glove boxes*: For a negative pressure glove box, ventilation rate must be at least 2 volume changes/hour and pressure at least 0.5 inches of water (gauge). For a positive pressure glove box, thoroughly check for leaks before each use. In either case, trap the exit gases or filter them through a HEPA filter and then release them into the hood exhaust. HEPA filters must be evaluated and replaced as necessary by competent laboratory staff. Filters must be disposed of in accordance with hazardous waste regulations. Contact **EH&S** for additional information.

- *Waste*: Use chemical decontamination whenever possible; ensure that containers of contaminated waste (including washings from contaminated flasks) are transferred from the Designated Area in a secondary container under the supervision of authorized personnel.

(4) Working with Perchloric Acid

Perchloric acid solutions shall not be evaporated or heated unless the process takes place in a designated perchloric acid fume hood. These special fume hoods are designed in such a way as to allow systematic wash downs with water after using perchloric acid. The evaporation of perchloric acid leads to the formation of highly explosive anhydrous perchloric acid being deposited on the surfaces of ducts. Additionally, evaporated perchloric acid can form equally explosive metallic perchlorate compounds in ductwork.

Florida Tech laboratories lack fume hoods specifically designed for the use of perchloric acid; therefore, use of perchloric acid, when solutions are evaporated or heated, is not permitted, with one exception. In the case of infrequent use of small quantities of perchloric acid, hoods not specifically designed for use with perchloric acid may be permitted to be used if the vapors are trapped and scrubbed prior to release into the hood. Notify EH&S before performing this work.

(5) Conducting Procedures with Hydrofluoric Acid

Hydrofluoric acid (HF) is a corrosive material that is dangerous even at low concentrations (50-250ppm) and brief exposure times. Skin contact causes serious skin burns which may not be immediately apparent or painful since HF interferes with nerve function, initially blocking pain. Symptoms may be delayed 8 hours or longer, resulting in deep acid penetration and severe burns. The fluoride ion readily penetrates the skin causing destruction of deep tissue layers and bone. Systemic fluoride poisoning has been associated with sudden death due to cardiac arrest, which can occur with burns to as little as 2.5% of body surface area. Inhalation of HF vapor may cause ulcers of the upper respiratory tract and can also lead to systemic fluoride ion poisoning.

HF should be used in an operational chemical fume hood. In addition to a chemical fume hood, customary PPE including an apron or lab coat, close-toed shoes, goggles, and nitrile gloves, a full-face shield and heavy neoprene over-gloves are required. HF is usually stored in polypropylene containers since it attacks glass and other silicon containing compounds. **NOTE**: HF reacts with silica to produce silicon tetrafluoride, a poisonous, corrosive gas known to cause pneumonitis and pulmonary edema. Older polypropylene containers can become brittle or start to bubble. If such a container is found, contact EH&S immediately. If concentrated HF contacts the skin call 911 immediately and inform medical personnel that a hydrofluoric acid exposure has occurred; also, inform EH&S of the exposure incident.

Labs using hydrofluoric acid must have a supply of either calcium gluconate gel (preferred), or a 10% W/V calcium gluconate solution on hand as an antidote. Topical applications of the gel or solution should be applied frequently and liberally while the victim is awaiting further medical attention. Contact **EH&S** for more information.

(6) **Nanomaterials**

Anyone who uses nanomaterials in research may potentially be exposed to resultant nanoparticles through inhalation, dermal contact, or ingestion, depending upon how nanomaterials are used and handled. Although the potential health effects of such an exposure are not fully understood, scientific studies indicate that at least some of these particles are biologically active, may readily penetrate intact skin, and have produced toxicologic reactions in the lungs of exposed animals.

It is important to note that the properties of engineered nanomaterials differ substantially from those of the same material in bulk or macro-scale form. Properties that may be important in understanding the toxic effects of nanomaterials include particle size and size distribution, agglomeration state, shape, crystal structure, chemical composition, surface area, surface chemistry, surface charge, and porosity.

Research involving the use and/or development of nanomaterials may carry with it the following potential health risks:

- Toxicity of nanoparticles is likely greater than that of the same mass of larger particles.
- Granulomatous pneumonia, fibrosis and other nonmalignant respiratory diseases could result from exposure to nanoparticles.
- Exposure to metal and metal oxide nanoparticles could result in DNA damage.
- Certain nanoparticles may be human carcinogens.

Prior to working with nanomaterials, implement appropriate control measures, and develop SOP(s). Laboratory best practices must also be observed to effectively minimize or eliminate exposure to nanoparticles. There may be specialized engineering controls required for such work. Notify EH&S if you plan to use nanomaterials.

15 APPENDIX A
REFERENCES

Florida Tech 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., 2011.

"Flammable and Combustible Liquids Code"; NFPA Standard 30, National Fire Protection Association, Quincy, MA, 1993.

City of Melbourne, Florida, Prohibited Discharge Standards & Local Limits.

“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.

16 APPENDIX B

DEFINITIONS

Chemical Hygiene Officer (CHO)
Has the responsibility as defined in the OSHA Laboratory Standards and the Florida Tech Chemical Hygiene Plan, to implement the Chemical Hygiene Plan thus ensuring compliance with the regulatory requirements and maintaining a safe work environment.

Chemical Hygiene Plan (CHP)
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 chemicals" occurs. It is a workplace where relatively small quantities of hazardous chemicals are used on a non-production basis.

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

Laboratory-type hood (chemical fume food)
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 usage of hazardous chemicals
The handling or use of such chemicals in which all 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.

17 APPENDIX C

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.” Contact **EH&S** for assistance in developing appropriate SOPs.

APPENDIX C – Continued
SOP Format

Sect. 1. Process, Hazardous Chemical, or Hazard Class - circle one.

Sect. 2. 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. 3. Potential Hazards - Describe the potential hazards for each process, hazardous chemical or hazard class. Include physical and health hazards. Consult SDS and other chemical literature.

Sect. 4. 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 Florida Tech's Respiratory Protection Program. Contact EH&S for more information**.

Sect. 5. 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. Such equipment must be approved for use by EH&S as to effectively mitigate the hazard.

ect. 6. 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. 7. 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. 8. 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. 9. Waste Disposal Procedures - Indicate how wastes will be disposed. Include the name of the person responsible for managing laboratory waste. See also Appendix F Chemical Storage.

Sect. 10. 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. NOTE: these were formerly know as “Material Safety Data Sheets (MSDS)”.

Sect. 11. Principal Investigator/Lab Manager Approval – Sign and date to indicate the SOP has been approved.

Example Standard Operating Procedure

Location: _____ Principal Investigator: _____ Date: _____

Section 1. Process, Hazardous Chemical, or Hazard Class – circle one.

Section 2. Describe Hazard Class- Concentrated inorganic acid solutions. Examples are hydrochloric and sulfuric acids

Section 3. 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 4. 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 5. 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 6. 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 7. 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 321-674-7715 or campus security at 321-674-8111. Restrict people from entering the affected area until cleanup is completed.

Section 8. 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 9. 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 at ehs@fit.edu or call EH&S at 321-674-7715.

Section 10. Safety Data Sheets Locations- are kept in a binder labeled SDS in room___, or may be found on the web through: at either https://www.fit.edu/office-of-environmental-health-and-safety/safety-data-sheet-information.

Section 11. Principal Investigator/ Lab Manager Approval:

Signature: _____ Date: _____

Standard Operating Procedure

Location: _____ Principal Investigator: _____ Date: _____

Section 1. Process, Hazardous Chemical, or Hazard Class - circle one.

Section 2. Describe Process, Hazardous Chemical, or Hazard Class.

Section 3. Potential Hazards

Section 4. Personal Protective Equipment

Section 5. Engineering Controls

Section 6. Special Handling and Storage Requirements

Section 7. Spill and Accident Procedures

Section 8. Decontamination Procedures

Section 9. Waste Disposal Procedures

Section 10. Safety Data Sheet Locations

Section 11. Principal Investigator/Lab Manager Approval:

Signature: _____

Date: _____

18 APPENDIX D
HAZARDOUS MATERIALS MANUAL

1. Purpose

The purpose of this policy is to provide Florida Tech faculty, staff, and students with guidance in the safe and proper storage, handling and disposal of Hazardous Materials. While this document does not cover all regulatory requirements concerning the handling, storage and disposal of hazardous materials, it provides the basic information necessary for most laboratories to comply with applicable regulations. Additional information is available in the references listed in Appendix A. Contact Environmental Health & Safety (EH&S) for help in accessing the references.

2. Definition of Hazardous Materials

A hazardous material is a substance capable of producing harmful physical or health effects. Harmful physical effects include: fire, sudden release of pressure, explosion, and other violent reactions. Harmful health effects include: acute conditions and chronic conditions. Acute conditions develop soon after an over-exposure to hazardous materials and include: burns, rashes, respiratory distress, convulsions, and possibly even death. Chronic conditions develop after long term exposure to hazardous materials and include; cancers, nervous system disorders, and damage to other organ systems.

3. Classification of Hazardous Materials

To safely handle and store hazardous materials, it is important to know the hazards. The hazards of most materials fall into one or more of the following classifications:

Flammable Liquid

Generally, any liquid that produces enough vapor at a temperature less than or equal to 140 ^{o}F (60.0 ^{o}C) to ignite when exposed to an ignition source. In the United States, the legal definition of a flammable liquid has different meanings from agency-to-agency as follows:

- DOT defines a flammable liquid as any liquid having a flash point of not more than 141 °F (60.6 °C), or any material in a liquid phase with a flash point at or above 100 °F (37.8 °C) that is intentionally heated and offered for transportation.

- OSHA defines a flammable liquid as any liquid having a flashpoint below 100 °F (37.8 °C), except any mixture having components with flashpoints of 100 °F (37.8 °C) or higher, the total of which make up 99 percent or more of the total volume of the mixture.

- EPA uses the term “ignitable” rather than flammable, and defines it as a liquid, other than an aqueous solution containing less than 24 percent alcohol by volume, and has flash point less than 140 °F (60 °C),

Note that a chemical might not be labeled as flammable under the auspices of OSHA; however, it may still meet the definition of flammable or ignitable as defined by DOT and EPA, respectively.

Combustible Liquid
Any liquid which has a flash point between 141 °F (60.5 °C) and 200°F (93.3°C).

Flammable Solid
A substance that can cause a fire through friction, absorption of moisture or spontaneous chemical changes and, when ignited, will burn so vigorously that it creates a hazard e.g. sodium borohydride, coal, etc.

Oxidizer
A substance that readily yields oxygen or other electron acceptor to stimulate the combustion of organic matter (fuel) e.g. nitrates, permanganates, etc.

Corrosive
A liquid that corrodes steel (SAE 1020) at a rate greater than 6.35 mm (0.250 in.) per year at a test temperature of 130°F (55°C) or has a pH less than 2 or greater than 12.5 e.g. acids, bases, anhydrides, etc.

Organic Peroxide
An organic compound containing the chemical bond -0-0- (oxygen joined to oxygen).

Poison
A substance so toxic that it presents a risk to life or health.

Explosive
Any chemical compound, mixture or device that reacts or decomposes with substantial instantaneous release of gas and heat.

Compressed Gas
A substance in gas or liquid form contained in a vessel under pressure. This includes cylinders, lecture bottles, and aerosol cans. These substances may be flammable, non-flammable, or poisonous.

Cryogenics
Substances which are extremely cold such as liquid nitrogen, liquid helium and dry ice. These substances can displace air and may become asphyxiation hazards if spilled in non-ventilated areas.

Radioactive
Any material that contains atoms which are unstable and attempt to become more stable by ejecting alpha particles, beta particles, gamma rays, x-rays, neutrons, high-speed electrons, high-speed protons, and other particles capable of producing ions. Examples of radioactive waste materials include:

(1) solid waste; such as, contaminated PPE and glassware, scintillation vials, plastic ware, paper, gels, animal carcasses, and plant tissue and;

(2) liquid waste; such as, scintillation cocktails, electrophoresis gels, and discarded stock radioisotopes.

See the Florida Tech Radiation Safety Manual for specific information on the generation and proper disposal of radioactive material.

Biomedical/Biohazards

Tissues, organs, blood, and other potentially infectious material (OPIM) from humans and primates. (e.g. Syringes, needles, sharps, cultures, and other objects containing materials above).

4. Hazardous Materials Training Requirements

Laboratory personnel working with any of the mentioned hazardous materials **must** receive Laboratory Safety Training. **EH&S** provides general Laboratory Safety Training. The Principal Investigator or Lab Manager is responsible for training other lab personnel about specific hazards and Standard Operating Procedures in their areas. Federal and State regulations may require other training, such as Hazard Communication, Hazardous Waste Management and Bloodborne Pathogens. These are offered by **EH&S**. Radiation Safety, Radiation Handling, Laser Safety, X-Ray Safety training is also available. See the section Employee Information and Training for more information.

5. Storage and Handling of Hazardous Materials

Hazardous materials must be stored based on their compatibility, not in alphabetical order. Store materials of the same hazard together i.e. flammables with flammables, oxidizers with oxidizers etc. Refer to the section on Proper Storage and Handling of Chemicals in the main body of the CHP and Appendix F Chemical Storage for additional guidelines.

6. Accidents, Spills, and Emergencies

Hazardous chemical spills can be handled effectively when a plan of action has been developed. For accidents, emergencies and spill awareness and/or procedures see Appendix I Hazardous Materials Emergencies and Spills.

7. Disposal of Chemical Hazardous Materials

- Federal, state and local laws strictly regulate the disposal of hazardous materials. The disposal of any hazardous material in the sewer, on the ground or in the regular trash is illegal. See the City of Melbourne Sewer Use Policy at the end of this appendix for additional information.

- **EH&S** is responsible for collecting hazardous waste and preparing it for shipment to an approved hazardous waste disposal facility.

- Waste storage containers must be non-leaking, chemically compatible, safe, and clearly labeled with the words **"Hazardous Waste."** The label must also include the complete name(s) of the container's chemical constituents. Contact **EH&S** for pickups and include the following information: the name of the products to be picked up, the location, the person in charge of the area, a phone number, and the quantity to be picked up. Lab workers can also fill out the Waste Pickup Request Form (which duplicates this information) and send the completed form to **EH&S**.

8. Disposal of Empty Containers

- Hazardous chemical containers cannot be discarded until they are considered "empty."

- In order to be considered empty, containers holding acutely hazardous "P" waste must be tripled rinsed and the rinsate must be collected and disposed of as hazardous waste. This can create much more waste than just disposing of the container as a hazardous waste when empty. Contact **EH&S** for pickup of the container and do not put this type of container in the normal waste stream.

- Compressed gases including, non-returnable cylinders, and aerosol cans are not considered empty until they reach atmospheric pressure. **EH&S** will dispose of these types of cylinders. Empty Aerosol cans must be managed according to the requirements in the Special Waste section.

- Other hazardous chemical containers less than 110-gallon capacity are considered empty when as much material as possible has been removed through ordinary means (pouring, pumping, scraping, etc.), and there is less than 3% by weight of the original contents left in the container. Once these types of containers are empty, rinse out the container, let it air dry (preferably in a hood), and finally remove or deface the label prior to recycling or placing in the regular trash.

9. Disposal of Ink and Toner Cartridges

If an ink or toner cartridge has been used under normal circumstances until it is empty, it is not considered hazardous waste and can be managed by one of the following means:

1. Ship the container back to the supplier for reclamation or reuse. Many companies now provide free containers and shipping (Xerox, HP, etc).

2. Disposing of it into a trash container.

Whenever possible, unused or defective cartridges should be returned to the supplier for replacement or credit. This practice minimizes the number of unused cartridges needing disposal. Any cartridges that cannot be returned and still contain residual ink or toner that is determined to be hazardous waste maybe be picked up by **EH&S** for proper disposal. Contact **EH&S** for assistance if you are uncertain of how to properly dispose of any unused or defective ink or toner cartridges.

10. Biomedical Waste Disposal

Personnel who handle biomedical waste, sharps or work in areas which handle human blood, tissues and body fluids **must** comply with the policy and procedures for the handling and disposal of biomedical waste as required by the Florida Administrative Code, F.A.C. 64-E16. The regulation requires, among other things, waste containment, marking and labeling, and disposal of potentially contaminated material. For specific disposal information refer to the Biomedical Waste Management Plan or contact **EH&S**.

11. Disposal of Radiological Waste

Only "Authorized Use" Supervisors/Principle Investigators may purchase and use radioactive material in a designated laboratory. Disposal of radioactive waste must be in compliance with F.A.C. 64E-5 and with

the rules contained in the Florida Tech Radiation Safety Manual. For more information, contact **EH&S** or the Radiation Safety Officer.

For a radioactive waste pickup, send a completed Radiation Waste Disposal form to EH&S or the Radiation Safety Officer.

12. Laboratory Animal Waste Disposal Procedures

All research using animals at Florida Tech must be done in accordance with the guidelines set forth by the Institutional Animal Care and Use Committee (IACUC). These requirements include but are not limited to the following:

Fixed Animal Tissues

Preserved specimen generated from teaching or research labs will be disposed of as biomedical waste. Disposal procedures will adhere to waste disposal guidelines within the Florida Tech Biomedical Waste Management Plan. For more information contact **EH&S (ehs@fit.edu)**.

Research Animal Carcasses, Feces and Bedding

The guidelines for animal carcass waste disposal can be found in the Florida Tech Biomedical Waste Management Plan. These guidelines will vary depending upon how the animal tissue was used. For more information on specific laboratory disposal requirements contact **EH&S (ehs@fit.edu)**.

13. Mixed Waste

The creation of mixed waste (radioactive and chemical) is not allowed because of regulatory constraints and expense. Please consult with **EH&S** and the Radiation Safety Officer before generating mixed waste.

14. Waste Minimization

The Institute is required by regulations to reduce the amount of hazardous chemical waste generated. Departments should take the following waste minimization measures:

1. Only purchase chemicals in quantities that can be used before the expiration date of the material.

2. Recycle surplus or unwanted chemicals. **EH&S** maintains a list of available chemicals periodically. Surplus chemicals are available free of charge and on a first come, first served basis.

15. Florida Tech Hazardous Waste Disposal Requirements

Failure to comply with hazardous waste regulations can result in fines of $50,000 per day per offense and possible criminal charges against the responsible person(s).

1. All employees working with hazardous waste must receive initial training and annual retraining. Initial training is conducted online or in a classroom setting; and annual retraining.

2. Each lab will appoint a lab manager/alternate and designate a waste collection area.

3. All chemical containers **must be properly labeled**. **An unlabeled chemical becomes an unknown and disposal is expensive.** Hazardous waste containers must be marked with the words, "hazardous waste" and chemical and/or chemicals in question (i.e. 100 ml acetone, 500 ml hexane, 500 ml ethyl acetate). Labels can be obtained from **EH&S.**

4. All compatible wastes shall be collected in approved sealed containers. Foil or film closures are not acceptable. **EH&S** provides containers of various sizes for halogenated or non-halogenated solvents, acids, bases, metals, etc. The use of glass or plastic containers for smaller amounts is acceptable. **Containers must be closed except when adding waste** to a container.

5. Laboratories are not allowed to accumulate more than 40 L of waste or 500 ml or 500 grams of acutely hazardous "P" waste at any one time.

6. Keep the waste containers near the process generating the waste. Keep open flame and ignition sources away from all chemicals. Do not overfill waste containers.

7. Peroxide-forming chemicals should be either (1) consigned to waste before the expiration date on the label, or (2) tested for the presence of peroxides and re-dated, to safeguard against the formation of shock-sensitive peroxides. See Appendix F Table VII for additional information.

8. Only **EH&S** is permitted to dispose of hazardous waste. **Do not dispose of waste down the drain**.

9. **Major laboratory chemical clean-outs must be planned in advance**. Contact EH&S and prepare a detailed list of the chemicals that need to be disposed.

10. All discharged, damaged, or out of date fire extinguishers must be reported immediately to **EH&S**.

11. All chemical spills must be cleaned up properly and safely. Large spills or any spill directly on the ground, into water, or sanitary sewer must be immediately reported to **EH&S**. See Appendix I.

To request a chemical, biohazardous, or radioactive waste pickup, call **EH&S** or fill out a waste pickup form on the EH&S website under "Regulated Waste."

16. Special Waste

Special waste refers to commonly used items that need special procedures for disposal. Examples of these include aerosol cans, fluorescent light bulbs, ballasts, hazardous batteries, pharmaceuticals, and used oil.

16.1 Aerosol Cans

According to hazardous waste regulations pressurized aerosol cans must be disposed of as hazardous waste. Aerosol cans also pose a potential risk of explosion if handled improperly. All departments that generate aerosol cans must follow these procedures:

1. Collect and store all aerosol cans at Designated Accumulation Point(s) within the work area. Areas that generate large quantities of aerosol cans should have a 5-gallon trash container with a lid at the designated accumulation point.

2. The container will be labeled as follows: Hazardous Waste Aerosol Cans Only.

3. Request a pick-up from EH&S when the container is full.

16.2 Fluorescent Light Bulbs

Fluorescent light (FL) bulbs contain enough elemental mercury to be categorized as a hazardous waste. The Florida Tech Facilities Department is generally responsible for the collection and recycling of used fluorescent light bulbs. **EH&S** will provide assistance with vendors for shipment of FL bulbs.

Many retailers are now offering "green" fluorescent bulbs that they claim will not be hazardous waste when disposed. These bulbs have different names but are often referred to as "green" bulbs because they have green markings, such as a green printed monogram, green end-caps or other green indicators. Many varieties of "green" bulbs still contain low levels of mercury that, even at very low levels, can become air-borne and be deposited into the environment. For this reason, "green" fluorescent bulbs are collected and recycled the same as standard fluorescent light bulbs.

16.3 Ballasts

Ballasts control the starting and operating voltages and regulate the current passing through fluorescent lights. Some ballasts contain polychlorinated biphenyls (PCBs) that must be removed and disposed of as hazardous waste. Other non-PCB ballasts may contain DEHP (di (2-ethylhexyl) phthalate) which is classified by EPA as a hazardous substance. Ballasts must not be disposed in the trash. The Florida Tech maintenance department is generally responsible for the collection and recycling of all ballasts. **EH&S** can also be contacted for ballast pickups.

16.4 Hazardous Batteries

Many batteries contain one or more hazardous chemical components, which are considered to be hazardous wastes. The following battery types are considered hazardous batteries and must be recycled by **EH&S**.

1. Lead Acid
2. Mercury
3. Silver
4. Lithium
5. Nickel Cadmium (NiCad)
6. Nickel Metal Hydride (NiMH)

Common alkaline batteries (Duracell or Energizer batteries) are exempt and may be disposed of in the regular trash. The normal composite of alkaline batteries is 24% iron, 22% manganese and 15% zinc. Direct any questions concerning the type or nature of batteries found in the work area to **EH&S**.

16.5 Pharmaceuticals

Pharmaceutical waste includes expired, recalled, damaged, overstocked, unwanted, or contaminated drugs, vaccines, supplements, vitamins, and sera. Effective March 26, 2009, pharmaceuticals containing hazardous ingredients may be managed as special waste in the State of Florida, per F.A.C. 62-730.186. The Institute's Student Health Services Clinic manages their own pharmaceutical waste. All expired, recalled, damaged or overstocked pharmaceutical products from the clinic are bulked with those from the pharmacy and picked up quarterly by a reverse distribution service. The reverse distribution service

returns pharmaceuticals that have residual value directly to the manufacturer for credit. All other waste pharmaceuticals are incinerated at a co-generation facility that converts the waste to useable energy. Principle investigators who are licensed to use controlled substances for teaching and research purposes are responsible for the proper disposition of their controlled pharmaceutical waste streams under the auspices of their license. **EH&S** may be contacted as needed for assistance with the proper disposition procedures of these substances.

EH&S can also provide assistance on a case-by-case basis with the disposal of research and teaching-related prescription and over-the-counter medications.

All pharmaceutical waste should be kept in a secured location until removed for disposal. Under no circumstances should pharmaceutical waste be disposed in the regular trash or down the sink.

16.6 Used Oil

Used oil is regulated as a special waste in Florida, per the requirements specified in F.A.C. 62-710. Used oil is defined as any oil which has been refined from crude oil or synthetic oil and, as a result of use, storage, or handling, has become contaminated and unsuitable for its original purpose due to the presence of physical or chemical impurities or loss of original properties.

All used oil storage tanks and containers must be labeled with the words "Used Oil" in order to minimize the risk of cross contamination with other chemicals. All used oil containing tanks and containers must also have secondary containment (unless they are double-walled) that has the capacity to hold 110% of the volume of the largest tank or container within the containment area.

Since the risk posed to the environmental from a small, indoor spill is minimal, portable collection containers, satellite accumulation containers, and other small containers (those with a total capacity of equal to or less than 55 gallons) which are stored on an oil-impermeable surface inside a structure satisfy the requirements for secondary containment, as do portable collection containers on wheels that are emptied within 24 hours.

Used oil must not be discharged into soils, sewers, drainage systems, septic tanks, surface or ground waters, watercourses, or marine waters. Used compressor, pump, hydraulic or motor oils must be recycled. Collect used oil in proper containers (5-gal or less) which are labeled, “Used Oil” and contact **EH&S** for pickup.

NOTE: ONLY MATERIAL GENERATED ON CAMPUS WILL BE MANAGED BY EH&S. DO NOT BRING PERSONAL MATERIAL FROM HOME.

City of Melbourne Sewer Use Policy Limits Regulated Pollutants

The following information is taken from policies and procedures instituted by the City of Melbourne:

General Prohibitions

No user shall introduce or cause to be introduced into the wastewater facility any pollutant or wastewater that causes pass through or interference.

Specific Prohibitions

No user shall introduce or cause to be introduced into the wastewater facility the following pollutants, substances, or wastewater.

Material or characteristic
Local Limits

Arsenic	0.62 mg/l
$CBOD_5$	1000 mg/l
Cadmium, Cd	0.42 mg/l
Chromium, Cr	6.30 mg/l
Copper, Cu	6.00 mg/l
Lead, Pb	0.62 mg/l
Mercury, Hg	0.12 mg/l
Molybdenum, Mo	0.12 mg/l
Nickel, Ni	2.18 mg/l
Selenium, Se	0.24 mg/l
Silver, Ag	1.34 mg/l
Zinc	1.34 mg/l
Oil and Grease, O&G	100.00 mg/l
Total Suspended Solids, TSS	300 mg/l
pH	less than 5.5; or more than 9.5 (or otherwise causing corrosive structural damage to equipment)
Temperature	140F

Also Prohibited:

a) Any gasoline, benzene, naphtha, fuels oil or other flammable explosive liquid, solid, or gas.

b) Waste from restaurants or places where a large amount of cooking is done or where the waste carries large amounts of grease.

c) Any noxious or malodorous gas or substance which, either singly or by interaction with other wastes, may create a public nuisance or increase the hazard of entry into sewers from maintenance and repair. Domestic sewage is excluded.

d) Any solid or viscous substance which may cause obstruction to the flow in sewers or interference with the proper operations of the city wastewater facilities.

e) Any waters or wastes containing toxic, poisonous or radioactive substances in concentrations which may constitute or create a public nuisance or hazard to humans or animals or may interfere with any wastewater treatment process or the city wastewater facilities.

f) Any waters or wastes which, after treatment by the city, exceeds federal, state, or local quality requirements, unless a current and lawful permit allows such discharge.

g) Any stormwater or drainage from a yard, roof, basement, air conditioning unit,

cooling tower, or street catch basin. Existing air conditioning units and cooling towers discharging into wastewater facilities prior to the adoption of Article IV of the Melbourne Municipal Code are exempt.

h) Any wastewater which causes a hazard to human life or creates a public nuisance.

i) Any wastes from septic tanks or other facilities, or wastes emanating from locations outside the city sewer service area without previous written approval of the director; such discharges shall only be made at a site approved by the director.

j) Petroleum oil, non-biodegradable cutting oil, or products of mineral oil origin, discharged at any flow rate or concentration, which will cause interference or pass through.

k) Pollutants that create a fire or explosion hazard in the wastewater facility.

l) Pollutants which will cause corrosive structural damage to the wastewater facility, but in no case discharges with pH lower than 6.0, unless the wastewater facility is specifically designed to accommodate such discharges.

m) Solid or viscous pollutants in amounts which will cause obstruction to the flow in the wastewater facility resulting in interference.

n) Any pollutant, including oxygen-demanding pollutants, released in a discharge at a flow rate or pollutant concentration that will cause interference with the wastewater facility.

o) Heat in amounts which will inhibit biological activity in the wastewater facility resulting in interference, but in no case heat in such quantities that result in the discharge from the treatment plant having a temperature that exceeds 40˚C (104˚F) unless the appropriate agency approves alternate temperature limits in accordance with Rule 62-302.520, F.A.C.

p) Pollutants which result in the presence of toxic gases, vapors or fumes within the wastewater facility in a quantity that will cause acute worker health and safety problems.

q) Any trucked or hauled pollutants, except at discharge points designated by the control authority.

r) Wastewater containing any radioactive wastes or isotopes except in compliance with applicable State or Federal regulations.

19 APPENDIX E

Hazardous Materials Shipping/Receiving Guide

Shipping Hazardous Materials

Since 1990, the U.S. Department of Transportation (DOT) has regulated the transport of "hazardous materials" in all modes of transportation (air, ground and sea). Transportation of "dangerous goods" by air has been regulated by the International Air Transport Association (IATA) since 1956. The DOT and IATA regulations are intended to ensure that all who come in contact with a shipment of hazardous materials are properly informed of the hazards presented by the materials, and the measures necessary for their safe transport.

What are Hazardous Materials and Dangerous Goods?

Hazardous materials are substances or materials, which have been determined by the Secretary of Transportation to be capable of posing an unreasonable risk to health, safety, and property when transported in commerce. The term includes hazardous substances, hazardous wastes, marine pollutants, elevated temperature materials, materials designated as hazardous in the Hazardous Materials Table (HMT), and materials that meet the defining criteria for hazard classes and divisions in 49 CFR 173.

Dangerous goods are articles or substances which are capable of posing a significant risk to health, safety or property when transported by air. The transportation of these articles and substances is regulated under the IATA Dangerous Goods Regulations. DOT and IATA regulations are similar but are not always the same. For example, dry ice shipped via ground transportation is not regulated as a hazardous material; however, when shipped by air, dry ice is considered a dangerous good.

Hazardous materials and dangerous goods include items such as laboratory chemicals, radioactive materials, compressed gases, biological agents, dry ice (when shipped by air) and equipment or instruments that contain hazardous materials or dangerous goods. To comply with DOT and IATA regulations, these materials must be properly classified, packaged, labeled, documented and handled.

Florida Tech Procedures for Offering Hazardous Materials for Shipment

Following these procedures will help to ensure that your package will arrive at its destination on time and intact. More importantly, it will ensure that everyone involved in the transport of the material will know what it is and how to safely deliver it. The following procedures apply to all hazardous material/dangerous goods packages except radioactive materials. For assistance shipping radioactive materials please contact the Radiation Safety Officer (ehs@fit.edu).

1. Sender brings hazardous materials to EH&S along with the Safety Data Sheet (SDS).

2. EH&S will package, label and provide assistance in completing the proper shipping papers for the material.
3. EH&S will work with the Shipping & Receiving Department for the shipment by a Commercial Carrier.
4. The sender will be responsible for all shipping costs, including packaging, labels, and shipping.

Note: Certain Institute employees may be authorized by EH&S to ship hazardous materials and/or dangerous goods provided they have successfully completed the training requirements specified in the DOT and IATA regulations (49 CFR 172.700 and DGR 1.5 respectively). See "Training Requirements" below.

Commercial Carrier of Hazardous Materials

For Shipping Assistance, Contact:

EH&S 321-674-7562 or ehs@fit.edu.

Receiving Hazardous Materials

Hazardous materials received at Florida Tech via domestic carrier are regulated during transport by the U.S. Department of Transportation (DOT). These materials have specific packaging and labeling requirements. All packages containing hazardous materials display a diamond shaped DOT label(s) that fall into one or more of 9 categories or hazard classes (refer to the DOT labels) **If your area receives any package displaying these types of labels, the following procedures should be followed:**

- Packages displaying an "**Explosive**" label (Hazard Class 1) - contact EH&S
- Packages displaying a "**Radioactive**" label (Hazard Class 7) - Should not be accepted. Please contact EH&S Radiation Safety Officer at 321.674.8889 or ehs@fit.edu.
- If packages displaying a "**Radioactive**" label (Hazard Class 7) are accidentally accepted, contact the Radiation Safety Officer (RSO) (ehs@fit.edu)
- All packages received displaying labels with Hazard Classes 2-6 and 8-9 can be campus delivered as any other package unless they are damaged or leaking.
- Hazardous material packages should be campus delivered immediately or within three hours after receiving for refrigerated material or within 24 hours for all other packages. If this is not possible, contact EH&S and the package recipient.
- While hazardous material packages are awaiting campus delivery, segregate them according to the hazardous material segregation table.
- If packages are damaged or leaking at the time of delivery, do not accept from carrier, and contact EH&S.
- If package becomes damaged or leaks after the carrier has delivered it, contact EH&S. Do not handle, cordon off the area and notify other personnel working in the area.

Training Requirements

Anyone who…

- Loads, unloads or handles hazardous material/dangerous goods packages;
- Determines acceptable shipping containers;
- Determines whether a material to be shipped is a hazardous material or dangerous good;
- Packages hazardous materials/dangerous goods for shipment;

- Labels hazardous materials/dangerous goods packages;
- Fills out shipping papers; and/or
- Transports hazardous materials

…must be trained according to the training requirements specified in the DOT and IATA regulations (49 CFR 172.700 and DGR 1.5 respectively). For assistance in receiving training contact EH&S at ehs@fit.edu.

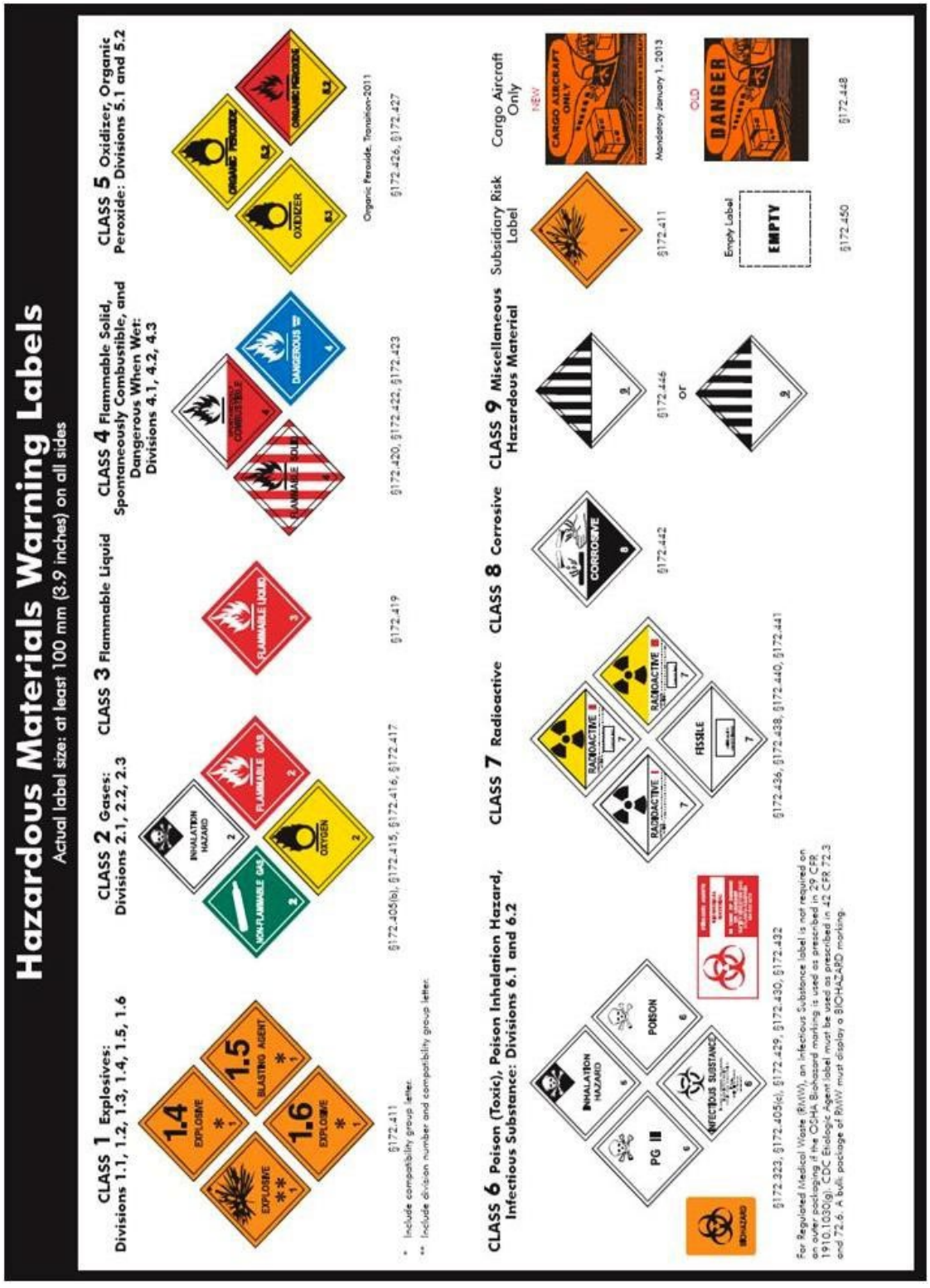
Additional Information: US Postal Service Suspicious Package Guidelines

The following link refers to information about suspicious packages that may arrive through the mail or other parcel delivery services: Suspicious Mail or Packages.

Laboratories Shipping Hazardous Chemicals

Laboratories that ship hazardous chemicals (other than certain small quantities for analysis) are considered chemical manufacturers or distributors under the Hazard Communication Standard and must ensure that any hazardous chemicals leaving the laboratory have manufacturer's labels that include the minimum content specified in the "Labeling" section of the Hazard Communication Program. Also, the name and address of the Institutes' department responsible for the hazardous chemical(s) is required. Additionally, laboratories shipping hazardous chemicals must provide a GHS-compliant Safety Data Sheet to distributors or other employers who will receive the hazardous chemicals.

Chart II: DOT Shipping Labels



20 Appendix F
Chemicals Storage

Rules for Safely Storing Chemicals

1. Store like chemicals together and away from incompatible groups of chemicals. Do not store chemicals in alphabetical order. An easy way to store chemicals properly is to use the chemical manufacturer's color-coding system. (i.e. store reds with reds, blues with blues, etc.) Contact EH&S at 321-674-7562, 8889 or 7715, for assistance, if needed.

2. Flammable materials should be stored in an approved, dedicated, flammable materials storage cabinet or room if the volume exceeds ten (10) gallons.

3. Liquids should be stored in unbreakable or double-contained packaging, or the storage cabinet should have the capacity to hold the contents if the container breaks.

4. Avoid floor chemical storage (even temporary).

5. Chemicals should be stored no higher than eye level (*approximately 5-feet/reduces the likelihood of accidental splashed to the eyes and face/this will depend the height of the personnel*) and never on the top shelf of a storage unit.

6. Shelf assemblies should be firmly secured to the walls. Avoid island shelves.

7. Each shelf should have an anti-roll lip.

8. Store acids in a dedicated acid cabinet. Nitric acid may be stored there also, if it is kept isolated from the others and away from Acetic Acid.

9. Store severe poisons in a dedicated poison cabinet.

10. All chemicals should be labeled and dated.

11. Look for unusual conditions in chemical storage areas, such as:

    - improper storage of chemicals
    - leaking or deteriorating containers
    - spilled chemicals
    -
    - temperature extremes (too hot or cold in storage area)
    - lack of or low lighting levels
    - blocked exits or aisles

- doors blocked open, lack of security
- trash accumulation
- smoking or open lights or matches
- fire equipment blocked, broken or missing
- lack of information or warning signs ("No Smoking", "Flammable Liquids", "Acids", "Corrosives", "Poisons", Chemical Storage")

Any of these conditions should be corrected immediately. **Routine inspections of chemical storage areas will prevent accidents.**

Table VI Suggested Storage Limits For Common Peroxidizable Compounds

Class A - HIGHLY HAZARDOUS: Discard on or before **3 months**.

Peroxide formation hazard during storage.

isopropyl ether	divinyl acetylene
vinylidene chloride	potassium metal
sodium amide	potassium amide

Class B - HAZARDOUS: Discard or test after 6 months.

Peroxide formation hazard during storage and on concentration (i.e. distillation) of compound

diethyl ether	dicyclopentadiene
tetrahydrofuran	diacetylene
dioxane	methyl acetylene
acetal	cumene
methyl isobutyl ketone	tetrahydronaphthalene
ethylene glycol dimethyl ether	cyclohexene
vinyl ethers	methylcyclopentane

CLASS C – POTENTIALLY HAZARDOUS: Discard or test after one year.

Peroxide formation causes initiation of hazardous polymerization.

methyl methacrylate	chorotrifluoroethylene
styrene	vinyl acetylene
acrylic acid	vinyl acetate
acrylonitrile	vinyl chloride
butadiene	vinyl pyridine
tetrafluoroethylene	chloroprene

Safety Hints:

1. Do not purchase these compounds in quantities greater than can be used in the specified storage time period.
2. Ethers should be stored in the dark and under nitrogen if possible.
3. Always check for the presence of peroxides before distilling any peroxide former.
4. Consult safety references before working with peroxidizable compounds.

Table VII Short List of Incompatible Materials

ALKALI METALS, such as calcium, potassium, and sodium with: water, carbon dioxide, carbon tetrachloride, and other chlorinated hydrocarbons.	**ACETIC ACID** with: chromic acid, nitric acid, hydroxyl containing compounds, ethylene glycol, perchloric acid, peroxides, and permanganates.
ACETONE with: concentrated sulfuric acid and nitric acid mixtures.	**ACETYLENE** with: copper (tubing), fluorine, bromine, chlorine, iodine, silver, mercury, or their compounds.
AMMONIA, ANHYDROUS with: mercury, halogens, calcium hypochlorite, or hydrogen fluoride.	**AMMONIUM NITRATE** with: acids, metal powders, flammable liquids, chlorates, nitrates, sulfur, and finely divided organics or other combustibles.
ANILINE with: nitric acid, hydrogen peroxide, or other strong oxidizing substances.	**BROMINE** with: ammonia, acetylene, butadiene, butane, hydrogen, sodium carbide, turpentine, or finely divided metals.
CHLORATES with: ammonium salts, acids, metal powders, sulfur, carbon, finely divided organics or other combustibles.	**CHROMIC ACID** with: acetic acid, naphthalene, camphor, alcohol, glycerin, turpentine, and other flammable liquids.
CHLORINE with: ammonia, acetylene, butadiene, benzene and other petroleum fractions, hydrogen, sodium carbides, turpentine, and finely divided metals.	**CYANIDES** with: acids.
HYDROGEN PEROXIDE with: copper, chromium, iron, most metals or their respective salts, flammable liquids and other combustible materials, aniline, and nitromethane.	**HYDROGEN SULFIDE** with: nitric acid, oxidizing gases.
HYDROCARBONS, generally, with: fluorine, chlorine, bromine, chromic acid, or sodium peroxide.	**IODINE** with: acetylene or ammonia.
MERCURY with: acetylene, fulminic acid, or hydrogen.	**NITRIC ACID** with: acetic, chromic, or hydrocyanic acids, aniline, carbon, hydrogen sulfide, flammable liquids or gases, or other substances which are readily nitrated.
OXYGEN with: oils greases, hydrogen, flammable liquids, solids, or gases.	**OXALIC ACID** with: silver or mercury
PERCHLORIC ACID with: acetic anhydride, bismuth and its alloys, alcohol, paper, wood, and other organic materials.	**PHOSPHOROUS PENTOXIDE** with: water.
POTASSIUM PERMANGANATE with: glycerin, ethylene glycol, benzaldehyde, or sulfuric acid.	**SODIUM PEROXIDE** with: any oxidizable substances, for instance: methanol, glacial acetic acid, acetic anhydride, benzaldehyde, carbon disulfide, glycerin, ethylene glycol, ethyl acetate, furfural, etc.
SULFURIC ACID with: chlorates, perchlorates, permanganates, and water	

NOTE: This list is not a complete list of incompatible materials. It contains some of the more common incompatible materials. Always research the materials you work with in order to be safe.

Shock Sensitive Compounds

Acetylenic compounds
especially polyacetylenes, haloacetylenes and heavy metal salts of acetylenes (copper, silver, and mercury salts are particularly sensitive).

Acyl nitrates

Alkyl nitrates
particularly poly nitrates (i.e. nitrocellulose and nitroglycerine).

Alkyl and acyl nitrites

Alkyl perchlorates

Aminemetal oxosalts
metal compounds with coordinated ammonia, hydrazine or similar nitrogenous donors and ionic perchlorate, nitrate, permanganate or other oxidizing groups.

Azides
including metal, nonmetal and other organic azides.

Chlorite salts or metals (i.e. $AgCLO_2$ and $Hg\ (ClO_2)_2$

Diazo compounds (i.e. CH_2N_2)

Diazonium salts (when dry)

Fulminates
Silver fulminate (AgCNO) can form in the reaction mixture from the Tollen' test for aldehydes if it is allowed to stand for some time; this can be prevented by adding dilute nitric acid to the test mixture as soon as the test has been completed.

Hydrogen peroxide
becomes increasingly treacherous as the concentration rises above 30%, forming explosive mixtures with organic materials and decomposing violently in the presence of traces of transition metals.

N-Halogen compounds
(i.e. difluoroamino compounds and halogen azides).

N-Nitro compounds
(i.e. N-nitromethylamine, nitrourea, nitroguanidine and nitric amide).

Oxo salts of nitrogenous bases
perchlorates, dichromates, nitrates, iodates, chlorites, chlorates and permanganates of ammonia, amines, hydroxylamine, guanidine, etc.

Perchlorate salts
most metal, nonmetal and amine perchlorates can be detonated and may undergo violent reaction in contact with combustible materials.

Peroxides and hydroperoxides

Peroxides (solid)
Crystallized form or are left from evaporation of peroxidizable solvents.

Peroxides
transition-metal salts

Picrates
especially salts of transition and heavy metals (i.e. Ni, Pb, Hg, Cu and Zn); picric acid is explosive but less sensitive to shock or friction than its metal salts and is relatively safe as long as wetted and not dried out.

Polynitroalkyl compounds
(i.e. tetranitromethane and dinitroacetonitrile)

Polynitroaromatic compounds
especially polynitro hydrocarbons, phenols and amines

21 APPENDIX G

Glove Selection

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.

The Occupational Safety and Health Administration (OSHA) addresses the need for hand protection in 29 Code of Federal Regulations (CFR) 1910.138:

> 1910.138(a) "**General requirements**. Employers shall select and require employees to use appropriate hand protection when employees' hands are exposed to hazards such as those from skin absorption of harmful substances; severe cuts or lacerations; severe abrasions; punctures; chemical burns; thermal burns; and harmful temperature extremes."
>
> 1910.138(b) "**Selection**. Employers shall base the selection of the appropriate hand protection on an evaluation of the performance characteristics of the hand protection relative to the task(s) to be performed, conditions present, duration of use, and the hazards and potential hazards identified." Employers must match the right glove with each application or task. The selection of proper gloves begins with a hazard assessment. The hazard assessment process helps identify the chemicals or combination of chemicals and their properties a task or job requires. This information is critical when selecting chemical resistant gloves.

Florida Tech must match the right glove with each application or task. The selection of proper gloves begins with a hazard assessment. The hazard assessment process helps identify the chemicals or combination of chemicals and their properties a task or job requires. This information is critical when selecting chemical resistant gloves.

Factors that influence chemical resistant glove selection include:

Chemical(s) being handled
Concentration of the chemical(s)
Temperature of the chemical(s)
Frequency and duration of contact with the chemical(s)
Nature of contact – total immersion or splash only
Length to be protected – hand, forearm, arm
Dexterity required
Grip requirements
Size and comfort requirements

Please contact EH&S for assistance for glove selection.

22 APPENDIX H
ACKNOWLEDGEMENTS

Florida Atlantic University

Florida State University

Harvard University

Johns Hopkins University

University of Miami

University of Southern California

University of West Florida

23 Appendix I

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.**

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 National Capital Poison 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.

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 worktime must be documented. Persons responsible for the affected individual(s) must complete the appropriate report. (See University Accident Reporting Procedures.)

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:

Florida Tech Chemical Hygiene Plan

- 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.

Emergency Procedures:

- Call 911 immediately for all fires and any accidents or spills with injuries that require urgent medical attention.
- Call EH&S at **321 674 7715** during normal business hours for accidents or spills without injuries or with injuries that **do not require** urgent medical attention. Call at any time: Florida Tech Security Office at **321 674 8111**.
- Emergencies involving radiation or radioactive materials must also be reported to the Florida Tech Radiation Safety Officer at **321 674 8889**. Call at any time: Florida Tech Security Office at **321 674 8111**.

Table IX 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 Security 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 321 674 7715 At Any Time: Campus Security 321 674 8111
Emergencies involving radiation or radioactive materials	During Normal Business Hours Radiation Safety Officer 321 674 8889 At Any Time: Campus Security 321 674 8111

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:

- The potential location of spills.
- The quantities of material that might be released.
- Chemical, physical and hazardous properties of the material. This information may be obtained from the Safety Data Sheet or label.

- The types of personal protection equipment that is needed for cleanup.
- Location and contents of spill kits that should be made available where possible.

Table X 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 X Suggested Items for Laboratory Spill Control Kits

COMPONENTS	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
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.

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:

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

- *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.

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

- *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.

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

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 used on the Florida Tech 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.

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 Florida Tech Biomedical Waste Program.

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 ehs@fit.edu.

Major Incident Procedure:

1. **Clear** the area of all personnel.
2. **Notify** the RSO immediately at 321 674 8889.
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 **Florida Tech Radiation Safety Manual** for more information on managing accidental releases of radioactive materials.

24 APPENDIX J

FORMS AND CHECKLISTS

LABORATORY CONTACT INFORMATION*

Department: _____

Lab Manager/Principal Investigator: _____ Phone:_____

Emergency Contact Person: _____ Phone:_____

After Hours Phone: _____

Emergency Responder Contact Information

Call 911 immediately for all fires and any accidents or spills with injuries that require urgent medical attention.

Call EH&S at 321.674.7715 during normal business hours for accidents or spills without injuries or with injuries that do not require urgent medical attention. Call at any time: **Florida Tech Campus Security at 321.674.8111**.

Emergencies involving radiation or radioactive materials must be also reported to the **Florida Tech Radiation Safety Officer at 321.674.8889**. Call at any time: **Florida Tech Campus Security at 321.674.8111**.

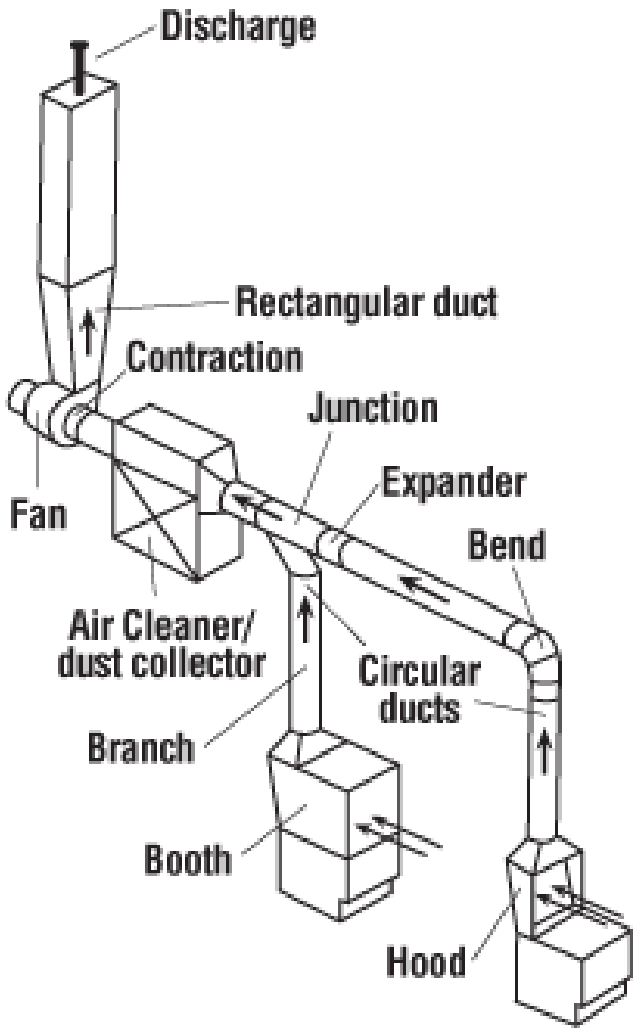
General Emergency Procedures

Type of Emergency	Who to Call
All Fires Accidents or Spills WITH injuries that require urgent medical attention	At Any Time: Campus Security or Local Emergency Responders 911
Accidents or spills WITHOUT injuries, or with injuries that do not require urgent medical attention (*e.g.* on-site first aid only)	During Normal Business Hours Environmental Health & Safety 321.674.7715 At Any Time: Campus Security 321.674.8111
Emergencies involving radiation or radioactive materials	During Normal Business Hours Radiation Safety Officer 321.674.8889 At Any Time: Campus Security 321.674.8111

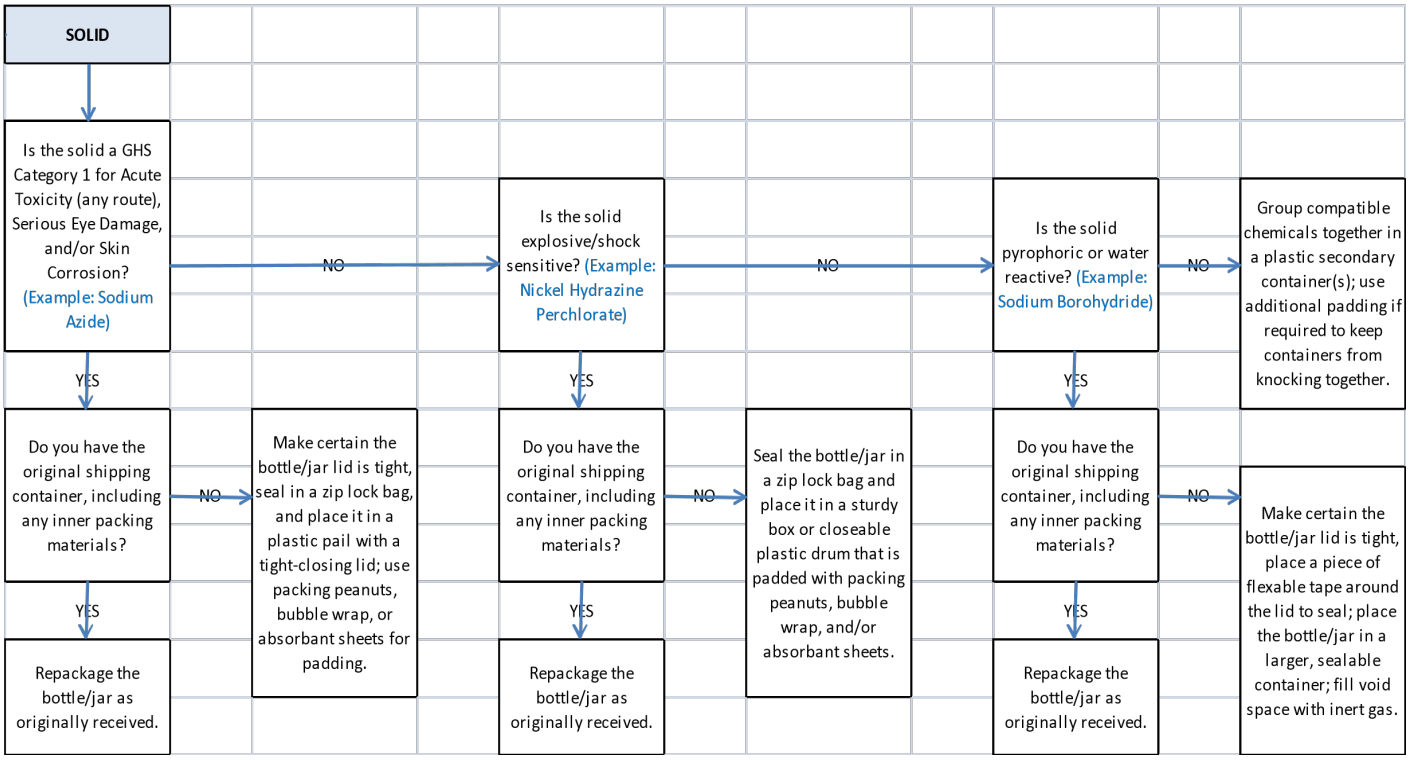
* Fill in appropriate information and post on entry door to laboratory and next to the laboratory phone, if one is present. ***Always follow up with EH&S after any emergency.***

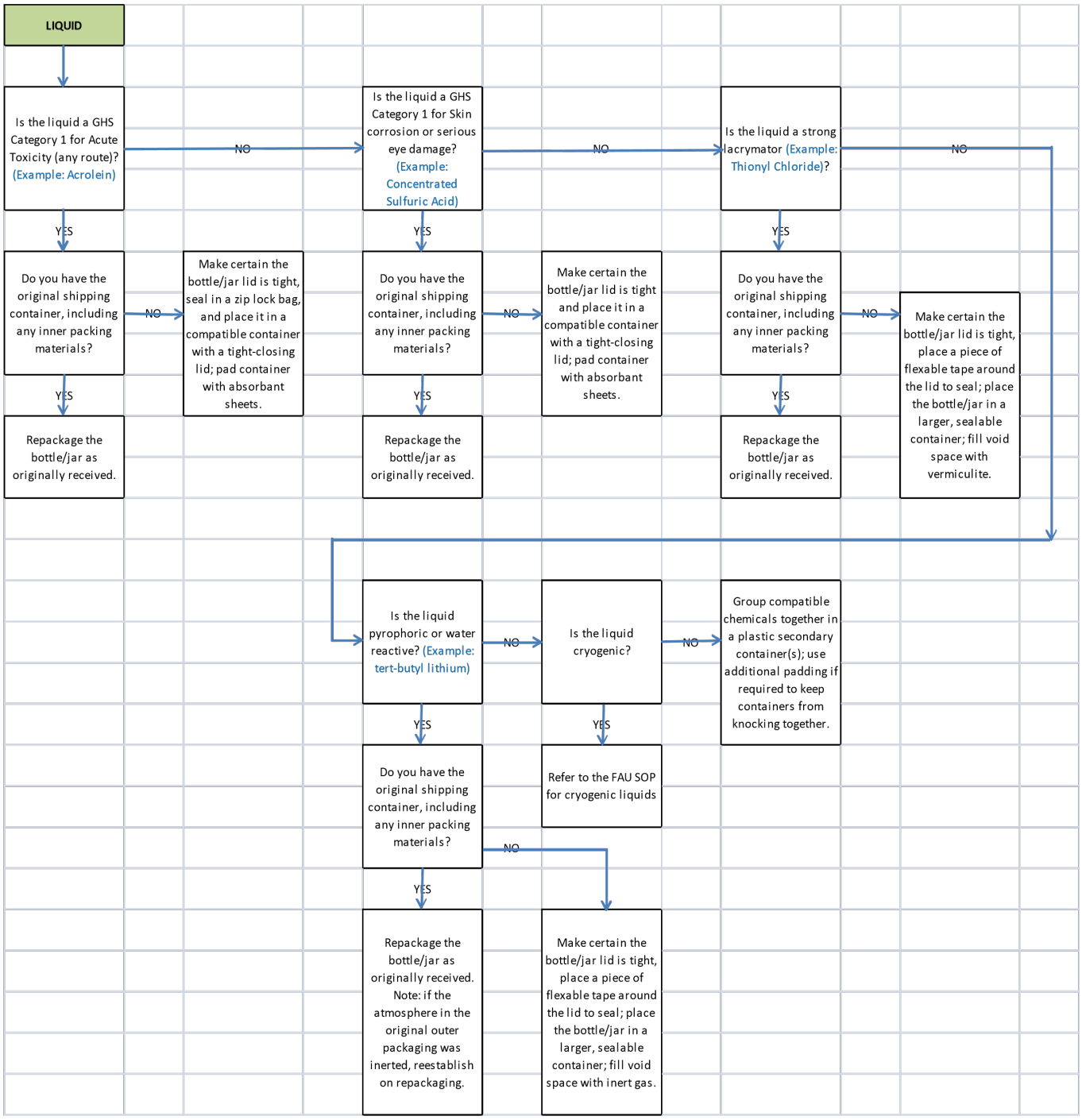
25 APPENDIX K

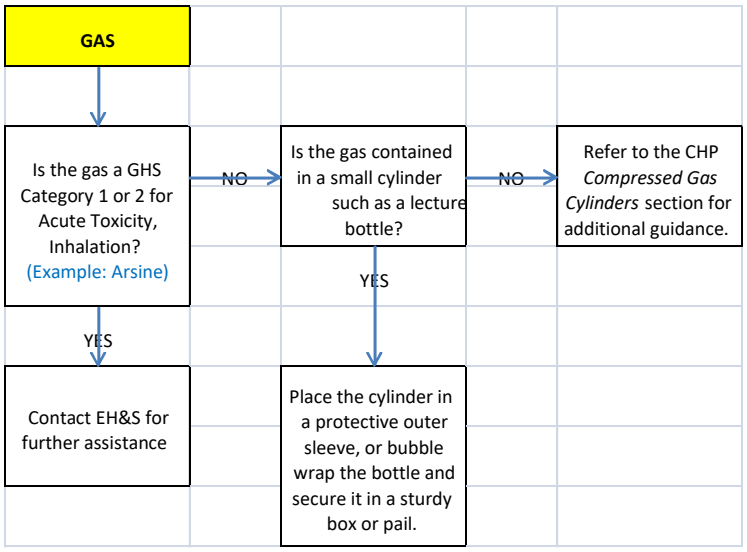
Diagrams of local exhaust devices



26 APPENDIX L
OVERPACKING DECISION TREE




LIQUID
Is the liquid a GHS Category 1 for Acute Toxicity (any route)? (Example: Acrolein)
NO
Is the liquid a GHS Category 1 for Skin corrosion or serious eye damage? (Example: Concentrated Sulfuric Acid)
NO
Is the liquid a strong lacrymator (Example: Thionyl Chloride)?
NO
YES
YES
YES
Do you have the original shipping container, including any inner packing materials?
NO
Make certain the bottle/jar lid is tight, seal in a zip lock bag, and place it in a compatible container with a tight-closing lid; pad container with absorbant sheets.
Do you have the original shipping container, including any inner packing materials?
NO
Make certain the bottle/jar lid is tight and place it in a compatible container with a tight-closing lid; pad container with absorbant sheets.
Do you have the original shipping container, including any inner packing materials?
NO
Make certain the bottle/jar lid is tight, place a piece of flexable tape around the lid to seal; place the bottle/jar in a larger, sealable container; fill void space with vermiculite.
YES
YES
YES
Repackage the bottle/jar as originally received.
Repackage the bottle/jar as originally received.
Repackage the bottle/jar as originally received.
Is the liquid pyrophoric or water reactive? (Example: tert-butyl lithium)
NO
Is the liquid cryogenic?
NO
Group compatible chemicals together in a plastic secondary container(s); use additional padding if required to keep containers from knocking together.
YES
YES
Do you have the original shipping container, including any inner packing materials?
Refer to the FAU SOP for cryogenic liquids
NO
YES
Repackage the bottle/jar as originally received. Note: if the atmosphere in the original outer packaging was inerted, reestablish on repackaging.
Make certain the bottle/jar lid is tight, place a piece of flexable tape around the lid to seal; place the bottle/jar in a larger, sealable container; fill void space with inert gas.


GAS
Is the gas a GHS Category 1 or 2 for Acute Toxicity, Inhalation? (Example: Arsine)
NO
Is the gas contained in a small cylinder such as a lecture bottle?
NO
Refer to the CHP *Compressed Gas Cylinders* section for additional guidance.
YES
YES
Contact EH&S for further assistance
Place the cylinder in a protective outer sleeve, or bubble wrap the bottle and secure it in a sturdy box or pail.

27 APPENDIX M

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

DEP
Department of Environmental Protection

DNA
Deoxyribonucleic Acid

rDNA
Recombinant Deoxyribonucleic Acid

DOT
Department of Transportation

EH&S
Environmental Health and Safety

FAC
Florida Administrative Code

FDLES
Florida Department of Labor and Employment Securities

HEPA
High Efficiency Particulate Air

IACUC
Institutional Animal Care and Use Committee

LFPM
Linear Feet per Minute

LSO
Laser Safety Officer

NFPA
National Fire Protection Association

NIH
National Institutes of Health

OSHA
Occupational Safety and Health Administration

PEL
Permissible Exposure Limit

PI
Principle Investigator

PPE
Personal Protective Equipment

RCRA
Resource Conservation and Recovery Act

RSO
Radiation Safety Officer

SDS
Safety Data Sheet

SOP
Standard Operating Procedure

28 APPENDIX N
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.

American Conference of Governmental Industrial Hygienists (ACGIH)
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.

American National Standards Institute (ANSI)
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 because 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 Florida Tech 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 Plan
The Institute'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.

British thermal unit (BTU)
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.

Chemical Abstract Service (CAS) registration number
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.

Chemical Hygiene Officer/CHP. Works with administrators and other employees to develop and implement appropriate chemical hygiene policies and practices, and hazard communication policies and practices, and monitor procurement, use, and disposal of chemicals.

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.

Department of Environmental Protection (DEP) 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.

U.S. Department of Transportation (DOT)
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.

U.S. Environmental Protection Agency (EPA)
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
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 enough 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.

High-Efficiency Particulate Air (HEPA)
High-Efficiency Particulate Air-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.

Lower Explosive Limit (LEL)
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 change to liquid.

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.

National Fire Protection Association (NFPA)

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.

National Institute of Occupational Safety and Health (NIOSH)
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.

Occupational Safety and Health Administration (OSHA)
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.

Recommended Exposure Limit (REL)
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.

Safety Data Sheet (SDS)
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 4oC 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.

Toxic Concentration Low (TCLo)
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.

Threshold Limit Value (TLV)
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 Time-Weighted Average concentration for a normal 8-hour workday or 40-hour week; (2) TLV-STEL, the Short Term Exposure Limit 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, Ceiling, the concentration that should not be exceeded at any time.

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

Upper Explosive Limit (UEL)
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.