COLLEGE of CENTRAL FLORIDA	**COLLEGE of CENTRAL FLORIDA** **ADMINISTRATIVE PROCEDURE**

Title: Laboratory Safety Program	
Page 1 of 12	**Implementing Procedure for Policy 8.05**
Date Approved/Revised: 11/26/03, 5/03/10	**Division: Academic Affairs**

1.1 PURPOSE:

The purpose of this policy is to establish guidelines and provide information for the establishment of a safe working environment for students in vocational and technical training classes. Consult the CF Safety Management Manual for further information.

1.2 PROCEDURE:

Safety Training

Safety Training should be conducted at the beginning of each semester or prior to the individual using a specific piece of equipment. The training should be documented on Training Records. These records should be maintained for a period of 3 years and are subject to inspection and audit by the CF Public Safety Department or State of Florida Department of Education or other agencies.

It is reasonable and prudent for an instructor to provide all students with adequate safety training. This could include, but it not limited to:

- Safety demonstrations – attentively watched by all
- Safety videos
- The proper and adequate wearing of personal protective equipment (PPE) appropriate to the industry or program area.
- Safety quizzes and tests, etc.
- Students demonstrate proficiency in facility, tool, and equipment safety to the instructor, who uses his or her professional assessment in allowing the student to utilize shop facilities.

Lab Safety vs. Risk

Hazards present in laboratories include toxic chemicals, electrical equipment, radioisotopes, compressed gasses, and biohazards. By identifying sources of hazards and by assessing the risks of accidents, however, even activities of high potential risk can be engaged in safely. Most hazards that are faced in the laboratory are already known and their associated risks have been defined. Techniques to avoid unnecessary exposure to these hazards have been developed and are incorporated into the safety standards, regulations, policies, and procedures which you will be expected to follow.

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The best way to learn about the hazards in the workplace and how to avoid them is to work with an experienced and knowledgeable person and to actively seek relevant information and training.

Safety Standards, Policies, and Guidelines are designed to reduce to an acceptable level the risks inherent in the use of dangerous materials. They are for the protection of all students.

This policy includes general rules of laboratory safety, fume hood use, and emergency procedures, chemical storage, and electrical safety.

Preplanning and Clean-up

Preplanning experiments and a properly organized work area can eliminate a lot of potential problems. Clean-up and decontamination must be a routine part of experimental design for all lab personnel.

The careful routing and identification of contaminated and waste materials as they are generated can make clean-up safer for lab personnel as well for the other people who must deal with the glassware, discards, and wastes once they have left the lab. Be knowledgeable about what happens to any hazardous, radioactive, or other dangerous material that leaves the lab. Make sure that it is placed in an appropriate container, that it is appropriately labeled, and that it is placed in the appropriate location for pick-up.

Don't depend on sophisticated equipment set up to protect you. Thousands of dollars worth of safety cabinets, fume hoods, disinfectants, and the barrier protection offered by gloves, shielding, and lab coats can be easily defeated by sloppy work habits and a reluctance to recognize or deal with a problem. Safe and acceptable working habits and personal hygiene are the most important protection against an accident or a laboratory acquired infection. Recognize and understand the risks that exist in the work place and be able to logically assess which risks are acceptable and which are not. If the appropriate equipment that is required to do an experiment safely is not available, redesign the experiment or perform it until it can be done safely.

Guidelines for Personal Laboratory Safety

- Eye protection should be worn at all times.
- No eating, drinking or smoking in laboratories.
- Lab coats must he worn when handling corrosive, toxic, or flammable materials. Gloves should be worn, when necessary, especially when handling corrosive and highly toxic materials.
- Never work alone.
- Do not mouth pipette.
- If you see a student doing something dangerous, point it out to him or her.
- Know where safety equipment (eyewash, shower, extinguishers) is located and how to use it.
- Know how to clean up spills of the chemicals that you use.
- Wash your hands after handling chemicals and before leaving the lab.
- Open shoes are not to be worn.
- Bare legs are not acceptable when handling hot, cold or sharp materials as well as toxic or corrosive chemicals.

Preliminary Hazard Analysis Checklist

1. Conduct literature search but remember accidents and unusual results are not always reported.
2. List possible reactions and side reactions. Can less hazardous chemicals be substituted to achieve desired results?
3. Obtain MSDS Sheets. Review the characteristics of all reactants, intermediates and products in terms of flammability, toxicity and reactivity hazards. Where information is not available, treat the materials as hazardous.
4. What is the flash point, flammability range, auto-ignition point, vapor pressure and density?
5. What is the threshold limit value and type of hazard (inhalation, ingestion, skin contact)? What protective measures are required?
6. What is the recommended first aid in case of accidental exposure?
7. Will work require radiation or noise control measures, monitoring for biological or chemical air contaminants, or medical surveillance?
8. How much material/energy is involved and how violent may the reaction be? Determine quantity and rate of evolution of heat and gases.
9. Does it decompose and if so, how rapidly, and to what?
10. Is it impact sensitive?
11. What is its stability on storage to cold, heat, light, water, metals, etc.?
12. What are effects of catalysts, inhibitors, or contaminants (like iron) on the reactions?
13. Will water or air affect the reaction?
14. Can mischarge or wrong addition order affect the reaction?
15. Are incompatible chemicals involved or likely to be generated?
16. Will requires special precautions to prevent odor problems, air pollution, or sewer contamination?
17. Can wastes be safely handled and arrangements for disposal completed?
18. Does equipment fit safely into area allocated? Need isolation, shielding, pressure relief, ventilation, redundant controls, automatic shutdown, etc.?
19. Can all parts of the system be vented before breaking any lines?
20. What would happen and what should be done if:
    - Electric power fails?
    - Cooling or heating system fails?
    - Automatic controls or equipment air fails?
    - Ventilation fails?
    - Pressure gets out of hand?
    - Water or air leaks into system?
    - Material or reaction container falls and breaks or spills contents?
21. Have personnel who may be involved been notified of any special hazards or precautions: neighbors, service, medical, emergency response personnel, etc.?

Safety Controls

In order to control the hazards of chemicals used in the laboratory, it is necessary to utilize a variety of safety controls. Engineering controls are always the best choice for regulating hazardous materials; they do not require continual monitoring but do require regular maintenance. They do not depend, on a day-to-day basis, on individuals to ensure they are working. They are more expensive to implement but also more likely to be used. They do not cause the personal discomfort offered by personal protective equipment. In laboratories where hazardous materials are used, engineering controls usually comprise fume hoods, local exhaust hoods and safety cabinets. In some biology or medical laboratories, laminar flow hoods are used to protect the product from contamination from humans. It is extremely important to be aware of the differences between simple fume hoods, laminar flow hoods, and the various types of biological safety cabinets.

In working with biohazards, personal protective equipment includes the proper use of safety cabinets to contain the aerosols created by working with biohazardous materials. There are several different types of air flow cabinets and hoods used in research and diagnostic labs and they are not interchangeable, although they may be visibly quite similar in appearance.

Chemical Storage

A. Inventory Control

I. Conducting an annual inventory

- To check for ethers and other chemicals with limited shelf life.
- To remove surplus hazardous chemicals.
- To remove chemicals that will not or has not been used in the past 1-3 years.
- To correct incompatible storage.
- To identify which chemicals are present.
- To conduct a regular clean-up of containers and shelving.

II. Locating chemicals

Develop system for finding information such as a Cardex or Computer database system. A good system should direct you quickly to the chemical, and be easy to use and maintain. Keep inventory up to date.

B. Chemical Storage

General Rules

- Store in central, properly ventilated area; this includes forced ventilation from floor to ceiling with exhaust above roof level.
- Know the location of the master control shut-off valves for gas, water and electricity
- Smoke detector is required.
- Shelving should be accessible with chemicals at eye level or lower; no high shelf storage.
- Avoid floor chemical storage.
- Firmly secure shelf assemblies to walls. Avoid island shelf assemblies.

- Provide anti-roll lips on all shelves.
- Shelving assemblies should be of wood construction (except for storage of oxidizers).
- Avoid metal, adjustable shelf supports and clips; use fixed, wooden supports.
- For emergencies, have:
    - Fire extinguishers of the approved type positioned near an escape route
    - Spill control and clean-up materials
    - Approved eye/face wash and shower.

II. Laboratory Chemical Storage

Laboratories are not storerooms. This applies to the storage of chemicals, solvents and equipment. For success in chemical storage, use these criteria.

1. Small amounts, not stockpiled

Ordering the 1-kilogram (kg) size, because it is cheaper than the 100-gram size, is often false economy in the long run. The result is:

- it takes up more valuable space
- it presents a greater potential hazard
- it may eventually be a disposal problem.

If you need to check out a reaction, try borrowing a small amount of the necessary chemical from another researcher instead of buying it on speculation.

2. Secure

- Do not overcrowd shelves.
- Do not store too high; provide a proper kick stool or ladder where necessary.
- Chain compressed gas cylinders.
- Store lecture bottles upright and chain or secure in a proper holder.
- Store solvents in a proper flammable liquids cabinet, and keep door closed.
- Use appropriate containers for solvents and waste.
- Store highly toxic or controlled materials in a secure or locked cupboard.

3. Signed properly (labeled)

- Label contents clearly.
- Labels must be intact and legible.
- Do not overwrite labels.
- Label solvent stills.
- Label and regularly check peroxidizable materials.

4. Sealed

- Keep solvent containers closed.
- Ensure chemical containers are intact.
- Ensure container lids are intact and closed.
- Regularly vent materials capable of building up pressure; e.g., formic acid.

5. Segregated

- Know what is in storage; separate incompatible materials.
- Be aware of nomenclature problems, e.g., PHENOL is also known as:
    - carbolic acid
    - hydroxy benzene
    - oxybenzene
    - phenic acid
    - phenyl hydroxide
    - phenylic acid or phenylic alcohol.

III. Methods

1. Introduction

Chemical storage, whether in a laboratory or central storeroom, should be under the supervision of a qualified person; storerooms must have adequate security.

Safety cabinets should be used for specialized groups of compatible substances.

The alphabet was one of the first things that you learned. However, when it comes to chemical storage, it should be one of the last criteria used. Examples of compatibility problems arising from storing chemicals alphabetically include:

- Alkanes and Ammonium Nitrate
- Hydrogen Peroxide and Hydrazine
- Ammonia and Bromine
- Nitric Acid and Phenol
- Aldehydes and Amines
- Sodium Cyanide and Sulfuric Acid
- Calcium Hypochlorite and Carbon

Even apparently safe storage can be a potential problem. The following materials are often stored together even though there are hazards should the materials mix:

- Acetic Acid and Nitric Acid
- Perchloric Acid and Sulfuric Acid
- Concentrated Acids and Bases

Separate by Compatibility

"Compatibility is Synonymous with Chemical Functionality"

Refer to:

- Material Safety Data Sheets
- Chemical Catalogues
- US School System Lab Storage Guide

Isolate and store chemicals using the suggested guidelines outlined below.

2. Acid and Bases

- store acids and bases separately
- store acids in dedicated acid cabinet
- store oxidizing acids (e.g., nitric acid) away from organic acids (e.g. acetic acid)
- store hydrofluoric and perchloric acids in secondary containers manufactured from compatible materials
- safety showers and eye wash facilities must be within easy access
- protective equipment must be inspected regularly to insure proper working order, especially in corrosive atmospheres.

3. Flammable Liquids

Flammable liquids should be stored in a dry, cool well-ventilated area, such as a flammable liquid storage room or cabinet.

i) Laboratory Storage

Flammable liquids should be stored according to the following rules:

- Maximum size of containers recommended for lab use is 5 liters.
- Maximum volume outside flammable liquid cabinet, in the open lab, is 25 liters of those materials with a flash point below 37.8·C.
- Flammable liquids should preferably be stored in metal safety cans which meet the fire code requirements (listed approved safety cans equipped with flash arrestor and self-closing lid), glass containers, of >1 liter, may be used only if purity of the material is affected by exposure to metal, or it is the original container.
- Waste solvent containers must be capped when not in active use; their volume is included in the 5-liter container size for laboratories and 25 L maximum volume in open lab

ii) Flammable Liquid Cabinets

An approved flammable liquid storage cabinet may be used when quantities of flammables exceed those previously mentioned. Unlike a regular metal type cabinet, an approved flammable liquid storage cabinet must be listed by an acceptable testing agency.

Advantages of flammable liquid cabinets are:

- Better control of flammables, thus eliminating the problem of careless open storage of small containers.
- Offers a safe means of storage over a short period of time time-saving method of storage by locating cabinets in, or adjacent to, work areas.

This reduces the frequency of trips to the drum storage or dispensing facility.

Flammable liquids cabinets must:

- be U.L.C. listed and approved
- be closed at all times, with door latches operable
- have vents that are either plugged or vented directly to the outside
- be either wood (must meet specifications of fire code) or metal
- be suitably placed, i.e., not located near an exit door or blocking access to an exit

- may have to be in a room which has a second exit depending on the quantity and hazards of flammable liquids in the room
- contain no more than 500 liters maximum of flammable and combustible liquids of which no more than 250 liters may be flammable be no more than one (1) per fire compartment, unless otherwise approved by the local Fire Department.

iii) Refrigerator Storage

In the event that chemicals need to be stored in a refrigerator, certain guidelines must be followed. The materials must be securely packaged, tightly sealed and properly labeled. Ensure that materials, especially those that are highly reactive or corrosive, are inspected regularly and that lids are intact. Flammable materials, when they must be kept cool, must be stored in an explosion proof refrigerator.

Refrigerators must be approved (U.L.C.) for storage of flammable liquids (explosion-proof), or acceptably tested and approved. A number of refrigerators have exploded due to flammable vapors.

iv) Flammable Compressed Gas Cylinders

- Protect against mechanical damage.
- Store in a secure area.
- Store with protective caps on.
- Store in a dry, well-ventilated area.
- Store flammable, oxidizing and poison gases separately.
- If stored indoors, the room must have a 2-hour fire separation with entry from the exterior.
- Natural ventilation to outside wall must exist.
- Room must have no other purpose.
- Compressed gas is heavier than air.
- Only one (1) cylinder is allowed in any one room and must not be located below grade.
- Poisonous compressed gases shall be separated from remainder of building by a gas tight fire separation.
- Poisonous compressed gases shall be stored in a room with an exterior entrance and not with combustible or flammable material.

v) Flammable Liquid Storage Rooms

A properly designed flammable liquid storage room must satisfy many requirements, e.g., location, ventilation, electrical equipment, fire protection, etc. It must also meet the needs of the user, e.g., adequate size, conveniently located, etc.

The flammable liquids room should be easily accessible to fire fighting. From a fire safety standpoint, rooms located in corners of buildings meet this requirement; e.g., window openings and doors all providing sufficient entry; also, explosion venting can be incorporated into the exterior walls. From a management point of view, such a location is advantageous in that incoming shipments of flammables can be handled without having to transport them through the main work area.

There are specific guidelines for flammable liquid storage rooms. The maximum number of liters per square meter of floor space; maximum room size with and without a sprinkler system (or other automatic extinguishing system); fire resistance rating of the interior walls. Other additional requirements include: a raised liquid-tight sill of at least 102 mm in height (a sunken floor or open grated trench is also permissible); floor drains which drain to a safe location; self-closing, listed, one and one-half hour Class B fire door (listed 3-hour Class A may be required for walls with a rating greater than 2 hours).

Rooms containing Class I flammables must have electrical equipment suitable for Class I, division 2; for Class II and Class III liquids, electrical fixtures must be approved for general use. The room must also have gravity or mechanical exhaust ventilation system (ICFM/sq.ft. of floor area) equipped with suitable interlocks.

4. Oxidizing Materials

Oxidizing materials must be stored away from flammable and combustible materials as well as separate from reducing agents.

The simplest method of ensuring that this occurs is to locate all oxidizing materials and store them in a separate location. Read material safety data sheets to ensure that they are all compatible with each other.

5. Dangerously Reactive Materials

Read MSDS. Isolate from other chemicals and ensure that storage conditions are appropriate. Cool, dry well-ventilated areas are required. Additional criteria may include an oxygen free environment for water reactive materials.

Once the chemicals are sorted into the previously described groupings, they can then be sorted into organic and inorganic classes. The Flinn Chemical Catalogue Reference Manual suggests organic and inorganic grouping which are further sorted into compatible families (see next page). The compatible families suggested are:

Inorganic

- Metals, hydrides
- Halides, sulfates, sulfites, thiosulfates
- Amides, nitrates** (except ammonium nitrate), nitrites**, azides**, nitric acid
- Ethers**, ketones, ketenes, halogenated carbon
- Sulfides, selenides, phosphides, carbides,nitrides
    - Chlorates, perchlorates**, perchloric acid**, chlorites, hypochlorites, peroxides**, hydrogen peroxide
    - Arsenates, cyanides, cyanates
    - Borates, chromates, manganates, permanganates
    - Acids (except nitric)
    - Sulfur, phosphorus**, arsenic, phosphorus pentoxide**

Organic

- Acids, anhydrides, peracids
- Alcohols, glycols, amines, amides, imines, phosphates, halogens, imides
- Hydrocarbons, esters, aldehydes
- Hydroxides, oxides, silicates, carbonates, hydrocarbons, ethylene oxide
- Epoxy compounds, isocyanates
- Peroxides, hydroperoxides, azides*
- Sulfides, polysulfides, sulfoxides, nitriles
- Phenols, cresols

*potentially unstable

Guidelines for Handling Compressed Gases

- Know the hazards associated with the gases you work with.
- Use the appropriate personal protective equipment (i.e. foot guards).
- Keep cylinders away from fire, sparks, and electricity.
- Always use a hand truck for transport. Chain cylinders to hand truck.
- Do not transport in closed vehicles.
- Cylinders should be chained in place or other wise secured at all times.
- Protect cylinders from any objects that might cut or scrape them.
- Do not drop cylinders, or otherwise permit them to strike each other.
- Leave valve cap on cylinder until secured and ready for use.
- Ground all cylinders containing flammable gases.
- Use only in an upright position.
- All valves should be closed when not in use.
- Use the proper regulator for the particular gas.
- Carefully open all valves and adjust gas flow rates.
- Always consider cylinders to be full and handle accordingly.
- Discontinue using a high-pressure cylinder when the pressure approaches 30 psi, and clearly mark EMPTY; then remove for return to vendor.
- Oily regulators should never be used with oxygen. Oxygen under pressure will rapidly oxidize oil or grease, resulting in an explosion.
- Acetylene under pressure can decompose with explosive force. It can explode with extreme violence if ignited. Copper or brass (with more than 65% copper) can form explosive compounds in contact with acetylene.
- Glass equipment should not be pressurized. A general rule is no pressure greater than 10” of water, without special protective equipment.
- Never mix gases in a cylinder. Explosion, contamination, corrosion, and other hazards can result.
- Cylinders containing large amounts of a flammable gas (hydrogen, acetylene, ethylene) should be stored outside in a protected area and piped into the working area.
- Store in a fire-proof, well ventilated area.
- Storage area temperature should not exceed 100 F.
- Store gases supporting combustion (02, CO2 etc.) at least 25’ from fuel gases, preferably in another gas storage area.
- Store with valve caps in place, even when empty.

Pressure Regulator Handling and Use

- Pressure regulators are used in a gas system to reduce the pressure from high pressure sources, such as gas cylinders or gas supply pipelines, to a safe working pressure range.
- A pressure regulator should be attached to a cylinder without forcing the threads. If the inlet of a regulator does not fit the cylinder outlet, no effort should be made to try to force the fitting. A poor fit may indicate that the regulator is not intended for use on the gas chosen. (Regulators for "fuel" gases -H2, acetylene, etc.- generally have a left-hand thread.)
- The following procedure should be used to obtain the required delivery pressure:
- After the regulator has been attached to the cylinder valve outlet, turn the delivery pressure-adjusting screw counter-clockwise until it turns freely.
- Open the cylinder valve slowly until the tank gauge on the regulator registers the cylinder pressure. At this point, the cylinder pressure should be checked to see if it is at the expected value. A large error may indicate that the cylinder valve is leaking.
- With the flow-control valve at the regulator outlet closed, turn the delivery pressure-adjusting screw clockwise until the required delivery pressure is reached. Control of flow can be regulated by means of a valve supplied in the regulator outlet or by a supplementary valve put in a pipeline downstream from the regulator. The regulator itself should not be used as a flow control by adjusting the pressure to obtain different flow rates.

Use of Animals or Plants

Animals

Before using animals, teachers should establish guidelines to avoid any intentional or unintentional abuse, mistreatment, or neglect of animals and to promote humane care and proper animal husbandry practices. Whenever animals are to be used in science activities with students, it is imperative that care be exercised to protect both the animals and the students. If animals are to be kept for any time in the room in cages, be certain that adequately sized and clean cages are provided to all animals. Keep cages locked and in safe, comfortable settings.

Animals can stimulate and enhance learning and should be used safely in the laboratory/classroom. Because increased activity and sudden movements can make animals feel threatened, ALL students contact with animals should be highly organized and supervised. Teachers should keep the following precautions in mind to ensure an enjoyable and comfortable experience for their students.

- Inquire beforehand about student allergies associated with animals.
- Allow students to handle/touch animals only after proper directions and demonstrations have been given.
- Have students use gloves while handling vertebrates and appropriate invertebrates and wash hands afterward.
- Report to Public Safety immediately any animal bites or scratches.
- Have a veterinarian evaluate all animals that die unexpectedly.
- Never dispose of fecal matter in sinks or with commonly used equipment.
- Never use wild animals. Obtain classroom animals from reputable pet suppliers.
- Never use poisonous animals in the classroom.
- Never allow students to tease animals or touch animals to their mouths.

Plants

While plants produce the oxygen necessary for animal life, provide us with food, and beautify our surroundings, some produce very toxic substances. Teachers should familiarize themselves thoroughly with any plans they plan to use in the classroom.

- Inquire beforehand about student allergies associated with plants.
- Never use poisonous or allergy-causing plants in the classroom.
- Never burn plants that might contain allergy-causing oils, e.g., poison ivy.
- Make a clear distinction between edible and non-edible plants.
- Never allow plants to be tasted without clear direction from the teacher.
- Have students use gloves while handling plants and wash hands afterward.

RECORDKEEPING

1. Always keep an adequate record of accidents and report it through proper channels.
2. An analysis of accidents should be made for the purpose of corrective action.

1.3 RESPONSIBILITY

It is the responsibility of each instructor to ensure that a safe environment is maintained in their area and that this procedure is adhered to.

Vice President, Workforce Development and Innovation		Date:
Approved by President		Date:

SAFETY TRAINING RECORD

THIS TRAINING IS BEING CONDUCTED IN COMPLIANCE WITH THE STATE OF FLORIDA STATUTES TITLE XLVIII 1006.65, AND APPLICABLE FEDERAL REGULATIONS.

DATE: _____ INSTRUCTOR: _____ PROGRAM: _____

NAME	SIGNATURE	NAME	SIGNATURE

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