Chemical Hygiene Plan (CHP)

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I. Introduction.

A. Scope.

1. The Georgia Gwinnett College continually strives to provide a learning, teaching, and research environment free from recognized hazards. Pursuant to Occupational Safety and Health Administration Regulations (29 CFR 1910.1450 and 1910.132) the College establishes this Chemical Hygiene Plan (CHP) to protect employees and students from potential health hazards associated with the handling, use, and storage of hazardous chemicals in laboratories.

2. The Chemical Hygiene Plan applies to all laboratories at the Georgia Gwinnett College. The safe storage, use and disposal of chemicals in the laboratory requires policies for the protection of students, employees, and the environment. Chemicals, which include reagent grade materials through trade name products and wastes, are the focus of increased regulatory actions by federal, state and local governments. The purpose of this Chemical Hygiene Plan is to provide the chemical user with basic safety information regarding the use of chemicals. This Chemical Hygiene Plan forms the foundation of the safe use of chemicals in the laboratory. The Chemical Hygiene Plan is an adjunct to the Georgia Gwinnett College Hazard Communication Program, copies of which are available at the Safety Office.

3. The manual is not intended as an encyclopedia of chemicals and their hazards; it will not contain listings of hundreds of chemicals that employees may encounter while working in research and development. Although numerous chemicals may be mentioned for the most part they will serve as illustrations for broad categories of hazards, except in the case of chemical incompatibility charts or listings.

4. The safe use and development of biological organisms requires control measures similar to those found in chemical safety. However, biological agents may have the added dimension of self-replication. See the Georgia Gwinnett College Biological Safety Manual, for proper work practices involving biological agents.

5. The safe use and development of radioactive materials require control measures similar to those found in chemical safety. However, the use of radioactive materials has additional requirements. See the Georgia Gwinnett College Radiation Safety User's Guide for safe work practices involving radioactive materials.

B. Responsibilities.

1. The Lab Resource Safety Committee (LRSC) is responsible for recommending to the Dean of the School of Science and Technology the minimum requirements of the CHP that all laboratories must follow. The LRSC will review the CHP in December of each year up on recommendation from the Environmental Health and Safety Officer.

2. Deans and/or department chairpersons are responsible for establishing and maintaining compliance with the CHP. To this end, deans may wish to designate Safety Officers within the School.

3. The Laboratory Supervisor has the overall responsibility for compliance with the CHP in his or her laboratory. This responsibility may not be shifted to inexperienced or untrained personnel. The investigator must assure that:

a. Laboratory workers and others entering laboratory know and follow chemical hygiene rules.

b. Lab attire is worn and that a laundry service is provided for lab coats. Appropriate protective equipment is provided, is in working order, and is properly used as detailed in Section XV.

c. Appropriate training (as detailed in Section II and XV) has been provided to all occupants of the laboratory.

d. Unsafe acts, conditions or inadequate facilities are reported to their supervisor or the Safety Office.

e. Chemical registration is performed. The use of certain toxins is restricted by CDC regulations and may require laboratory registration.

4. Individual laboratory workers are responsible for:

a. Planning and conducting each operation in accordance with the standard operating procedures (SOP) outlined in this CHP.

b. Wearing a lab coat and safety glasses in the laboratory.

c. Developing good laboratory hygiene habits.

d. Reporting unsafe acts or conditions to their principal investigator or Safety.

5. The Safety Office is responsible for working with faculty, staff, students, and others to develop and implement appropriate chemical hygiene practices and procedures. To accomplish this, the SST SAFETY OFFICER or designee shall be the Hygiene Officer. SST SAFETY OFFICE will establish procedures to:

a. Monitor the procurement, use, and disposal of chemicals used in laboratory.

b. Assure, on a periodic basis, that appropriate laboratory chemical hygiene are conducted and that records are maintained.

c. Help PI's develop precautions and adequate facilities.

d. Know the current legal requirements for regulated substances.

6. Wherever hazardous chemicals are used a written chemical hygiene plan must be developed and implemented. The Chemical Hygiene Plan (CHP) must be capable of protecting laboratory workers and others from the health hazards associated with the hazardous chemicals used in the laboratory. This manual serves as the reference document for all Chemical Hygiene Plans developed at the Georgia Gwinnett College. The Chemical Hygiene Plan (CHP) must be:

a. Available on the SST web page..

b. Consistent with the College safety policies.

7. According to federal regulations and standards, the Chemical Hygiene Plan (CHP) must include at a minimum:

a. Standard operating procedures (SOP's) for each activity that uses hazardous materials. The SOP's may be generic in nature, that is, similar operations using chemicals of the same general class may be covered by one SOP.

b. Criteria used to determine the risk associated with chemicals and the procedures used. For example, material safety data sheets/safety data sheets (MSDS/SDS's) may be used for this determination. NOTE: To avoid underestimating risks, it must be assumed that a mixture is more toxic than its most toxic component and that all unknown substances are toxic.

c. Criteria used to determine and implement control measures to reduce laboratory workers' exposure to hazardous chemicals including engineering controls, the use of personal protective equipment, and hygiene practices. Particular attention must be given to the selection of control measures for chemicals known or suspected of being carcinogens, reproductive hazards, or acutely toxic chemicals.

d. Provisions for laboratory worker training must be commensurate with the severity of the hazard that the laboratory worker is exposed. Specialized training may be required for laboratory workers using carcinogens, reproductive hazards, or acutely toxic chemicals.

II. How to Prepare a Chemical Hygiene Plan. This document provides the background information required to establish safe working practices for chemical use and handling. The responsibility for implementation and enforcement of safe work practices is the responsibility of the principal investigator of each laboratory. This document functions as both a training tool and a reference source.

A. Standard Operation Procedures. The SST Safety Officer obtained Standard Operating Procedures (SOP) for 14 classes of chemical and physical hazards commonly found in College Laboratories. These SOP's define the minimum use and handling procedures permitted at the College. Adherence to the SOPs by all Georgia Gwinnett College lab workers is mandatory. It is the responsibility of the Faculty in each area of each laboratory to review the SOPs and assure that the protective equipment and procedures outlined are in place.

B. Documentation Requirements. The faculty must complete training and sign the Chemical Hygiene Work Plan (See example in Appendix E) for his or her laboratory after reviewing all the items outlined in the Standard Operating Procedures applicable to the laboratory. The completed document must be posted in the laboratory by October 1 of each year; when research conditions change; or when new research is initiated.

1. Each laboratory will display a room sign which provides safety information to visitors and non-SST support personnel. The faculty is responsible for providing the correct information for the room sign to the Safety Officer (Section VII and Appendix I). SAFETY OFFICER will provide the sign and assure that appropriate warning information is included.

2. Because of the special hazards associated with the storage of chemicals outside of a laboratory (such as a hallway or in a shared use area) all such storage must be identified. The principal investigator is responsible to complete a Chemical Storage Sign form and return it to the SST Safety Officer (See Appendix J). SAFETY OFFICER will provide the sign and assure that appropriate warning information is included.

3. Researchers are encouraged to complete the Chemical Hygiene Self Inspection form in Appendix H. This document guides you through an audit of your lab.

C. Training Requirements. Faculty should assure that all laboratory workers are provided with information and training to ensure that they are appraised of the hazards of chemicals present in their work area. This training is mandated by OSHA. In fulfillment of part of this training requirement, the Safety Officer shall assure that all new laboratory workers attend Laboratory Safety at GGC (Chemical Hygiene training) provided by Safety Officer. Laboratory workers shall attend Refresher Training each year following attendance of initial Chemical Hygiene training. A list of lab safety training programs are listed on the inside back cover of this manual. The following topics are covered in Chemical Hygiene Training.

1. The contents of the OSHA standard 29 CFR 1910.1450 and its appendices that shall be available to employees (available from Safety Officer).

2. The location and availability of the Georgia Gwinnett College's Chemical Hygiene Plan. The location and availability of known reference material on the hazards, safe handling, storage and disposal of hazardous chemicals found in the laboratory. This may include Material Safety Data Sheets and other reference sources.

3. The existence of Standard Operating Procedures and their applicability to the laboratory. The existence of a Chemical Hygiene Work Plan and its applicability to the laboratory.

4. The emergency procedures are provided in the Georgia Gwinnett College Emergency Operating Procedure.

5. Additional training provided by the research faculty should be as specific to the activities conducted in the laboratory as possible. It should include:

a.. The permissible exposure limits for OSHA regulated substances (or published exposure limits for hazardous chemicals where there is no applicable OSHA standard) for chemicals used in their lab.

b. Signs and symptoms associated with exposures to hazardous chemicals used in their laboratory.

c. Health risks (both chemical and physical) posed by the experimental procedures conducted in their lab.

d. The existence and location of all designated areas in the laboratory. The selection and use of personal protective equipment appropriate for laboratory tasks. See section XV for additional information on personal protective equipment.

III. Hazardous Chemicals.

A. General. Hazardous chemical means a chemical for which there is statistically significant evidence (based on at least one study conducted according to established scientific principles), that acute or chronic health effects may occur in exposed employees, or if it is listed in any of the following:

1. OSHA, 29 CFR 1910 Subpart Z, Toxic and Hazardous Substances.

2. "Threshold Limit Values for Chemical Substances and Physical Agents in the Work Environment", ACGIH (latest edition).

3. "The Registry of Toxic Effects of Chemical Substances", NIOSH (latest edition).

4. In most cases, the label will indicate if the chemical is hazardous. Look for key words like caution, hazardous, toxic, dangerous, corrosive, irritant, or carcinogen. Old containers of hazardous chemicals (pre 1985) may not contain hazard warnings. If you are not sure a chemical you are using is hazardous, review the Material Safety Data Sheet/SDS (MSDS) or contact your supervisor, instructor, or the Safety Officer.

B. Irritants. Irritants are materials that cause inflammation of the body surface with which they come in contact. The inflammation results from concentrations far below those needed to cause corrosion.

1. Common irritants include substances such as: ammonia, alkaline dusts and mists, hydrogen chloride, hydrogen fluoride*, halogens, ozone, phosgene*, nitrogen dioxide, phosphorus chloride, arsenic trichloride (* these materials also have other hazardous properties).

2. Irritants can also cause changes in the mechanics of respiration and lung function. These include: sulfur dioxide, acetic acid, formaldehyde*, formic acid, sulfuric acid, acrolein, halogens (* these materials also have other hazardous properties).

3. Long term exposure to irritants can result in increased mucous secretions and chronic bronchitis. A primary irritant exerts no systemic toxic action, either because the products formed on the

tissue of the respiratory tract are non-toxic or because the irritant action is more severe than any systemic toxic action. Example: hydrogen chloride. A secondary irritant's effect on mucous membranes is overshadowed by a systemic effect resulting from absorption. These include: hydrogen sulfide, aromatic hydrocarbons. Exposure to a secondary irritant can result in pulmonary edema, hemorrhage and tissue necrosis.

C. Simple Asphyxiants. Asphyxiants deprive the tissue of oxygen. Simple asphyxiants are inert gases that displace oxygen. These include: nitrogen, nitrous oxide, carbon dioxide, helium. Chemical asphyxiants render the body incapable of maintaining an adequate oxygen supply. They are active at very low concentrations (few ppm). These include: carbon monoxide, cyanides.

D. Primary Anesthetics. Anesthetics have a depressant effect upon the central nervous system, particularly the brain. These include: halogenated hydrocarbons, alcohols.

E. Hepatotoxic Agents. Hepatotoxics cause damage to the liver. These include: carbon tetrachloride, tetrachloroethane, nitrosamines.

F. Nephrotoxic Agents. Nephrotoxics damage the kidneys. These include: halogenated hydrocarbons, uranium compounds.

G. Neurotoxic Agents. Neurotoxics damage the nervous system. The nervous system is especially sensitive to organometallic compounds and certain sulfide compounds. These include: trialkyl tin compounds, tetraethyl lead, methyl mercury, carbon disulfide, organic phosphorus insecticides, manganese, thallium.

H. Hematopoietic Agents. Some toxic agents act on the blood or hematopoietic system. The blood cells can be directly affected or the bone marrow can be damaged. These include: nitrites, aniline, toluidine, nitrobenzene, benzene. There are toxic agents that produce damage of the pulmonary tissue (lungs) but not by immediate irritant action. Fibrotic changes can be caused by free silica and asbestos. Other dusts can cause a restrictive disease called pneumoconiosis.

I. Carcinogenic Agents. The term carcinogen describes any agent that can initiate or speed the development of malignant or potentially malignant tumors, malignant neoplastic proliferation of cells, or cells that possess such material. A listing of carcinogenic materials can be found in Appendix C.

1. Carcinogens commonly used in large quantities at the College in SST Labs include formaldehyde, benzene, ethylene amine, ethylene oxide, and chloroform.

2. Select carcinogen is any substance that meets one of the following criteria:

a. It is regulated by OSHA as a carcinogen

b. It is listed under the category, "known to be carcinogens" in the National Toxicology Program (NTP), "Annual Report of Carcinogens" (latest edition)

c. It is listed under Group 1, "carcinogenic to humans" by the International Agency for Research on Cancer Monographs (IARC)

d. It is listed under Group 2A or 2B by IARC or under the category "reasonably anticipated to be carcinogens" by NTP, and causes statistically significant tumor incidence in experimental animals according to any of the following criteria: after inhalation exposure of 6-7 hours per day, 5 days per week, for a significant portion of a lifetime, to doses of less than 10 mg/m3; after repeated skin application of 300 mg/kg of body weight per week; after oral doses of less than 50 mg/kg of body weight per day.

J. Reproductive Hazards. These hazards are chemicals that affect the reproductive capabilities including chromosomal damage (mutagens) and effects on the fetus (teratogens). A mutagen affects the chromosome chains of exposed cells. The effect is hereditary and becomes part of the genetic pool passed on to future generation. A teratogen (embryotoxic or fetotoxic agent) is an agent that interferes with normal embryonic development without damage to the mother or lethal effect on the fetus. Effects are not hereditary. A sensitizer causes a majority of the exposed population to develop an allergic reaction in normal tissue after repeated exposure to the chemical. The reaction may be as mild as a rash (contact dermatitis) or as serious as anaphylactic shock. A list of reproductive hazards can be found in Appendix D of this document.

K. Acutely Toxic Chemicals. A list of acutely toxic chemicals can be found in Appendix B of this document. Acutely toxic chemicals are substances falling into the following categories:

1. A chemical that has a median lethal dose (LD50) of 50 milligrams or less per kilogram of body weight, when administered to albino rats weighing 200 g to 300 g each. A chemical that has a median lethal dose (LD50) of 2000 milligrams or less per kilogram of body weight, when administered by continuous contact for 24 hours, (or less if death occurs within 24 hours), to the bare skin of albino rabbits weighing 200 g to 300 g each.

2. A chemical that has a median lethal concentration (LC50) in air of 200 parts per million by volume, or less, of gas, or vapor, or 2 milligrams per liter or less, of mist, fume, or dust, when administered by continuous inhalation for one hour, (or less if death occurs within one hour), to albino rats weighing 200g to 300g each.

L. Extremely Toxic Chemicals. These are substances that cause irreversible neurological damage or death with extremely small doses. Substances in this class include many organic mercury compounds such as dimethyl mercury and MPTP (1-methyl-4phenyl-1, 2, 3, 6-tetrahydropyridine) which can cause irreversible Parkinsonian syndrome. Lab work with these materials requires review by SAFETY OFFICER and typically includes chemical resistant gloves and protective clothing.

IV. Labels.

A. General. A label is any written, printed, or graphic material displayed on, or affixed to, containers of chemicals. Labels or other forms of hazard warnings, such as tags or placards, provide immediate warning of potential danger. They are used to warn of a variety of potential physical hazards, or health hazards. The Occupational Safety and Health Administration's Hazard Communication Standard established minimum labeling requirements for most chemical container in the workplace. All chemical containers at the College shall be labeled according to these OSHA requirements. The container shall be labeled with:

1. The contents of the container (i.e. common name of the chemical). Chemical formulas and structural formulas are not acceptable except for small quantities of compounds synthesized in the laboratory.

2. Name and address of the manufacturer.

3. Physical and health hazards.

4. Recommended protective equipment.

Existing labels on new containers of chemicals or containers in storage shall not be removed or defaced. Employees and students should not work with any chemical from an unlabeled container. However portable containers intended for the immediate use, by the employee or student performing the transfer, do not need to be labeled. This labeling requirement also does not apply to students assigned unknown chemicals for analysis. However, hazard information should be provided with all unlabeled chemicals in student laboratories. Carefully read all the information on the label. If you do not understand something, contact your supervisor or instructor for an explanation or request the MSDS.

B. Special Labeling Requirements. All containers that hold carcinogens, reproductive hazards or acutely toxic reagents must be properly labeled concerning the health hazard posed by the chemical. Most new reagent containers will have the chemicals hazard clearly displayed on the label. However older reagents and containers of solutions that are mixed in the lab must be properly labeled by the laboratory worker. The laboratory worker may write the hazard class (e.g. carcinogen, etc.) on the container or use labels available from SAFETY OFFICER.

V. Handling of Chemicals.

A. General. Know the physical and health hazards associated with the chemicals you are using. Carefully read the chemical's label and safety data sheet (SDS) before using a chemical for the first time. Also review the appropriate Standard Operating Procedure. These documents will provide any special handling information that you may need. After the potential hazards associated with the chemicals and the experimental processes are evaluated you can modify work procedures so that laboratory hazards are minimized or eliminated. Keep the following guidelines in mind when handling chemicals:

1. Do not work alone in the laboratory. If you do need to work alone notify someone.

2. Use required personal protective equipment.

3. Label all containers with chemical content.

4. Wear disposable nitrile gloves to prevent skin exposure.

5. Keep your hands and face clean. Wash thoroughly with soap and water after handling any chemical and whenever you leave the lab.

6. Avoid direct contact with any chemical. Always wear a laboratory coat.

7. Keep chemicals off your hands, face and clothing, including shoes.

8. Never smell, inhale or taste a chemical.

9. Smoking, drinking, eating and the application of cosmetics is forbidden in areas where hazardous chemicals are used or stored.

10. Always use chemicals with adequate ventilation or in a chemical fume hood. Refer to the MSDS and the standard operating procedure to determine what type of ventilation is needed.
Use hazardous chemicals only as directed and for their intended purpose.

11.Inspect equipment or apparatus for damage before adding a hazardous chemical. Do not use damaged equipment.

12. Never use mouth suction to fill a pipette. Use a pipette bulb or other pipette filling device. (See the Biosafety Manual for more on pipetting.)

13. Electrically ground and bond containers using approved methods before transferring or dispensing a flammable liquid from a large container.

14. For specific information regarding chemical handling, contact your supervisor, instructor or SAFETY OFFICE.

B. Laboratory Fume Hoods. Local exhaust ventilation is the one of the best engineering methods available to reduce the health hazard risk associated with the use of hazardous chemicals in the laboratory. Laboratory fume hoods are the most common local exhaust ventilation devices found in the laboratory. Note that laboratory fume hoods and biosafety cabinets, although similar in appearance, are extremely

different devices. Biosafety cabinets are used for protection against exposure to biological materials and should not be used with chemicals unless properly vented. If you are uncertain about the type of hood in your laboratory check with the faculty.

1. Fume hoods are used to prevent hazardous, offensive, or flammable gases and vapors from mixing with the general room air. A hood, especially with the sash down, acts as a physical barrier between the laboratory workers and chemical reactions. The hood can also contain accidental spills of chemicals. Check the SDS, appropriate Standard Operating Procedure, or chemical label for special ventilation requirements, such as: use with adequate ventilation; use in a fume hood; avoid inhalation of vapors; provide local ventilation; ventilation recommendations must be adapted to the work site and the specific process.

2. Reporting fume hood problems. Check your hood before each use. If a problem exists, contact your building administrator. If the hood is not functioning properly the building administrator will place an orange Hood out of order sign on the sash of the hood. A hood must never be used when this orange sign is present. A mechanic will evaluate the hood and make the necessary repairs. Once the hood is repaired it will be flow tested by the Office of Fire and Occupational Safety. If the hood's face velocity is adequate the orange sign will be removed. Persistent problems with fume hoods or repair delays longer than 5 working days should be reported to SAFETY OFFICER.

a. To be effective, laboratory fume hoods must be installed and used correctly. The National Research Council in Prudent Practices for Handling Hazardous Chemicals in Laboratories (1981) recommends that the following factors be remembered in the daily use of hoods: hoods should be considered as backup safety devices that can contain and exhaust toxic, offensive, or flammable materials, when the design of an experiment fails; hoods should not be used as a means for disposing of chemicals. Thus, apparatus used in hoods should be fitted with condensers, traps, or scrubbers to contain and collect waste solvents or toxic vapors or dusts.

b. Hoods should be evaluated before use to ensure adequate face velocities (typically 60-100 fpm) and the absence of excessive turbulence. Further, some continuous monitoring device for adequate hood performance should be present and should be checked before each hood is used. If inadequate hood performance is suspected, it should be established that the hood is performing adequately before it is used. Call your building administrator to report inoperable hoods.

c. Except when adjustments of apparatus within the hood are being made, the hood should be kept closed: vertical sashes down and horizontal sashes closed. Sliding sashes should not be removed from horizontal sliding-sash hoods. Keeping the face opening of the hood small improves the overall performance of the hood.

d. The airflow pattern, and thus the performance of a hood, depends on such factors as placement of equipment in the hood, room drafts from open doors or windows, persons walking by, or even the presence of the user in front of the hood. For example, the placement of equipment in the hood can have a dramatic effect on its performance. Moving an apparatus 5-10 cm back from the front edge into the hood can reduce the vapor concentration at the user's face by 90%.

e. Hoods are not intended primarily for storage of chemicals. Materials stored in them should be kept to a minimum. Stored chemicals should not block vents or alter airflow patterns. Whenever practical, chemicals should be moved from hoods into cabinets for storage. Solid objects and materials (such as paper) should not be permitted to enter the exhaust ducts of hoods as they can lodge in the ducts or fans and adversely affect their operation. An emergency plan should always be prepared for the event of ventilation failure (power failure, for example) or other unexpected occurrence such as fire or explosion in the hood.

C. Personal Protective Equipment. Lab workers must, at a minimum, wear lab coats and safety glasses in the laboratory. Additional protective equipment may also be required. Shorts and sandals may not be

worn into the lab even under a lab coat. Personal protective devices are to be used only where engineering and administrative controls cannot be used or made adequate, or while controls are being instituted.

1. Engineering and administrative controls to reduce or eliminate exposures to hazardous chemicals include: substitution of a less hazardous substance; substitution of less hazardous equipment or process (e.g., safety cans for glass bottles); isolation of the operator or the process; local and general ventilation (use of fume hoods); hazard education; job rotation.

2. The SDS and Standard Operating Procedure/Lab Rules will list the personal protective equipment recommended for use with the chemical. The SDS addresses "worst case" conditions. Therefore, not all of the equipment shown may be needed for a specific job. The employer must provide appropriate personal protective equipment to employees.

D. Eye Protection. Eye and face protection must be worn whenever its use will reduce or eliminate injury. It is recommended that eye protection be worn in the laboratory whenever chemicals are in use. The need for adequate eye protection is fundamental to the use of chemicals, including housekeeping materials such as wax strippers, detergent and toilet bowl cleaners, and operations such as grinding, drilling, sawing with power tools. Eye protection, and at times face protection, is required wherever the potential for eye injury exists.

1. Areas where eye protection must be worn are laboratories, glass cleaning and glassblowing shops, and machine shops or any area where active or automated work with chemicals is conducted. Eye protection is required for all personnel and visitors in these areas. No personnel may enter laboratories where chemicals are being handled or automated processes are in operation without eye protection. Ordinary (street) prescription glasses do not provide adequate protection. Contrary to popular opinion, these glasses cannot pass the rigorous test for industrial safety glasses. Adequate safety glasses must meet the requirements of the standard Practice for Occupational and Educational Eye and Face Protection (ANSI Z.87.1 1989) and must be equipped with side shields.

2. Safety glasses with side shields do not provide adequate protection from splashes, therefore, when the potential for a splash hazard exists other eye protection and/or face protection must be worn. Splash goggles (acid goggles) with splash proof sides or a face shield must be used when protection from a chemical splash is needed. Face shields afford protection to the face and neck. Face shields must be worn if there is an explosion or implosion (pressure or vacuum) hazard and when transferring cryogenic liquids. Special eye protection is available for protection against laser, ultraviolet (UV), welding and brazing, or intense light sources.

3. Managers, supervisors, and principal investigators should refer to the appropriate College Standard Operating Procedure to determine the type(s) of eye and/or face protection necessary.
Eye protection must be made available to employees, students and visitors, at no cost to them, when the potential for eye injury exists. If you have any questions regarding the selection of appropriate face protection, call the Safety Office.

E. Lab Coats. Lab workers must wear lab coats while in a lab where chemicals are being handled. Lab coats should not be worn outside of the lab. The employer (principal investigator) must provide lab coats and lab coat laundering services at no cost to all employees who work in the lab. Shorts and sandals should not be worn under a lab coat.

F. Glove Selection. Disposable nitrile gloves provide adequate protection against accidental hand contact with small quantities of most laboratory chemicals. These gloves provide a non chemical resistant barrier between the worker's hand the reagent. Lab workers who contaminate their gloves should immediately removed them, wash their hands and don new gloves. Gloves should not be worn outside of the lab. Latex gloves are not recommended for laboratory use. Lab workers should contact SAFETY OFFICE for advice on chemical resistant glove selection when direct or prolonged contact with hazardous chemicals is anticipated. The selection of the proper glove requires knowledge of the health and physical hazards of the chemical that is used; familiarity with the glove manufacturer's test data (permeation rate and breakthrough

time) and the length of the hand exposure. Lab workers should not select chemical resistant gloves based on data from generic selection charts.

G. Use of Respirators. If your work requires the use of a respirator, you must receive special training from SAFETY OFFICER. Do not use respiratory protective equipment until you have received proper training. Respirators are designed to protect only against specific types of substances and in certain concentration ranges, depending on the type of equipment used. Never use a respirator unless you have been assigned one and have been trained and fit tested by the Office of Safety. Respirator selection is based on the hazard and the protection factor required. Types of respiratory protective equipment include: particle-removing air purifying respirators (N95, N100); gas and vapor-removing air purifying respirators; air supplied respirators. You should familiarize yourself with the limitations of each type of respiratory protective equipment used and the signals for respirator failure (odor breakthrough, filter clogging, etc.). Respirators are not to be used except in conjunction with a written respiratory protection program.

H. Designated Areas. All locations within the laboratory where acutely toxic, carcinogenic, or reproductive hazards are handled should be demarcated with designated area caution tape. Alternately the lab worker may write designated area on yellow tape and use that. Areas that should be designated include all fume hoods, sinks and bench tops where the acutely toxic, carcinogenic, or reproductive hazards are handled. The tape should be used in the same manner as radiation caution tape; the lab worker may designate an area only during the time the chemical is used and then remove it or may permanently designate an area and leave the tape in place.

I. Other Protection of the Body. Skin and body contact should not occur during routine lab operations that involve small quantities of laboratory chemicals. Any lab activity that is anticipated to result in body contact must be evaluated by SAFETY OFFICE. Lab staff must wear lab coats when handling hazardous chemicals to prevent against body contact that may result from accidental spills and splashes. Chemical protective clothing in the form of disposable work suits should be provided for the rare instances where body contact is anticipated or when extremely toxic chemicals are handled. Special attention must be given to sealing all openings in the clothing. Tape can be used for this purpose. Caps should be worn to protect hair from contamination. Selection of the protective clothing shall be made by SAFETY OFFICER.

VI. Chemical Storage and Transportation. Carefully read the label before storing a hazardous chemical. The SDS will also provide any special storage information and incompatibilities.

A. Segregation. Do not store unsegregated chemicals in alphabetical order or incompatible chemicals in close proximity to each other. The amount of space that can be placed between different chemical classes depends on the amount of storage area available in the lab suite. Do not segregate chemical classes into separate rooms unless they will only be used in that room. Segregation that disrupts normal work flow or requires more frequent transport of chemicals between labs will increase the probability of a chemical spill. Use common sense in planning chemical storage areas. Store dry reagents, liquids reagents and solutions and compressed gases in separate areas. Within each of these chemical forms segregate into hazard classes.

1. Segregate dry reagents as follows:
    a. oxidizing solids
    b. flammable solids
    c. water reactive solids
    d. all others solids
2. Segregate liquid reagents and solutions as follows:
    a. acid liquids

b.caustic liquids

c. oxidizing liquids

d. perchloric acid solutions

e. flammable or combustible liquids

f. all other liquids

3. Segregate compressed gases as follows:

a. toxic gases

b. flammable gases

c. oxidizing and inert gases

4. Once separated into hazard classes, chemicals may be stored alphabetically. Use approved storage containers and safety cans for flammable liquids. Use spill trays under containers of strong corrosive reagents. Do not store liquids above eye level. Dispose of old chemicals promptly. See waste disposal section of this manual. Ensure that all containers are properly labeled. For more information on chemical storage, contact your supervisor, instructor, or SAFETY OFFICE.

B. Chemical Storage Outside the Lab. All storage cabinets located in hallways must be placarded with the name of the owner and also with identification of the cabinets contents. This information is critical for emergency personnel who may respond in the evening The principal investigator must complete a Hallway Storage Sign Form (Appendix G) for each cabinet located in a hallway.

C. Flammable and Combustible Liquid Storage. Storage of flammable and combustible liquids in a laboratory, shop, or building area must be kept to the minimum needed for research and operations. When large quantities of flammable liquids are present in a lab they must be stored in a flammable-liquids storage cabinet. Flammable-liquids storage cabinets are not intended for the storage of highly toxic materials, acids, bases, compressed gases or pyrolytic chemicals.

1. Flammable Liquids. Storage in a Cabinet. Storage cabinets shall be designed and constructed to limit the internal temperature to not more than 325°F when subjected to a 10-minute fire test using the standard time temperature chart set forth in NFPA 251. All flammable-liquids cabinets shall be labeled in conspicuous letters "Flammable - Keep Fire Away." Storage cabinets shall be constructed of at least No. 18 gauge sheet iron and shall be double walled with 1-1/2 inch air space. Joints shall be riveted, welded, or made tight by some equally effective means. The door shall be provided with a three point lock, and the door sill shall be raised at least 2 inches above the bottom of the cabinet. All flammable liquid storage cabinets must be grounded. A ground cable of 3/8" copper braid or a 12 gauge copper conductor can be used. The ground must be tested and resistance to ground cannot exceed one megohm. The grounding cable must be connected to a building structural member or an electrical building ground. Due to increased use of plastic piping, (which breaks the ground) water pipes must not be used for grounding. The NFPA Technical Committee on General Storage of Flammable Liquids considers that providing vents to storage cabinets reduces the limited fire protection provided by such cabinets because a single walled duct will transmit heat faster than a double-walled cabinet. Ventilation of storage cabinets is recommended only when highly odoriferous conditions exist. Ventilation requires a steel duct and an appropriate exhaust fan discharging to a appropriate location outside the building. All chemical storage in cabinets must be compatible.

a. No more than 60 gallons of a Class I flammable liquids (flash point below 100°F) or Class II combustible liquids (flash point between 100 to 140°F) may be stored in a flammable-liquids storage cabinet.

b. No more than 120 gallons of a Class III combustible liquid (flash point between 140°F and 200°F) may be stored in a flammable-liquids storage cabinet.

2. Storage Outside of a Cabinet. Storage of flammable liquids outside of a storage cabinet should avoided when possible. Flammable liquids that are not in use should be stored in an appropriate cabinet. The maximum quantity of flammable liquids permitted to be stored in a laboratory outside of a flammable-liquids cabinet varies depending on the design of the research building. The maximum permissible quantity will be determined on a case-by-case basis by the Offices of Fire and Occupational Safety and the Safety Office. Flammable liquids should not be stored in refrigerators unless it is UL approved for flammable liquid storage. Storage of flammable liquids in household grade refrigerators is a fire hazard. Household grade refrigerators should be labeled: "No food or flammable liquid storage".

D. Chemical Stability. Stability refers to the susceptibility of the chemical to dangerous decomposition. Ethers, and olefins form peroxides on exposure to air and light. Since these chemicals are packaged in an air atmosphere, peroxides can form even though the containers have not been opened. Write the date received and date opened on all containers of ether. Unless an inhibitor was added by the manufacturer, closed containers of ether should be discarded after 1 year. Open containers of ether should be discarded consistent with the Class B peroxide forming compounds. . The following are examples of materials that may form explosive peroxides:

Note: The chemical containers must be dated with the receiving person's initials. The chemical container(s) must be dated when opened. The chemical container of materials that may form peroxides must be used or sent for off site disposal before the expiration date.

Materials that May Form Explosive Peroxides.	
acetal decahydronaphthalene dicyclopentadiene diethylene glycol dioxane ethyl ether isopropyl ether tetrahydrofuran vinyl ether	cyclohexene diacetylene diethyl ether dimethyl ether divinyl acetylene terahydronaphthalene methyl acetylene vinylidene chloride ethylene glycoldimethylether (glyme)

E. Shock Sensitive Chemicals. This refers to the susceptibility of the chemical to rapidly decompose or explode when struck, vibrated or otherwise agitated. Some chemicals become increasingly shock sensitive with age. Write the date received and date opened on all containers of shock sensitive chemicals. Unless an inhibitor was added by the manufacturer, closed containers of shock sensitive materials should be discarded after 1 year. Open containers of shock sensitive materials should be discarded within 6 months of opening. The label and MSDS will indicate if a chemical is shock sensitive. Wear appropriate personal protective equipment when handling shock sensitive chemicals. The table below lists materials that can be shock sensitive.

Materials that May be Shock Sensitive. This list is not all inclusive. Review the material safety data sheet for reactivity information concerning the chemicals you use.		
acetylides of heavy metals ammonium perchlorate copper acetylide	aluminum ophorite explosive ammonium picrate	amatol ammonium salt lattice cyclotrimethylenetrinitramine

dinitroglycerine dipicryl sulfone fulminate of silver germane hexite hyrazoic acid lead salts mercury tartrate nitrated polyhydric alcohol nitroglycol organic amine nitrates picratol potassium nitroaminotetrazole sodatol syphnic acid trinitroanisole trinitronaphthalene tritonal	cyanuric triazide dinitrophenol dipicylamine fulminating gold guanyl nitrosamino guanyltetrazene hexanitrodiphenyl-amine lead azide lead styphnate mononitrotoluene nitrogen trichloride nitroguanidine organic nitramines picric acid silver acetylide sodium amatol tetrazene trintrobenzene trinitrophenetol urea nitrate	dinitrophenolates erythritol tetranitrates fulminating mercury guanyl nitrosamino guanylidene hydrazine hexanitrostilbene lead mannite magnesium ophorite nitroaminotetrozole nitrogen tri-iodide nitroparaffins organic peroxides picryl chloride silver azide sodium dinitro-ortho-cresolate tetranitrocarbazole trinitrobenzoic acid trinitrophloro-glucinol
ammonal butyl tetryl cyclotetramethylenetranitramine dinitrophenyl hydrazine explosive mixtures fulminating platinum guanylidene hexogen lead mononitro-resorcinate mannitol hexanitrate nitrated carbohydrate nitroglycerin nitronium perchlorate picramic acid picryl fluoride silver styphnate sodium nitrate-potassium explosive mixtures tetrytol trinitrocresol trinitrotoluene	ammonium nitrate calcium nitrate dinitroethyleneurea dinitrotoluene fulminate of mercury compounds gelatinized nitrocellulose heavy metal azides hydrazinium nitrate lead picrate mercury oxalate nitrated glucoside nitroglycide nitrourea picramide polynitro aliphatic compounds silver tetrazene sodium picramate trimonite trimethylolethane trinitroresorcinol	

F. Designated Areas. All locations within the laboratory where acutely toxic, carcinogenic, or reproductive hazards are stored should be demarcated with designated area caution tape. Storage areas should be segregated from other chemical storage as space permits. Do not segregate chemicals into separate rooms. This will increase the need to transport the chemical and increase the risk of a spill.

G. Compressed Gases. Carefully read the label before using or storing compressed gas. The MSDS will provide any special hazard information. Always use the minimum size cylinder required to perform the work.

1. Cylinders of compressed gases must be handled as high energy sources. When storing or moving a cylinder, have the cap securely in place to protect the stem. Use suitable racks, straps, chains or stands to support cylinders. Compressed gas cylinders pose a crush hazard to hands and feet. Do not expose cylinders to temperature extremes.

2. Do not store cylinders or lecture bottles with the regulator in place. If the regulator fails, the entire contents of the gas cylinder may be discharged. Always use the correct regulator. Do not use a regulator adapter. Oil or grease on the high pressure side of an oxygen cylinder can cause an explosion. Do not lubricate an oxygen regulator.

3. Cylinders of toxic, flammable or reactive gases should be stored and used in a fume hood or with local ventilation.

4. Never bleed a cylinder completely empty. Leave a slight pressure to keep contaminants out. Always wear safety glasses when handling compressed gases.

5. Flammable Gas Cylinders. The storage of flammable gas cylinders is limited to two (2) type 1 (10" x 50") cylinders per 500 square feet of unsprinklered laboratory space. Liquefied flammable gas containers should be limited to two (2) 9" x 30" cylinders per 500 square feet of unsprinklered laboratory space or three (3) 9" x 30" cylinders per 500 square feet of sprinkled laboratory space.

H. Transportation and Storage of Chemicals. The transportation of hazardous chemicals in laboratory buildings provides the greatest potential for chemical exposure to the building occupants. Spills occurring outside store rooms and laboratories may lead to hazardous concentrations of vapors and gases being distributed throughout the building. The following guidelines should be observed when transporting chemicals outside the laboratory:

1. Elevators may be used to transport hazardous materials in H building. The chemicals should be in closed containers and in secondary containment during transportation. If a spill occurs in the elevator, notify the Lab Supervisor and/or the EHSO,

2. Flammable Liquids. Flammable liquids shall be transported in rugged pressure-resistant safety containers. Original containers of flammable liquids shall be placed in an outside container or acid-carrying bucket. No more than 5 gallons of flammable liquids in glass containers shall be transported on the elevator unless the original shipping carton (box) is used and the materials are on an appropriate cart.

3. Corrosives or Oxidizing Materials. Original glass shipping containers holding liquid acids and bases must be placed in an outside container or acid-carrying bucket.

4. Incompatible chemicals, for example chromic acid (oxidizing acid) and ethyl acetate (flammable liquid), should not be transported on the same cart unless they are in original shipping cartons and physically separated.

5. Water Reactive Chemicals. Wherever possible, use the original outside shipping containers (packaging) when transporting water reactive chemicals. Once opened, water reactive chemicals must be placed in a rigid outside container or acid carrying bucket for transporting.

6. Pyrophoric (spontaneously igniting) Substances. Whenever possible, the original outside shipping container (packaging) must be used to transport pyrophoric substances. Once opened, pyrophoric substances must be placed in a rigid outside container or acid carrying bucket for transporting.

7. Acutely Toxic Compounds (See list Appendix B). Whenever possible, the original outside shipping container (packaging) must be used to transport acutely toxic compounds. Once opened, acutely toxic compounds must be placed in a rigid outside container or acid carrying bucket for transporting.

8. General chemicals, substances and research materials must be clearly labeled with the correct chemical name when transported. Hand-written labels are acceptable; chemical formulas and structural formulas are not acceptable (except for small quantities of compounds synthesized in the laboratory). Carts used for chemical transport must have sides, on each shelf, that are high enough to retain the containers. Cart wheels must be large enough to prevent the carts from being caught in floor cracks, and door and elevator thresholds.

9. Personnel transporting chemicals must wear disposable gloves and safety glasses.

VII. Room Signs. Each laboratory has a room sign that provides safety information to visitors, occupants, and emergency response personnel. The Faculty using the room is responsible for assuring that appropriate warning information is included on this sign. Signs will be made by the Safety Officer.

A.. Sign Sections. The sign is composed of four sections. Section one contains the room number and department name. Section two includes the names of the researchers. Section three provides warning information to visitors and housekeeping personnel. Section four provides safety department phone numbers.

B. Special Labels. Special labels are available that are placed into the boxes of this section. The labels contain icons alerting the reader that one of the following conditions exists inside the laboratory: CAUTION-BIOHAZARD; CAUTION-DESIGNATED AREA WITHIN; CAUTION-RADIOACTIVE MATERIALS; CAUTION-LASER; CAUTION-MAGNETIC FIELD.

C. Room Access. Students, faculty, staff and administrators shall not enter a designated area of a lab unless they are familiar with the facility or accompanied by an authorized user of the facility. Custodians are permitted to enter restricted or designated areas to perform routine tasks. However, labeled waste containers, other research equipment or materials, must not be handled. Other support services, such as: College Police, Physical Plant, Safety Personnel, etc., are permitted to enter a designated areas. Support services should avoid disturbing the following areas: fume hoods; biological safety cabinets; sinks; placarded equipment; chemicals or materials on laboratory benches. Support personnel shall contact an authorized user of the facility or SAFETY OFFICE before performing work that may involve any of the above items. Contact SAFETY OFFICE if emergency response or service is required in a designated area. Immediately report any unusual conditions to SAFETY OFFICE or College Police, such as: spills; leaks; fires; injury; contamination.

Figure 1 Laboratory Room sign

VIII. Laboratory Chemical Waste Management Guidelines.

A. Introduction. Excellence in research, education and environmental health and safety is of primary importance at Georgia Gwinnett College. In support of this activity, the SST Safety Officer provides for the proper disposal of hazardous waste. The College policy is zero tolerance for non-compliance with Environmental Regulations. The enclosed procedures must be followed to comply with rules from the U.S. Environmental Protection Agency (EPA) and the Georgia Department of Natural Resources, which regulate the disposal of hazardous wastes in a cradle-to-grave fashion.

B. General Guidelines. Potentially Hazardous chemicals must be disposed of in accordance with federal and state regulations and procedures established by SST SAFETY OFFICER. Your discipline may also have procedures that you are required to follow. Contact your supervisor, instructor or SAFETY OFFICER before discarding of any potentially hazardous chemical. The following guidelines will assist waste collection:

1. Unless you have written approval from SAFETY OFFICER, disposal of chemicals by way of the sanitary sewer system is prohibited.

2. To determine if the chemical you want removed from your laboratory or work area is a regulated hazardous waste contact SAFETY OFFICER, or consult the EPA regulation 40 CFR 261-Identification and Listing of Hazardous Waste.

3. All lab personnel must be familiar with the location and composition of all wastes produced in the lab.

4. Waste containers must remain closed except when actually adding waste. Open containers violate state and federal waste regulations.

5. For waste disposal pick-up, coordinate with your lab supervisor.

6. Disposal of radioactive materials and etiologic agents or cultures require special procedures. Contact SAFETY OFFICER before proceeding.

C. Satellite Accumulation Areas. These are locations within laboratories where chemical wastes are collected and properly stored until they are picked up by SAFETY OFFICER.

D. Hazardous Waste Defined. Hazardous materials have hazardous characteristics such as: flammable, corrosive, reactive, toxic, radioactive, poisonous, carcinogenic or infectious. In a general sense, these materials are considered hazardous because they present a potential risk to humans and/or the environment. A waste is any discarded material. By law a hazardous waste is defined as a waste, or combination of wastes, that because of its quantity, concentration, or physical, chemical or infectious characteristics may cause or significantly contribute to an increase in serious irreversible, or incapacitating reversible illness or pose a substantial present or potential hazard to human health, safety or welfare or to the environment when improperly treated, stored, transported, used or disposed of or otherwise managed. Hazardous waste management plans generally separate waste into three broad groups: radioactive, chemical and biological. This guide addresses only chemical waste. The EHSO for SST will make all waste determinations and manage the transportation and disposal of hazardous waste generated from the labs in SST.

1. Hazardous waste includes a wide range of material such as discarded commercial chemical products, process wastes and wastewater. Some chemicals and chemical mixtures are hazardous wastes because they are specifically listed by the EPA. Most of the common laboratory solvents are listed wastes. A chemical waste that is not listed by the EPA is still a hazardous waste if it has one or more of EPA's four hazardous characteristics: ignitablity, corrosivity, reactivity or toxicity.

2. A chemical waste is considered to be a hazardous waste if it is specifically listed by the EPA or DNR as a hazardous waste or if it meets any of the four hazardous characteristics below. If a chemical waste is not on the EPA list of hazardous wastes, and does not meet any of the hazardous waste characteristics, it is a nonhazardous waste. For complete definitions of hazardous characteristics of waste see the EPA regulation 40 CFR 261-Identification and Listing of Hazardous Waste.

a. Ignitable. A liquid which has a flash point of less than 60°C is an ignitable waste (e. g. Acetone, Methanol). A solid is an ignitable waste if it is capable of causing fire through friction or absorption of moisture, or can undergo spontaneous chemical change which can result in vigorous and persistent burning under standard temperature and pressure (e. g. Benzoyl Peroxide). A substance which is an ignitable compressed gas or oxidizer is an ignitable waste (e. g. Propane, Hydrogen Peroxide).

b. Corrosive. An aqueous solution which has a pH less than or equal to 2 or greater than or equal to 12.5 (e. g. Hydrochloric Acid, Ammonium Hydroxide),or is a liquid and corrodes steel at a rate greater than 6.35 mm per year at a test temperature of 55°C, is a corrosive waste.

c. Reactive. A reactive waste is a material that is normally unstable and undergoes violent chemical change without detonating, can react violently with water to form potentially explosive mixtures or can generate dangerous or possibly toxic gases, vapors or fumes in a quantity sufficient to present a danger to public safety, health or welfare or to the environment; or a material that is capable of detonation or explosive decomposition or reaction at standard temperature (e. g. Picric Acid, Potassium Cyanide, Lithium Aluminum Hydride).

d. Toxic. A waste that contains one of the constituents in concentrations equal to or greater than the values listed in EPA regulation 40 CFR 261-Identification and Listing of Hazardous Waste is a toxic waste.

3. Process wastes and discarded commercial chemical products. A hazardous waste can also be classified as either a process waste or a discarded commercial chemical product. This distinction is

important when manifesting and labeling. A process waste is any waste that, by virtue of some use, process or procedure, no longer meets the manufacturer's original product specifications. Examples of process wastes are chromatography effluents, diluted chemicals, reaction mixtures, contaminated paper, etc. A discarded commercial chemical product is the original (virgin) material, in the original container. Examples are small bottles of unused or outdated chemicals from laboratories, darkrooms, or service areas.

E. Requirements for Hazardous Waste Management in the Laboratory. Laboratories and other areas that generate hazardous waste are required to comply with the generator requirements of the Resource Conservation and Recovery Act (RCRA, CFR Title 40) and Georgia Department of Natural Resources. Every generator site (laboratory) is subject to inspection by the EPA and DNR. The steps necessary for compliance are summarized below.

1. Weekly Inspections. The EHSO is responsible for assuring this inspection is done weekly.
2. Segregation and Containment. The wastes must be separated by chemical compatibility groups. Each group of containers must be provided with appropriate secondary containment. All waste are managed by the EHSO. Additional information on compatibility is provided below.
3. Storage. Only one container per waste stream (type of waste) is allowed in a lab, i.e., one container for halogenated solvents, one container for non-halogenated solvents.
4. Closed Containers. All containers must be closed at all times except when actually adding waste.
5. Labeling. Reagents in their original containers with legible manufacturer's labels require no additional labeling or packaging. Each container must be labeled with Chemical Disposal Label. When the container is full place the date when full on the label. The SST EHSO will manage all aspects of waste management for SST.
6. Liquids (Small Quantities). Please ask is you need your own collection container if you generate small quantities (<1 L a week) of hazardous liquid waste. Collect this waste in a labeled, plastic screw top container. Do not use glass bottles.
7. Liquids (Large Quantities). SAFETY OFFICE provides white polyethylene 19 liter waste containers for labs that produce large volumes of compatible liquid wastes (See Figure 3). If your lab produces more than eight liters of any solvent mixture per month, call SAFETY OFFICE to request a container. Always attach a chemical waste label and circle the appropriate waste stream before using the container. This tag identifies the contents of the container. Do not write on 5gallon carboys with markers. Containers are reused and the markings cannot be removed. Leave two inches of empty space in the top of the 5 gallon container and ensure that the rubber gasket inside the lid is in place. This will prevent leaks during transportation.

Figure 3: 19 liter carboy with chemical waste label

8. Chemical Compatibility. The following chart is provided as a guide to segregating hazardous waste containers, it is not to be used for mixing chemicals. Containers of incompatible wastes must be stored in separate areas. Tubs are available from SAFETY OFFICE. Many hazardous wastes, when mixed with other waste or material, can produce effects which are harmful to human health and the environment, such as (1) heat or pressure, (2) fire or explosion, (3) violent reaction, (4) toxic dusts; mists, fumes, or gases, or (5) flammable fumes or gases. Below are examples of potentially incompatible wastes, waste components, and materials, along with the harmful consequences which might result from mixing material in one group with material in another group. The list is intended only as a guide to indicate the need for special precautions when managing these potentially incompatible waste materials or components. This list is not intended to be exhaustive. A laboratory director shall, as regulations require, adequately analyze his or her wastes so that he can prevent creating uncontrolled substances or reactions of the type listed below, whether they are listed below or not. In the lists below, the mixing of a Group A material with a Group B material might have the potential consequences as noted.

Chemical Compatibility Chart	
Group 1-A	**Group 1-B**
Alkaline Liquids	Acid Liquids
Potential consequences: Heat generation, violent reaction.	

Group 2-A	**Group 2-B**
Aluminum	Wastes in Group 1-A or 1-B
Beryllium	
Calcium	
Magnesium	
Sodium	
Other reactive metals and metal hydrides	
Potential consequences: Fire or explosion generation of flammable hydrogen gas	

Group 3-A	**Group 3-B**
Alcohols	Concentrated waste in Groups 1-A or 1-B
Water	Calcium
	Lithium
	Metal hydrides
	Potassium
	SO2Cl2, SOCl2, PCl3, CH3SiCl3
	Other water-reactive wastes
Potential consequences: Fire, explosion, or heat generation; generation of flammable or toxic gases.	

Group 4-A	**Group 4-B**
Alcohols	Concentrated Group 1-A or 1-B wastes
Aldehydes	Group 2-A wastes
Halogenated hydrocarbons	
Nitrated hydrocarbons	
Unsaturated hydrocarbons	
Other reactive organic compounds and solvents	
Potential consequences: Fire, explosion, or violent reaction.	

Group 5-A	**Group 5-B**
Spent cyanide and sulfide solutions	Group 1-B wastes
Potential consequences: Generation of toxic hydrogen cyanide or hydrogen sulfide gas.	

Group 6-A	**Group 6-B**
Chlorates	Acetic acid and other organic acids
Chlorine	Concentrated mineral acids
Chlorites	Group 2-A wastes
Chromic acid	Group 4-A wastes
Hypochlorites	Other flammable and combustible wastes
Nitrates	
Nitric acid, fuming	
Perchlorates	
Permanganates	
Peroxides	
Potential consequences: Fire, explosion, or violent reaction.	

9. Waste Minimization – A waste minimization plan is maintained in the SST EHSO office.

10. Training. All personnel who handle hazardous waste in laboratories will receive training on proper waste handling procedures and emergency response procedures. Initial training must be completed during the first six months of employment; refresher training is provided annually thereafter. Hazardous waste training will be conducted as part of the annual laboratory safety training. Additional training sessions can be arranged by calling SAFETY OFFICER.

11. Disposal of Unknowns. All chemicals must be identified and containers properly labeled at all times. Each laboratory director is responsible for seeing that this requirement is met in their laboratories. If an unknown chemical is discovered, label it as "unknown" and attach a note detailing any information about what the chemical may be or what experiment it may have been used for and where it was found. Contact SAFETY OFFICE for disposal. If you find any unlabeled chemical that has crystallized or there is any other indication that it may be unstable, DO NOT TOUCH IT! Contact SST EHSO.

12. Generally empty chemical containers are not considered hazardous waste. The container must be completely empty, that is all of the contents that can be removed by normal means must be removed and the residue must be less than 1%. The word "empty" must be written across the label. The container may then be disposed of in the regular trash. An exception to the above applies to containers that held chemicals listed by the EPA as "Acutely Hazardous Wastes". A complete list of the Acutely Hazardous Wastes can be found the EPA regulation 40 CFR 261-Identification and Listing of Hazardous Waste. Empty containers that formerly held any of these Acutely Hazardous Wastes in the pure unused form, not mixtures or spent material, must be disposed of as hazardous waste.

13. Mutagen Carcinogen Policy. Mutagens and carcinogens are used extensively in laboratories. A list of the most commonly used chemicals in this category is provided in the following table. (Remember this is not a comprehensive list.) Mutagen or carcinogen waste in solid form or concentrated solution is hazardous chemical waste and must not be thrown in the trash or down the drain. Call the Safety Office to arrange for pick-up of your hazardous waste or if you need more information.

14. Segregate and store your waste as follows:

a. Solutions. Do not discard non-aqueous solutions down the drain. Place all waste in a suitable container provided by the SST EHSO.

b. Solids (gloves, centrifuge tubes, towels, etc.) that are contaminated but can be thrown in the garbage ask the Safety Officer.

c. Gels. Ethidium bromide gel waste (low concentration, < 10 ug/ml) may be wrapped in plastic wrap and discarded in the biomedical waste. For disposal information on other mutagen/carcinogen gel waste, call SAFETY OFFICE.

Common Gel Chemicals			
Chemical	**CAS Number**	**Chemical**	**CAS Number**
1,2-Dibromo-3-chloropropane	96-12-8	2-Aminofluorene	153-78-6
1,1-Dimethylethylenimine		Benz[a]anthracene	56-55-3
Ethylenedibromide	106-93-4	Benzo[a]pyrene	50-32-8
Propylenimine	75-55-8	Chlorambucil	305-03-3
Ethionine	67-21-0	Cycasin	14901-08-7
3'-methyl-4-amino-azobenzene		Diazomethane	334-88-3
Urethane	51-79-6	Dibenz[a,h]anthracene	53-70-3
Bromoethylmethanesulfonate		7,12-Dimethylbenz[a]anthracene	57-97-6
Chloromethylmethylether	107-30-2	4-Dimethylaminazobenzene	60-11-7
Diepoxybutane	1464-53-5	3-3'-Dimethylbenzidine	612-82-8
Dimethyleaminobezene	60-11-7	1,4-Dinitrosopiperazine	140-79-4
1,1-Dimethylhydrazine	57-14-7	N-Hydroxy-2-acetylaminofluorene	
1,2-Dimethylhydrazine	540-73-8	3-Methylcholanthrene	56-49-5
Ethidium Bromide	1239-45-8	4,4'-Methylenebis(2-	101-14-4

		chloroaniline)	
Ethylmethanesulfonate	62-50-0	Methyazomethyl acetate	5926-62-1
Hydrazine	302-01-2	1-Methyl-3-nitro-1-nitrosoguanidine	70-25-7
Methylhydrazine	60-34-4	1-Naphthylamine	
Methylmethanesulfonate	66-27-3	N-[4-(5-Nitro-2-furyl)-2-thiazoyl]-formamide	
N-Nitorsodiethylamine	55-18-5	N-Nitroso-N-ethylurea	
N-Nitrosodimethylamine	62-75-9	N-Nitroso-N-methylurea	684-93-5
N-Nitrosodi-n-butylamine	924-16-3	4-Nitroquinoline-1-oxide	56-57-5
N-Nitrosodi-n-propylamine	621-64-7	Procarbazine	366-70-1
N-Nitroso-N-ethylurethane		1,3-Propanesultone	1120-71-4
N-Nitroso-N-methylurethane	615-53-2	m-Toluenediamine	95-80-7
N-Nitrosopiperidine	100-75-4	Uracil mustard	66-75-1
Polychlorinatedbiphenyls	11141-16-5	4-Aminobiphenyl	92-67-1
ß-Propiolactone	57-57-8	Benzidine	92-87-5
N-Acetoxy-2-acetylaminofluorene		3,3'-Dichlorobenzidine	91-94-1
2-Acetylaminofluorene	53-96-3	3,3'-Dimethoxy-benzidine	20325-40-0
Aflatoxins-	1162-65-8	2-Naphthylamine	91-59-8
Methylnitrosourea			
17ß-estradiol			
ø-Aminoazotoluene	97-56-3	4-Nitro-biphenyl	

IX. Material Safety Data Sheets are now Safety Data Sheets..

A. General. The safety data sheet (SDS) is the hazard communication tool that provides details on all important aspects of chemical use, handling, and storage. Review both the appropriate Standard Operating Procedure and the SDS when working with a chemical for the first time or when training staff. The Safety Office maintains SDSs for all chemicals used in SST at the College. The OSHA Hazard Communication standard (29 CFR 1910.1200) requires manufacturers to provide SDSs at no cost. Information is divided into sixteen sections. Some SDSs may not contain all sixteen sections or the information may be in a slightly different order. However, the basic information described above must be provided. Some SDSs are more complete than others. Do not assume everything you need to know is contained on the SDS. Do not assume if a section is left blank that there is no risk.

B. SDS Format is covered in the right to know training and because we do not generate SDS will be skipped at this time.

X. Chemical Spills.

A. General Information. Anticipate spills by having the appropriate spill cleanup equipment on hand. If a spill occurs immediately alert personnel in the area and do what is necessary to protect life. Confine the spill if possible. Call for assistance if the spill is large; a threat to personnel, students or the public; corrosives, highly toxic, or reactive chemicals. If there is the slightest doubt how to proceed, do not hesitate to call for assistance. For specific spill cleanup information, contact your supervisor, instructor, or SAFETY OFFICE.

B. Spill Cleanup Supplies. Spill of chemicals that do not pose a fire, toxic, or corrosive hazard, may be cleaned up by the laboratory workers that are 24 hour HAZWOPER trained.

1. Use an absorbent material that will neutralize the spill if available. Examples of spill cleanup materials include: trisodium phosphate; sand; sodium bicarbonate for acids; powdered citric acid for bases; "Oil-Dri","Zorb-All","Speedi-Dri"; paper towels. A dustpan and brush should be used and rubber gloves and goggles should be worn during the cleanup. Decontaminate area with soap and water after clean-up. Place residue in a container for waste collection. Contact your supervisor, instructor or SAFETY OFFICE for disposal information.

2. Notify all personnel in the area if a flammable, carcinogenic, reactive, toxic, or reproductive hazard is spilled. Extinguish flames and all other sources of ignition (such as brush-type motors.) Maintain fume hood ventilation, vacate the area and call for assistance.

C. Hazardous Spills. You must use great care in clean up of any chemical spill. Contact one of the lab supervisors or part time techs in SST. They are all 24 hr. Hazwoper trained.

XI. Medical Consultation. Employees and students must notify their immediate supervisor or instructor of all illness and injuries related to exposure to hazardous chemicals. Contact your supervisor, instructor, or SAFETY OFFICE if you have any questions regarding the procedure for treating a non-serious injury or illness. If the emergency requires an ambulance, dial 911. Do not move a seriously injured person unless they are in further danger. If an ambulance is not required, report to the Public Safety Division for further instructions.

Section XII. Personal Contamination. Do what is necessary to protect life. Remain calm. Do not move an injured person unless they are in further danger. A blanket should be used immediately to protect the victim from shock and exposure. Get medical attention promptly by calling 911.

A. Chemical Spilled Over a Large Area of the Body. Quickly remove all contaminated clothing while using the safety shower or other available source of water. Immediately flood the affected body area in cold water for at least 15 minutes. Wash off chemical with water but do not use neutralizing chemicals, unguents, creams, lotions, or salves. Get medical attention promptly.

B. Chemicals on the Skin in Confined Areas. Immediately flush with cold water. If there is no visible burn, scrub area with warm water and soap. Remove all jewelry to facilitate removal of any residual material. If a delayed action is noted (often the next day), report immediately for medial attention and explain carefully what chemicals were involved. If the incident involves Hydrofluoric acid (HF), seek immediate medical attention. If there is any doubt, seek immediate medical attention.

C. Chemicals in the Eyes. Irrigate with plenty of cool water for at least 15 minutes. Simultaneously, check for and remove contact lenses. Get medical attention promptly.

D. Smoke and Fumes. Anyone overcome with smoke or chemical fumes should be removed to uncontaminated air and treated for shock. If certified, follow standard CPR protocols. Get medical attention promptly. Do not enter the area if a life threatening condition still exists, such as the presence of: oxygen depletion; explosive vapors; cyanide gas; hydrogen sulfide; nitrogen oxides; carbon monoxide.

E. Burning Clothing. Extinguish burning clothing by dousing with cold water or use emergency shower or the drop-and-roll technique. Remove contaminated clothing. If possible, send clothing with the victim. Wrap injured person to prevent shock. Get medical attention promptly.

F. Ingestion of Hazardous Chemicals. Identify the chemical ingested and 911. Wrap injured person to prevent shock. Provide the ambulance crew and physician the chemical name and any other relevant information.

XIII. Fire and Fire Related Emergencies.

A. Procedures. If you discover a fire or fire-related emergency, such as abnormal heating of material, hazardous gas leaks, hazardous material or flammable liquid spill, smoke, or odor of burning, immediately follow these procedures.

1.Activate the building alarm (fire pull station); if not available or operational, verbally notify persons in the building.
2. Dial 911.
3. Isolate the area and evacuate the building:
4. Shut down equipment in the immediate area (if possible).
5. Close doors to isolate the area.
6. Use a portable fire extinguisher to: assist oneself or another to evacuate, or control a small fire, if possible.
7. Identify yourself as the person who notified police and provide the fire or police teams with the details of the problem upon their arrival.
8. Evacuate the building.
9. Move away from the building to a designated area and stay clear of driveways, sidewalks and other means of access to the building. Do not reenter the building until directed to do so. Follow any special procedures established for your unit.
10. If you are a supervisor account for your employees and report any missing persons to the emergency personnel at the scene. Assist emergency personnel as may be requested.

B. Special Hazard Information. Specific hazard information you may know is essential for responding personnel. Be prepared to inform responders as required.

XIV. Industrial Toxicology Overview. Toxicity is the ability of a chemical molecule or compound to produce injury once it reaches a susceptible site in or on the body. Toxicity hazard is the probability that injury will occur considering the manner in which the substance is used.

A. Dose-Response Relationships. The potential toxicity (harmful action) inherent in a substance is manifest only when that substance comes in contact with a living biological system. A chemical normally thought of as "harmless" will evoke a toxic response if added to a biological system in sufficient amount. The toxic potency of a chemical is defined by the relationship between the dose (the amount) of the chemical and the response that is produced in a biological system.

B. Routes of Entry into the body.

1. There are three main routes by which hazardous chemicals enter the body:
    a. Absorption through the respiratory tract through inhalation. This is most important in terms of severity.
    b. Absorption or injection through the skin (chemicals dissolved in dimethyl sulfoxide (DMSO) pose a serious skin absorption hazard. DMSO greatly increases the transport of solute through the skin) or eyes.
    c. Absorption through the digestive tract. This can occur through eating or smoking with contaminated hands or in contaminated work areas.
2. Most exposure standards, Threshold Limit Values (TLVs) and Permissible Exposure Limits (PELs), are based on the inhalation route of exposure. They are normally expressed in terms of either parts per million (ppm) or milligrams per cubic meter (mg/m^3) concentration in air. If a significant route of exposure for a substance is through skin contact, the MSDS will have a "skin" notation. Examples include: pesticides, carbon disulfide, phenol, carbon tetrachloride, dioxane, mercury, thallium compounds, xylene, hydrogen cyanide.

C. Health Effects. Impact on health is generally categorized based on the types of exposures.

1. Acute poisoning is characterized by rapid absorption of the substance and the exposure is sudden and severe. Normally, a single large exposure is involved. Examples: carbon monoxide or cyanide poisoning.
2. Chronic poisoning is characterized by prolonged or repeated exposures of a duration measured in days, months or years. Symptoms may not be immediately apparent. Examples: lead or mercury poisoning and pesticide exposure.
3. Local refers to the site of action of an agent and means the action takes place at the point or area of contact. The site may be skin, mucous membranes, the respiratory tract, gastrointestinal system, eyes, etc. Absorption does not necessarily occur. Examples: strong acids or alkalis.
4. Systemic refers to a site of action other than the point of contact and presupposes absorption has taken place. For example, an inhaled material may act on the liver. Examples: arsenic affects the blood, nervous system, liver, kidneys and skin; benzene affects the bone marrow.
5. Cumulative poisons are characterized by materials that tend to build up in the body as a result of numerous chronic exposures. The effects are not seen until a critical body burden is reached. Examples: heavy metals.
6. Synergistic responses occur when two or more hazardous material exposures occur the resulting effect can be greater than the effect of the individual exposures. This is called a synergistic or potentiating effect. Example: exposure to both alcohol and chlorinated solvents.

D. Other Factors Affecting Toxicity. Rate of entry and route of exposure; that is, how fast is the toxic dose delivered and by what means. Age can affect the capacity to repair tissue damage. Previous exposures can lead to tolerance, increased sensitivity or make no difference. State of health, physical condition, and life style, can affect the toxic response. Preexisting disease can result in increased sensitivity. Environmental factors such as temperature and pressure may also affect the exposed individual as well as host factors including genetic predisposition and the sex of the exposed individual.

XV. Notices to Employees. The College is required to advise you of your rights regarding the Hazard Communication Standard, Personal Protective Equipment Standard and Occupational Exposure to Hazardous Chemicals in the Laboratory. This manual meets these requirements in part. In addition, a standard OSHA "Notice to Employee" poster will be posted at locations where notices are normally posted. It is to your advantage to know your rights. Take time to read the "Notice to Employee" form posted in your work area.

A. Employee Rights. Employees who may be exposed to hazardous chemicals have access to the following information where appropriate: chemical exposure information; workplace chemical lists; material safety data sheets. In addition, employees and students shall receive training on the hazards of chemicals and on the measures they can take to protect themselves from those hazards. Employees have the right to file a complaint against the College regarding alleged violations of the Hazard Communication Standard or Chemical Hygiene Plan. If you file a complaint, the Act protects you from: discharge; discipline; discrimination; loss of pay, position, seniority or benefits. Alleged violations of the OSHA standard should be referred to your supervisor, instructor, or the Office of Safety. However, you always have the right to file a complaint with the Occupational Safety and Health Administration (OSHA).

B. Protective Equipment. The employer must assess the workplace to determine if hazards are present, or are likely to be present, which necessitate the use of personal protective equipment. The EHSO fulfills this responsibility by completing a Chemical Hygiene Work Plan as described in Section II of this document. The faculty and EHSO is responsible to select and provide employees with routine personal protective equipment appropriate for laboratory work (e.g. lab coats, disposable gloves, safety glasses, face shields and other similar items along with laundry facilities or service for lab coats). Students may be required to purchase common items such as laboratory aprons or goggles. The faculty in consultation with the SST Office of Safety will select non routine personal protective equipment such as respirators, chemical protective gloves, and chemical protective clothing. Principal Investigators shall assure that training in the use of routine laboratory personal protective equipment is provided. This training is provided through attendance of the program "Laboratory Safety at GGC", provided by the Office of Safety and through laboratory specific training provided by the Principal Investigator. The Safety Office in conjunction with the Principal Investigator will provide training in the use of non routine personnel protective equipment.

C. Educational Programs. Upon appointment, the College will provide an education and training program for employees using or handling chemicals. Additional instruction is required whenever the potential for exposure to hazardous chemicals is altered or whenever new information concerning a chemical is received.

1. New or newly assigned employees must be provided training before working with, or in a work area containing hazardous chemicals. For students, training may be required for each course. Training programs shall include, as appropriate, the following:

    a. Interpreting labels and SDSs.
    b. Location of hazardous chemicals.
    c. A description of the acute and chronic effects of chemicals.
    d. Safe handling procedures.
    e. Personal protective equipment.
    f. Cleanup procedures.
    g. Waste disposal.

2. In an area or laboratory where a large variety of hazardous chemicals are stored or used, the College may substitute generic training for chemical specific training. The contents of this manual meet the requirements of 29 CFR 1910.1200, Hazard Communication Standard and 29 CFR 1910.1450, the Chemical Hygiene Plan.

3. The College is required to keep a record of training sessions provided to employees. This is accomplished with a data base notification to the RTK Coordinator.

XVI. Fact Sheets and Standard Operating Procedures.

A. Laboratory Fact Sheet. Flammable and Combustible Liquid Storage and Dispensing.

1. Description. Fire and explosion hazards of flammable liquids exist in research laboratories throughout the Georgia Gwinnett College. Research experimentation in chemistry and medicine, for example, require dispensing significant quantities of flammable liquids for distillation and liquid chromatography. The safe handling of these materials requires a basic understanding of the hazards and the steps needed to minimize them.

2. Flammable and Combustible Liquids. Flammable liquids are commonly divided into three classes.

Class	Flash Point	Boiling Point	Example
IA	Below 73°F	Below 100 °F	Ethyl Ether
IB	Below 73 °F	At or above 100 °F	Acetone, Benzene, Toluene
IC	At or above 73°F and below 100°F		Hydrazine and Styrene

3. Combustible Liquids. Combustible liquids are divided into three classes.

Class	Flash Point	Example
II	100-139 °F	Acetic acid, naptha and stoddard solvent
IIIA	140-199 °F	Cyclohexanol, formic acid and nitrobenzene
IIIB	200 °F or above	Formalin and picric acid

The flashpoint of a flammable liquid is the lowest temperature at which it can form an ignitable mixture with air and produce a flame when a source of ignition is present.

4. Static Electricity Hazards in the Laboratory. The flow of flammable and combustible liquids can cause the buildup of static electricity. When enough of a charge is built up a spark can result and potentially cause a fire or explosion. The likelihood of this happening is dependent upon how well the liquid conducts electricity, the flash point and the capacity to generate static electricity. Static electricity can be generated when liquid is transferred from one metal container to another. Liquids have the ability to generate static electricity when they move in contact with other materials during pouring, pumping or agitating. The build up of this static electricity can cause a spark to form where the solvent exits the container. This could result in a fire or explosion.

5. Procedures to Avoid Static Electricity.

To avoid the build up of static electricity that may cause a spark, it is important to bond and ground metal or special conductive plastic containers. Bonding eliminates the electrical potential between two containers therefore eliminating the likelihood of sparks. A bonding wire is connected to two conductive objects as metal drums.

Grounding eliminates the difference in static potential charge between the conductive object and ground. Grounding is accomplished by connecting the conductive object directly to the earth, usually using cold water copper pipes, building steel or grounding bus/bar. Bonding and grounding require good electrical connections. Remove any dirt, paint or rust ensuring metal to metal contact. Bonding and Grounding wires come in a variety of styles and lengths. They can be purchased through Fisher Scientific**:,** Justrite Manufacturing: and through Lab Safety Supply**.**

Static hazards may also exist in non-metallic plastic or glass containers that cannot be grounded. Static may be generated by the free fall and turbulence of the liquid being poured. To minimize this hazard, pour as slowly as possible and use a grounded nozzle extension that allows filling the container from the bottom.

6. Dispensing Flammable Liquids from 5 Gallon Pails.

Manual dispensing pumps for 5-gallon pails/cans are available. These pumps are specifically designed to dispense liquids into small laboratory-size bottles without spilling. If you are pouring into a conductive container, a bonding wire should be attached from the 5-gallon pail to the container being filled. The 5-gallon pail should be grounded.

Safety cans have self-closing air tight lids and a flame arrester that protects the contents from an external ignition source. Bonding and grounding is still required on safety cans since static electricity generation is possible. The nozzle provides a bonding path to a receiving metallic vessel. If either of the containers are non-metallic (conductive) it is still important to follow the limited velocity and grounded nozzle extension information given previously. Safety cans do not offer protection from heat when exposed to fire and should be stored in a flammable liquids storage cabinet when not in use.

7. Flammable Liquids Storage Cabinets. In most university laboratories flammable liquids storage is provided under the chemical fume hood in specifically designed vented cabinets. These cabinets are clearly marked "Flammable Storage". Flammable liquids storage cabinets are constructed to limit the internal temperature when exposed to fire. When additional storage is needed, NFPA 30-4.3.3 approved flammable liquids storage cabinet (FLSC) may be purchased. All containers of flammable liquids must be stored in a FLSC when not in use. The following requirements apply.

General Requirements. Cabinets shall be no larger than 45 gallon capacity; should be located near fume hood alcoves; shall be marked "Flammable-Keep Fire Away"

Biomedical Laboratories. Free standing cabinets in biomedical labs shall not be vented. Bungs shall be used to seal vent openings.

Physical Science Laboratories. Free standing cabinets may be vented into the fume hood exhaust system or a dedicated system for hazardous materials exhaust if present. Replacement air shall be ducted into the cabinet in such a way as not to compromise the specified performance of the cabinet. Venting details shall be submitted to the Safety Office for approval.

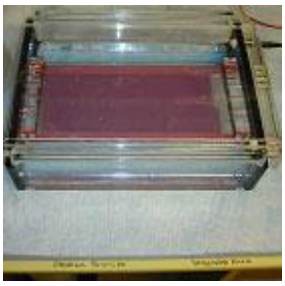
Grounding of Flammable Liquids Storage Cabinets. Flammable liquids storage cabinets are equipped with a grounding system that can be connected to a building ground. If you are pouring from a container in the storage cabinet and if the container being poured to is conductive then a bonding strap should be attached between them as explained in 'PROCEDURES TO AVOID STATIC ELECTRICITY' found above. Fisher Scientific and Grainger carry a wide variety of flammable liquids storage cabinets.

8. Personal Protective Equipment. Splash proof goggles in addition to standard laboratory personal protective equipment (PPE) consisting of a lab coat, closed toe shoes and nitrile gloves should be worn while pouring flammable liquids. Pouring larger volumes may require additional PPE consisting of thicker gloves and an apron. Follow your laboratory Standard Operating Procedures (SOP).

9. Emergency Procedures. In the case of a fire, call 911 from a college phone to reach Police/Fire, pull the fire alarm and leave the building. Make yourself available to the emergency responders. Follow your laboratory specific SOP for emergencies. An eyewash/safety shower must be nearby when dispensing flammable liquids.

B. Laboratory Safety Fact Sheet. Working Safely with Ethidium Bromide

1. Description.



Ethidium bromide, (Dromilac, homidium bromide), CAS # 1239-45-8, is commonly used in molecular biology laboratories for visualizing nucleic acids using electrophoresis and other gel-based nucleic acid separation methods. Ethidium bromide fluoresces when exposed to ultraviolet light and exhibits a vivid red-orange color when bound to nucleic acids.

2. Hazards. Ethidium bromide is a potent mutagen and is an irritant to the eyes, skin and respiratory tract. Ethidium bromide can be absorbed through exposed skin and mucus membranes.

3. Personal Protective Equipment.

Protective Clothing: Wear standard laboratory apparel including a fully-buttoned lab coat, long pants and closed-toe shoes.
Eye Protection: Wear safety glasses with side shields at all times within the laboratory. Wear chemical splash goggles when there is a splash hazard.
Gloves: Wear disposable nitrile gloves to protect exposed skin on the hands. Wash hands thoroughly after removing gloves.

4. Special Work Practices.

Locations where ethidium bromide is used or stored must be identified as "Designated Areas" and demarcated with either printed Designated Area tape available from the Safety Office or yellow tape with "DESIGNATED AREA" written upon it.

Procedures requiring the use of ethidium bromide powder or having the potential to generate aerosols must be performed in a fume hood. To minimize inhalation exposure, purchase ready-made stock solutions or tablets in lieu of preparing stock solutions from ethidium bromide powder.

During normal use, small spills may occur and residues may build up on equipment and other laboratory surfaces. A solution of soap and water is recommended for cleaning small spills and removing residues on equipment and laboratory surfaces.

Due to the potential for equipment contamination, ethidium bromide-containing agarose gel should not be heated in a microwave.

Since ethidium bromide is used in conjunction with an ultraviolet light source, please review the Ultraviolet Radiation Safety Fact Sheet.

5. Emergency Procedures.

Eye Contact: Immediately irrigate. Hold eyes open and irrigate for 15 minutes. Obtain medical attention.
Skin Contact: Remove contaminated clothing. Immediately wash affected areas with soap and water. Obtain medical attention.
Ingestion: Obtain medical attention immediately.
Inhalation: Seek medical attention if symptoms develop (wheezing, coughing, shortness of breath, burning in mouth, throat or chest).
Medical Attention: Report to the nearest hospital emergency room.

6. Ethidium Bromide Waste Disposal.

The gels should be disposed of in the biowaste container in the room. If a container is not available please contact a supervisor or EHSO

7. Sharps containers and broken glass

Contaminated sharps (needles, syringes, slides, broken glass, etc.): Discard in an infectious waste sharps container clearly labeled "Biomedical CONTAMINATED SHARPS-DO NOT AUTOCLAVE". Discard the sharps container as infectious waste without autoclaving when it is 2/3 to 3/4 full.

Solids (contaminated gloves, centrifuge tubes, towels, etc.): Store in a properly labeled translucent polyethylene container for disposal as biological waste. Do not use glass containers.

7. Spill Procedures.

Small spills of ethidium bromide solutions should be cleaned by laboratory staff. For large spills outside the fume hood, evacuate/restrict access to the laboratory and contact the Safety Office for assistance.

Laboratory Safety Fact Sheet. Phenol:Chloroform Extraction

1. Description. Phenol: Chloroform Extraction is a common laboratory technique used to separate proteins from nucleic acids. An equal volume of phenol: chloroform (50:50) is added to a nucleic acid sample. The mixture is centrifuged to separate the organic and aqueous phases. The organic phase is discarded. Ethyl ether is sometimes used to remove traces of chloroform.

2. Hazards.

Biological Hazards. There are no biological hazards associated with this procedure unless human source materials are used.
Chemical Hazards. Phenol is readily absorbed through the skin and can cause severe burns to the eyes and skin. Phenol has a local anesthetic effect, so that no pain may be felt on initial contact. Systemic effects include damage to the liver and kidneys.
Chloroform is a skin and eye irritant, and it is a suspected human carcinogen and reproductive hazard. Adding chloroform to phenol enhances the ability of phenol to be absorbed by the skin.
Ethyl ether is a mild skin and eye irritant. The primary hazard associated with ethyl ether is that it is extremely flammable and it forms explosive peroxides after prolonged exposure to light and air. When kept for prolonged periods after it has been opened, ethyl ether forms peroxides that may explode when the container cap is removed or when it is concentrated during laboratory activities. The plan is to use the ethyl ether prior to the expiration date or dispose of the material, off site as soon as, possible after the expiration date.
Refer to a material safety data sheet (MSDS) for more detailed information on these and other laboratory chemicals.
Equipment Hazards. Centrifugation may result in the formation of aerosols and droplets.

3. Special Work Practices. Perform all procedures involving greater than 500 ml of phenol or chloroform or any amount of ether in a chemical fume hood. Wash hands thoroughly immediately after working with these chemicals. Never eat, drink, chew gum, apply cosmetics, take medicine or store food in a laboratory where these chemicals are used and stored. Grasp both the tube and the cap when vortexing to prevent the cap from opening, causing a splash or aerosol. Use sealed safety cups when centrifuging phenol: chloroform, and wait at least 10 minutes before opening the centrifuge to prevent exposure to aerosols.

4. Personal Protective Equipment.

Eye Protection: Wear safety glasses when performing phenol: chloroform extraction, even when working in a fume hood. Phenol can cause severe burns to the eyes. Wear chemical splash goggles when there is a splash hazard (for example, when pouring phenol).

Gloves: Wear disposable nitrile gloves to protect against accidental hand contact. If accidental contact occurs, remove and discard contaminated gloves immediately. (The breakthrough time for a 4 mil nitrile glove is approximately 3 minutes for chloroform.)

Protective Clothing: Wear standard laboratory apparel. (Lab coat, long pants and closed toe shoes.)

5. Emergency Procedures.

Eye Contact: Immediately irrigate eyes at eyewash for 15 minutes, holding eyes open. Obtain medical attention.

Skin Contact: Immediately wash affected areas with soap and water. Remove contaminated clothing. Obtain medical attention.

Ingestion: Obtain medical attention immediately.

Inhalation: Seek medical attention if symptoms develop (wheezing, coughing, shortness of breath, burning in mouth, throat or chest).

Medical Attention – 911

6. Storage. Store ethyl ether in a flammable liquid storage cabinet. Store phenol away from strong oxidizers and store chloroform away from strong alkalis. Store chloroform in a dark location. Write the date received and the date opened on all containers of ether. Discard open containers of ether within six months of opening or expiration date.

7. Waste Disposal. Contact the SST Safety Officer to arrange for disposal.

8. Spill Procedures. Laboratory personnel should clean up small spills in the fume hood. Wear Viton or Silver Shield/4H gloves when cleaning up a spill. (Do not wear nitrile gloves due to the risk of direct or prolonged contact when cleaning up a spill.) Place absorbent materials used to clean up the spill in plastic bags and discard as hazardous waste. For spills greater than 500 ml outside a fume hood, evacuate the laboratory and contact the Safety Officer.

D. Laboratory Safety Fact Sheet. Cryogen & Dry-Ice Safety

1. Definitions.

Cryogen: A liquefied gas with a boiling point typically below 77 K (-196°C). The most commonly used cryogens are liquid nitrogen and liquid helium.
Dewar: an insulated container used to store and transport liquefied gases. It is insulated by a vacuum between its two walls and is equipped with pressure relief device(s).
Dry Ice: Frozen carbon dioxide. Dry ice sublimates from a solid to a gas at room temperature.
Pressure-relief devices: Devices on cryogenic systems in place to relieve pressure build up. These devices may be: (1) valves which open to relieve pressure, (2) bursting discs that break to relieve pressure and must be replaced or (3) loose-fitting lids on Dewar flasks.

2. Hazards Associated with Cryogens & Dry Ice.

Burns: Skin contact with a cryogen, dry ice or non-insulated equipment parts can cause cold burn and frostbite. Eye contact with a cryogen or dry ice can cause permanent damage. Always wear the proper PPE when working with or around cryogens and dry-ice.
Asphyxiation: NMR magnet quenching (the loss of superconductivity followed by the rapid release of gaseous cryogens) can result in an oxygen deficient atmosphere. The volumetric expansion rate from the liquid to gaseous phase ranges between 690 to 750 times. The use of dry ice in cold rooms can cause increased breathing, headache, dizziness, nausea and visual disturbances due to elevated carbon dioxide concentrations in the air. Dry ice can also cause asphyxiation in confined spaces.
Remember: You can not detect oxygen deficiency or over exposure to Carbon Dioxide. Always work with cryogens and dry ice in well ventilated spaces especially when filling dewars. If you are working in a small space, open a door to increase ventilation. Do not work with or store large quantities of dry ice in cold rooms.
Fire and Explosion Hazards: Liquid nitrogen and helium are not flammable. However they are capable of condensing oxygen out of the air creating an oxygen-rich environment. Flammable materials can ignite in the presence of condensed oxygen.
Dewars have an insulating vacuum space in between its double walls. If a dewar becomes damaged air or liquid can leak into the vacuum space. This will reduce its insulating properties and can greatly increase the pressure inside the dewar. Dewars and storage vessels are equipped with pressure-relief devices that prevent high pressure from developing (liquid nitrogen dewars have one valve and one bursting disc; liquid helium dewars have two valves and one disc, dewar flasks are equipped with loose-fitting lids or specially vented stoppers.) Air or liquid that leaks into a vacuum space can freeze. If the space is rapidly warmed after starting a transfer the pressure-relief valve will vent the gas that is generated, preventing an explosion. Never cover a pressure relief valve that is venting. Cyrotubes stored in liquid nitrogen may "explode" when removed from the dewar: Cyrotubes are not guaranteed to be leak tight if stored in liquid nitrogen. Because of the "super fluidity" of liquid nitrogen it can leak into sealed cyrotubes. When removed from the dewar the liquid nitrogen that leaked into the cryotube expands causing the tube to "explode". If you must store samples in liquid nitrogen wear cryogloves, face shield and safety glasses when removing samples.
Property Damage: Cryogens can damage rubber tubing and crack floor tiles if spilled. Special care should be taken to avoid spilling any cryogens. Cracked floor tiles may also present a tripping hazard to other workers. Notify your Building Administrator of any floor tiles that require repair.

3. Personal Protective Equipment (PPE). Laboratory personnel must always wear safety glasses and lab coats when working with cryogens, dry ice or around dispensing lines where cold burns may occur. The following PPE must be worn when filling dewars or removing specimens or samples from a dewar: Cryo-gloves; Face Shield; Safety goggles; Lab coat; Long pants. The following must be worn when handling dry ice: Cyro gloves; Lab Coat; Long Pants

4. Filling Dewars or Other Storage Vessels. Dewars and other storage vessels (e.g. cylinders) are available in a variety of shapes and sizes. Always use a dewar or storage vessel rated for the cryogen you are refilling or transporting. (Do not use styrofoam containers or thermos bottles for holding and transporting liquid nitrogen). Remove all metal jewelry from wrists and hands (a spill/splash could freeze

the jewelry to your skin). Always wear cryo-gloves when dispensing a cryogenic liquid. Available from Fisher Scientific; Catalog # 11-394-305. Note: Cryo-gloves only povide short-term protection against accidental skin exposures and are no designed to proect skin agains prolonged contact. Only fill a dewar from a transfer line that has a phase separator attached to the end of the line. Phase separators separate gas from liquid preventing an overabundance of gas from surrounding the end of the transfer line and allow only liquid nitrogen to fall into the dewar. When filling a dewar flask at a filling station, place the phase separator so that it rests on the bottom of the dewar. Do not allow the cryogen to splash into the dewar. Dispense directly into the dewar. Never use a funnel in the dispensing process. The funnel can freeze creating a splash hazard. Use stainless steel tubing to transfer cryogens. Never use rubber or plastic tubing. The temperature can cause rubber or plastic tubing to become brittle and crack, spraying the liquid onto surrounding surfaces. Never fill a dewar or storage vessel if the tubing is damaged. (Liquid helium must be transferred through a vacuum insulated tube because of its extremely low heat of vaporization.) Never overfill a dewar. This may cause liquid nitrogen to leak into the cryotubes stored in the dewar. Upon removal from the dewar, cryotubes may explode when the liquid nitrogen inside is warmed and expands. Never leave a filling process unattended.

5. Additional Safety Precautions. When cooling objects with liquid nitrogen lower them very slowly into the liquid using tongs to prevent boiling and splashing. Always use a CryoClaw to retrieve samples that have fallen into a dewar. (CryoClaw available from Fisher Scientiic; Caalog # 11-675-95). Be sure that all cryogen containers are clearly labeled with a cryogen warning and the cryogen's name. Always use appropriate glassware rated for use with cryogens. Do not overfill the dewar. Where possible only store cryogenic vials in the vapor phase of liquid nitrogen (above the liquefied gas). Do not store vials in the liquid phase. Always use an appropriate wheeled cart to transport a dewar or storage vessel. Never pull, push or roll a dewar or storage vessel. Training and special packaging is required when shipping samples on dry ice. Always read the Material Safety Data Sheet (SDS) for a cryogenic substance prior to working with it. If you work in an NMR laboratory and would like to receive more information on cryogens and high field magnet systems, please contact the Safety Office.

6. Injuries. If skin comes in contact with a cryogen or dry ice, run the area of skin under cool or warm water for fifteen minutes (do not use hot or cold water). If your finger is burned do not place it in your mouth. This could burn your mouth. Do not rub the area; rubbing can cause further tissue damage. Notify your supervisor and proceed immediately to your physician.

7. Emergencies. Do not attempt to clean up a spilled cryogen. If a large volume of gas is released, leave the area immediately and call the Safety Office. In the case of fire, leave the area immediately and dial 911 or 678-407-5330.

E. Laboratory Safety Fact Sheet. Ultraviolet Radiation Hazards.

1. Description. Ultraviolet light (UV) is non-ionizing radiation in the 180 to 400-nanometer wavelength region of the electromagnetic spectrum. The ultraviolet spectrum is commonly divided into the following three regions:

Region	Region Name	Wavelength (nm)
UVA	Black Light	315-400
UVB	Erythermal	280-314
UVC	Germicidal	180-280

Exposure to ultraviolet radiation is typically limited to the UVA region resulting from exposure to direct sunlight. The Earth's atmosphere shields us from the more harmful UVC and greater than 99% of UVB radiation. However, some equipment can generate concentrated UV radiation in all the spectral regions that, if used without the appropriate shielding and personal protective equipment, can cause injury with only a few seconds of exposure.

2. Common Sources of UV Radiation in the Laboratory. There are several sources of UV radiation in the laboratory including germicidal lamps in biological safety cabinets, nucleic acid transillumination boxes, nucleic acid crosslinkers and UV lasers.

Transilluminator

Crosslinker

3. Hazards Associated with Exposure to UV Light. An unfortunate property of UV radiation is that there are no immediate warning symptoms to indicate overexposure. Symptoms of overexposure including varying degrees of erythema (sunburn) or photokeratitis (welder's flash) typically appear hours after exposure has occurred.

Skin Injury: UV radiation can initiate a photochemical reaction called erythema within exposed skin. This "sunburn" can be quite severe and can occur as a result of only a few seconds exposure. Effects are exaggerated for skin photosensitized by agents such as coal tar products, certain foods (e.g., celery root), certain medications and photoallergens. Chronic skin exposure to UV radiation has been linked to premature skin aging, wrinkles and skin cancer.

Eye Injury: UV radiation exposure can injure the cornea, the outer protective coating of the eye. Photokeratitis is a painful inflammation of the eye caused by UV radiation-induced lesions on the cornea. Symptoms include a sensation of sand in the eye that may last up to two days. Chronic exposures to acute high-energy UV radiation can lead to the formation of cataracts.

4. Special Work Practices. Never allow the skin or eyes to be exposed to UV radiation sources. The UV radiation generated by laboratory equipment can exceed recommended exposure limits and cause injury with exposures as brief as three seconds in duration.
Biological Safety Cabinets – Never work in a biological safety cabinet while the germicidal lamp is on. If possible, close the sash while lamp is on.

Transilluminators: Never use a transilluminator without the protective shield in place. Shields must be kept clean and replaced when damaged.

Crosslinkers: Crosslinkers must not be used if the door safety interlock is not working properly.

5. Equipment Labeling. Many overexposures to UV radiation have occurred as a result of individuals not knowing the hazards associated with UV-emitting equipment. To help prevent eye and skin injuries, any equipment that emits UV radiation must be conspicuously labeled with a caution label. The label should contain language similar to:

CAUTION
UV RADIATION HAZARD
USE ONLY WITH SHIELDING IN PLACE
PROTECT EYES AND SKIN FROM EXPOSURE TO UV LIGHT

6. Personal Protective Equipment.

Protective Clothing: Wear standard laboratory apparel including a fully buttoned lab coat, long pants and closed toe shoes. While working with UV radiation sources, lab workers must be particularly vigilant to prevent gaps in protective clothing that commonly occur around the neck and wrist areas.

Eye/Face Protection: If there is any potential for the eyes and face to be exposed to UV radiation, a polycarbonate face shield stamped with the ANSI Z87.1-1989 UV certification must be worn to protect the eyes and face. Ordinary prescription eyeglasses may not block UV radiation. UV certified goggles and safety glasses will protect the eyes, but it is common for lab workers to suffer facial burns in the areas not covered by the goggles or glasses.

Gloves : Wear disposable nitrile gloves to protect exposed skin on the hands. Ensure wrists and forearms are covered between the tops of gloves and the bottom of the lab coat sleeves.

F. Laboratory Safety Fact Sheet. Handling and Dispensing of Hazardous Gases

1. Definitions.

Hazardous gases: For the purposes of these guidelines gases that are flammable, toxic, corrosive, pyrophoric or oxidizing are considered hazardous gases.

CGA: Compressed Gas Association. A trade organization that promotes industry standards for manufacture, storage, transportation and use of compressed gases. The CGA sets standards for cylinder valve outlet connections.

Two stage regulator: A device that reduces the higher pressure in the gas cylinder to a lower working pressure. Two stage regulators control pressure in two steps allowing precise control of pressure.

Needle valve: A flow regulating device that allows fine control of gas flow and provides a secondary means of gas shut off.

Purge assembly: A valving system that permits the flushing of the regulator and delivery tubing with inert gas.

Flow restricting orifice: A flow limiting devices that restricts the maximum flow out of a compressed gas regulator. These devices are typically critical orifices.

2. Procedures and Practices. The use of hazardous gases by Georgia Gwinnett College faculty, students, and staff requires adherence to the following in addition to the Standard Operating Procedures in Appendix F of the Chemical Hygiene Plan.

Safety Office approval: Use of hazardous gases requires Safety Office approval prior to purchase and a final approval of the experimental set up prior to the start of work. Notification is also required if there are significant changes in procedures or amounts of material hazardous gases used.

Ventilation: Proper ventilation is required in laboratories using hazardous compressed gases. The presence of a fume hood is mandatory (except for oxygen use) unless a gas cabinet and special local exhaust system or filtering system is used. Contact SAFETY OFFICE to determine if your lab has a ventilation system appropriate for hazardous gas use before purchasing the gas.

Cylinder Size: Use lecture sphere or bottle size hazardous gas sources in a returnable cylinder when small volumes are needed. While the initial purchase cost per cubic foot may be lower when hazardous gases are purchased in full sized cylinders the over all cost of experimental setup which may require local ventilation, gas cabinets, stainless steel piping and purging systems may off set the apparent saving from buying hazardous gases in full sized cylinders.

Cylinder holders: All compressed gas cylinders, regardless of size, must be properly secured. Use floor or bench clamps or secure gases to the wall with chains installed by Facilities Services. A single floor or bench clamp may not be used to secure multiple cylinders unless it is designed for multiple cylinder support.

Regulators: Gases from full sized gas cylinders must be dispensed using a two stage regulator that is both compatible with the gas and the intended use. The maximum pressure of the second stage of the regulator should be a low as is practical for the intended experimental work. Do not select or reuse existing regulators with very high second stage pressure ranges unless needed since this will require the entire experimental setup (tubing, connections) to be engineered to withstand high pressures.

Flow control valves: A mechanical flow control valve (needle valve) that is compatible and properly cleaned for the hazardous gas must be attached directly to the gas out port of the gas regulator. This is required even if other flow control devices are present in the experimental device. Flow control must not be attempted through use of the gas regulator.

Flow restricting orifices: Where feasible flow restricting devices must be installed after the regulator. Select the appropriate flow restricting orifice based on gas used and the flow rate required for the research.

Tubing and piping: Hazardous gases must be dispensed using systems that are properly cleaned and compatible with the gas in use. Bust pressure of tubing and piping must be twice the maximum pressure on the second stage regulator. Exceptions to this requirement may be made for short sections of tubing when it and the compressed gas cylinder are completely enclosed in a fume hood and low pressures and flow rates are used.

Purge assembly: Required for all hazardous gas systems that are not used in a fume hood or other ventilated enclosure. Purge assemblies must exhaust into a fume hood or other approved exhaust system. Exceptions may be made for laser systems that contain small quantities of hazardous gas that will be effectively filtered when exhausted. Exemptions must be approved by the Safety Office.

Vacuum pumps: Hydrocarbon based vacuum pump oil is incompatible with strongly oxidizing and many reactive gases. New vacuum pumps that have inert lubricants such as DuPont Krytox and never contained oil-based lubricants must be used with oxidizing and reactive gases. Vacuum pumps must be securely vented to a fume hood or other approved exhaust system with tubing that is compatible with the gases used. Exhaust lines must be as short as feasible. Vented enclosures may be required for vacuum pumps depending on the toxicity of the gases used.

Leak testing: Hazardous gas systems must be leak tested using inert gas and leak detection solutions such as Snoop (TM) before use.

G. Laboratory Safety Fact Sheet. Hydrofluoric Acid.

GGC does not use HF.
If HF is ordered for the lab the antidote must be ordered also.

H. Laboratory Safety Fact Sheet. Acutely Toxic Chemicals.

1. General Information. Standard operating procedures (SOP) are intended to provide you with general guidance on how to safely work with a specific class of chemical or hazard. This SOP is generic in nature. It addresses the use and handling of substances by hazard class only. In some instances multiple SOPs may be applicable for a specific chemical (i.e., both the SOPs for flammable liquids and carcinogens would apply to benzene). If you have questions concerning the applicability of any items listed in this procedure contact the Office of Safety or the Principal Investigator of your laboratory. Specific written procedures are the responsibility of the principal investigator. If compliance with all the requirements of this standard operating procedure is not possible, the principal investigator must develop a written procedure that will be used in its place.

2. Acutely Toxic Chemicals. A list of acutely toxic chemicals (which includes "Select Agents toxins") is included in Appendix B of the chemical hygiene plan. The purchase or possession of Select Agent toxins requires registration.

3. Decontamination Procedures.

Personnel: Wash hands and arms with soap and water immediately after handling acutely toxic chemicals.
Area: Decontamination procedures vary depending on the material being handled. The toxicity of some materials can be neutralized with other reagents. All surfaces should be wiped with the appropriate cleaning agent following dispensing or handling. Waste materials generated should be treated as a hazardous waste.
Equipment: Decontaminate vacuum pumps or other contaminated equipment (glassware) before removing them from the designated area.

4. Designated Areas. The room sign for the laboratory must contain a Designated Areas Within identifier. All locations within the laboratory where acutely toxic chemicals are handled should be demarcated with designated area caution tape and/or posted with designated area caution signs. This includes all fume hoods and bench tops where the acutely toxic chemicals are handled. Where feasible acutely toxic chemicals should be manipulated over plastic-backed disposable paper work surfaces. These disposable work surfaces minimize work area contamination and simplify clean up.

5. Emergency Procedures and Standard Operating Policies. Procedures and Policies which address response actions to fires, explosions, spills, injury to staff, or the development of signs and symptoms of overexposure must be developed by those using Acutely Toxic Chemicals. The procedures should address as a minimum the following:

a. Who to contact: (College Police and Safety Office, Contact of the laboratory personal including evening phone number).

b. The location of all safety equipment (showers, eye wash, fire extinguishers, etc.)

c. The method used to alert personnel in nearby areas of potential hazards.

d. Special first aid treatment required by the type of acutely toxic material(s) handled in the laboratory.

e. Eye protection. Eye protection in the form of safety glasses must be worn at all times when handling acutely toxic chemicals. Ordinary (street) prescription glasses do not provide adequate protection. (Contrary to popular opinion these glasses cannot pass the rigorous test for industrial safety glasses.) Adequate safety glasses must meet the requirements of the Practice for Occupational and Educational Eye and Face Protection (ANSI Z.87. 1 1989) and must be equipped with side shields. Safety glasses with side shields do not provide adequate protection from splashes, therefore, when the potential for splash hazard exists other eye protection and/or face protection must be worn.

f. Eyewash. Where the eyes or body of any person may be exposed to acutely toxic chemicals, suitable facilities for quick drenching or flushing of the eyes and body shall be provided within the work area for immediate emergency use. Bottle type eyewash stations are not acceptable.

g. Fume hood. Manipulation of acutely toxic chemicals should be carried out in a fume hood. If the use of a fume hood proves impractical refer to the section on special ventilation. All areas where acutely toxic chemicals are stored or manipulated must be labeled as a designated area.

h. Glove (dry) box. Certain acutely toxic chemicals must be handled in a glove box rather than a fume hood. The Office of Safety or the Principal Investigator will determine if this is required.

i. Gloves. Gloves should be worn when handling acutely toxic chemicals. Disposable nitrile gloves provide adequate protection against accidental hand contact with small quantities of most laboratory chemicals. However, the handling of some acutely toxic chemicals will require chemical resistant gloves. Lab workers should review the MSDS for the acutely toxic agent and contact SAFETY OFFICE for advice on glove selection.

j. Hazard assessment. Hazard assessment should focus on proper use and handling procedures, the education of employees concerning the health risk posed by acutely toxic materials, and on the demarcation of designated areas.

k. Safety Office Notification. You should notify the Safety Office prior to the initial use of acutely toxic substances. Use the form in Appendix F for this purpose. Notification is also required following significant changes in procedures or the quantity of materials used.

l. Protective Apparel. Lab coats, closed toed shoes and long sleeved clothing should be worn when handling acutely toxic chemicals. Additional protective clothing should be worn if the possibility of skin contact is likely.

m. Safety Shielding. Safety shielding is required any time there is a risk of explosion, splash hazard or a highly exothermic reaction. All manipulations of acutely toxic chemicals which pose this risk should occur in a fume hood with the sash in the lowest feasible position. Portable shields, which provide protection to all laboratory occupants, are acceptable.

n. Safety Shower. A safety or drench shower should be available in a nearby location where the acutely toxic chemicals are used.

o. Signs and Labels. The room sign must contain a Designated Area Within Caution where carcinogens, reproductive hazards, and/or acutely toxic chemicals are stored or used. All acutely toxic chemicals must be clearly labeled with the correct chemical name. Handwritten labels are acceptable; chemical formulas and structural formulas are not acceptable.

p. Special storage. Acutely toxic chemicals must be stored in a designated area.

q. Special ventilation. Manipulation of acutely toxic chemicals outside of a fume hood may require special ventilation controls in order to minimize exposure to the material. Fume hoods provide the best protection against exposure to acutely toxic chemicals in the laboratory and are the preferred ventilation control device. Where possible handle acutely toxic chemicals in a fume hood. If the use of a fume hood proves impractical attempt to work in a glove box or in an isolated area on the laboratory bench top. If available, consider using a Biological Safety Cabinet. The biological safety cabinet is designed to remove the acutely toxic chemicals before the air is discharged into the environment. Acutely toxic chemicals that are volatile must not be used in a biological safety cabinet unless the cabinet is vented to the outdoors. If your research does not permit the handing of acutely toxic chemicals in a fume hood, biological safety cabinet, or glove box, you must contact the Safety Office.

r. Spill response. Anticipate spills by having the appropriate clean up equipment on hand. The appropriate clean up supplies can be determined by consulting the material safety data sheet. This should occur prior to the use of any acutely toxic chemical. In the event of a spill alert personnel in the area that a spill has occurred. Do not attempt to handle a large spill of acutely toxic chemicals. Vacate the laboratory immediately and call for assistance. Remain on the scene, but at a safe distance, to receive and direct safety personnel when they arrive.

s. Vacuum protection. Evacuated glassware can implode and eject flying glass, and splattered chemicals. Vacuum work involving acutely toxic chemicals must be conducted in a fume hood, glove box or isolated in an acceptable manner. Mechanical vacuum pumps must be protected using cold traps and, where appropriate, filtered to prevent particulate release. The exhaust for the pumps must be vented into an exhaust hood.

t. Waste disposal. All materials contaminated with acutely toxic chemicals should be disposed of as a hazardous waste. Wherever possible, attempt to design research in a manner that reduces the quantity of waste generated.

I. Laboratory Safety Fact Sheet. Acutely Toxic Gases.

1. General Information. Standard operating procedures (SOP) are intended to provide you with general guidance on how to safely work with a specific class of chemical or hazard. This SOP is generic in nature. It addresses the use and handling of substances by hazard class only. In some instances multiple SOPs may be applicable for a specific chemical (i.e., both the SOPs for flammable liquids and carcinogens would apply to benzene). If you have questions concerning the applicability of any items listed in this procedure contact the Safety Office or the Principal Investigator of your laboratory. Specific written procedures are the responsibility of the principal investigator. If compliance with all the requirements of this standard operating procedure is not possible, the principal investigator must develop a written procedure that will be used in its place. This alternate procedure must provide the same level of protection as the SOP it replaces.

2. Acutely Toxic Gases. A list of acutely toxic gases is included in Appendix B of the chemical hygiene plan.

3. Securing of GasCylinders. Cylinders of compressed gases must be handled as high energy sources. When storing or moving a cylinder, have the cap securely in place to protect the stem. Use suitable racks, straps, chains or stands to support cylinders.

4. Personnel Decontamination. Wash hands and arms with soap and water immediately after handling acutely toxic gases.

5. Designated Area. The room sign for the laboratory must contain a Designated Areas Within identifier. All locations within the laboratory where acutely toxic gases are handled should be demarcated with designated area caution tape (available from SAFETY OFFICE, the cell center, or chemistry stockroom) and/or posted with designated area caution signs. This includes all fume hoods and bench tops where the acutely toxic gases are handled.

6. Emergency Procedure. Emergency procedures which address response actions to fires, explosions, spills, injury to staff, or the development of sign and symptom of overexposure must be developed. The procedures should address as a minimum the following:

a. Who to contact: Campus police, and Office of Safety, Principal investigator of the laboratory including evening phone number

b. The location of all safety equipment (showers, eye wash, fire extinguishers, etc.)

c. The method used to alert personnel in nearby areas of potential hazards.

d. Special first aid treatment required by the type of acutely toxic material(s) handled in the laboratory.

e. Eye protection. Eye protection in the form of safety glasses must be worn at all times when handling acutely toxic gases. Ordinary (street) prescription glasses do not provide adequate protection. (Contrary to popular opinion these glasses cannot pass the rigorous test for industrial safety glasses.) Adequate safety glasses must meet the requirements of the Practice for Occupational and Educational Eye and Face Protection (ANSI Z.87. 1 1989) and must be equipped with side shields. Safety glasses with side shields do not provide adequate protection from splashes; therefore, when the potential for splash hazard exists other eye protection and/or face protection must be worn.

f. Eyewash. Where the eyes or body of any person may be exposed to acutely toxic gases, suitable facilities for quick drenching or flushing of the eyes and body shall be provided within the work area for immediate emergency use. Bottle type eyewash stations are not acceptable.

g. Fume hood. Manipulation of acutely toxic gases should typically be carried out in a fume hood. All areas where acutely toxic gases are stored or manipulated must be labeled as a designated area. Glove (dry) box. Some processes involving acutely toxic gases may be performed in a properly vented glove box rather than a fume hood.

h. Gloves. Gloves should be worn when handling acutely toxic gases. Disposable nitrile gloves provide adequate protection against accidental hand contact with small quantities of most laboratory chemicals.

i. Hazard assessment. Hazard assessment should focus on the education of employees concerning the health risk posed by acutely toxic gases, on proper use and handling procedures, the demarcation of designated areas, and emergency evacuation and notification procedures in the event of a spill.

j. Safety Office Notification. You should notify the Safety Office prior to the initial use of acutely toxic gases. Use the form in Appendix F for this purpose. Notification is also required following significant changes in procedures or the quantity of materials used.

k. Protective apparel. Lab coats, closed toed shoes and long sleeved clothing should be worn when handling acutely toxic gases. The need for additional protective equipment will be determined by the Office of Safety on a case-by-case basis.

l. Safety shielding. Safety shielding is required any time there is a risk of explosion, splash hazard or a highly exothermic reaction. All manipulations of acutely toxic gases which pose this risk should occur in a fume hood with the sash in the lowest feasible position. Portable shields, which provide protection to all laboratory occupants are acceptable.

m. Safety shower. A safety or drench shower should be available in a nearby location where the acutely toxic gases are used.

n. Signs and labels. The room sign must contain a Designated Area Within Caution where carcinogens, reproductive hazards, and/or acutely toxic chemicals are stored or used. All acutely toxic gas cylinders must be clearly labeled with the correct chemical name. Handwritten labels are acceptable; chemical formulas and structural formulas are not acceptable.

o. Special storage. Acutely toxic gases must be stored in a designated area. Special ventilation of the stored cylinders is required and must be approved by the Safety Office. Continuous monitoring devices which will alert staff of a release of the acutely toxic gas is required for certain gases. The quantity of an acutely toxic gas that may be stored in a laboratory will be determined on a case-by-case basis by the Safety Office.

p. Special ventilation. Manipulation of acutely toxic gases outside of a fume hood will require special ventilation controls in order to minimize exposure to the material. Fume hoods provide the best protection against exposure to acutely toxic gases in the laboratory and are the preferred ventilation control device. Always attempt to handle acutely toxic gases in a fume hood. If your research does not permit the handing of acutely toxic gases in your fume hood you must contact the Safety Office.

q. Spill response. In the event of a escape of gas alert personnel in the area that a spill has occurred. Do not attempt to handle a spill of acutely toxic gases. Vacate the laboratory immediately and call for assistance. Remain on the scene, but at a safe distance, to receive and direct safety personnel when they arrive.

r. Vacuum protection. Not applicable.

s. Waste disposal. All empty or partially filled acutely toxic gas cylinders should be returned to the supplier. If the supplier does not accept empty or partially filled cylinders, contact the Safety Office concerning disposal.

J. Laboratory Safety Sheet and Standard Operating Procedures. Carcinogens.

1. General Information. Standard operating procedures (SOP) are intended to provide you with general guidance on how to safely work with a specific class of chemical or hazard. This SOP is generic in nature. It addresses the use and handling of substances by hazard class only. In some instances multiple SOPs may be applicable for a specific chemical (i.e., both the SOPs for flammable liquids and carcinogens would apply to benzene). If you have questions concerning the applicability of any items listed in this procedure contact the Office of Safety or the Principal Investigator of your laboratory. Specific written procedures are the responsibility of the principal investigator. If compliance with all the requirements of this standard operating procedure is not possible, the principal investigator must develop a written procedure that will be used in its place. This alternate procedure must provide the same level of protection as the SOP it replaces. The Office of Safety is available to provide guidance during the development of alternate procedures.

2. Carcinogens. A carcinogen commonly describes any agent that can initiate or speed the development of malignant or potentially malignant tumors, malignant neoplastic proliferation of cells, or cells that possess such material. A listing of carcinogenic materials can be found in Appendix C**.**

3. Securing of Gas Cylinders. Not applicable.

4. Personnel Decontamination. Wash hands and arms with soap and water immediately after handling carcinogens. Decontamination procedures vary depending on the material being handled. The toxicity of some materials can be neutralized with other reagents. All surfaces should be wiped with the appropriate cleaning agent following dispensing or handling. Waste materials generated should be treated as a hazardous waste. Decontaminate vacuum pumps or other contaminated equipment (glassware) before removing them from the designated area.

5. Designated Area. The room sign for the laboratory must contain a Designated Areas Within identifier. All locations within the laboratory where carcinogens are handled should be demarcated with designated area caution tape (available from SAFETY OFFICE, the cell center, or chemistry stockroom) and/or posted with designated area caution signs. This includes all fume hoods and bench tops where the carcinogens are handled. Where feasible, carcinogens should be manipulated over plastic-backed disposable paper work surfaces. These disposable work surfaces minimize work area contamination and simplify clean up.

6. Emergency Procedure. Emergency procedures which address response actions to fires, explosions, spills, injury to staff, or the development of sign and symptom of overexposure must be developed. The procedures should address as a minimum the following:

a. Who to contact: Safety Office and Principle Investigator.
b. The location of all safety equipment (showers, eye wash, fire extinguishers, etc.).

c. The method used to alert personnel in nearby areas of potential hazards.
d. Special first aid treatment required by the type of carcinogens handled in the laboratory.
e. Eye protection. Eye protection in the form of safety glasses must be worn at all times when handling carcinogens. Ordinary (street) prescription glasses do not provide adequate protection. (Contrary to popular opinion these glasses cannot pass the rigorous test for industrial safety glasses.) Adequate safety glasses must meet the requirements of the Practice for Occupational and Educational Eye and Face Protection (ANSI Z.87. 1 1989) and must be equipped with side shields. Safety glasses with side shields do not provide adequate protection from splashes; therefore, when the potential for splash hazard exists other eye protection and/or face protection must be worn.
f. Eyewash. Where the eyes or body of any person may be exposed to carcinogens, suitable facilities for quick drenching or flushing of the eyes and body shall be provided within the work area for immediate emergency use. Bottle type eyewash stations are not acceptable.
g. Fume hood. Manipulation of carcinogens should be carried out in a fume hood. If the use of a fume hood proves impractical refer to the section on special ventilation.
h. All areas where carcinogens are stored or manipulated must be labeled as a designated area.
i. Glove (dry) box. Certain carcinogens must be handled in a glove box rather than a fume hood. The Office of Safety or the Principal Investigator will determine if this is required.
j. Gloves. Gloves should be worn when handling carcinogens. Disposable nitrile gloves provide adequate protection against accidental hand contact with small quantities of most laboratory chemicals. Lab workers should contact SAFETY OFFICE for advice on chemical resistant glove selection when direct or prolonged contact with hazardous chemicals is anticipated.
k. Hazard assessment. Hazard assessment should focus on proper use and handling techniques, education of laboratory workers concerning the health risks posed by carcinogens, and the demarcation of designated areas.
l. Safety Office Notification. You should notify the Safety Office prior to the initial use of carcinogens. Use the form in Appendix F for this purpose. Notification is also required following significant changes in procedures or the quantity of materials used.
m. Protective apparel. Lab coats, closed toed shoes and long sleeved clothing should be worn when handling carcinogens. Additional protective clothing should be worn if the possibility of skin contact is likely.
n. Safety shielding. Safety shielding is required any time there is a risk of explosion, splash hazard or a highly exothermic reaction. All manipulations of carcinogens which pose this risk should occur in a fume hood with the sash in the lowest feasible position. Portable shields, which provide protection to all laboratory occupants, are acceptable.

o. Safety shower. A safety or drench shower should be available in a nearby location where the carcinogens are used.

p. Signs and labels. The room sign must contain a Designated Area Within Caution where carcinogens, reproductive hazards, and/or acutely toxic chemicals are stored or used. All containers of carcinogens must be clearly labeled with the correct chemical name. Handwritten labels are acceptable; chemical formulas and structural formulas are not acceptable.

q. Special storage . Carcinogens must be stored in a designated area..

r. Special ventilation. Manipulation of carcinogens outside of a fume hood may require special ventilation controls in order to minimize exposure to the material. Fume hoods provide the best protection against exposure to carcinogens in the laboratory and are the preferred ventilation control device. When possible, handle carcinogens in a fume hood. If the use of a fume hood proves impractical, attempt to work in a glove box or on an isolated area on the bench top. If available, consider using a Biological Safety Cabinet. The biological safety cabinet is designed to remove particulates (the carcinogen) before the air is discharged into the environment. Carcinogens that are volatile must not be used in a biological safety cabinet unless the cabinet is vented to the outdoors. If your research does not permit the handling of carcinogens in a fume hood, biological safety cabinet, or glove box, you must contact the Safety Office.

s. Spill response. Anticipate spills by having the appropriate clean up equipment on hand. The appropriate clean up supplies can be determined by consulting the material safety data sheet. This should occur prior to the use of any carcinogen. In the event of a spill alert personnel in the area that a spill has occurred. Do not attempt to handle a large spill of carcinogenic material. Vacate the laboratory immediately and call for assistance. Remain on the scene, but at a safe distance, to receive and direct safety personnel when they arrive.

t. Vacuum protection. Evacuated glassware can implode and eject flying glass, and splattered chemicals. Vacuum work involving carcinogens must be conducted in a fume hood, glove box or isolated in an acceptable manner. Mechanical vacuum pumps must be protected using cold traps and, where appropriate, filtered to prevent particulate release. The exhaust for the pumps must be vented into an exhaust hood.

u. Waste disposal. All materials contaminated with carcinogens should be disposed of as hazardous waste. Wherever possible, attempt to design research in a manner that reduces the quantity of waste generated. Questions regarding waste pick up should be directed to the Office of Safety. This office can also assist you in minimizing waste generation.

K. Laboratory Safety Fact Sheet. Compressed Gases.

1. General Information. Standard operating procedures (SOP) are intended to provide you with general guidance on how to safely work with a specific class of chemical or hazard. This SOP is generic in nature. It addresses the use and handling of substances by hazard class only. In some instances multiple SOPs may be applicable for a specific chemical (i.e., both the SOPs for flammable liquids and carcinogens would apply to benzene). If you have questions concerning the applicability of any item listed in this procedure contact the Office of Safety or the Principal Investigator of your laboratory. Specific written procedures are the responsibility of the principal investigator.

If compliance with all the requirements of this standard operating procedure is not possible, the principal investigator must develop a written procedure that will be used in its place. This alternate procedure must provide the same level of protection as the SOP it replaces. The Office of Safety is available to provide guidance during the development of alternate procedures.

Additional requirements may apply if the materials is an acutely toxic compressed gas. Please refer to the SOP for acutely toxic gases if applicable.

2. Securing of gas cylinders. Cylinders of compressed gases must be handled as high energy sources. They pose a serious hazard if the cylinder valve is dislodged. When storing or moving a cylinder, have the cap securely in place to protect the stem. Use suitable racks, straps, chains or stands to support cylinders. Do not store cylinders or lecture bottles with the regulator in place. If the regulator fails, the entire contents of the gas cylinder may be discharged.

3. Decontamination procedures. Not Applicable.

4. Designated area. Compressed gas cylinders which contain acutely toxic gases must be stored in a designated area. See the SOP for acutely toxic compressed gases.

5. Emergency procedures. Emergency procedures which address response actions to fires, explosions, spills, injury to staff, or the development of sign and symptoms of overexposure must be developed. The procedures should address as a minimum the following:

a. Who to contact: (Safety Office and Principal investigator of the laboratory including evening phone number).

b. The location of all safety equipment (showers, eye wash, fire extinguishers, etc.).

c. The method used to alert personnel in nearby areas of potential hazards.

d. Special first aid treatment required by the type of compressed gas handled in the laboratory.

e. Eye protection. Eye protection in the form of safety glasses must be worn at all times when handling compressed gases. Ordinary (street) prescription glasses do not provide adequate protection. (Contrary to popular opinion these glasses cannot pass the rigorous test for industrial safety glasses.) Adequate safety glasses must meet the requirements of the Practice for Occupational and Educational Eye and Face Protection (ANSI Z.87. 1 1989) and must be equipped with side shields.

f. Eyewash. Not applicable.

g. Fume hood. Manipulation of compressed gases should typically be carried out in a fume hood if the compressed gas is an irritant, oxidizer, asphyxiant, or has other hazardous properties.

h. Glove (dry) box. Not applicable.

i. Gloves. Not applicable.

j. Hazard assessment. Hazard assessment for work with compressed gases should assure that all staff understand proper use and handling precautions; that all pressurized equipment is properly shielded; regulators are not interchanged between different gas types; all hose connections are properly secured and are appropriate for the pressure(s) used.

k. Safety Office Notification. Not applicable.

l. Protective apparel. Lab coats, closed toed shoes and long sleeved clothing should be worn when handling compressed gases.

m. Safety shielding. Safety shielding is required any time there is a risk of explosion, splash hazard or a highly exothermic reaction. All manipulations of compressed gases which pose this risk should occur in a fume hood with the sash in the lowest feasible position. Portable shields, which provide protection to all laboratory occupants are acceptable.

n. Safety shower. Not applicable.

o. Signs and labels. All compressed gases must be clearly labeled with the correct chemical name. Handwritten labels are acceptable; chemical formulas and structural formulas are not acceptable. The compressed gas cylinder should be labeled to indicate if the container is full or empty.

p. Special storage. Cylinders should be stored in an upright position and secured to a wall or laboratory bench through the use of chains or straps. Cylinder caps should remain on the cylinder at all times unless a regulator is in place. Cylinders should be stored in areas where they will not become overheated. Avoid storage near radiators, areas in direct sunlight, steam pipes and heat releasing equipment such as sterilizers. Transport compressed gas cylinders on equipment designed for this function. Never carry or "walk" cylinders by hand.

q. Special ventilation. Manipulation of compressed gas that is an irritant, oxidizer, asphyxiant, or has other hazardous properties outside of a fume hood may require special ventilation controls in order to minimize exposure to the material. Fume hoods provide the best protection against exposure to compressed gases in the laboratory and are the preferred ventilation control device. If you have questions contact the Office of Safety to review the adequacy of all special ventilation.

r. Spill response. In the event of a spill of a compressed gas that is an irritant, oxidizer, asphyxiate, or has other hazardous properties all personnel in the area should be alerted. Vacate the laboratory immediately and call for assistance. Remain on the scene, but at a safe distance, to receive and direct safety personnel when they arrive.

s. Vacuum protection. Not applicable.

t. Waste disposal. All empty or partially filled compressed gas cylinders should be returned to the supplier. If the supplier does not accept empty or partially filled cylinders, contact the Safety Office concerning disposal.

L. Laboratory Safety Fact Sheet. Corrosive Chemicals.

1. General Information. Standard operating procedures (SOP) are intended to provide you with general guidance on how to safely work with a specific class of chemical or hazard. This SOP is generic in nature. It addresses the use and handling of substances by hazard class only. In some instances multiple SOPs may be applicable for a specific chemical (i.e., both the SOPs for flammable liquids and carcinogens would apply to benzene). If you have questions concerning the applicability of any item listed in this procedure contact the Office of Safety or the Principal Investigator of your laboratory. Specific written procedures are the responsibility of the principal investigator. If compliance with all the requirements of this standard operating procedure is not possible, the principal investigator must develop a written procedure that will be used in its place. This alternate procedure must provide the same level of protection as the SOP it replaces. The Office of Safety is available to provide guidance during the development of alternate procedures. Corrosive chemicals are substances that cause visible destruction or permanent changes in human skin tissue at the site of contact, or are highly corrosive to steel. The major classes of corrosives include strong acids, bases, and dehydrating agents.

2. Securing of gas cylinders. Not applicable.

3. Decontamination procedures. Personnel: Immediately flush contaminated area with copious amounts of water after contact with corrosive materials. Remove any jewelry to facilitate removal of chemicals. If a delayed response is noted report immediately for medical attention. Be prepared to detail what chemicals were involved. If the incident involves Hydrofluoric acid (HF), seek immediate medical attention. If there is any doubt about the severity of the injury, seek immediate medical attention. Decontamination procedures vary depending on the material being handled. The corrosivity of some materials can be neutralized with other reagents. Special neutralizing agents should be on hand to decontaminate areas.

4. Designated area. Not applicable.

5. Emergency procedures. Emergency procedures which address response actions to fires, explosions, spills, injury to staff, or the development of sign and symptom of overexposure must be developed The procedures should address as a minimum the following:

a. Who to contact: (University police, and Office of Safety, Principal investigator of the laboratory including evening phone number).

b. The location of all safety equipment (showers, spill clean up supplies, eye wash, fire extinguishers, etc.).

c. The method used to alert personnel in nearby areas of potential hazards.

d. Special first aid treatment required by the type of corrosive material(s) handled in the laboratory.

e. Eye protection. Eye protection in the form of safety glasses must be worn at all times when handling corrosive materials. Ordinary (street) prescription glasses do not provide adequate protection. (Contrary to popular opinion these glasses cannot pass the rigorous test for industrial safety glasses.) Adequate safety glasses must meet the requirements of the Practice for Occupational and Educational Eye and Face Protection (ANSI Z.87. 1 1989) and must be equipped with side shields. Safety glasses with side shields do not provide adequate protection from splashes; therefore, when the potential for splash hazard exists other eye protection and/or face protection must be worn. It is recommended that face shields be worn when a splash potential exists with corrosive materials.

f. Eyewash. Where the eyes or body of any person may be exposed to corrosive chemicals, suitable facilities for quick drenching or flushing of the eyes and body shall be provided within the work area for immediate emergency use. Bottle type eyewash stations are not acceptable.

g. Fume hood. Manipulation of corrosive substances should be carried out in a fume hood if corrosive vapor production is anticipated.

h. Glove (dry) box. Not applicable.

i. Gloves. Gloves should be worn when handling corrosive chemicals. Disposable nitrile gloves provide adequate protection against accidental hand contact with small quantities of most laboratory chemicals. Lab workers should contact SAFETY OFFICE for advice on chemical resistant glove selection when direct or prolonged contact with hazardous chemicals is anticipated.

j. Hazard assessment. Hazard assessment should include instruction on proper use and handling; spill control; and splash protection.

k. SAFETY OFFICE Notification. Not applicable.

l. Protective apparel. Lab coats, closed toed shoes and long sleeved clothing should be worn when handling corrosive materials. Additional protective clothing should be worn if the possibility of skin contact is likely.

m. Safety shielding. Safety shielding is required any time there is a risk of explosion, splash hazard or a highly exothermic reaction. All manipulations of corrosive materials which pose this risk should occur in a fume hood with the sash in the lowest feasible position. Portable shields, which provide protection to all laboratory occupants, are acceptable.

n. Safety shower. A safety or drench shower should be available in a nearby location where the corrosive materials is used.

o. Signs and labels. Containers: All corrosive chemical must be clearly labeled with the correct chemical name. Handwritten labels are acceptable; chemical formulas and structural formulas are not acceptable.

p. Special storage. Segregate the various types of corrosives. Separate acids and bases. Liquids and solids should also be separated. Specially designed corrosion resistant cabinets should be used for the storage of large quantities of corrosive materials. Store corrosives on plastic trays. Do not store corrosive materials on high cabinets or shelves.

q. Special ventilation. Manipulation of some corrosive materials outside of a fume hood may require special ventilation controls in order to minimize exposure to the material. Fume hoods provide the best protection against exposure to corrosive materials in the laboratory and are the preferred ventilation control device.

r. Spill response. Anticipate spills by having the appropriate clean up equipment on hand. The appropriate clean up supplies can be determined by consulting the material safety data sheet. This should occur prior to the use of any corrosive chemical. Corrosive spill controls neutralize the hazardous nature of the spilled material. Acids and bases require different types of spill control materials. In the event of a spill all personnel in the area should be alerted.. Do not attempt to handle a large spill of corrosive materials. Vacate the laboratory immediately and call for assistance. Remain on the scene, but at a safe distance, to receive and direct safety personnel when they arrive.

s. Vacuum protection. Not applicable.

t. Waste disposal. Most corrosive materials are hazardous wastes. Questions regarding waste disposal should be directed to the Safety Office.

M. Laboratory Safety Fact Sheet. Flammable Liquids.

1. General Information. Standard operating procedures (SOP) are intended to provide you with general guidance on how to safely work with a specific class of chemical or hazard. This SOP is generic in nature. It addresses the use and handling of substances by hazard class only. In some instances multiple SOPs may be applicable for a specific chemical (i.e., both the SOPs for flammable liquids and carcinogens would apply to benzene). If you have questions concerning the applicability of any item listed in this procedure contact the Office of Safety or the Principal Investigator of your laboratory. Specific written procedures are the responsibility of the principal investigator. If compliance with all the requirements of this standard operating procedure is not possible, the principal investigator must develop a written procedure that will be used in its place. This alternate procedure must provide the same level of protection as the SOP it replaces. Flammable liquids are chemicals that have a flash point below 100oF (38.7o C) and a vapor pressure that does not exceed 40 psig at 100^{o}F.

2. Securing of gas cylinders. Not applicable.

3. Decontamination procedures. Wash hands and arms with soap and water immediately following any skin contact with flammable liquids.

4. Designated area. Not applicable.

5. Emergency procedures. Emergency procedures which address response actions to fires, explosions, spills, injury to staff, or the development of sign and symptom of overexposure must be developed The procedures should address as a minimum the following:

a. Who to contact: Safety Office, Principal Investigator of the laboratory including evening phone number.

b. The location of all safety equipment (showers, eye wash, fire extinguishers, etc.).

c. The method used to alert personnel in nearby areas of potential hazards.

d. Special spill control materials required by the type of flammable liquids handled in the laboratory.

e. Eye protection. Eye protection in the form of safety glasses must be worn at all times when handling flammable liquids. Ordinary (street) prescription glasses do not provide adequate protection. (Contrary to popular opinion these glasses cannot pass the rigorous test for industrial safety glasses.) Adequate safety glasses must meet the requirements of the Practice for Occupational and Educational Eye and Face Protection (ANSI Z.87. 1 1989) and must be equipped with side shields. Safety glasses with side shields do not provide adequate protection from splashes; therefore, when the potential for splash hazard exists other eye protection and/or face protection must be worn.

f. Eyewash. Where the eyes or body of any person may be exposed to flammable liquids suitable facilities for quick drenching or flushing of the eyes and body shall be provided within the work area for immediate emergency use. Bottle type eyewash stations are not acceptable.

g. Fume hood. When possible experiments involving greater than 500 ml of flammable liquids should be carried out in a fume hood.

h. Glove (dry) box. Not applicable.

i. Gloves. Gloves should be worn when handling flammable liquids. Disposable nitrile gloves provide adequate protection against accidental hand contact with small quantities of most laboratory chemicals. Lab workers should contact SAFETY OFFICE for advice on chemical resistant glove selection when direct or prolonged contact with hazardous chemicals is anticipated.

j. Hazard assessment. Hazard assessment for work involving flammable liquids should thoroughly address the issues of proper use and handling, fire safety, chemical toxicity, storage, and spill response.

k. Safety Office Notification. Not applicable.

l. Protective apparel. Lab coats, closed toed shoes and long sleeved clothing should be worn when handling flammable liquids. Additional protective clothing should be worn if the possibility of skin contact is likely.

m. Safety shielding. Safety shielding is required any time there is a risk of explosion, splash hazard or a highly exothermic reaction. All manipulations of flammable liquids which pose this risk should occur in a fume hood with the sash in the lowest feasible position. Safety shielding is required any time there is a risk of explosion, splash hazard or a highly exothermic reaction. Portable shields, which provide protection to all laboratory occupants, are acceptable.

n. Safety shower. A safety or drench shower should be available in a nearby location where the flammable liquids are used.

o. Signs and labels. All flammable liquids must be clearly labeled with the correct chemical name. Handwritten labels are acceptable; chemical formulas and structural formulas are not acceptable.

p. Special storage. The storage of flammable and combustible liquids in a laboratory, shop or building area must be kept to the minimum needed for research and/or operations. If more than 5 gallons of flammables are present outside of safety cans per 100 square feet of area, a flammable-liquids storage cabinet is required. Flammable-liquids storage cabinets are not intended for the storage of highly toxic materials, acids, bases, compressed gases or pyrolytic chemicals. Where feasible (if the quality of the solvent will not be adversely affected) transfer flammable liquids from glass bottles into metal safety cans.

q. Special ventilation. Manipulation of flammable liquids outside of a fume hood may require special ventilation controls in order to minimize exposure to the material. Fume hoods provide the best protection against exposure to flammable liquids in the laboratory and are the preferred ventilation control device. Always attempt to handle large quantities of flammable liquids in a fume hood. If your research does not permit the handing of large quantities of flammable liquids in your fume hood, contact the Office of Safety to review the adequacy of all special ventilation.

r. Spill response. Anticipate spills by having the appropriate clean up equipment on hand. The appropriate clean up supplies can be determined by consulting the material safety data sheet. This should occur prior to the use of any flammable liquids. Spill supplies for flammable liquids are designed to control the liquid portion of the spill and minimize the production of flammable vapors. Never use paper towels on large spills of flammable liquids because it exacerbates vapor production. In the event of a spill all personnel in the area should be alerted. Turn off all sources of ignition. Do not attempt to handle a large spill of flammable liquids. Vacate the laboratory immediately and call for assistance. Remain on the scene, but at a safe distance, to receive and direct safety personnel when they arrive.

s. Vacuum protection. Evacuated glassware can implode and eject flying glass, and splattered chemicals. Vacuum work involving flammable liquids must be conducted in a fume hood, glove box or isolated in an acceptable manner. Mechanical vacuum pumps must be protected using cold traps and, where appropriate, filtered to prevent particulate release. The exhaust for the pumps must be vented into an exhaust hood. Vacuum pumps should be rated for use with flammable liquids.

t. Waste disposal. Some flammable liquids are hazardous wastes. Questions regarding waste disposal should be directed to the Safety Office.

N. Laboratory Safety Fact Sheet. Oxidizing Chemicals.

1. General Information. Standard operating procedures (SOP) are intended to provide you with general guidance on how to safely work with a specific class of chemical or hazard. This SOP is generic in nature. It addresses the use and handling of substances by hazard class only. In some instances multiple SOPs may be applicable for a specific chemical (i.e., both the SOPs for flammable liquids and carcinogens would apply to benzene). If you have questions concerning the applicability of any item listed in this procedure contact the Safety Office or the Principal Investigator of your laboratory. Specific written procedures are the responsibility of the principal investigator. If compliance with all the requirements of this standard operating procedure is not possible, the principal investigator must develop a written procedure that will be used in its place. This alternate procedure must provide the same level of protection as the SOP it replaces. The Safety Office is available to provide guidance during the development of alternate procedures. Oxidizing chemicals are materials that spontaneously evolve oxygen at room temperature or with slight heating or promote combustion. This class of chemicals includes peroxides, chlorates, perchlorates, nitrates, and permanganates. Strong oxidizers are capable of forming explosive mixtures when mixed with combustible, organic or easily oxidized materials. Examples of strong oxidizers are listed at the end of this SOP.

2. Securing of gas cylinders.

Store in the gas cylinder room. Store in cylinder holders with the straps closed in labs and BSCs.

3. Decontamination procedures. Wash hands and arms with soap and water immediately after handling oxidizing chemicals. Carefully clean work area after use. Paper towels or similar materials contaminated with strong oxidizing chemicals may pose a fire risk.

4. Designated area. Not applicable.

5. Emergency procedures. Emergency procedures which address response actions to fires, explosions, spills, injury to staff, or the development of sign and symptom of overexposure must be developed The procedures should address as a minimum the following:

a. Who to contact: Safety Office and Principal investigator of the laboratory including evening phone number.

b. The location of all safety equipment (showers, spill equipment, eye wash, fire extinguishers, etc.).

c. The method used to alert personnel in nearby areas of potential hazards.

d. Special first aid treatment required by the type of oxidizing chemicals material(s) handled in the laboratory.

e. Eye protection. Eye protection in the form of safety glasses must be worn at all times when handling oxidizing chemicals. Ordinary (street) prescription glasses do not provide adequate protection. (Contrary to popular opinion these glasses cannot pass the rigorous test for industrial safety glasses.) Adequate safety glasses must meet the requirements of the Practice for Occupational and Educational Eye and Face Protection (ANSI Z.87. 1 1989) and must be equipped with side shields. Safety glasses with side shields do not provide adequate protection from splashes; therefore, when the potential for splash hazard exists other eye protection and/or face protection must be worn.

f. Eyewash. Where the eyes or body of any person may be exposed to oxidizing chemicals, suitable facilities for quick drenching or flushing of the eyes and body shall be provided within the work area for immediate emergency use. Bottle type eyewash stations are not acceptable.

g. Fume hood. The use of certain concentrations of perchloric acid must be performed in a fume hood equipped with wash down facilities. Contact the Safety Office for fume hood requirements.

h. Glove (dry) box. Not applicable.

i. Gloves. Gloves should be worn when handling oxidizing chemicals. Disposable nitrile gloves provide adequate protection against accidental hand contact with small quantities of most laboratory chemicals. Lab workers should contact the Safety Office for advice on chemical resistant glove selection when direct or prolonged contact with hazardous chemicals is anticipated.

j. Hazard assessment. Hazard assessment should address proper use and handling techniques, fire safety, storage, and waste disposal issues.

k. Safety Office Notification. You should notify the Safety Office prior to the initial use of the following oxidizers: perchloric acid.

l. Protective apparel. Lab coats, closed toed shoes and long sleeved clothing should be worn when handling oxidizing chemicals. Additional protective clothing should be worn if the possibility of skin contact is likely.

m. Safety shielding. Safety shielding is required any time there is a risk of explosion, splash hazard or a highly exothermic reaction. All manipulations of oxidizing chemicals which pose this risk should occur in a fume hood with the sash in the lowest feasible position. Portable shields, which provide protection to all laboratory occupants are acceptable.

n. Safety shower. A safety or drench shower should be available in a nearby location where the oxidizing chemicals are used.

o. Signs and labels. All oxidizing chemicals must be clearly labeled with the correct chemical name. Handwritten labels are acceptable; chemical formulas and structural formulas are not acceptable.

p. Special storage. Oxidizers should be stored in a cool and dry location. Keep oxidizers segregated from all other chemicals in the laboratory. Minimize the quantities of strong oxidizers stored in the laboratory. Never return excess chemicals to the original container. Small amounts of impurities may be introduced into the container which may cause a fire or explosion.

q. Special ventilation. The use of certain concentrations of perchloric acid must be performed in a fume hood equipped with wash down facilities. Contact the Safety Office for fume hood requirements.

r. Spill response. Anticipate spills by having the appropriate clean up equipment on hand. The appropriate clean up supplies can be determined by consulting the material safety data sheet. This should occur prior to the use of any oxidizing chemicals. Spill control materials for oxidizers are designed to be inert and will not react with the reagent. Never use paper towels or other inappropriate materials which are combustible. The waste materials generated during spill cleanup may pose a flammability risk and should not remain in the laboratory overnight unless it is stored in an appropriate container. In the event of a spill. Alert personnel in the area that a spill has occurred. Do not attempt to handle a large spill of oxidizing chemicals. Vacate the laboratory immediately and call for assistance. Remain on the scene, but at a safe distance, to receive and direct safety personnel when they arrive.

s. Vacuum protection. Evacuated glassware can implode and eject flying glass, and splattered chemicals. Vacuum work involving oxidizing chemicals must be conducted in a fume hood, glove box or isolated in an acceptable manner. Mechanical vacuum pumps must be protected using cold traps and,

where appropriate, filtered to prevent particulate release. The exhaust for the pumps must be vented into an exhaust hood.

t. Waste disposal. All materials contaminated with oxidizing chemicals pose a fire hazard and should be disposed of as hazardous waste. Alert the Safety Office if you generate wastes contaminated by oxidizers. Do not let contaminated wastes remain in the laboratory overnight unless proper containers are provided.

Examples of Strong Oxidizers	
Ammonium perchlorate Barium peroxide Calcium chlorate Chlorine trifluoride Chromic acid Fluorine Magnesium peroxide Perchloric acid Potassium chlorate Propyl nitrate Sodium chlorite Sodium peroxide	Ammonium permanganate Bromine Calcium hypochlorite Chromium anhydride Dibenzoyl peroxide Hydrogen peroxide Nitrogen trioxide Potassium bromate Potassium peroxide Sodium chlorate Sodium perchlorate
Source: CRC Handbook of Laboratory Safety	

O. Laboratory Safety Fact Sheet. Pyrophoric Chemicals.

1. General Information. Standard operating procedures (SOP) are intended to provide you with general guidance on how to safely work with a specific class of chemical or hazard. This SOP is generic in nature. It addresses the use and handling of substances by hazard class only. In some instances multiple SOPs may be applicable for a specific chemical (i.e., both the SOPs for flammable liquids and carcinogens would apply to benzene). If you have questions concerning the applicability of any item listed in this procedure contact the Safety Office or the Principal Investigator of your laboratory. Specific written procedures are the responsibility of the principal investigator. If compliance with all the requirements of this standard operating procedure is not possible, the principal investigator must develop a written procedure that will be used in its place. This alternate procedure must provide the same level of protection as the SOP it replaces. The Safety Office is available to provide guidance during the development of alternate procedures.

Pyrophoric chemicals are liquids and solids that will ignite spontaneously in air at about 130 °F. Titanium dichloride and phosphorus are example of pyrophoric solids; tributylaluminum and related compounds are examples of pyrophoric liquids.

2. Securing of gas cylinders. Not applicable.

3. Decontamination procedures. Wash hands and arms with soap and water immediately following any skin contact with pyrophoric chemicals.

4. Designated area. Not applicable.

5. Emergency procedures. Emergency procedures which address response actions to fires, explosions, spills, injury to staff, or the development of sign and symptom of overexposure must be developed The procedures should address as a minimum the following:

a. Who to contact: Safety Office or the Principal investigator of the laboratory including evening phone number.

b. The location of all safety equipment (showers, eye wash, fire extinguishers, etc.).

c. The method used to alert personnel in nearby areas of potential hazards.

d. Special spill control materials required by the type of pyrophoric chemicals handled in the laboratory.

e. Eye protection. Eye protection in the form of safety glasses must be worn at all times when handling pyrophoric chemicals. Ordinary (street) prescription glasses do not provide adequate protection. (Contrary to popular opinion these glasses cannot pass the rigorous test for industrial safety glasses.) Adequate safety glasses must meet the requirements of the Practice for Occupational and Educational Eye and Face Protection (ANSI Z.87. 1 1989) and must be equipped with side shields. Safety glasses with side shields do not provide adequate protection from splashes; therefore, when the potential for splash hazard exists other eye protection and/or face protection must be worn.

f. Eyewash. Where the eyes or body of any person may be exposed to pyrophoric chemicals, suitable facilities for quick drenching or flushing of the eyes and body shall be provided within the work area for immediate emergency use. Bottle type eyewash stations are not acceptable.

g. Fume hood. Many pyrophoric chemicals release noxious or flammable gases and should be handled in a hood. In addition some pyrophoric materials are stored under kerosene (or other flammable solvents), therefore the use of a fume hood is required to prevent the release of flammable vapors in the laboratory. Glove boxes may be also be used (see special ventilation).

h. Glove (dry) box. Glove boxes may be used to handle pyrophoric chemicals if inert or dry atmospheres are required.

i. Gloves. Gloves should be worn when handling pyrophoric chemicals. Disposable nitrile gloves provide adequate protection against accidental hand contact with small quantities of most laboratory chemicals. Lab workers should contact the Safety Office for advice on chemical resistant glove selection when direct or prolonged contact with hazardous chemicals is anticipated.

j. Hazard assessment. Hazard assessment for work involving pyrophoric chemicals should thoroughly address the issue of fire safety (including the need for Class D fire extinguishers), proper use and handling techniques, chemical toxicity, storage, and spill response.

k. Safety Office Notification. Not applicable.

l. Protective apparel. Lab coats, closed toed shoes and long sleeved clothing should be worn when handling pyrophoric chemicals. Additional protective clothing should be worn if the possibility of skin contact is likely.

m. Safety shielding. Safety shielding is required any time there is a risk of explosion, splash hazard or a highly exothermic reaction. All manipulations of pyrophoric chemicals which pose this risk should occur in a fume hood with the sash in the lowest feasible position. Portable shields, which provide protection to all laboratory occupants are acceptable.

n. Safety shower. A safety or drench shower should be available in a nearby location where the pyrophoric chemicals are used.

o. Signs and labels. Containers: All pyrophoric chemicals must be clearly labeled with the correct chemical name. Handwritten labels are acceptable; chemical formulas and structural formulas are not acceptable.

p. Special storage. Pyrophoric chemicals should be stored under an atmosphere of inert gas or under kerosene as appropriate. Do not store pyrophoric chemicals with flammable materials or in a flammable-liquids storage cabinet. Store these materials away from sources of ignition. Minimize the quantities of pyrophoric chemicals stored in the laboratory. Never return excess chemicals to the original container. Small amounts of impurities may be introduced into the container which may cause a fire or explosion.

q. Special ventilation. Always attempt to handle pyrophoric chemicals in a fume hood or glove box. If your research does not permit the handing of pyrophoric chemicals in a fume hood or glove box you must contact the Safety Office to review the adequacy of all special ventilation.

r. Spill response. Anticipate spills by having the appropriate clean up equipment on hand. The appropriate clean up supplies can be determined by consulting the material safety data sheet. This should occur prior to the use of any pyrophoric chemicals. Spill control materials for pyrophoric chemicals are

designed to be inert and will not react with the reagent. In the event of a spill alert personnel in the area that a spill has occurred. Do not attempt to handle a large spill of pyrophoric chemicals. Turn off all ignition sources and vacate the laboratory immediately. Remain on the scene, but at a safe distance, to receive and direct safety personnel when they arrive.

s. Vacuum protection. Evacuated glassware can implode and eject flying glass, and splattered chemicals. Vacuum work involving pyrophoric chemicals must be conducted in a fume hood or isolated in an acceptable manner. Mechanical vacuum pumps must be protected using cold traps and, where appropriate, filtered to prevent particulate release. The exhaust for the pumps must be vented into an exhaust hood. Vacuum pumps should be rated for use with pyrophoric chemicals.

t. Waste disposal. All materials contaminated with pyrophoric chemicals should be disposed of as hazardous waste. Alert the Safety Office if you generate wastes contaminated with pyrophoric chemicals. These wastes may pose a flammability risk and should not remain in the laboratory overnight.

P. Laboratory Safety Fact Sheet. Reactive Solids.

1. General Information. Standard operating procedures (SOP) are intended to provide you with general guidance on how to safely work with a specific class of chemical or hazard. This SOP is generic in nature. It addresses the use and handling of substances by hazard class only. In some instances multiple SOPs may be applicable for a specific chemical (i.e., both the SOPs for flammable liquids and carcinogens would apply to benzene). If you have questions concerning the applicability of any item listed in this procedure contact the Safety Office or the Principal Investigator of your laboratory must develop written procedures are the responsibility of the principal investigator. If compliance with all the requirements of this standard operating procedure is not possible, the principal investigator must develop a written procedure that will be used in its place. This alternate procedure must provide the same level of protection as the SOP it replaces. The Safety Office is available to provide guidance during the development of alternate procedures.

Reactive solids are chemicals that react vigorously with moisture and other substances. The most common reactive solids include sodium, potassium and lithium metals; acid anhydrides and acid chlorides.

2. Securing of gas cylinders. Not applicable.

3. Decontamination procedures. Wash hands and arms with soap and water immediately after handling reactive solids. Carefully clean work area after use.

4. Designated area. Not applicable.

5. Emergency procedures. Emergency procedures which address response actions to fires, explosions, spills, injury to staff, or the development of sign and symptom of overexposure must be developed The procedures should address as a minimum the following:

a. Who to contact: Safety Office or Principal investigator of the laboratory, including evening phone number)

b.The location of all safety equipment (showers, spill equipment, eye wash, fire extinguishers, etc.)

c. The location and quantity of all reactive solids in the laboratory.

d. The method used to alert personnel in nearby areas of potential hazards.

e. Special first aid treatment required by the type of reactive solids material(s) handled in the laboratory.

f. Eye protection. Eye protection in the form of safety glasses must be worn at all times when handling reactive solids. Ordinary (street) prescription glasses do not provide adequate protection. (Contrary to popular opinion these glasses cannot pass the rigorous test for industrial safety glasses.) Adequate safety glasses must meet the requirements of the Practice for Occupational and Educational Eye and Face Protection (ANSI Z.87. 1 1989) and must be equipped with side shields. Safety glasses with side shields do not provide adequate protection from splashes; therefore, when the potential for splash hazard exists other eye protection and/or face protection must be worn.

g. Eyewash. Where the eyes or body of any person may be exposed to reactive solids, suitable facilities for quick drenching or flushing of the eyes and body shall be provided within the work area for immediate emergency use. Bottle type eyewash stations are not acceptable.

h. Fume hood. Many reactive solids will liberate hydrogen when they react with water. The use of a fume hood is recommended to prevent the buildup of combustible gases.

i. Glove (dry) box. Glove boxes may be used to handle reactive solids if inert or dry atmospheres are required.

j. Gloves. Gloves should be worn when handling reactive solids. Disposable nitrile gloves provide adequate protection against accidental hand contact with small quantities of most laboratory chemicals. Lab workers should contact SAFETY OFFICE for advice on chemical resistant glove selection when direct or prolonged contact with hazardous chemicals is anticipated.

k. Hazard assessment. Hazard assessment of work involving reactive solids should address proper use and handling techniques, fire safety (including the need for Class D fire extinguishers), storage, potential peroxide formation, water and air reactivity, and waste disposal issues.

l. Safety Office Notification. Not applicable.

m. Protective apparel.

n. Lab coats, closed toed shoes and long sleeved clothing should be worn when handling reactive solids. Additional protective clothing should be worn if the possibility of skin contact is likely.

o. Safety shielding. Safety shielding is required any time there is a risk of explosion, splash hazard or a highly exothermic reaction. All manipulations of reactive solids which pose this risk should occur in a fume hood with the sash in the lowest feasible position. Portable shields, which provide protection to all laboratory occupants, are acceptable.

p. Safety shower. A safety or drench shower should be available in a nearby location where the reactive solids is used.

q. Signs and labels. Containers: All reactive solids must be clearly labeled with the correct chemical name. Handwritten labels are acceptable; chemical formulas and structural formulas are not acceptable.

r. Special storage. Reactive solids should be stored in a cool and dry location. Keep reactive solids segregated from all other chemicals in the laboratory. Minimize the quantities of reactive solids stored in the laboratory. Date all containers upon receipt. Potassium will form peroxides and superoxides when stored under oil at room temperature. Examine storage containers frequently. Dispose of any container that exhibits salt build up on its exterior. Dispose of all reactive solids whenever they are no longer required for current research. Never return excess chemicals to the original container. Small amounts of impurities may be introduced into the container which may cause a fire or explosion.

s. Special ventilation. Special ventilation is required if these materials are used outside of a fume hood or glove box. If your research does not permit the handing of reactive solids in a fume hood or glove box you must contact the Office of Safety to review the adequacy of all special ventilation.

t. Spill response. Anticipate spills by having the appropriate clean up equipment on hand. The appropriate clean up supplies can be determined by consulting the material safety data sheet. This should occur prior to the use of any reactive solids chemical. Spill control materials for reactive solids are designed to be inert and will not react with the reagent. In the event of a spill alert personnel in the area that a spill has occurred. Do not attempt to handle a large spill of reactive solids. Turn off all ignition sources and vacate the laboratory immediately. Remain on the scene, but at a safe distance, to receive and direct safety personnel when they arrive.

u. Vacuum protection. Not applicable

v. Waste disposal. All materials contaminated with reactive solids should be disposed of as hazardous waste. Alert the Office of Safety if you generate wastes contaminated by reactive solids. These wastes may pose a flammability risk and should not remain in the laboratory overnight.

Q. Laboratory Safety Fact Sheet. Reproductive Hazards.

1. General Information. Standard operating procedures (SOP) are intended to provide you with general guidance on how to safely work with a specific class of chemical or hazard. This SOP is generic in nature. It addresses the use and handling of substances by hazard class only. In some instances multiple SOPs may be applicable for a specific chemical (i.e., both the SOPs for flammable liquids and carcinogens would

apply to benzene). If you have questions concerning the applicability of any items listed in this procedure contact the Safety Office or the Principal Investigator of your laboratory. Specific written procedures are the responsibility of the principal investigator. If compliance with all the requirements of this standard operating procedure is not possible, the principal investigator must develop a written procedure that will be used in its place. This alternate procedure must provide the same level of protection as the SOP it replaces. The Office of Safety is available to provide guidance during the development of alternate procedures.

Reproductive hazards are substances which affect the reproductive capabilities including chromosomal damage (mutagens) and effects on the fetus (teratogens). A list of reproductive hazards is included in Appendix D of this document.

2. Securing of gas cylinders. Not applicable.

3. Decontamination procedures. Wash hands and arms with soap and water immediately after handling reproductive hazards. Decontamination procedures vary depending on the material being handled. The toxicity of some materials can be neutralized with other reagents. All surfaces should be wiped with the appropriate cleaning agent following dispensing or handling. Waste materials generated should be treated as hazardous waste. Decontaminate vacuum pumps or other contaminated equipment (glassware) before removing them from the designated area.

4. Designated area. The room sign for the laboratory must contain a Designated Areas Within identifier. All locations within the laboratory where reproductive hazards are handled should be demarcated with designated area caution tape (available from SAFETY OFFICE, the cell center, or chemistry stockroom) and/or posted with designated area caution signs. This includes all fume hoods and bench tops where the reproductive hazards are handled. Where feasible, reproductive hazards should be manipulated over plastic-backed disposable paper work surfaces. These disposable work surfaces minimize work area contamination and simplify clean up.

5. Emergency procedures. Emergency procedures which address response actions to fires, explosions, spills, injury to staff, or the development of sign and symptom of overexposure must be developed. The procedures should address as a minimum the following:

a. Who to contact: Safety Office or Principal investigator of the laboratory including evening phone number.

b. The location of all safety equipment (showers, eye wash, fire extinguishers, etc.).

c. The method used to alert personnel in nearby areas of potential hazards.

d. The location and quantity of all reproductive hazards stored in the laboratory.

e. Special first aid treatment required by the type of reproductive hazards handled in the laboratory.

f. Eye protection. Eye protection in the form of safety glasses must be worn at all times when handling reproductive hazards. Ordinary (street) prescription glasses do not provide adequate protection. (Contrary to popular opinion these glasses cannot pass the rigorous test for industrial safety glasses.) Adequate safety glasses must meet the requirements of the American Standard Practice for Occupational and Educational Eye and Face Protection (ANSI Z.87. 1 1989) and must be equipped with side shields. Safety glasses with side shields do not provide adequate protection from splashes; therefore, when the potential for a splash hazard exists other eye protection and/or face protection must be worn.

g. Eyewash. Where the eyes or body of any person may be exposed to reproductive hazards, suitable facilities for quick drenching or flushing of the eyes and body shall be provided within the work area for immediate emergency use. Bottle type eyewash stations are not acceptable.

h. Fume hood. Manipulation of reproductive hazards should be carried out in a fume hood. If the use of a fume hood proves impractical refer to the section on special ventilation. All areas where reproductive hazards are stored or manipulated must be labeled as a designated area.

i. Glove (dry) box. Certain reproductive hazards must be handled in a glove box rather than a fume hood. The Safety Office or the Principal Investigator will determine if this is required.

j. Gloves. Gloves should be worn when handling reproductive hazards. Disposable nitrile gloves provide adequate protection against accidental hand contact with small quantities of most laboratory

chemicals. Lab workers should contact the Safety Office for advice on chemical resistant glove selection when direct or prolonged contact with hazardous chemicals is anticipated.

k. Hazard assessment. Hazard assessment should focus on proper handling techniques, education of laboratory workers concerning the health risks posed by reproductive hazards, and the demarcation of designated areas.

l. Safety Office Notification. You should notify the Safety Office prior to the initial use of reproductive hazards. Use the form in Appendix F for this purpose. Notification is also required following significant changes in procedures or the quantity of materials used.

m. Protective apparel. Lab coats, closed toed shoes and long sleeved clothing should be worn when handling reproductive hazards. Additional protective clothing should be worn if the possibility of skin contact is likely.

n. Safety shielding. Safety shielding is required any time there is a risk of explosion, splash hazard or a highly exothermic reaction. All manipulations of reproductive hazards which pose this risk should be performed in a fume hood with the sash in the lowest feasible position. Portable shields, which provide protection to all laboratory occupants, are acceptable.

o. Safety shower. A safety or drench shower should be available in a nearby location where the reproductive hazards are used.

p. Signs and labels. The room sign must contain a Designated Area Within Caution where carcinogens, reproductive hazards, and/or acutely toxic chemicals are stored or used. All containers of reproductive hazards must be clearly labeled with the correct chemical name. Handwritten labels are acceptable; chemical formulas and structural formulas are not acceptable.

q. Special storage. Reproductive hazards must be stored in a designated area.

r. Special ventilation. Manipulation of reproductive hazards outside of a fume hood may require special ventilation controls in order to minimize exposure to the material. Fume hoods provide the best protection against exposure to reproductive hazards in the laboratory and are the preferred ventilation control device. When possible, handle reproductive hazards in a fume hood. If the use of a fume hood proves impractical attempt to work in a glove box or on an isolated area of the bench top.
If available, consider using a Biological Safety Cabinet. The biological safety cabinet is designed to remove particulates (the reproductive hazard) before the air is discharged into the environment. Reproductive hazards that are volatile must not be used in a biological safety cabinet unless the cabinet is vented to the outdoors. If your research does not permit the handing of reproductive hazards in a fume hood, biological safety cabinet, or glove box, you must contact the Office of Safety.

All areas where reproductive hazards are stored or manipulated must be labeled as a designated area.

s. Spill response. Anticipate spills by having the appropriate clean up equipment on hand. The appropriate clean up supplies can be determined by consulting the material safety data sheet. This should occur prior to the use of any reproductive hazard. In the event of a spill alert personnel in the area that a spill has occurred. Do not attempt to handle a spill of reproductive hazards. Vacate the laboratory immediately and call for assistance. Remain on the scene, but at a safe distance, to receive and direct safety personnel when they arrive.

t. Vacuum protection. Evacuated glassware can implode and eject flying glass, and splattered chemicals. Vacuum work involving reproductive hazards must be conducted in a fume hood, glove box or isolated in an acceptable manner. Mechanical vacuum pumps must be protected using cold traps and, where appropriate, filtered to prevent particulate release. The exhaust for the pumps must be vented into an exhaust hood.

u. Waste disposal. All materials contaminated with reproductive hazards should be disposed of as a hazardous waste. Wherever possible, attempt to design research in a manner that reduces the quantity of waste generated. Questions regarding waste pick up should be directed to the Safety Office. This office can also assist you in minimizing waste generation.

R. Laboratory Safety Fact Sheet. Water Sensitive Chemicals.

1. General Information. Standard operating procedures (SOP) are intended to provide you with general guidance on how to safely work with a specific class of chemical or hazard. This SOP is generic in nature. It addresses the use and handling of substances by hazard class only. In some instances multiple SOPs may be applicable for a specific chemical (i.e., both the SOPs for flammable liquids and carcinogens would apply to benzene). If you have questions concerning the applicability of any item listed in this procedure contact the Office of Safety or the Principal Investigator of your laboratory. Specific written procedures are the responsibility of the principal investigator. If compliance with all the requirements of this standard operating procedure is not possible, the principal investigator must develop a written procedure that will be used in its place. This alternate procedure must provide the same level of protection as the SOP it replaces. The Office of Safety is available to provide guidance during the development of alternate procedures.

Water sensitive chemicals are chemicals that react vigorously with moisture. The most common water sensitive chemicals include sodium, potassium, lithium metals and aluminum alkyls.

2. Securing of gas cylinders. Not applicable.

3. Decontamination procedures. Wash hands and arms with soap and water immediately after handling water sensitive chemicals. Carefully clean work area after use.

4. Designated area. Not applicable.

5. Emergency procedure. Emergency procedures which address response actions to fires, explosions, spills, injury to staff, or the development of sign and symptom of overexposure must be developed The procedures should address as a minimum the following:

a. Who to contact: Safety Office or Principal investigator of the laboratory including evening phone number.

b. The location of all safety equipment (showers, spill equipment, eye wash, fire extinguishers, etc.).

c. The location and quantity of all water sensitive chemicals in the laboratory.

d. The method used to alert personnel in nearby areas of potential hazards.

e. Special first aid treatment required by the type of water sensitive chemicals handled in the laboratory.

f. Eye protection. Eye protection in the form of safety glasses must be worn at all times when handling water sensitive chemicals. Ordinary (street) prescription glasses do not provide adequate protection. (Contrary to popular opinion these glasses cannot pass the rigorous test for industrial safety glasses.) Adequate safety glasses must meet the requirements of the American Standard Practice for Occupational and Educational Eye and Face Protection (ANSI Z.87. 1 1989) and must be equipped with side shields. Safety glasses with side shields do not provide adequate protection from splashes; therefore, when the potential for splash hazard exists other eye protection and/or face protection must be worn.

g. Eyewash. Where the eyes or body of any person may be exposed to water sensitive chemicals, suitable facilities for quick drenching or flushing of the eyes and body shall be provided within the work area for immediate emergency use. Bottle type eyewash stations are not acceptable.

h. Fume hood. Many water sensitive chemicals will liberate hydrogen when they react with water. The use of a fume hood is recommended to prevent the buildup of combustible gases.

i. Glove (dry) box. A glove box may be used to handle water sensitive chemicals when a dry atmosphere is required.

j. Gloves. Gloves should be worn when handling water sensitive chemicals. Disposable nitrile gloves provide adequate protection against accidental hand contact with small quantities of most laboratory chemicals. Lab workers should contact SAFETY OFFICE for advice on chemical resistant glove selection when direct or prolonged contact with hazardous chemicals is anticipated.

k. Hazard assessment. Hazard assessment of work involving water sensitive chemicals should address proper use and handling techniques, fire safety (including the need for Class D fire extinguishers), storage, water reactivity, and waste disposal issues.

l. Safety Office Notification. Not Applicable.

m. Protective apparel. Lab coats, closed toed shoes and long sleeved clothing should be worn when handling water sensitive chemicals. Additional protective clothing should be worn if the possibility of skin contact is likely.

n. Safety shielding. Safety shielding is required any time there is a risk of explosion, splash hazard or a highly exothermic reaction. All manipulations of water sensitive chemicals which pose this risk should occur in a fume hood with the sash in the lowest feasible position. Portable shields, which provide protection to all laboratory occupants, are acceptable.

o. Safety shower. A safety or drench shower should be available in a nearby location where the water sensitive chemicals is used.

p. Signs and labels. Containers: All water reactive chemicals chemical must be clearly labeled with the correct chemical name. Handwritten labels are acceptable; chemical formulas and structural formulas are not acceptable.

q. Special storage. Water sensitive chemicals should be stored in a cool and dry location. Keep water sensitive chemicals segregated from all other chemicals in the laboratory. Minimize the quantities of water sensitive chemicals stored in the laboratory. Date all containers upon receipt. Potassium will form peroxides and superoxides when stored under oil at room temperature. Examine storage containers frequently. Dispose of any container that exhibits salt build up on its exterior. Dispose of all water sensitive chemicals whenever they are no longer required for current research. Never return excess chemicals to the original container. Small amounts of impurities may be introduced into the container which may cause a fire or explosion.

r. Special ventilation. Special ventilation is required if these materials are used outside of a fume hood. If your research does not permit the handing of water sensitive chemicals in a fume hood you must contact the Safety Office to review the adequacy of all special ventilation.

s. Spill response. Anticipate spills by having the appropriate clean up equipment on hand. The appropriate clean up supplies can be determined by consulting the material safety data sheet. This should occur prior to the use of any water sensitive chemicals. Spill control materials for water sensitive chemicals are designed to be inert and will not react with the reagent. Do not put water on the spill. In the event of a spill alert personnel in the area that a spill has occurred. Do not attempt to handle a large spill of water sensitive chemicals. Turn off all ignition sources and vacate the laboratory immediately. Call for assistance. Remain on the scene, but at a safe distance, to receive and direct safety personnel when they arrive.

t. Vacuum protection. Not applicable.

u. Waste disposal. All materials contaminated with water sensitive chemicals should be disposed of as hazardous waste. Alert the Safety Office if you generate wastes contaminated by water sensitive chemicals. These wastes may pose a flammability risk and should not remain in the laboratory overnight.

S. Laboratory Fact Sheet. Reactive Liquids.

1. General Information. Standard operating procedures (SOP) are intended to provide you with general guidance on how to safely work with a specific class of chemical or hazard. This SOP is generic in nature. It addresses the use and handling of substances by hazard class only. In some instances multiple SOPs may be applicable for a specific chemical (i.e., both the SOPs for flammable liquids and carcinogens would apply to benzene). If you have questions concerning the applicability of any item listed in this procedure contact the Safety Office or the Principal Investigator of your laboratory. Specific written procedures are the responsibility of the principal investigator. If compliance with all the requirements of this standard operating procedure is not possible, the principal investigator must develop a written procedure that will be used in its place. This alternate procedure must provide the same level of protection as the SOP it replaces. The Safety Office is available to provide guidance during the development of alternate procedures.

Reactive liquids are chemicals that react vigorously with moisture or oxygen or other substances.

2. Securing of gas cylinders. Not applicable.

3. Decontamination procedures. Personnel: Wash hands and arms with soap and water immediately after handling reactive liquids. Carefully clean work area after use. Decontaminate vacuum pumps or other contaminated equipment (glassware) before removing them from the designated area.

4. Designated area. Not applicable.

5. Emergency procedures. Emergency procedures which address response actions to fires, explosions, spills, injury to staff, or the development of signs and symptoms of overexposure must be developed. The procedures should address as a minimum the following:

a. Who to contact: Safety Office or Principal investigator of the laboratory including evening phone number).

b. The location of all safety equipment (showers, spill equipment, eye wash, fire extinguishers, etc.).

c. The location and quantity of all reactive liquids in the laboratory.

d. The method used to alert personnel in nearby areas of potential hazards.

e. Special first aid treatment required by the type of reactive liquids handled in the laboratory.

f. Eye protection. Eye protection in the form of safety glasses must be worn at all times when handling reactive liquids. Ordinary (street) prescription glasses do not provide adequate protection. (Contrary to popular opinion these glasses cannot pass the rigorous test for industrial safety glasses.) Adequate safety glasses must meet the requirements of the Practice for Occupational and Educational Eye and Face Protection (ANSI Z.87.1 1989) and must be equipped with side shields. Safety glasses with side shields do not provide adequate protection from splashes; therefore, when the potential for splash hazard exists other eye protection and/or face protection must be worn.

g. Eyewash. Where the eyes or body of any person may be exposed to reactive liquids, suitable facilities for quick drenching or flushing of the eyes and body shall be provided within the work area for immediate emergency use. Bottle type eyewash stations are not acceptable.

h. Fume hood. Many reactive liquids will ignite or liberate combustible gas when exposed to water vapor or air. The use of a fume hood is recommended to prevent the buildup of flammable gases.

i. Glove (dry) box. A glove box may be used to handle reactive liquids if an inert or dry atmosphere is required.

j. Gloves. Gloves should be worn when handling reactive liquids. Disposable nitrile gloves provide adequate protection against accidental hand contact with small quantities of most laboratory chemicals. Lab workers should contact the Safety Office for advice on chemical resistant glove selection when direct or prolonged contact with hazardous chemicals is anticipated.

k. Hazard assessment. Hazard assessment of work involving reactive liquids should address proper use and handling techniques, fire safety (including the need for Class D fire extinguishers), storage, the specific reactive nature of the material (such as water and air reactivity), and waste disposal issues.

l. Safety Office Notification. Not applicable.

m. Protective apparel. Lab coats, closed toed shoes and long sleeved clothing should be worn when handling reactive liquids. Additional protective clothing should be worn if the possibility of skin contact is likely.

n. Safety shielding. Safety shielding is required any time there is a risk of explosion, splash hazard or a highly exothermic reaction. All manipulations of reactive liquids that pose this risk should occur in a fume hood with the sash in the lowest feasible position. Portable shields, which provide protection to all laboratory occupants are acceptable.

o. Safety shower. A safety or drench shower should be available in a nearby location where the reactive liquids are used.

p. Signs and labels. All reactive liquids must be clearly labeled with the correct chemical name. Handwritten labels are acceptable; chemical formulas and structural formulas are not acceptable.

q. Special storage. Reactive liquids should be stored in a cool and dry location. Keep reactive liquids segregated from all other chemicals in the laboratory. Minimize the quantities of reactive liquids stored in the laboratory. Date all containers upon receipt. Examine storage containers frequently. Dispose of any container that exhibits salt build up on its exterior. Dispose of all reactive liquids whenever they are no longer required for current research. Never return excess chemicals to the original container. Small amounts of impurities may be introduced into the container that may cause a fire or explosion.

r. Special ventilation. Special ventilation may be required if these materials are used outside a fume hood. If your research does not permit the handing of reactive liquids in a fume hood you must contact the Safety Office to review the adequacy of all special ventilation.

s. Spill response. Anticipate spills by having the appropriate clean up equipment on hand. The appropriate clean up supplies can be determined by consulting the material safety data sheet. This should occur prior to the use of any reactive liquids. Spill control materials for reactive liquids are designed to be inert and will not react with the reagent. In the event of a spill alert personnel in the area that a spill has occurred. Do not attempt to handle a spill of reactive liquids. Turn off all ignition sources and vacate the laboratory immediately. Call for assistance. Remain on the scene, but at a safe distance, to receive and direct safety personnel when they arrive.

t. Vacuum protection. Not applicable.

u. Waste disposal. All materials contaminated with reactive liquids should be disposed of as hazardous waste. Alert the Safety Office if you generate wastes contaminated by reactive liquids. These wastes may pose a flammability risk and should not remain in the laboratory overnight.

T. Laboratory Fact Sheet. Animal Inhalation Anesthetics not applicable

1. General Information. Standard operating procedures (SOP) are intended to provide you with general guidance on how to safely work with a specific class of chemical or hazard. This SOP addresses the use and handling of inhalation anesthetics for animals. If you have questions concerning the applicability of any item listed in this procedure contact the Safety Office or the Principal Investigator of your laboratory. Specific written procedures are the responsibility of the principal investigator. If compliance with all the requirements of this standard operating procedure is not possible, the principal investigator must develop a written procedure that will be used in its place. This alternate procedure must provide the same level of protection as the SOP it replaces. The Safety Office is available to provide guidance during the development of alternate procedures.

2. Decontamination procedures. Wash hands and arms with soap and water immediately following any skin contact with anesthetic agents.

3. Emergency procedures. Emergency procedures which address response actions to fires, explosions, spills, injury to staff, or the development of signs and symptoms of overexposure must be developed. The procedures should address as a minimum the following:

a. Who to contact: Safety Office or Principal investigator of the laboratory including evening phone number).

b. The location of all safety equipment (showers, eye wash, fire extinguishers, spill materials, etc.).

c. The method used to alert personnel in nearby areas of potential hazards.

d. Eye protection. Eye protection in the form of safety glasses must be worn at all times when handling anesthetic agents. Ordinary (street) prescription glasses do not provide adequate protection. (Contrary to popular opinion these glasses cannot pass the rigorous test for industrial safety glasses.) Adequate safety glasses must meet the requirements of the Practice for Occupational and Educational Eye and Face Protection (ANSI Z.87. 1 1989) and must be equipped with side shields.

e. Eyewash. Where the eyes or body of any person may be exposed to anesthetic agents, suitable facilities for quick drenching or flushing of the eyes and body shall be provided within the work area for immediate emergency use. Bottle type eyewash stations are not acceptable.

f. Fume hood. Use of small quantities: In most campus labs small quantities of liquid anesthetics (<100 cc) may be handled on the bench top without special ventilation. If you are located in an older building or a very small room you may not have adequate ventilation to work on the bench. Contact the Safety Office if you have concerns about the adequacy of the lab environment. Do not permit containers to remain open on the bench top. Ether is flammable. Be certain that there are no ignition sources present when handling ether. There are restrictions concerning the use of ether with animals. The odor thresholds for most liquid anesthetics (except for ether) are well above permissible exposure limits. If you smell the anesthetic the control procedures you are using are inadequate and must be re-evaluated.

Use of large quantities: Fume hoods provide the best protection against exposure to anesthetic in the laboratory and are the preferred ventilation control device when handling greater than 100 cc outside of the

original container. Always handle large quantities of ethyl ether in a fume hood due to the flammable nature of the material. If your research does not permit the handling of large quantities of ethyl ether in your fume hood, contact the Safety Office to review the adequacy of all special ventilation. Liquid anesthetics administered with a vaporizer must be scavenged. Large quantities must be handled in a hood.

g. Gloves. Single use nitrile or latex gloves should be worn when handling anesthetic agents.

h. Hazard assessment. Hazard assessment for work involving anesthetic agents should thoroughly address the issues of proper use and handling, fire safety (for ether), chemical toxicity, storage, and spill response.

i. Protective apparel. Lab coats, closed toed shoes and long sleeved clothing should be worn when handling anesthetic agents. Additional protective clothing should be worn if the possibility of skin contact is likely.

j. Safety shower. A safety or drench shower should be available in a nearby location where the anesthetic agents are used.

k. Signs and labels. All anesthetic agents must be clearly labeled with the correct chemical name. Handwritten labels are acceptable; chemical formulas and structural formulas are not acceptable.

l. Special storage. Ethers, and olefins form peroxides after exposure to air and light. Since these chemicals are packaged in an air atmosphere, peroxides can form even though the containers have not been opened. Write the date received and date opened on all containers of ether. Opened containers of ether should be discarded within 6 months of opening. Unless an inhibitor was added by the manufacturer, closed containers of ether should be discarded after 1 year. Liquid anesthetic agents (i.e. halothane, enflurane, isoflurane) are not flammable but do have limited shelf life. Be certain to date the chemical when it is opened and to check expiration date before use. Always purchase the smallest quantity required for use. Ether used for anesthetic purposes should be purchased in the smallest quantity available (typically 150 cc, Fisher Scientific E136-150) due to its short (6 month) shelf life after it is opened.

m. Special ventilation. Liquid anesthetics administered with a vaporizer must be scavenged.

n. Spill response. Anticipate spills by having the appropriate clean up equipment on hand. Spill materials for anesthetic agents are designed to control the liquid portion of the spill and minimize the production of flammable vapors. Never use paper towels on large spills of anesthetic agents because it exacerbates vapor production. In the event of a spill all personnel in the area should be alerted. Turn off all sources of ignition. Do not attempt to handle a large spill of anesthetic agents. Vacate the laboratory immediately and call for assistance. Remain on the scene, but at a safe distance, to receive and direct safety personnel when they arrive.

o. Waste disposal. Anesthetic agents are hazardous wastes. Questions regarding waste disposal should be directed to the Safety Office.

U. Laboratory Fact Sheet. Electrical Safety.

1. General Information. This SOP applies to equipment and appliances used in a laboratory. It does not address computers or other office equipment used in non-laboratory settings.

2. Extension Cords. Use extension cords for temporary (less than three months) use. Situations that require extension cords for greater than three months are considered permanent installations and must be addressed through upgrades to building wiring systems. Extension cords should be no less than 16 gauge. Do not place extension cords in foot traffic areas or under equipment. Length shall be the minimum required for the specific application but shall not exceed 15 feet. Ground wires are required for all extension cords (i.e., the cord should have three prongs).

3. Single Conductor Wires. Single conductors shall not conduct greater than 24 volts. Code single conductors red or black and keep them as short as possible. Single conductors shall be a single continuous length of wire unless spliced or joined in a grounded electrical box that provides appropriate strain-relief. Wire nut or other connections that are not housed in a grounded electrical box are not permitted.

4. Terminal Connections. All electrical connections at the supply end (bus bars) for 24 volt or greater services shall have strain relief and be enclosed. Label the enclosure with the voltage. Plug style connections are permitted if the conductor is fully insulated and the conducting wire is not exposed when

disconnected. When possible enclose electrical connections in a protective housing. Insulate high temperature (>1808C) connections, such as furnaces, with 3M 69 Class "H" glass cloth tape.

XVII. Glossary

ACGIH. The American Conference of Governmental Industrial Hygienists is a voluntary membership organization of professional industrial hygiene personnel in governmental or educational institutions. The ACGIH develops and publishes recommended occupational exposure limits each year called Threshold Limit Values (TLVs) for hundreds of chemicals, physical agents, and biological exposure indices.

ACUTE. Severe, often dangerous conditions in which relatively rapid changes occur.

ACUTE EXPOSURE. An intense exposure over a relatively short period of time.

ANSI. The American National Standards Institute is a voluntary membership organization (run with private funding) that develops consensus standards nationally for a wide variety of devices and procedures.

ASPHYXIANT. A chemical (gas or vapor) that can cause death or unconsciousness by suffocation. Simple asphyxiants such as nitrogen, either use up or displace oxygen in the air. They become especially dangerous in confined or enclosed spaces. Chemical asphyxiants, such as carbon monoxide and hydrogen sulfide, interfere with the body's ability to absorb or transport oxygen to the tissues.

BOILING POINT. The temperature at which the vapor pressure of a liquid equals atmospheric pressure or at which the liquid changes to a vapor. The boiling point is usually expressed in degrees Fahrenheit. If a flammable material has a low boiling point, it indicates a special fire hazard.

"C" or CEILING. A description usually used with a published exposure limit. It refers to the concentration that should not be exceeded, even for an instant. It may be written as TLV-C or Threshold Limit Value - Ceiling. See also THRESHOLD LIMIT VALUE.

CARCINOGEN. A substance or physical agent that may cause cancer in animals or humans.

C.A.S. NUMBER. Identifies a particular chemical by the Chemical Abstracts Service, a service of the American Chemical Society that indexes and compiles abstracts of worldwide chemical literature called "Chemical Abstracts."

CC. Cubic centimeter, a volumetric measurement that is also equal to one milliliter (mL).

CHEMICAL. An element or a compound, produced by chemical reactions on a large scale for direct industrial and consumer use, or for reaction with other chemicals.

CHEMICAL REACTION. A change in the arrangement of atoms or molecules to yield substances of different composition and properties. SEE REACTIVITY

CHP. Chemical Hygiene Plan

CHRONIC. Persistent, prolonged, or repeated conditions.

CHRONIC EXPOSURE. A prolonged exposure occurring over a period of days, weeks, or years.

COMBUSTIBLE. According to the DOT and NFPA, combustible liquids are those having a flash point at or above l00°F (37.8°C), or liquids that will burn. They do not ignite as easily as flammable liquids. However, combustible liquids can be ignited under certain circumstances, and must be handled with caution. Substances, such as wood, paper, etc., are termed "Ordinary Combustibles".

CONCENTRATION. Ten thousand parts per million is equal to one percent.

CORROSIVE. A substance defined by DOT, as causing visible destruction or permanent changes in human skin tissue at the site of contact, or is highly corrosive to steel.
CUBIC METER (m^3). A measure of volume in the metric system.

CUTANEOUS. Pertaining to or affecting the skin.

DECOMPOSITION. The breakdown of a chemical or substance into different parts or simpler compounds. Decomposition can occur due to heat, chemical reaction, decay, etc.

DERMAL. Pertaining to, or affecting the skin.

DERMATITIS. An inflammation of the skin.

DESIGNATED AREA . Means an area that may be used for work with select carcinogens, reproductive toxins, or substances that have a high degree of acute toxicity. A designated area may be an entire laboratory, an area of a laboratory, or a device such as a laboratory hood.Designated areas must be demarcated with designated area caution tape (available from SAFETY OFFICE, the Cell Center, or Chemistry stockroom) and/or posted with designated area caution signs. Storage areas must be segregated from other chemical storage. This includes all fume hoods and bench tops where the acutely toxic, carcinogenic, or reproductive hazards are handled.

DILUTION VENTILATION. See GENERAL VENTILATION

DOT. The United States Department of Transportation is the federal agency that regulates the labeling and transportation of hazardous materials.

DYSPNEA. Shortness of breath. Difficult or labored breathing.

EPA. The Environmental Protection Agency is the governmental agency responsible for administration of laws to control and reduce pollution of air, water, and land systems.

EPA NUMBER. The number assigned to chemicals (typically hazardous wastes) regulated by the Environmental Protection Agency (EPA).

EPIDEMIOLOGY. The study of diseases in populations.

ERYTHEMA. A reddening of the skin.

EVAPORATION RATE. The rate at which a material is converted to vapor (evaporates) at a given temperature and pressure compared to the evaporation rate of water. Health and fire hazard evaluations of materials involve consideration of evaporation rates as one aspect of the evaluation.

EXPLOSIVE. Means a chemical that causes a sudden, almost instantaneous release of pressure, gas, and heat when subjected to sudden shock, pressure or high temperature.

^oF. Degrees, Fahrenheit. A temperature scale.

FLAMMABLE LIQUID. According to the DOT and NFPA, a flammable liquid is one that has a flash point below l00oF (37.8^oC). See FLASH POINT.

FLASH POINT. The lowest temperature at which a liquid gives off enough vapor to form an ignitable mixture and burn when a source of ignition (sparks, open flames, cigarettes, etc.) is present. Two tests are used to determine the flash point: open cup and closed cup. The test method is indicated on the MSDS after the flash point.

g. See GRAM

GENERAL VENTILATION. Also known as general dilution ventilation, this is a system of ventilation consisting of either natural or mechanically induced fresh air movements to mix with and dilute contaminants in the workroom air. Dilutional ventilation is not the preferred method to control contaminants that are highly toxic; when there may be corrosion problems from the contaminant; when the worker is close to where the contaminant is being generated; or where fire or explosion hazards are generated close to sources of ignition.

g/kg. See GRAMS PER KILOGRAM

GRAM (g). A metric unit of weight. One ounce equals 28.4 grams.

GRAMS PER KILOGRAM (g/kg). This indicates the dose of a substance given to test animals in toxicity studies. For example, a dose may be 2 grams (of substance) per kilogram of body weight (of the experimental animal).

HAZARDOUS MATERIAL. Any substance or compound that has the capability of producing adverse effects on the health and safety of humans.

IGNITABLE. A solid, liquid, or compressed gas that has a flash point of less than 140^{o}F. Ignitable material may be regulated by the EPA as a hazardous waste, as well.

INCOMPATIBLE. The term applied to two substances, to indicate that one material cannot be mixed or stored with the other, without the possibility of a dangerous reaction.

INGESTION. Taking a substance into the body through the mouth.

INHALATION. The breathing in of an airborne substance that may be in the form of gases, fumes, mists, vapors, dusts, or aerosols.

INHIBITOR. A substance that is added to another to prevent, or slow down an unwanted reaction or change.

IRRITANT. A substance that produces an irritating effect when in contact with skin, eyes, nose, or respiratory system.

kg. See KILOGRAM

KILOGRAM (kg). A unit of weight in the metric system equal to 2.2 pounds.

L. See LITER

LC50. See LETHAL CONCENTRATION 50

LD50. See LETHAL DOSE 50

LEL. See LOWER EXPLOSIVE LIMIT

LETHAL CONCENTRATION 50. The concentration of an air contaminant (LC50) that kills 50 percent of the test animals in a group, within the first 30 days following exposure.

LETHAL DOSE 50. A calculated dose of a substance which is expected to cause the death of 50% of the entire defined experimental animal population.

LFL. See LOWER EXPLOSIVE LIMIT

LITER (L). A measure of volume. One quart approximately equals 0.946 liters
LOCAL EXHAUST VENTILATION (Also known as exhaust ventilation). A ventilation system that captures, and removes the contaminants, at the point they are being produced, before they escape into the workroom air. The system consists of hoods, duct work, a fan, and possibly an air cleaning device. Advantages of local exhaust ventilation over general ventilation include: requires less air volume; more economical over the long term. However, the system must be properly designed, with properly designed and located hoods, and correctly sized fans and duct work.

LOWER EXPLOSIVE LIMIT. The lower limit of flammability of a gas or vapor. It is usually expressed in percentage of gas or vapor in air by volume.

m^3. See CUBIC METER

MELTING POINT. The temperature at which a solid changes to a liquid. A melting range may be given for mixtures.

mg. See MILLIGRAM

mg/kg. See MILLIGRAMS PER KILOGRAM

mg/m^3. See MILLIGRAMS PER CUBIC METER

MILLIGRAM (mg). A unit of weight in the metric system One thousand milligrams equal one gram.

MILLIGRAMS PER CUBIC METER. Units used to measure (mg/m^3) concentration of dusts, gases, mists, and fumes in air.

MILLIGRAMS PER KILOGRAM. This indicates the dose of a substance (mg/kg) given to test animals in toxicity studies. For example, a dose may be 2 milligrams (of substance) per kilogram of body weight (of the experimental animal).

MILLILITER (mL). A metric unit used to measure VOLUME. One milliliter equals one cubic centimeter. One thousand milliliters equal one liter.

mL. See MILLILITER

MSHA . The Mine Safety and Health Administration; a federal agency that regulates the mining industry in the safety and health area.

MUTAGEN. Anything that can cause a change (or mutation) in the genetic material of a living cell.

NARCOSIS. Stupor or unconsciousness caused by exposure to a chemical.

NFPA. The National Fire Prevention Association is a voluntary membership organization whose aims are to promote and improve fire protection and prevention. NFPA has published 16 volumes of codes known as the National Fire Codes. Within these codes is Standard No. 704, "Identification of the Fire Hazards of Materials". This is a system that rates the hazard of a material during a fire. These hazards are divided into health, flammability, and reactivity hazards and appear in a well-known diamond system using from zero through four to indicate the severity of the hazard.

NIOSH. The National Institute of Occupational Safety and Health is a federal agency that among its various responsibilities, trains occupational health and safety professionals. NIOSH conducts research on health and safety concerns and tests and certifies respirators for work place use.

ODOR THRESHOLD. The minimum concentration of a substance at which a majority of test subjects can detect and identify the substance's characteristic odor.

SAFETY OFFICE. Currently located with the Dean of Science and Technology.

ORAL. Having to do with the mouth.

OSHA. The Occupational Safety and Health Administration - a federal agency under the Department of Labor that publishes and enforces safety and health regulations for most businesses and industries in the United States.

OXIDATION. The process of combining oxygen with some other substance or a chemical change in which an atom loses electrons.

OXIDIZER. Is a substance that gives up oxygen easily, to stimulate combustion of organic material.

OXYGEN DEFICIENCY. An atmosphere having less than 21% oxygen.

PEL. See PERMISSIBLE EXPOSURE LIMIT

PERMISSIBLE EXPOSURE LIMIT (PEL). An exposure limit that is published and enforced by OSHA as a legal standard. PEL may be either a time-weighted-average (TWA) exposure limit (8 hour), a 15 minute short term exposure limit (STEL), or a ceiling (C). The PELs are found in Tables Z-1, Z-2, or Z-3 of OSHA REGULATIONS 1910.1000. SEE ALSO TLV.

PERSONAL PROTECTIVE EQUIPMENT. Any device or clothing worn by the worker to protect against hazards in the environment. Examples are: respirators; gloves; and chemical splash goggles.

POLYMERIZATION. A chemical reaction in which two or more small molecules combine to form larger molecules.

ppm. Parts (of vapor or gas) per million (parts of air) by volume.

REACTIVITY. A substance's susceptibility to undergoing a chemical reaction or change that may result in dangerous side effects, such as explosion, burning, and corrosive, or toxic emissions. The conditions that cause the reaction, such as heat, other chemicals, and dropping, will usually be specified as "Conditions to Avoid": when a chemical's reactivity is discussed on a MSDS.

RESPIRATOR. A device that is designed to protect the wearer from inhaling harmful contaminants.

RESPIRATORY HAZARD. A particular concentration of an airborne contaminant that, when it enters the body by way of the respiratory system, or by being breathed into the lungs, results in some bodily function impairment.

SELECT AGENT TOXINS. A group of toxins regulated by USA PATRIOT ACT of 2001.

SENSITIZER. A substance that may cause no reaction in a person during initial exposures, but afterwards, further exposures will cause an allergic response to the substance.

SHORT TERM EXPOSURE LIMIT. Represented as STEL or TLV-STEL, this is: a maximum concentration to which workers can be exposed for a 15 minute period, four times a day, with at least one hour between exposures. Also the daily TLV-TWA must not be exceeded.

SKIN. This designation sometimes appears alongside a TLV or PEL. It refers to the likelihood of absorption of the chemical through the skin and eyes.

STEL. See SHORT TERM EXPOSURE LIMIT.

SUBSTANCE. Any chemical entity.
SYNONYM. Another name by which the same chemical may be known.

SYSTEMIC. Spread throughout the body; affecting many or all body systems or organs, not localized in one spot or area.

TERATOGEN. An agent or substance that may cause physical defects in the developing embryo or fetus when a pregnant female is exposed to the substance.

THRESHOLD LIMIT VALUE. Airborne concentrations of substances devised by the ACGIH, that represents conditions under which it is believed that nearly all workers may be exposed day after day, with no adverse effect. TLVs are advisory exposure guidelines, not legal standards, that are based on evidence from industrial experience, animal studies, or human studies when they exist. There are three different types of TLVs. They are: Time Weighted Average (TLV-TWA), Short Term Exposure Limit (TLV-STEL), and Ceiling (TLV-C). See also PEL.

TIME WEIGHTED AVERAGE. The average time, over a given work period (e.g., 8-hour workday), of a person's exposure to a chemical or an agent. The average is determined by sampling for the contaminant throughout the time period. Represented as TLV-TWA.

TLV. See THRESHOLD LIMIT VALUE

TOXICITY. The potential of a substance to exert a harmful effect, on humans or animals, and a description of the effect and the conditions or concentration, under which the effect takes place.

TRADE NAME. The commercial name or trademark by which a chemical is known. One chemical may have a variety of trade names depending on the manufacturers or distributors involved.

TWA. See TIME WEIGHTED AVERAGE

UEL. See UPPER EXPLOSIVE LIMIT

UFL. See UPPER EXPLOSIVE LIMIT.

UNSTABLE LIQUID. A liquid that in its pure state or as commercially produced, will react vigorously in some hazardous way under shock conditions (i.e., dropping), certain temperatures, or pressures.

UPPER EXPLOSIVE LIMIT. (Also known as Upper Flammable Limit) It is the highest concentration (expressed in percentage of vapor or gas in the air by volume) of a substance that will burn or explode, when an ignition source is present. Theoretically, above this limit, the mixture is said to be too "rich" to support combustion. The range between the LEL and the UEL, constitutes the flammable range, or explosive range of a substance. That is, if the LEL is 1 ppm and UEL is 5 ppm, then the explosive range of the chemical is 1 ppm to 5 ppm. See also LEL.

VAPOR. The gaseous form of substances that are normally in the liquid, or solid state (at normal room temperature and pressure). Vapors evaporate into the air from liquids, such as solvents. Solvents with low boiling points will evaporate.

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XIX. Appendicies.

Appendix A: List of Acutely Toxic Gases. This list is provided as a guide and is not all inclusive. Review safety data sheet.

Name	CAS#		Name	CAS#
arsenic pentafluoride	784-36-3		oxygen difluoride	7783-41-7
arsine	7784-42-1		phosgene	75-45-5
boron trifluoride	7637-07-2		phosphine	1498-40-4
chlorine	7782-50-5		phosphorus pentafluoride	7641-19-0
diazomethane	334-88-3		selenium hexafluoride	7783-79-1
diborane	19287-45-7		silicon tetrafluoride	7783-61-1
fluorine	7681-49-4		stibine	10025-91-9
methyl mercaptan	74-93-1		sulfur tetrafluoride	7783-60-0

Appendix B: List of Acutely Toxic Chemicals. This list is provided as a guide and is not all inclusive. Review material safety data sheet.

Acrolein	Acrylyl chloride	2-Aminopyridine
Benzyl chloride	Bromine	Chlorine dioxide
Chlorine trifluoride	Chlorpicrin	Cyanogen chloride
Cyanuric fluoride	Decaborane	Dichloro acetylene
Dimethyl disulfide	Dimethylsulfate	Dimethylsulfide
Ethylene chlorohydrin	Ethylene fluorohydrin	Hexamethylene diisocyanate
Hexamethyl phosphoramide	Iodine	Iron pentacarbonyl
Isopropyl formate	Methacryloyl chloride	Methacryloxyethyl isocyanate
Methyl acrylonitrile	Methyl chloroformate	Methylene biphenyl isocyanate
Methyl fluoroacetate	Methyl fluorosulfate	Methyl hydrazine
Methyl Mercury (and other	Methyltrichlorosilane	Methyl vinyl ketone

organicforms)		
Nickel carbonyl	Nitrogen tetroxide	Nitrogen trioxide
Organo Tin compounds	Osmium tetroxide	Oxygen difluoride
Ozone	Pentaborane	Perchloromethyl mercaptan
Phosphorus oxychloride	Phosphous trichloride	Sarin
Select Agents		
Sulfur monochloride	Sulfur pentafluoride	Sulfuryl chloride
Tellurium hexafluoride	Tetramethyl succinonitrile	Tetranitromethane
Thionyl chloride	Toluene-2,4-diisocyanate	Trichloro (chlormethyl) silane

Appendix C. **List of Select and Suspected Carcinogens**. This list is provided as a guide and is not all inclusive. Carefully review material safety data sheets before working with chemicals.

Chemical Name	**CAS**
A-alpha-C (2-Amino-9H-pyrido{2,3-b]indole)	26148685
Acetaldehyde	76070
Acetamide	60355
Acetochlor	34256821
2-Acetylaminofluorene	53963
Acifluorfen	62476599
Acrylamide	79061
Acrylonitrile	107131
Actinomycin D	50760
Adriamycin (Doxorubicin hydrochloride)	23214928
AF-2; [2-(2-furyl)-3-(5-nitro-2-furyl)]acrylamide	3588537
Aflatoxins	----
Alachlor	15972608
Aldrin	309002
Allyl chloride	107051
2-Aminoanthraquinone	117793

p-Aminoazobenzene	60093
ortho-Aminoazotoluene	97563
4-Aminobiphenyl (4-aminodiphenyl)	92671
3-Amino-9-ethylcarbazole hydrochloride	6109973
1-Amino-2-methylanthraquinone	82280
2-Amino-5-(5-nitro-2-furyl)-1,3,4-thiadiazole	712685
Amitrole	61825
Aniline	62533
ortho-Anisidine	90040
ortho-Anisidine hydrochloride	134292
Antimony oxide (Antimony trioxide)	130964
Aramite	140578
Arsenic (inorganic arsenic compounds)	---
Asbestos	1332214
Auramine	492808
Azaserine	115026
Azathioprine	446866
Azacitidine	320672
Azobenzene	103333
Benz[a]anthracene	56553
Benzene	71432
Benzidine [and its salts]	92875
Benzo [b] fluoranthene	205992
Benzo [j] fluoranthene	205823
Benzo [k] fluoranthene	207089
Benzofuran	271896
Benzo [a] pyrene	50328
Benzotrichloride	98077
Benzyl chloride	100447
Benzyl violet 4B	1694093

Beryllium and beryllium compounds	---
Betel quid with tobacco	---
Bis(2-chloroethyl)ether	111444
N,N,-Bis(2-chloroethyl)-2-naphthylamine (Chlornapazine)	494031
Bischloroethyl nitrosourea (BCNU) (Carmustine)	154938
Bis (chloromethyl) ether	542881
Bitumens, extracts of steam-refined and air-refined	---
Bracken fern	---
Bromodichloromethane	75274
Bromoform	75252
1,3-Butadiene	106990
1,4-Butanediol dimethanesulfonate (Busulfan)	55981
Butylated hydroxyanisole	25013165
vbeta-Butyrolactone	3068880
Cadmium and cadmium compounds	---
Captafol	2425061
Captan	133062
Carbon tetrachloride	56235
Carbon-black extracts	---
Ceramic fibers	---
Chlorambucil	305033
Chloramphenicol	56757
Chlordane	57749
Chlordecone (Kepone)	143500
Chlordimeform	115286
Chlorendic acid	115286
Chlorinated paraffins	108171262
Chlorodibromethane	124481
Chloroethane (Ethyl chloride)	75003

1-(2-Chloroethyl)-3-cyclohexyl-1-nitrosourea	13010474
1-(2-Chloroethyl)-3-(4-methylcyclohexyl)-1-nitrosourea (Methyl-CCNU)	13909096
Chloroform	67663
Chloromethyl methyl ether	107302
3-Chloro-2-methylpropene	563473
4-Chloro-ortho-phenylenediamine	95830
p-Chloro-o-toluidine	95692
Chlorothalonil	1897456
Chlorozotocin	54749905
Chromium (hexavalent)	---
Chrysene	18019
C. I. Acid Red 114	6459945
C. I. Basic Red 9 monohydrochloride	569619
Ciclosporin (Cyclosporin A; Cyclosporine)	59865133;79217600
Cinnamyl anthranilate	87296
Cisplatin	15663271
Citrus Red No. 2	6358538
Cobalt metal powder	7440484
Cobalt [II] oxide	1307966
Conjugated estrogens	---
Creosotes	---
para-Cresidine	120718
Cupferron	135206
Cycasin	14901087
Cyclophosphamide (anhydrous)	50180
Cyclophosphamide (hydrated)	6055192
D&C Orange No. 17	46831
D&C Red No. 8	2092560
D&C Red No. 9	5160021

D&C Red No. 19	81889
Dacarbazine	4342034
Daminozide	1596845
Dantron (Chrysazin; 1,8-Dihydroxyanthraquinone)	117102
Daunomycin	20830813
DDD (Dichlorodiphenyldichloroethane)	72548
DDE (Dichlorodiphenyldichloroethylene)	72559
DDT (Dichlorodiphenyltrichloroethane)	50293
DDVP (Dichlorvos)	62737
N,N'-Diacetylbenzidine	613354
2,4-Diaminoanisole	615054
2,4-Diaminoanisole sulfate	39156417
4,4'-Diaminodiphenyl ether (4,4'-Oxydianiline)	101804
2,4-Diaminotoluene	95807
Diaminotoluene (mixed)	---
Dibenz[a,h]acridine	226368
Dibenz[a,j]acridine	224420
Dibenz[a,h]anthracene	53703
7H-Dibenzo[c,g]carbazole	194592
Dibenzo[a,e]pyrene	192654
Dibenzo[a,h]pyrene	189640
Dibenzo[a,i]pyrene	189559
Dibenzo[a,l]pyrene	191300
1,2-Dibromo-3-chloropropane (DBCP)	96128
p-Dichlorobenzene	106467
3,3'-Dichlorobenzidine	91941
1,4-Dichloro-2-butene	764410
3,3'-Dichloro-4,4'-diaminodiphenyl ether	28434868
1,1-Dichloroethane	75343
Dichloromethane (Methylene chloride)	75092

1,2-Dichloropropane	78875
1,3-Dichloropropene	542756
Dieldrin	60571
Dienestrol	84173
Diepoxybutane	1464535
Diesel engine exhaust	---
Di(2-ethylhexyl)phthalate	117817
1,2-Diethylhydrazine	1615801
Diethyl sulfate	64675
Diethylstilbestrol	56531
Diglycidyl resorcinol ether (DGRE)	101906
Dihydrosafrole	94586
3,3'-Dimethoxybenzidine (ortho-Dianisidine)	119904
3,3'-Dimethoxybenzidine dihydrochloride (ortho-Dianisidine dihydrochloride)	20325400
Dimethylcarbamoyl chloride	79447
1,1-Dimethylhydrazine (UDMH)	57147
1,2-Dimethylhydrazine	540738
Dimethylvinylchloride	513371
1,6-Dinitropyrene	42397648
1,8-Dinitropyrene	42397659
2,4-Dinitrotoluene	121142
1,4-Dioxane	123911
Diphenylhydantoin (Phenytoin)	57410
Diphenylhydantoin (Phenytoin), sodium salt	630933
Direct Black 38 (technical grade)	1937377
Direct Blue 6 (technical grade)	2602462
Direct Brown 95 (technical grade)	16071866
Disperse Blue 1	2475458
Epichlorohydrin	106898

Erionite	12510428
Estradiol 17ß	50282
Estrone	53167
Ethinylestradiol	57636
Ethyl acrylate	140885
Ethyl methanesulfonate	62500
Ethyl-4-4'-dichlorobenzilate	510156
Ethylene dibromide	106934
Ethylene dichloride (1,2-Dichloroethane)	107062
Ethylene oxide	75218
Ethylene thiourea	96457
Ethyleneimine	151564
Folpet	133073
Formaldehyde	50000
2-(2-Formylhydrazino)-4-(5-nitro-2-furyl)thiazole	3570750
Furazolidone	67458
Furmecyclox	60568050
Glu-P-1 (2-Amino-6-methyldipyrido[1,2-a:3',2'-d]imidazole)	67730114
Glycidaldehyde	765344
Glycidol	556525
Griseofulvin	126078
Gyromitrin (Acetaldehyde methylformylhydrazone)	16568028
HC Blue 1	2784943
Heptachlor	76448
Heptachlor epoxide	1024573
Hexachlorobenzene	118741
Hexachlorocyclohexane (technical grade)	---
Hexachlorodibenzodioxin	34465468
Hexachloroethane	67721

Hexamethylphosphoramide	680319
Hydrazine	302012
Hydrazine sulfate	10034932
Hydrazobenzene (1,2-Diphenylhydrazine)	122667
Indeno [1,2,3-cd]pyrene	193395
IQ (2-Amino-3-methylimidazp[4,5-f]quinoline)	76180966
Iron dextran complex	9004664
Isosafrole	120581
Lactofen	77501634
Lasiocarpine	303344
Lead acetate	301042
Lead phosphate	7446277
Lead subacetate	1335326
Lindane	---
Mancozeb	8018017
Maneb	12427382
Me-A-alpha-C (2-Amino-3-methyl-9H-pyrido[2,3-b]indole)	68005837
Medroxyprogesterone acetate	71589
Melphalan	148823
Merphalan	531760
Mestranol	72333
8-Methoxypsoralen with ultraviolet A therapy	298817
5-Methoxypsoralen with ultraviolet A therapy	484208
2-Methylaziridine (Propyleneimine)	75558
Methylazoxymethanol	590965
Methylazoxymethanol acetate	592621
3-Methylcholanthrene	56495
5-Methylchrysene	3697243
4,4'-Methylene bis(2-chloroaniline)	101144

4,4'-Methylene bis(N,N-dimethyl)benzenamine	101611
4,4'-Methylene bis(2-methylaniline)	838880
4,4'-Methylenedianiline	01779
4,4'-Methylenedianiline dihydrochloride	13552448
Methylhydrazine and its salts	13552448
Methyl iodide	74884
Methyl methanesulfonate	66273
2-Methyl-1-nitroanthraquinone	129157
N-Methyl-N'-nitro-N-nitrosoguanidine	70257
N-Methylolacrylamide	924425
Methylthiouracil	56042
Metiram	9005422
Metronidazole	443481
Michler's ketone	90948
Mirex	2385855
Mitomycin C	50077
Monocrotaline	315220
5-(Morpholinomethyl)-3-[(5-nitro-furfurylidene)-amino]-2 -oxalolidinone	139913
Mustard Gas	505602
Nafenopin	3771195
1-Naphthylamine	124327
2-Naphthylamine	91598
Nickel and certain nickel compounds	---
Nickel carbonyl	13463393
Nickel subsulfide	12035722
Niridazole	61474
Nitrilotriacetric acid	139139
Nitrilotriacetric acid, trisodium salt monohydrate	18662538
5-Nitroacenaphthene	602879

5-Nitro-o-anisidine	99592
4-Nitrobiphenyl	93933
6-Nitrochrysene	7496028
Nitrofen (technical grade)	1836755
2-Nitrofluorene	607578
Nitrofurazone	59870
1-[5-Nitrofurfurylidene)-amino]-2-imidazolidinone	555840
N-[4-(5-Nitro-2-furyl)-2-thiazolyl]acetamide	531828
Nitrogen mustard (Mechlorethamine)	51752
Nitrogen mustard hydrochloride (Mechlorethamine hydrochloride)	55867
Nitrogen mustard N-oxide	126852
Nitrogen mustard N-oxide hydrochloride	302705
2-Nitropropane	79469
1-Nitropyrene	5522430
4-Nitropyrene	57835924
N-Nitrosodi-n-butylamine	924163
N-Nitrosodiethanolamine	1116547
N-Nitrosodiethylamine	55185
N-Nitrosodimethylamine	62759
p-Nitrosodiphenylamine	156105
N-Nitrosodiphenylamine	86306
N-Nitrosodi-n-propylamine	621647
N-Nitroso-N-ethylurea	759739
3-(N-Nitrosomethylamino)propionitrile	60153493
4-(N-Nitrosomethylamino)-1-(3-pyridyl)1-butanone	64091914
N-Nitrosomethylethylamine	10595956
N-Nitroso-N-methylurea	684935
N-Nitroso-N-methylurethane	615532
N-Nitrosomethylvinylamine	4549400

N-Nitrosomorpholine	59892
N-Nitrosonornicotine	16543558
N-Nitrosopiperidine	100754
N-Nitrosopyrrolidine	930552
N-Nitrososarcosine	13256229
Norethisterone (Norethindrone)	68224
Ochratoxin A	303479
Oxadiazon	19666309
Oxymetholone	434071
Panfuran S	---
Pentachlorophenol	87865
Phenacetin	62442
Phenazopyridine	94780
Phenazopyridine hydrochloride	136403
Phenesterin	3546109
Phenobarbital	50066
Phenoxybenzamine	59961
Phenoxybenzamine hydrochloride	63923
Phenyl glycidyl ether	22601
Phenylhydrazine and its salts	---
o-Phenylphenate, sodium	132274
Polybrominated biphenyls	---
Polychlorinated biphenyls	---
Polygeenan	53973981
Ponceau MX	3761533
Ponceau 3R	3564098
Potassium bromate	7758012
Procarbazine	671169
Procarbazine hydrochloride	366701
Progesterone	57830

1,3-Propane sultone	1120714
beta-Propiolactone	57578
Propylene oxide	75569
Propylthiouracil	51525
Reserpine	50555
Saccharin	81072
Saccharin, sodium	128449
Safrole	94597
Selenium sulfide	7446346
Silica, crystalline	---
Streptozotocin	18883664
Styrene oxide	96093
Sulfallate	95067
Talc´ containing asbestiform fibers	---
Testosterone and its esters	58220
2,3,7,8-Tetrachlorodibenzo-para-dioxin (TCDD)	1746016
1,1,2,2-Tetrachloroethane	79345
Tetrachloroethylene (Perchloroethylene)	127184
p-a, a, a-Tetrachlorotoluene	5216251
Tetranitromethane	509148
Thioacetamide	62555
4,4´ - Thiodianiline	139651
Thiourea	62566
Thorium dioxide	1314201
Toluene diisocyanate	26471625
ortho-Toluidine	95534
ortho-Toluidine hydrochloride	636215
para-Toluidine	106490
Toxaphene (Polychorinated camphenes)	8001352
Trasulfan	299752

Trichlormethine (Trimustine hydrochloride)	817094
2,4,6-Trichlorophenol	88062
Triphenyltin hydroxide	76879
Trichloroethylene	79016
Tris (aziridinyl)-para-benzoquinone (Triaziquone)	68768
Tris (1-aziridinyl) phosphine sulfide (Thiotepa)	52244
Tris (2-chloroethyl) phosphate	115968
Tris (2,3-dibromopropyl) phosphate	126727
Trp-P-1 (Tryptophan-P-1)	62450060
Trp-P-2 (Tryptophan-P-2)	62450071
Trypan blue (commercial grade)	72571
Uracil mustard	66751
Urethane (Ethyl carbamate)	51796
Vinyl bromide	593602
Vinyl chloride	75014
4-Vinyl-1-cyclohexene diepoxide (Vinyl cyclohexene dioxide)	106876
Vinyl trichloride (1,1,2-Trichloroethane)	79005
2,6-Xylidine (2,6-Dimethylaniline)	87627
Zineb	12122677

Appendix D Reproductive Hazards. This list is provided as a guide and is not all inclusive. Review material safety data sheet.

Name	CAS#	Name	CAS#
Acetaldehyde	75-07-0	Hydrazine(s)	302-01-2
Arsenic	7440-38-2	Hexafluoroacetone	684-16-2
Aniline	62-53-3	Halothane	151-67-7
Aflatoxins		Karathane	131-72-6
Benzene	71-43-2	Lead (inorganic compounds)	7439-92-1
Benzo(a)pyrene	50-32-8	2-Methoxyethanol	109-86-4
Carbon disulfide	75-15-0	2-Methoxyethyl acetate	110-49-6
Chloroform	67-66-3	Methyl chloride	74-87-3
Chloroprene	126-99-8	N-Methyl-2-pyrrolidone	872-50-4
Dimethyl formamide	68-12-2	Propylene glycol monomethyl ether	107-98-2
Di-sec-octyl-phthalate	117-81-7	Propylene glycol monomethyl ether acetate	108-65-6
Dinitrooctyl phenol	63149-81-5	Propylene oxide	75-56-9
Dithane	111-54-6	Trichloroethylene	79-01-6
2-Ethoxy ethanol	110-80-5	RH-7592	
2-Ethoxyethyl acetate	111-15-9v	Systhane/RH-3866	88671-89-0
Ethylene thiourea	96-45-7	TOK (herbicide)	1836-75-5
2-Ethyhexanol	104-76-7	Toluene	108-88-3
Glycol ethers		Vinyl chloride	75-01-4

Appendix E. Chemical Hygiene Work Plan. To be Added.

Appendix F. Notification of the Use of Acutely Toxic, Carcinogenic, or Reproductive Hazards.		
Instructions: Please complete this form, print, sign, and return it to the Safety Office		
Principal Investigator:		
Room / Building:		
Phone:		
Department:		
Notification: In accordance with the requirements of the College Chemical Hygiene Plan, this document serves as notification to the Office of Safety of the use of the following class(es) of chemicals:		
	Used	Not Used
Carcinogens or suspected		
Acutely toxic chemicals		
Acutely toxic gases		
Reproductive hazards		
I have reviewed the requirements of the College's Chemical Hygiene Plan and the applicable Standard Operating Procedures as they apply to carcinogens, acutely toxic chemicals, and reproductive hazards and have complied with all applicable requirements where appropriate. Signature: _____ Date: _____		

Appendix G. Chemical Storage Sign			
Instructions: All chemical storage cabinets located in hallways must be adequately placarded to permit the identification of the cabinets contents and owner. The principal investigator is responsible for assuring that appropriate warning information is included on this sign.			
	BIOHAZARDS		LIQUID REAGENTS
	CARCINOGENS		SOLVENTS
	REPRODUCTIVE HAZARDS		OXIDIZERS
	ACUTELY TOXIC MATERIALS		DRY REAGENTS
	RADIOACTIVE MATERIALS		COMPRESSED GASES
	ACIDS		FLAMMABLES
	BASES		WATER REACTIVES
	other (list)		NO CHEMICALS

Appendix H. Chemical Hygiene Self Evaluation Form			
Instructions: This evaluation form will assist lab workers in identifying common safety problems. If your answer to a question is bold, there may be a safety problem.			
Question		Answer	
Hours of Operation			
Do staff work after 10:00 PM?		Yes	No
Do staff work weekends and holidays?		Yes	No
Do personnel work alone?		Yes	No
Is there a notification procedure for individuals who work alone?		Yes	No
Signs and Documentation			
Room sign present?		Yes	No
Work plan posted?		Yes	No
Emergency Equipment			
Fire Extinguisher Present in lab?		Yes	No
Eyewash present in lab?		Yes	No
Shower present in lab OR within 25 feet?		Yes	No
Shower inspected within last year ?		Yes	No
Employee Hygiene			
Eye or face protection in use?		Yes	No
Lab coats worn?		Yes	No
Appropriate clothing (long pants, no shorts etc.) worn under lab coats?		Yes	No
Food or drink present in the lab?		Yes	No
Chemical Storage: Flammable liquids			
> 10 gallons of flammable liquids stored outside of a flammable liquids storage cabinet?		Yes	No
Total quantity of flammables in lab > 25 gallons		Yes	No
NFPA approved flammable liquids storage cabinet present with vent ports open?		Yes	No
Are only flammable liquids stored in the cabinet (skip if a flammable liquids storage cabinet is not available)?		Yes	No

Chemical Storage: Corrosive materials			
Segregated from non-corrosives?		Yes	No
Acids stored on plastic trays?		Yes	No
Damage to cabinets (rust, charring)?		Yes	No
Chemical reactions occurring (discolored reagents, white haze on bottles)?		Yes	No
Labels damaged or not present?		Yes	No
Chemical Storage: Compressed Gases			
Cylinders secured so they can't fall?		Yes	No
Lecture bottles stored with regulators in place?		Yes	No
More than 10 lecture spheres stored?		Yes	No
Chemical Storage: Reactives (solids and liquids)			
Dated?		Yes	No
Stored in original containers?		Yes	No
Evidence of container damage or corrosion?		Yes	No
Segregated from other storage?		Yes	No
Old containers (>2 years)?		Yes	No
Chemical Storage: Acutely Toxic Chemicals, Reproductive Hazards, Carcinogens			
Are the chemicals stored in designated area		Yes	No
Are the chemicals handled in designated area?		Yes	No
Do you have old containers (>5 years)?		Yes	No
Evidence of container damage or corrosion?		Yes	No
Chemical Storage: General Chemical Storage			
Containers dated?		Yes	No
Overstocking evident (multiple containers of a single reagent is present)?		Yes	No
Storage shelves and cabinets secured (Will not tip over)?		Yes	No
Insufficient storage space (are containers stacked on top of each other)?		Yes	No
Solids and liquids segregated?		Yes	No
Chemical reactions occurring (discolored reagents, white haze on bottles)?		Yes	No

Refrigerators/Freezers			
Labeled "No food or flammable storage?"		Yes	No
Flammable liquids stored in refrigerator?		Yes	No
Waste Disposal			
Waste containers properly marked concerning contents?		Yes	No
Orphaned chemicals present?		Yes	No
Unknown or unlabeled chemicals stored?		Yes	No
Special Ventilation			
Glove box vented?		Yes	No
Biosafety cabinet certified within last year?		Yes	No
Special Instructions: If any of the following chemicals or pieces of equipment are used in the lab you may have special training or safety requirements. Contact the Safety Office.			
Formaldehyde--Special training required		Yes	No
Perchloric acid-- Used in hood		Yes	No
Ethylene oxide--Special hazard, contact SAFETY OFFICE		Yes	No
Picric acid--Older than 5 years		Yes	No
Ethyl ether--Opened more than 6 months ago or not dated		Yes	No
Phosgene--Special hazard, contact SAFETY OFFICE		Yes	No
Hydride gases--Special hazard, contact SAFETY OFFICE		Yes	No
Benzene--Special hazard, contact SAFETY OFFICE		Yes	No
Ethidium bromide wasteautoclaved		Yes	No

Appendix I. Formaldehyde Safety Information

Formaldehyde is a chemical regulated by the US Department of Labor and the Occupational Safety and Health Administration (OSHA). The Occupational Exposure to Formaldehyde Standard, 29 CFR 1910.1048 requires a written exposure control plan. The Formaldehyde Exposure Control Plan is available on the SAFETY OFFICE website.

The document provides information on uninhibited formalin solution (37% formaldehyde, no methanol stabilizer). Much of the information provided is general; however, some information is specific for formalin. The precise hazards associated with exposure to formaldehyde depend both on the form (solid, liquid, or gas) of the materials and the concentration of formaldehyde present. For example, 37-50 percent solutions of formaldehyde present a much greater hazard to the skin and eyes from spills or splashes than solutions containing less than 1 percent formaldehyde.

I. Substance Identification

Chemical Name: Formaldehyde
Chemical Family: Aldehyde
Chemical Formula: HCHO
Molecular Weight: 30.03
Chemical Abstracts Service Number (CAS Number): 50-00-0

Synonyms: Formalin; Formic Aldehyde; Paraform; Formol; formalin (Methanol-free); Fyde; Formalith; Methanal; Methyl Aldehyde; Methylene Glycol; Methylene Oxide; Tetraoxymethalene: Oxomethane; Oxymethylene.

II. Components and Contaminants

Percent: 37.0 Formaldehyde
Percent: 63.0 Water

(Note.-Inhibited solutions contain methanol).

Other Contaminants: Formic acid (alcohol free)

Exposure Limits:

OSHA TWA- 0.75ppm
OSHA STEL- 2 .00ppm

Physical Data

Description: Colorless liquid, pungent odor
Boiling point: 214 F (101 C)]
Specific Gravity: 1.08 (H20=1 @ 20 C)
pH: 2.8-4.0
Solubility in Water: Miscible
Solvent Solubility: Soluble in alcohol and acetone
Vapor Density: 1.04 (Air =1 @ 20 C)
Odor Threshold: 0.8-1ppm

III. Fire and Explosion Hazard

Moderate fire and explosion hazard when exposed to heat or flame. The flash point of 37% formaldehyde solutions is above normal room temperature, but the explosion range is very wide, from 7 to 73% by volume in air. Reaction of formaldehyde with nitrogen dioxide, nitromethane, perchloric acid and aniline, or peroxyformic acid yields explosive compounds.

Flash Point: 185 F (85 C) closed cup
Lower Explosion Limit: 7%
Upper Explosion Limit: 73%
Autoignition Temperature: 806 F (430 C)
Flammability Class (OSHA): III A

Extinguishing Media: Use dry chemical "alcohol foam", carbon dioxide, or water in flooding amounts as fog. Solid streams may not be effective.

IV. Reactivity

Stability: Formaldehyde solutions may self-polymerize to form white precipitates. Incompatibility (Materials to Avoid): Strong oxidizing agents, caustics, strong alkalis, isocyanates, anhydrides, oxides, and inorganic acids. Formaldehyde reacts with hydrochloric acid to form the potent carcinogen, bis-chloromethyl ether. Formaldehyde reacts with nitrogen dioxide, nitromethane, perchloric acid and aniline, or peroxyformic acid to yield explosive compounds. A violent reaction occurs when formaldehyde is mixed with strong oxidizers. Hazardous Combustion or Decomposition Products: Oxygen from the air can oxidize formaldehyde to formic acid, especial when heated. Formic acid is corrosive.

V. Health Hazard Data

Acute Effects of Exposure

Ingestion (Swallowing): Liquids containing 10 to 40% formaldehyde cause severe irritation and inflammation to the mouth, throat, and stomach. Severe stomach pains will follow ingestion with possible loss of consciousness and death. Ingestion of dilute formaldehyde solutions (0.03-0.04%) may cause discomfort in the stomach and pharynx.

Inhalation (Breathing): Formaldehyde is highly irritating to the upper respiratory tract and eyes. Concentrations of 0.5 to 2.0 ppm may irritate the eyes, nose, and throat of some individuals. Concentrations of 3 to 5 ppm also cause tearing of the eyes and are intolerable to some persons. Concentrations of 10 to 20 ppm cause difficulty in breathing, burning of the nose and throat, cough, and heavy tearing of the eyes; 25 to 30 ppm causes severe respiratory tract injury leading to pulmonary edema and pneumonitis. A concentration of 100 ppm is immediately dangerous to life and health. Deaths from accidental exposure to high concentrations of formaldehyde have been reported.

Skin (Dermal): Formalin is a severe skin irritant and a sensitizer. Contact with formalin causes white discoloration, smarting, drying, cracking, and scaling. Prolonged and repeated contact can cause numbness and a hardening or tanning of the skin. Previously exposed persons may react to future exposure with an allergic eczematous and dermatitis or hives.

Eye Contact: Formaldehyde solutions splashed in the eye can cause injuries ranging from transient discomfort to severe, permanent corneal clouding and loss of vision. The severity of the effect depends on the concentration of formaldehyde in the solution and whether or not the eyes are flushed with water immediately after the accident.

Note.-The perception of formaldehyde by odor and eye irritation becomes less sensitive with time as one adapts to formaldehyde. This can lead to overexposure if a worker is relying on formaldehyde's warning properties to alert him or her to the potential for exposure.

Acute Animal Toxicity:
Oral, rats: LD50=800 mg/kg
Oral, mouse: LD50=42 mg/kg
Inhalation, rats: LCLo=250 mg/kg
Inhalation, mouse: LCLo=900 mg/kg
Inhalation, rats: LC50=590 mg/kg

VI. Chronic Effects of Exposure

Carcinogenicity: Formaldehyde has the potential to cause cancer in humans. Repeated and prolonged exposure increases the risk. Various animal experiments have conclusively shown formaldehyde to be a carcinogen in rats. In humans, formaldehyde exposure had been associated with cancers of the lung, nasopharynx and oropharynx, and nasal passages.

Mutagenicity: Formaldehyde is genotoxic in several in vitro test systems showing properties of both an initiator and a promoter.

Toxicity: Prolonged or repeated exposure to formaldehyde may result in respiratory impairment. Rats exposed to formaldehyde at 2 ppm developed benign nasal tumors and changes of the cell structure in the nose as well as inflamed mucous membranes of the nose. Structural changes in the epithelial cells in the human nose have also been observed. Some persons have developed asthma or bronchitis following exposure to formaldehyde, most often as the result of an accidental spill involving a single exposure to a high concentration of formaldehyde.

VII. Emergency and First Aid Procedures

Employees and students must notify their immediate supervisor or instructor of all illness and injuries related to exposure to hazardous chemicals. Contact your supervisor, instructor or SAFETY OFFICE if you have any questions regarding the procedure for treating a non-serious injury or illness.

Proceed as follows if you are injured and require medical consultation:

On-campus medical emergencies requiring an ambulance for both students and staff dial 911.

Do not move a seriously injured person unless they are in further danger.

Ingestion (Swallowing): If the victim is conscious, dilute, inactivate, or absorb the ingested formaldehyde by giving milk, activated charcoal, or water. Any organic material will inactivate the formaldehyde. Keep affected person warm and at rest. **Get medical attention immediately.** If vomiting occurs, keep head lower than hips.

Inhalation (Breathing): Remove the victim from the exposure area to fresh air immediately. Do not enter areas with high levels of formaldehyde. Wait for rescuers with appropriate respiratory protection equipment. If breathing has stopped, give artificial respiration. Keep the affected person warm and at rest until ambulance arrives.

Skin Contact: Remove contaminated clothing (including shoes) immediately. Wash the affected area of your body with soap or mild detergent and large amounts of water until no evidence of the

chemical remains (at least 15 to 20 minutes). **Get medical attention after washing affected area.**

Eye Contact: Wash the eyes immediately with large amounts of water occasionally lifting lower and upper lids, until no evidence of chemical remains (at least 15 to 20 minutes). **Get medical attention immediately.** If you have experienced appreciable eye irritation from a splash or excessive exposure, you should be referred promptly to an ophthalmologist for evaluation.

VIII. Spill, Leak, and Disposal Procedures

Occupational Spill: Take up **small spills** with absorbent material and place the waste into properly labeled containers for later disposal. In the event of a **large spill** alert personnel in the area that a spill has occurred. Do not attempt to handle a large spill of formaldehyde. Vacate the laboratory immediately and call for assistance.

Waste Disposal: Contact the Safety Office for waste disposal instructions.

IX. Monitoring and Measurement Procedures

Monitoring Requirements: If your exposure to formaldehyde exceeds the 0.5 ppm action level or the 2 ppm STEL, your employer must monitor your exposure. Your employer need not measure every exposure if a "high exposure" employee can be identified. This person usually spends the greatest amount of time nearest the process equipment. If you are a "representative employee", you will be asked to wear a sampling device to collect formaldehyde. This device may be a passive badge, a sorbent tube attached to a pump, or an impinger containing liquid. You should perform your work as usual, but inform the person who is conducting the monitoring of any difficulties you are having wearing the device.

Evaluation of 8-hour Exposure: Measurements taken for the purpose of determining time-weighted average (TWA) exposures are best taken with samples covering the full shift. Samples collected must be taken from the employee's breathing zone air.

Short-term Exposure Evaluation: If there are tasks that involve brief but intense exposure to formaldehyde, employee exposure must be measured to assure compliance with the STEL. Sample collections are for brief periods, only 15 minutes, but several samples may be needed to identify the peak exposure.

Monitoring Techniques: OSHA's only requirement for selecting a method for sampling and analysis is that the methods used accurately evaluate the concentration of formaldehyde in employees' breathing zones. Sampling and analysis may be performed by collection of formaldehyde on liquid or solid sorbents with chemical analysis. Sampling and analysis may also be performed by passive diffusion monitors and short-term exposure may be measured by instruments such as real-time continuous monitoring systems and portable direct reading instruments.

Notification of Results: Your employer must inform you of the results of exposure monitoring representative of your job. You may be informed in writing, but posting the results where you have ready access to them constitutes compliance with the standard.

X. Protective Equipment and Clothing

Material impervious to formaldehyde is needed if the employee handles formaldehyde solutions of 1% or more. Other employees may also require protective clothing or equipment to prevent dermatitis.

Respiratory Protection: Contact the Safety Office if you believe respirators are required.

Protective Gloves: Wear protective (impervious) gloves provided by your employer, at no cost, to prevent contact with formalin. Your employer should select these gloves based on the results of permeation testing and in accordance with the ACGIH Guidelines for Selection of Chemical Protective Clothing.

Eye protection: If you might be splashed in the eyes with formalin, it is essential that you wear goggles or some other type of complete protection for the eye. You may also need a face shield if your face is likely to be splashed with formalin, but you must not substitute face shields for eye protection. (This section pertains to formaldehyde solutions of 1% or more.)

Other Protective Equipment: You must wear protective (impervious) clothing and equipment provided by your employer at no cost to prevent repeated or prolonged contact with formaldehyde liquids. If you are required to change into whole-body chemical protective clothing, your employer must provide a change room for your privacy and for storage of your street clothing.

If you are splashed with formaldehyde, use the emergency showers and eyewash fountains provided by your employer immediately to prevent serious injury. Report the incident to your supervisor and obtain necessary medical support.

XI. Engineering Controls

Ventilation is the most widely applied engineering control method of reducing the concentration of airborne substances in the breathing zones of workers. There are two distinct types of ventilation.

Local Exhaust: Local ventilation is designed to capture airborne contaminants as near to the point of generation as possible. To protect you, the direction of contaminant flow must always be toward the local exhaust system inlet and away from you.

General (Mechanical): General dilution ventilation involves continuous introduction of fresh air into the workroom to mix with the contaminated air and lower your breathing zone concentration of formaldehyde. Effectiveness depends on the number of air changes per hour. Where devices emitting formaldehyde are spread out over a large area, general dilution ventilation may be the only practical method of control.

Work Practices: Work practices are an important part of a control system. If you are asked to perform a task in a certain manner to limit your exposure to formaldehyde, it is extremely important that you follow these procedures.

XII. Medical Surveillance

Medical surveillance helps to protect employees' health. Your are strongly encouraged to participate in the medical surveillance program.

Your employer must make a medical surveillance program available at no expense to you and at a reasonable time and place if you are exposed to formaldehyde at concentrations above 0.5 ppm as an 8-hour average or 2 ppm over any 15 minute period. You will be offered medical surveillance at the time of your initial assignment and once a year afterward as long as your exposure is at least 0.5 ppm (TWA) or 2 ppm (STEL). Even if your exposure is below these levels, you should inform your employer if you have signs and symptoms that you suspect, through your training, are related to your formaldehyde exposure because you may need medical surveillance to determine if your health is being impaired by your exposure.

The surveillance plan includes:

(a) A medical disease questionnaire.
(b) A physical examination if the physician determines this is necessary.

If you are required to wear a respirator, your employer must offer you a physical examination and a pulmonary function test every year.

The physician must collect all information needed to determine if you are at increased risk from your exposure to formaldehyde. At the physician's discretion, the medical examination may include other tests, such as a chest x-ray, to make this determination.

After a medical examination the physician will provide your employer with a written opinion which includes any special protective measures recommended and any restrictions on your exposure. The physician must inform you of any medical conditions you have which would be aggravated by exposure to formaldehyde. All records from your medical examinations, including disease surveys, must be retained at your employer's expense.

Appendix J. Formaldehyde Exposure Control Plan

1.0. Purpose and Applicability

1.1. It is the policy of the Georgia Gwinnett College in coordination with the Office of Safety to provide the College community with a safe and healthful environment. This policy is designed to minimize employee and student exposures to formaldehyde.

1.2. This policy applies to all College employees and students who may come in contact with formaldehyde- producing materials.

1.3. This policy does not apply to empoyees of the College of GGCylvania Health System who are covered by their own policies.

2.0. Definitions and Scope

2.1. Formaldehyde - The chemical substance HCHO. Chemical Abracts Service Registry No. 50-00-0.

2.2. Formaldehyde Exposure Assessment (EA) - A quantitative determination of employee exposure to formaldehyde. Includes full shift personal samples that are representative of the monitored employee's regular, daily exposure to formaldehyde and fifteen minute short term exposure limit samples during tasks that are believed to resullt in the highest exposures.

2.3. Designated Area - A location within the laboratory where acutely toxic mutagenic, carcinogenic, or teratogenic materials are handled and stored. The areas should be demarcated with designated area caution tape of yellow tape with the words designated area written upon it.

2.4. OSHA Action Level (Al) - Under the US Department of Labor, Occupational Safety and Health Administration (OSHA) Occupatonal Exposure to Formaldehyde Standard 29 CFR 1910.1048 is defined as an exposure to an airborne, concentration of 0.50 parts per million (ppm) formaldehyde as an eight-hour time-weighed average (TWA).

2.5. OSHA Permissible Exposure Limit (PEL) - Under the US Department of Labor, Occupational Safety and Health Administration (OSHA) Occupational Exposure to Formaldehyde Standard 29 CFR 1910.1048 is defined as an exposure to an airborne concentration of 0.75 parts per million (ppm) formaldehyde as an eight-hour time-weighted average (TWA).

2.6. OSHA Short Term Exposure Limit (STEL) - Under the US Department of Labor, Occupational Safety and Health Administration (OSHA) Occupational Exposure to Formaldehyde Standard 29 CFR 1910.1048 is defined as an exposure to an airborne concentration of formaldehyde of 2.00 parts per million (ppm) over a fifteen minute duration.

2.7. Regulated Area - Any area where the concentration of airborne formaldehyde exceeds either the OSHA PEL or the STEL.

3.0. Roles and Responsibilities

3.1. The Office of Safety (SAFETY OFFICE) is responsible for: identifying at-risk job tasks, conducting formaldehyde exposure assessments, exposure monitoring, designing/evaluating engineering controls and safe work practices, defining regulated areas, conducting respirator fit testing, waste chemical disposal, training, and record keeping.

3.2. The Hospital of the Georgia Gwinnett College (HUP) Department of Occupational Medicine (OM) is responsible for all aspects of the medical surveillance program.

3.3. Supervisors are responsible for requesting formaldehyde exposure assessments for employees and notifying SAFETY OFFICE of unusual conditions or changes in work practices that would make formaldehyde exposure assessments non-representative. Supervisors are also responsible for: providing personal protective equipment at no cost to the employee, enrolling employees exposed to formaldehyde above the OSHA AL or STEL into a medical surveillance program, scheduling and ensuring employee attendance at annual SAFETY OFFICE Laboratory Safety Training and ensuring formaldehyde producing chemicals are properly labeled, stored in a "Designated Area" and that the laboratory room sign has a "Designated Area" sticker affixed to it.

3.4. Employees (for purposes of this document faculty, staff and students working in a laboratory) are responsible for participating in annual SAFETY OFFICE Laboratory Safety Training and the medical surveillance program if applicable. Employees are also responsible for: using assigned personal protective equipment, using prescribed engineering controls and administrative work practices, and notifying supervisors of unusual conditions or changes in work practices that would make SAFETY OFFICE formaldehyde exposure assessments as being non-representative.

4.0. Procedures

4.1. Written Formaldehyde Exposure Control Plan. The Formaldehyde Exposure Control Plan outlines management practices, procedures and controls implemented by SAFETY OFFICE to minimize formaldehyde exposures to College employees and students.

4.2. Determination of Employee Formaldehyde Exposure. SAFETY OFFICE will perform formaldehyde exposure assessments on all tasks having the potential to expose employees to levels of formaldehyde above the OSHA AL or STEL. The assessments shall include air monitoring and observation of work practices and engineering controls typically used for each task. SAFETY OFFICE shall provide the employee and supervisor with a written copy of the sampling results and findings within 15 working days of the assessment. The report will describe any required changes in work practices or engineering controls based upon SAFETY OFFICE observation of the task and also notify the employee of the frequency of follow-up sampling if applicable.

4.3. Waste Disposal. SAFETY OFFICE coordinates waste disposal of formaldehyde producing materials.

4.4. Training. SAFETY OFFICE, as part of its annual Laboratory Safety Training, shall discuss the Formaldehyde Exposure Control Plan, a Formaldehyde Material Safety Data Sheet (MSDS), and job tasks that are likely to result in exposure to formaldehyde above the OSHA Action Level. Employees will be informed of formaldehyde related services offered through SAFETY OFFICE.

4.5. Record Keeping. SAFETY OFFICE maintains all documents relating to formaldehyde exposure including formaldehyde exposure assessments, air sampling data, respirator fit testing documentation and waste disposal manifests. HUP OM maintains medical records relating to the medical surveillance program. All records are kept indefinitely.

5.0 Key References. OSHA Formaldehyde Standard