**CHEMICAL HYGIENE PLAN AND HAZARDOUS  
MATERIALS SAFETY MANUAL FOR**

**SOUTHERN CONNECTICUT STATE UNIVERSITY LABORATORIES, SHOPS, AND STUDIOS**

This is the Chemical Hygiene Plan specific to the following areas:

Laboratory name or room number(s):

Building:

Supervisor:

Department:

**IMPORTANT TELEPHONE NUMBERS**

911 Police, Fire, and/or Medical Emergency

25375 Police Non-Emergency

27073 Office of Environmental Health and Safety

26051 Facilities Operations

**May 2013**

Revised on:

*All laboratory chemical use areas must maintain a work-area specific Chemical Hygiene Plan which conforms to the requirements of the OSHA Laboratory Standard 29 CFR 19190.1450. SCSU laboratories may use this document as a starting point for creating their work area specific protocols.*

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**FORWARD**

This document serves as the Chemical Hygiene Plan for the University's laboratories, and was developed to meet the guidelines of 29 CFR 1910.1450, "Occupational Exposure to Hazardous Chemicals in Laboratories", a Standard issued by the Occupational Safety and Health Administration (OSHA), as well as 29 CFR 1910.1200, The Hazard Communication Standard, often called HazCom or employee Right to Know law, and NFPA 45: Standard on Fire Protection for Laboratories Using Chemicals. Department-Specific Safety Manuals may be appended to this document.

This plan applies to all employees of this facility engaged in the laboratory use of hazardous chemicals. Effective implementation requires a written program for job safety and health that is endorsed and advocated by the highest levels of management within this institution, and that outlines our goals and plans. This written plan will be communicated to all required personnel. It is designed to establish clear goals, and objectives to provide a safe working environment.

The Chemical Hygiene Plan places primary emphasis on engineering and administrative controls necessary to protect workers from overexposure to hazardous substances in laboratories.

Southern Connecticut State University will follow the National Research Council's general principles of Chemical Hygiene in Laboratories. They are as follows:

1. Minimize all chemical exposures.
2. Avoid underestimation of risk
3. Provide adequate ventilation.
4. Institute a formal safety program.
5. Observe the Permissible Exposure Limits (PELs, U.S. Dept. of Labor, OSHA) and the Threshold Limit Values (TLVs, American Conference of Governmental Industrial Hygienists).

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| These safety training resources, prepared solely for the use of the Southern Connecticut State University, were provided by a variety of sources. It is your responsibility to customize the information to match your specific operations. Neither Southern Connecticut State University nor any of its employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise, does not necessarily constitute or imply its endorsement, recommendation, or favoring by the Southern Connecticut State. |

**POLICY STATEMENT**

The Occupational Safety and Health (OSH) Act was enacted to "assure safe and healthful working conditions for working men and women." The OSH Act created the Occupational Safety and Health Administration (OSHA) at the federal level and provided that states could run their own safety and health programs as long as those programs were at least as effective as the federal program. The Occupational Safety and Health Act of 1970 clearly states our common goal of safe and healthful working conditions. The safety and health of our employees continues to be the first consideration in the operation of this University.

Safety and health must be a part of every operation. Without question it is every employee's responsibility at all levels. The prevention of occupationally-induced injuries, illnesses, and chemical exposure is of great consequence. To the greatest degree possible, management will provide all mechanical and physical facilities required for personal safety and health in keeping with the highest standards.

Employees must constantly be aware of conditions in all work areas that can produce injuries. No employee is required to work at a job he or she knows is not safe or healthful. Your cooperation in detecting hazards and, in turn, controlling them is a condition of your employment. Inform your supervisor and the Office of Environmental Health and Safety (OEHS) immediately, of any situation beyond your ability or authority to correct.

**REGULATORY STANDARDS:** OSHA - 29 CFR 1910.1450, OSHA Laboratory Standard

OSHA – 29 CFR 1910.1200, OSHA Hazard Communication Standard

NFPA - 45, Laboratory Fire Protection

**INTRODUCTION**

The OSHA Laboratory Standard (Occupational Exposures to Hazardous Chemicals in Laboratories (29 CFR 1910.1450) requires employers of laboratory employees to implement exposure control programs and convey chemical health and safety information to employees working with hazardous materials.

Specific provisions of the Standard require: (1) laboratory inspections; (2) establishment of standard operating procedures for routine and high hazard operations; (3) safety reviews for procedures; (4) exposure assessments; (5) medical consultations/exams; (6) training; (7) labeling of containers; and (8) the management of chemical safety information sheets – Material Safety Data Sheets (MSDS) and other safety reference materials.

The intent of this Standard establishes uniform requirements to ensure that the hazards associated with work in laboratories and other areas at Southern Connecticut State University (SCSU) are evaluated, safety procedures implemented, and that the proper hazard information is transmitted to all affected workers.

SCSU’s Office of Environmental Health and Safety Office (OEHS) will ensure that all potential hazards within laboratories and areas of chemical storage and/or use are evaluated. This plan is intended to comprehensively address the issues of evaluating and identifying potential hazards, evaluating engineering controls, work practices, administrative controls, medical management, training, disposal of hazardous materials, and establishing appropriate procedures.

**WRITTEN PROGRAM**

SCSU will review and evaluate this plan an annual basis, or when the following conditions are met:

 When regulatory changes occur that prompt revision of this plan.

 When facility operational changes occur that require a revision of this document.

**APPLICABILITY**

The Laboratory Standard applies to all employees engaged in the laboratory use of hazardous chemicals. Laboratory use of hazardous chemicals is defined as the use or handling of chemicals in which all of the following conditions are met:

 Chemical work is carried out on a laboratory scale.

 Multiple chemical procedures or chemicals are used where the procedures are not part of or simulating a production process.

 Protective laboratory practices and equipment are used.

1. **CHEMICAL HYGIENE RESPONSIBILITIES**

The **President of the University** has ultimate responsibility for chemical hygiene within the institution and must, along with other officers and administrators provide continuing support for institutional chemical safety.

**Deans/Department Heads** are responsible for the implementation of the Chemical Hygiene Plan (CHP) for any laboratories under their jurisdiction, and will insure that responsible individuals are designated to ensure compliance with this Plan.

**Faculty Member/Laboratory Supervisor** has the primary responsibility for chemical hygiene in the laboratory. He/she is responsible for chemical hygiene in the laboratory/laboratories assigned to them. He/she must have up-to-date knowledge of the chemical inventory in their laboratory, as well as provide Material Safety Data Sheets (MSDS) to their students and staff upon request. This includes knowing the hazards as well as how to control exposures through the proper selection of laboratory techniques and engineering controls.

The Faculty Member or Supervisor must inform all employees and visitors working in the laboratory of the hazards associated with the chemicals present, encourage safe techniques, and detail procedures for dealing with accidental spills. The Faculty Member/Supervisor should communicate with the parties mentioned above for assistance in monitoring engineering controls (ventilation), lab air quality, chemical waste disposal, chemical inventory maintenance, acquiring approval to obtain extremely hazardous substances, and understanding the legal requirements associated with all aspects of chemical usage in the laboratory.

**University Health and Safety Committee** isresponsible for assisting the University Chemical Hygiene Officer in implementing this plan. This Committee may develop additional policies with the intent to promote prudent work practices which are specific to departments, or specific to areas of research.

**Laboratory Workers**, as employees of the University, are obligated to understand the Chemical Hygiene Plan, and to report any unsafe practices or conditions to any of the aforementioned parties. They should develop good laboratory habits involving the use of chemicals, and know the proper means of disposal of waste chemicals. The laboratory worker is responsible for dating incoming chemicals, properly storing them, labeling containers holding chemicals or intermediates of reactions, and informing visitors to the laboratory of the potential hazards within, and the associated rules.

**Chemical Hygiene Officer:** The Coordinator of the Environmental Health and Safety Office is designated the Chemical Hygiene Officer (CHO) for SCSU. The CHO has full authority to make necessary decisions to ensure success of the program. This CHO is authorized to amend these instructions and is authorized to halt any operation where there is danger of serious personal injury.

1. **PROTOCOL REVIEW**

Under some circumstances a particular chemical substance and associated laboratory operation, procedure, or activity may be considered sufficiently hazardous to require prior approval from the OEHS before work or research begins. A list of chemicals and threshold quantities requiring review and approval is located in Table 1: Regulated Chemicals & Particularly Hazardous Chemicals Requiring Special Procedures. With the exception of pressurized hazardous gases, the review and approval procedure goes into effect only if the user selects safeguards that differ from those specified in “Special Handling Procedures for Regulated and Particularly Hazardous Chemicals”

Faculty who anticipate use of these materials in a manner requiring review, should notify the OEHS and complete the review form in Appendix A. A completed form should be sent to the OEHS via Campus Mail. The Chemical Hygiene Officer will visit the laboratory, conduct a survey of facility controls, and review the protocol.

1. **DEFINITIONS**

* **Action Level -** A concentration designated in 29 CFR part 1910 for a specific substance, calculated as an eight (8)-hour time-weighted average, which initiates certain required activities such as exposure monitoring and medical surveillance.
* **Acutely Hazardous/Toxic Chemical** - A highly toxic material is considered a chemical falling within any of the following categories:
* A chemical with a median lethal dose (LD50) of 50 mg or less per Kg of body weight when administered orally to albino rats weighing between 200 and 300 gm each.
* A chemical with a median lethal dose (LD50) of 200 mg or less per Kg of body weight when administered by continuous contact for 24 hours (or less if death occurs within 24 hours) with the bare skin of albino rabbits weighing between 2 and 3 Kg each.
* A chemical that has a median lethal concentration (LC50) in air of 5000 ppm by volume or less of gas or vapor, or 50 mg per liter or less of mist, fume, or dust, when administered by continuous inhalation for 1 hour (or less if death occurs within 1 hour) to albino rats weighing between 200 and 300 gm each. See Appendix B for the Environmental Protection Agency’s List of Acutely Hazardous Chemicals.
* **AIHA –** Acronym standing for the American Industrial Hygiene Association
* **ASHRAE** –Acronym standing for the American Society of Heating, Refrigerating and Air-Conditioning Engineers, An International technical society organized to advance the arts and sciences of heating, ventilation, air-conditioning and refrigeration
* **Chemical Fume Hood -** A device located in a laboratory, enclosed on five sides with a movable sash or fixed, partially enclosed on the remaining side; constructed and maintained to draw air from the laboratory and to prevent or minimize the escape of air contaminants into the laboratory. It allows chemical manipulations to be conducted in the enclosure without insertion of any portion of the employee's body other than hands and arms.
* **Combustible liquid -** Any liquid having a flashpoint at or above 100 deg. F (37.8 deg. C), but below 200 deg. F (93.3 deg. C), except any mixture having components with flashpoints of 200 deg. F (93.3 deg. C), or higher, the total volume of which make up 99 percent or more of the total volume of the mixture
* **Compressed gas:** 
  + A gas or mixture of gases having, in a container, an absolute pressure exceeding 40 psi at 70 deg. F (21.1 deg. C); or
  + A gas or mixture of gases having, in a container, an absolute pressure exceeding 104 psi at 130 deg. F (54.4 deg C) regardless of the pressure at 70 deg. F (21.1 deg. C); or
  + A liquid having a vapor pressure exceeding 40 psi at 100 deg. F (37.8 C) as determined by ASTM D-323-72.
* **DEEP** – Acronym standing for Connecticut Department of Energy and Environmental Protection**.**
* **Designated Area -** An area which may be used for work with "select carcinogens," reproductive toxins or substances which have a high degree of acute toxicity. A designated area may be the entire laboratory, an area of a laboratory or a device such as a laboratory hood.
* **EPA** – Acronym standing for United States Environmental Protection Agency.
* **Emergency -** Any occurrence such as, but not limited to, equipment failure, rupture of containers or failure of control equipment which results in an uncontrolled release of a hazardous chemical into the workplace.
* **Employee -** An individual employed in a laboratory workplace who may be exposed to hazardous chemicals in the course of his or her assignments.
* **Explosive -** A chemical that causes a sudden, almost instantaneous release of pressure, gas, and heat when subjected to sudden shock, pressure, or high temperature.
* **Flammable -** A chemical that falls into one of the following categories:
  + Aerosol, flammable means an aerosol that yields a flame protection exceeding 18 inches at full valve opening, or a flashback (a flame extending back to the valve) at any degree of valve opening;
  + Gas, flammable means: A gas that, at ambient temperature and pressure, forms a flammable mixture with air at a concentration of 13 percent by volume or less; or A gas that, at ambient temperature and pressure, forms a range of flammable mixtures with air wider than 12 percent by volume, regardless of the lower limit.
  + Liquid, flammable means any liquid having a flashpoint below 100 deg F (37.8 deg. C), except any mixture having components with flashpoints of 100 deg. C) or higher, the total of which make up 99 percent or more of the total volume of the mixture.
  + Solid, flammable means a solid, other than a blasting agent or explosive, that is liable to cause fire through friction, absorption of moisture, spontaneous chemical change, or retained heat from manufacturing or processing, or which can be ignited readily and when ignited burns so vigorously and persistently as to create a serious hazard. A chemical shall be considered to be a flammable solid if it ignites and burns with a self-sustained flame at a rate greater than one-tenth of an inch per second along its major axis.
* **Flashpoint -** The minimum temperature at which a liquid gives off a vapor in sufficient concentration to ignite**.** Organic peroxides, which undergo autoaccelerating thermal decomposition, are excluded from any of the flashpoint determination methods specified above.
* **Hazardous Chemical** – A chemical for which there is statistically significant evidence based on at least one study conducted in accordance with established scientific principles that acute or chronic health effects may occur in exposed employees. The term "health hazard" includes chemicals which are carcinogens, toxic or highly toxic agents, reproductive toxins, irritants, corrosives, sensitizers, hepatotoxins, nephrotoxins, neurotoxins, agents which act on the hematopoietic systems, and agents which damage the lungs, skin, eyes, or mucous membranes.Appendices A and B of the Hazard Communication Standard (29 CFR 1910.1200) provide further guidance in defining the scope of health hazards and determining whether or not a chemical is to be considered hazardous for purposes of this standard.

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| **Classes of health hazards include:**     * carcinogens * reproductive toxins * sensitizers * hepatotoxins * agents that act on hematopoietic systems * agents that damage the lungs, skin, eyes, or mucous membranes * irritants * corrosives * neurotoxins * nephrotoxins * asphixiants     In most cases, the chemical container’s original label will indicate if the chemical is hazardous. Look for key words like caution, hazardous, toxic, dangerous, corrosive, irritant, carcinogen, etc. Note that containers of hazardous chemicals acquired or manufactures prior to 1986 may not contain appropriate hazard warnings.  If you are not sure a chemical you are using is hazardous, review the Material Safety Data Sheet for the substance, or other reliable reference material, or contact the laboratory director or the OEHS. |

* **Laboratory -** For the purposes of the OSHA Standard, a laboratory is defined as a facility in which hazardous chemicals (defined below) are handled or manipulated in reactions, transfers, etc. in small quantities (containers that are easily manipulated by one person) on a non-production basis.
* **Laboratory Scale -** Work with substances in which the containers used for reactions, transfers, or other types of handling are designed to be easily and safety manipulated by one person. "Laboratory scale" excludes those workplaces whose function is to produce commercial quantities of materials.
* **Laboratory use of hazardous chemicals -** Handling or use of such chemicals in which all of the following conditions are met:
  + Chemical manipulations are carried out on a "laboratory scale;"
  + Multiple chemical procedures or chemicals are used;
  + The procedures involved are not part of a production process, nor in any way simulate a production process; and
  + "Protective laboratory practices and equipment" are available and in common use to minimize the potential for employee exposure to hazardous chemicals.
* **Lethal Dose 50 (LD50) –** In toxicology, the **median lethal dose**, **LD50** (abbreviation for “Lethal Dose, 50%”), **LC50** (Lethal Concentration, 50%) or **LCt50** (Lethal Concentration & Time) of a toxin, radiation or pathogen, is the dose required to kill half the members of a tested population after a specified test duration. LD50 figures are frequently used as a general indicator of a substance's acute toxicity.
* **Medical Consultation -** A consultation which takes place between an employee and a licensed physician for the purpose of determining what medical examinations or procedures, if any, are appropriate in cases where a significant exposure to a hazardous chemical may have taken place.
* **Organic Peroxide -** An organic compound that contains the bivalent -O-O- structure and which may be considered to be a structural derivative of hydrogen peroxide where one or both of the hydrogen atoms has been replaced by an organic radical.
* **Oxidizer -** A chemical other than a blasting agent or explosive that initiates or promotes combustion in other materials, thereby causing fire either of itself or through the release of oxygen or other gases.
* **Physical Hazard -** A chemical for which there is scientifically valid evidence that it is a combustible liquid, a compressed gas, explosive, flammable, an organic peroxide, an oxidizer pyrophoric, unstable (reactive) or water-reactive.
* **Protective Laboratory Practices and Equipment -** Those laboratory procedures, practices and equipment accepted by laboratory health and safety experts as effective, or that the employer can show to be effective, in minimizing the potential for employee exposure to hazardous chemicals.
* **Reproductive Toxins -** Chemicals which affect the reproductive capabilities including chromosomal damage (mutations) and effects on fetuses (teratogenesis).
* **SEFA – Scientific Equipment. & Furniture Association**
* **Select Carcinogen -** any substance which meets one of the following criteria:
  + It is regulated by OSHA as a carcinogen; or
  + It is listed under the category, "known to be carcinogens," in the Annual Report on Carcinogens published by the National Toxicology Program (NTP)(latest edition); or
  + It is listed under Group 1 ("carcinogenic to humans") by the International Agency for research on Cancer Monographs (IARC)(latest editions); or
  + It is listed in either 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 in accordance with 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 dosages of less than 10 mg/m(3);
    - After repeated skin application of less than 300 (mg/kg of body weight) per week; or
    - After oral dosages of less than 50 mg/kg of body weight per day.
* **Substances with a High Acute Toxicity** – High acute toxicity includes any chemical that falls within any of the following OSHA-defined categories:
  + A chemical with a median [lethal dose (LD50)](http://web.princeton.edu/sites/ehs/labsafetymanual/sec5.htm#LD50) of 50 mg or less per kg of body weight when administered orally to certain test populations.
  + A chemical with an LD50 of 200 mg less per kg of body weight when administered by continuous contact for 24 hours to certain test populations.
  + A chemical with a median lethal concentration (LC50) in air of 200 parts per million (ppm) by volume or less of gas or vapor, or 2 mg per liter or less of mist, fume, or dust, when administered to certain test populations by continuous inhalation for one hour, provided such concentration and/or condition are likely to be encountered by humans when the chemical is used in any reasonably foreseeable manner.
* **Unstable (Reactive) -** A chemical which is the pure state, or as produced or transported, will vigorously polymerize, decompose, condense, or will become self-reactive under conditions of shocks, pressure or temperature.
* **Water-Reactive -** A chemical that reacts with water to release a gas that is either flammable or presents a health hazard.

1. **TRAINING AND INFORMATION**
2. **Chemical Safety Training**

All employees exposed, or potentially exposed to hazardous chemicals while performing their job duties, must receive information and training regarding the Standard, this Chemical Hygiene Plan, and laboratory safety, prior to working with these chemicals. Training sessions are available on the Facilities Operations OEHS web site. Additional laboratory specific safety training shall be provided by the supervisor.

The content of the training programs will include the following:

* Physical and health hazards of various classes of laboratory chemicals;
* Methods/procedures for handling and safely using chemicals present in laboratories;
* Appropriate response in the event of a chemical emergency (spill, overexposure, etc.); and
* University chemical hygiene policies

All employees working in the laboratory must receive this training prior to beginning work with hazardous chemicals. When an employee is to perform a non-routine task presenting hazards for which he or she has not already been trained, the employee's supervisor will be responsible for discussing with the employee, the hazards of the task and any special measures (e.g. personal protective equipment or engineering controls) that should be used to protect the employee. The OEHS is available to consult with the supervisor or employee, as necessary.

1. **Chemical Safety Information Sources**

There are numerous sources of chemical safety information available. These sources include:

1. The labels found on containers of hazardous chemicals;
2. the substance's Material Safety Data Sheet;
3. Health and safety reference literature available from the OEHS

In addition, your supervisor and the OEHS are available to provide safety information.

1. **CHEMICAL EXPOSURE ASSESSMENT**

Regular environmental or employee exposure monitoring of airborne concentrations is not usually warranted or practical in laboratories because chemicals are typically used for relatively short time periods, in small quantities, and/or inside laboratory fume hoods. However, sampling may be appropriate when a highly toxic substance is used regularly or for an extended period of time, or when hazardous chemicals are used outside of a fume hood or used in larger than lab-scale quantities. During periodic laboratory safety inspections, the Chemical Hygiene Officer will identify these situations and assess exposures to laboratory employees who suspect and report that they have been overexposed to a toxic chemical in the laboratory or are displaying symptoms of overexposure to toxic chemicals. The assessment may include specific quantitative exposure monitoring. Follow-up exposure assessments will be conducted as necessary.

These results and any corresponding recommendations will be sent to the employee, his or her supervisor, and the Occupational Health Physician. A copy of the monitoring results will be kept on file in the OEHS.

Individual concerns about excessive exposures occurring in the laboratory should be brought to the attention of the OEHS and your supervisor immediately.

1. **MEDICAL CONSULTATION AND EXAMINATION**

The University will provide employees who work with hazardous chemicals an opportunity to receive medical attention through the employee health program, including any follow-up examinations which the examining physician determines to be necessary, whenever an employee:

* develops signs or symptoms associated with excessive exposure to a hazardous chemical used in their course of work;
* is exposed routinely above the action level (or in the absence of an action level, the applicable

OSHA work place exposure limit) for an OSHA regulated substance;

* may have been exposed to a hazardous chemical during a chemical incident such as a spill, leak, explosion or fire; or is referred for medical follow up by the Chemical Hygiene Officer.

Individuals with serious or life-threatening emergencies should proceed immediately to a local hospital emergency room. An ambulance can be obtained by dialing 911 from any phone.

1. **Medical and Workplace Consultations - Reproductive Toxins**

Although not everyone who is exposed to reproductive hazards will develop reproductive health problems, any employee who may be exposed needs to understand the risks and precautions.

It is recognized that exposure to certain chemicals may adversely affect the fertility of the parents and may affect the developing fetus during pregnancy. Therefore, if you are working with reproductive toxins or teratogenic agents and are planning to conceive a child or are pregnant, you should consult your Supervisor and the Chemical Hygiene Officer opinions regarding risks of exposure and potential exposure control options. Exposed employees need to be trained them about the dangers and how to avoid them. The Chemical Hygiene Officer can assess potential exposures and work with you, and your supervisor to adjust work practices to minimize any potential risk. A list of suspected reproductive toxins and teratogenic agents is available in Appendix C.

1. **LABORATORY SAFETY INSPECTION PROGRAM**

The Chemical Hygiene Officer conducts periodic inspections of all University areas handling or storing hazardous materials, including chemical and biological materials. These inspections evaluate (1) employee exposures (qualitative assessments); (2) the status of critical control equipment (hoods); (3) microbiological practices and the handling and storage of chemicals; (4) use of personnel protective equipment; (5) waste disposal; (6) employee training; and (7) compliance with Federal/State regulation and University policies. More frequent inspections may be established for laboratories working with higher risk materials. Inspection times are typically arranged in advance Supervisors receive a written report of the inspection results. Department chairs, business managers, and/or committees may receive inspection summary reports for their department.

1. **RESPIRATORY PROTECTION PROGRAM**

The University attempts to minimize employee respiratory exposure to potentially hazardous chemical substances through engineering methods (such as local exhaust ventilation) or administrative controls. It is recognized, however, that for certain situations or operations, the use of these controls may not be feasible or practical. Under these circumstances, while such controls are being instituted, or in emergency situations, the use of personal respiratory protective equipment may be necessary.

The University has a written plan governing the use of respirators on campus. This plan outlines organizational responsibilities for the following respirator program components: exposure assessment; respirator selection; medical approval and surveillance; fit testing; user training; inspection/repair; cleaning/disinfection; and storage. Each of these program components is required by OSHA's respiratory protection standard (29 CFR 1910.134) in all situations where respirators are used. Respiratory Protection Program is available for review in the Office of Environmental Health and Safety, and on the website. If you are using a respirator and are not included in the University's respiratory protection program, or have questions concerning the use of respirators or any of

the program components, contact your supervisor or the Office of Environmental Health and Safety.

1. **RECORDKEEPING**

All exposure assessments and occupational medical consultation/examination reports will be maintained in a secure area in accordance with OSHA's medical records rule (29 CFR 1910.1020). Individuals may obtain copies or read their reports by making a request in writing to the Office of Environmental Health and Safety.

1. **CHEMICAL HANDLING WORK PRACTICES AND PROCEDURES**
2. **Prior Approval**

Employees must obtain prior approval to proceed with a laboratory task from their supervisor (Department Chair, Dean) and the OEHS whenever:

* An unfamiliar laboratory procedure or test is to be carried out.
* It is likely that the toxic limit concentration could be exceeded or that other harm is likely.
* There is a change in a procedure or test, even if it is very similar to prior practices. "Change in a procedure or test" means:
  + A substantial increase or decrease in the amount of one or more chemicals used.
  + A substitution or deletion of any of the chemicals in a procedure.
  + Any change in other condition under which the procedure is to conducted.
* There is a failure of any of the equipment used in the process, especially of safeguards such as fume hoods or clamped apparatus.
* There are unexpected results.
* Members of the laboratory have become ill, suspect that they or others have been overexposed, or otherwise suspect a failure of any safeguards.
* The approval procedure begins with completing the information in Appendix A.

1. **General Rules**

Because few laboratory chemicals are without hazards, all employees are required to abide by the following general precautions for handling chemicals. All employees of this facility must operate under the assumption that any mixture of hazardous chemicals is more toxic than the most toxic component. Remember, Safety is everyone’s responsibility. To minimize exposure, the following procedures are to be used when working with chemicals:

* Avoid working alone in a laboratory, especially if the experiment involves a potentially dangerous operation. In situations where a worker knows he/she will be working alone, a periodic cross check should be maintained, either by phone calls or inter-laboratory personal checks.
* Wear appropriate personal protective equipment in the laboratory, shop, or studio at all times. This applies to visitors as well as employees.
* When working with flammable chemicals, be certain that there are no sources of ignition nearby to cause a fire or explosion in the event of a vapor release or liquid spill.
* Familiarize yourself with potential hazards associated with procedures before beginning any work.
* Use the proper personal protective equipment (PPE) and engineering controls for the task. Inspect PPE before use. Do not use defective PPE, or proceed with using hazardous chemicals if either the PPE is compromised or if engineering controls are not functioning properly.
* Know the location of emergency equipment in your area and be familiar with emergency procedures.
* Use equipment only for its designated purpose.
* Be certain that all chemicals are clearly labeled and stored in compatible containers.
* Position and clamp reaction apparatus to permit safe manipulation.
* Check all glassware **before use** to ensure that it is free from cracks, flaws or scratches that may cause it to fail in use.
* Enclose glass vessels under vacuum in plastic or wire mesh to prevent fragments being scattered, should the vessel implode.
* Combine reagents in the appropriate order and avoid adding solids to hot liquids.
* Know the locations of the nearest fire exits from the buildings at all times.
* Adhere to fire drills as though they are actual fires.
* Do not block aisles, doorways, access to exits or emergency equipment such as fire extinguishers, fire alarm pull stations, eyewash stations and safety deluge showers. Do not use hallways or stairways as storage areas.
* Keep the work area clean and uncluttered, with chemicals and equipment properly labeled and stored; clean up the work area on completion of an operation or at the end of each day.
* Inspect gloves and test glove boxes before use.
* Clean up spilled materials immediately using appropriate procedures.

1. **Procurement of Chemicals**

* Responsible use: Chemicals purchased by this University shall be used in a responsible manner, from receipt through disposal.
* Requests for material: Requests for extremely hazardous materials or material quantities in excess of normal usage quantities must be routed through the Chemical Hygiene Officer for approval.
* Hazard information: Before a chemical is received for use, a MSDS and any other safety information, as well as personal protective equipment, must be obtained. Employees must be trained on the hazards and equipment to safely use the material, before use.

1. **Protective Clothing and Equipment/Personal Protective Equipment (PPE)**

Personal protective equipment includes any devices or clothing worn by the worker to protect against the hazards in the work environment. Its function is to minimize exposure to a variety of hazards including hazardous chemicals, blood and body fluids, projectiles, particulates, vibrations, loud noises, and more. PPE is used for eye protection, skin protection, head protection, hand protection, hearing protection, foot protection, and respiratory protection.

PPE is required when whenever the employee has the potential for contact, with hazardous infectious materials, excessive noise, temperatures, etc.

Examples are lab coats, aprons, protective gloves, safety glasses, goggles, and face shields. Carefully inspect all protective equipment before using. Never use defective protective equipment.

1. **General PPE Guidelines**

* Wear laboratory coats or aprons over normal clothing to offer protection against spills. Shorts and open-toed shoes are not permitted in the laboratory. Lab coats shall be worn only in the laboratory area and shall be buttoned to protect the persons clothing and skin.
* An impervious apron shall be worn in areas where there is a reasonable probability that chemical splashes could occur.
* Protective gloves must be worn when there is a potential for a hand injury or skin contact with chemicals, extreme temperatures, biological or radiological hazards, or abrasives. Chemical-resistant gloves shall be worn as appropriate. Thermal-resistant gloves shall be worn for operations involving hot materials and materials contained in exothermic reaction vessels. The type glove used will be made of a non-asbestos material replaced when damaged or deteriorated.
* “Cryo-gloves” shall be worn for temperature extremes such as handling cryogenic materials such as liquid nitrogen.
* Eye protection must be worn while working with hazardous chemicals, where there is a potential for a splash the face, and must meet the requirements of the American National Standards Institute (ANSI) Z87.1 (latest version). Also wear a face shield large enough to protect the chin, neck, and ears, as well as the face, in situations where large quantities of chemicals may cause splashing, or where reactions may splash.
* When working with corrosive liquids, wear gloves made of a material known to be resistant to permeation by the corrosive chemical.
* Always wear low-heeled shoes with fully covering uppers. Shoes with open toes, or sandals are prohibited.
* Whenever exposure by inhalation is likely to exceed the threshold limits described in an MSDS, use a fume hood. Consult with your supervisor before doing any such work, or contact the OEHS.

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| **Wearing Personal Protective Equipment in General Areas** |
| Since every employee or visitor to this facility is not familiar with the work being conducted by an individual who wears gloves, a lab coat, or other PPE outside of the laboratory, concerns have been raised regarding laboratory personnel who enter common use areas such as offices, elevators, and dining areas while wearing PPE. Your cooperation is necessary to allay the concerns of employees and visitors, by adhering to the practice of removing PPE before entering common-use areas.  Wearing Personal Protective Equipment is intended to prevent or minimize contamination of individuals who work with potentially hazardous materials. Subsequent contact with other materials can cross contaminate them.    As a good safety practice, you are required to remove gloves and lab coats prior to leaving the laboratory and entering common use areas.    Gloves must be removed if one is to handle a telephone, doorknob, elevator buttons, etc.    When carrying hazardous material, use a secondary container for the material, or remove one glove while carrying the container with the remaining gloved hand. The ungloved hand is free to contact environmental surfaces. |

1. **Protective Gloves**

* Gloves must be worn when using hazardous chemicals, when handling materials at temperature extremes or when handling materials with sharp or rough surfaces. It is especially important to wear gloves when handling chemicals that can be absorbed through the intact skin. Consult the MSDS or other reliable source when determining which glove to use while handling chemicals.
* Gloves must be properly selected on the basis of the particular hazard involved or materials to be handled, and their suitability for the operation being conducted.
* Store gloves in a clean area outside of fume hoods and away from equipment that could potentially contaminate them.
* Always remove gloves before touching common use items such as phones, door knobs, elevator buttons, and computers. This will prevent contamination of unprotected individuals.
* Familiarize yourself with the limitations of the gloves you use, and the compatibility of the glove material with the chemicals likely to be encountered.
* Before each use, gloves should be checked for integrity. Check gloves for holes or tears. Non-disposable gloves should be replaced periodically, depending on the frequency of use and their resistance to the substances being handled. Discard if protective ability is impaired.
* Wash and dry hands thoroughly before donning gloves and after removing them.

1. **Glove Selection**

* Chemically resistant gloves are manufactured from a variety of materials, including nitrile, polyvinyl chloride, natural rubber (latex), and Viton. No single glove material provides universal protection against all chemical agents. Therefore, gloves must be selected on the basis of their resistance to the material(s) being handled, their suitability for the procedures being conducted, and their resistance to wear, as well as temperature extremes. Improper selection may degrade the gloves, allow the chemical to permeate through the gloves, and ultimately expose the wearer to the chemical. This is a potentially serious situation. Use the chemical’s MSDS, chemical resistance charts and glove selection databases to choose gloves.
* Other factors to consider in selecting gloves are how and where they will be used. In shop environments, gloves may be subjected to rougher handling and may be totally immersed in chemicals such as cleaners and degreasers. However, in labs, manual dexterity may be an issue, and splashes, as opposed to total immersion in the chemical, are more common. Gloves used in shop settings are thus required to be more resistant to tears and abrasion than those used in laboratory environments and are normally thicker (greater than 10-15 mils). In laboratories, thin, lightweight gloves are generally preferred (less than 10 mils). As a point of reference, typical dishwashing gloves are approximately 15 to 20 mils thick, and surgical latex gloves are on the order of 3 to 8 mils thick.
* In general, nitrile exam-style gloves offer better chemical protection than either latex or vinyl. Latex gloves are discouraged not only because they do not hold up well to many chemicals, but also because of the potential for the user or other lab personnel to develop a sensitization to the latex. Nitrile gloves are generally more chemically resistant than vinyl or latex, but due to the thinness of these gloves thicker utility-style reusable gloves should be worn if there is a probability of contact with hazardous chemicals. These gloves should be washed prior to removal and replaced periodically, depending on frequency of use and their resistance to the substances handled.
* A final consideration in glove selection is an individual’s sensitivity to the materials and chemicals used in the manufacture of gloves. Some people have allergic reactions to natural rubber proteins in latex, glove powder or other chemical constituents, such as rubber accelerators (carbamates, thiurams, and mercaptobenzothiazole).

**The following table offers a general guide to glove selection.**

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| **Glove Material** | **Intended Use** | **Advantages** | **Disadvantages** |
| Latex – exam style | Incidental Contact | * Good for biological and water-based materials | * Poor for organic solvents * Hard to detect puncture holes * Latex allergy issues |
| Nitrile – exam style | Incidental Contact | * Good for solvents, oils, greases, some acids and bases * Clear indication of tears and breaks |  |
| Nitrile – utility style | Extended Contact | * Good for solvents, oils, greases, some acids and bases * Can be washed and reused | * Not effective for halogenated and aromatic hydrocarbons |
| Neoprene – utility style | Extended Contact | * Good for acids, bases, alcohols, fuels, peroxides, hydrocarbons, and phenols | * Poor for halogenated and aromatic hydrocarbons |
| Butyl rubber utility gloves | Extended Contact | * Good for ketones and esters |  |

Contact the OEHS at 2-7073 for personal protective equipment selection assistance or information.

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| **The web sites listed below are recommended for selecting chemically resistant gloves. Some allow different ways to search for the most appropriate glove. Searching by chemical name will produce a list of gloves that protect against a particular agent. Searching by glove type will give a list of chemicals for which a specific glove was tested. Glove thickness is normally listed or is available by clicking on the link for the recommended glove.**  Glove Manufacturer Web Sites:   * SpecWare Online Chemical Hand Protection <http://www.ansellpro.com/specware/index.asp> * ChemRest Guide to Chemical Resistant Best Gloves   <http://www.showabestglove.com/site/languageselection/?redirectpage=http:$$www.showabestglove.com$site$chemrest$default.aspx>   * MAPA Chemical Resistance Guide   <http://www.mapaglove.com/index.cfm?CFID=444469&CFTOKEN=5715f7e489048d66-ADBAD0F8-2219-6DAD-14A0D8BEC50379FC>  Independent Glove Selection Web Sites:   * Michigan State University Chemical-Resistant Glove Guide   <http://www.hazmat.msu.edu/glove_guide/>   * Oklahoma State University Chemical Guide and Permeation Tables   <http://www.ehs.okstate.edu/hazmat/Gloves.htm> |

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| **!!!Latex Allergy Alert!!!** |
| It has been reported that approximately 1 in 10 people who have continual exposure to latex-containing products may develop a skin irritation or allergy to latex. Latex allergy is a serious condition and presents a significant risk of anaphylaxis as a result of inhalation, or if latex is introduced internally during a medical procedure.  It is the policy of SCSU that we only use latex-safe products. If it is not possible to fulfill this requirement, latex-containing products are limited to the low-antigen type or other synthetics.  Gloves that contain latex powder are prohibited at this institution.  Recommendations for employees with known latex allergy or sensitivity are as follows:   * Notify your Supervisor and contact the OEHS. * Obtain nitrile, or powder-free, latex-free gloves and supplies. * Become aware of all latex-containing products and avoid them. * During times of acute skin irritation, use cotton glove liners to increase comfort and absorb perspiration. * If you suspect that you are developing sensitivity to latex, you should alert your Supervisor, the Employee Health Physician and your Personal Physician. |

1. **Eye Protection**

* Eye protection is required for all personnel, students, and visitors present in locations where chemicals are handled and a chemical splash hazard exists.
* Safety glasses are the minimum protection required when handling chemicals. Safety glasses must be supplemented with goggles and/or face shields when there is a greater risk of exposure to chemical splashes or flying particles (e.g., when pouring or mixing chemicals or cryogens).
* Safety glasses with side shields are required for individuals wherever a flying particle hazard may exist. Safety glasses must meet the basic impact-resistance provisions of ANSI Z87.1 (latest edition).
* Where bulk quantities of chemicals are handled, goggles must be worn because they form a liquid proof seal around the eyes.
* When handling highly reactive substances, chemicals under pressure, or larger quantities of corrosives, poisons, and hot chemicals, goggles with face shield must be worn.
* Contact lenses may be worn in work areas. However, contact lenses do not provide eye protection. Safety glasses or goggles must be worn by people who use contact lenses when chemicals are being handled.
* Goggles are required for operations where there is a greater risk of exposure to chemicals and to flying particles. Furthermore, they are required for activities producing airborne eye irritants including gases, vapors, fumes, dusts, and mists. Safety glasses provide no protection against eye irritants.

***Contact lens wearers:*** The National Institute for Occupational Safety and Health (NIOSH) recommends that workers not wear contact lenses during work with chemicals that present an eye irritation or injury hazard [NIOSH 2004]. This recommendation is also consistent with general industry practice, OSHA regulations, and recommendations of professional groups such as the American Chemical Society. NIOSH recommends that workers be permitted to wear contact lenses when handling hazardous chemicals provided that the safety guidelines listed here are followed and that contact lenses are not banned by regulation or contraindicated by medical or industrial hygiene recommendations. However, contact lenses are not eye protective devices, and wearing them does not reduce the requirement for eye and face protection.

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| **Here is a partial list of some chemicals that can react with contact lens or are restricted due to regulatory guidance, and one should avoid contact lens use when handling them:**   * 1,2-dibromo-3-chloropropane (DBCP): OSHA regulation8, * 4,4'-methylene dianiline: OSHA regulation8, * Ethyl alcohol: Study of absorption by Cerulli, et al. 19853 * Ethylene oxide: OSHA regulation8 * Isopropyl alcohol: Study of absorption by Cerulli, et al. 19853 * Methylene chloride: OSHA regulation8 |

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| **The following guidelines are for contact lens use in a chemical environment:** |
| * For chemical vapor, liquid, or caustic dust hazards, the minimum protection consists of well-fitting, non-vented or indirectly vented goggles. Close-fitting safety glasses with side protection provide limited chemical protection but do not prevent chemicals from bypassing the protection. * Workers should wear face shields over other eye protection when needed for additional face protection; but they should not wear face shields instead of goggles or safety glasses—regardless of contact lens wear. * **In the event of a chemical exposure, begin eye irrigation immediately and remove contact lenses as soon as practical.** Do not delay irrigation while waiting for contact lens removal. * **After removing gloves and washing hands, remove the lenses at the first signs of eye redness or irritation, in a clean environment.** Evaluate continued lens wear with the wearer and the prescribing ophthalmologist or optometrist. |

1. **Respirators**

Respirators are designed to protect against specific types of substances in limited concentration ranges. Respirators must be selected based on the specific type of hazard (toxic chemical, oxygen deficiency, etc.), the contaminant's anticipated airborne concentration, and required protection factors.

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| Respiratory protection is not to be worn until the user has been approved to wear the device through the SCSU Respiratory Protection Program, as mandated by the OSHA Respiratory Protection Standard, 29CFR 1910.134. |

* Respirators should not be needed in most laboratory and shop settings. However, if engineering, work practice, and administrative controls are not adequate to minimize an airborne chemical hazard, respiratory protection is required.
* Use of respirators requires a hazard evaluation conducted by the OEHS, and enrollment in the University’s Respiratory Protection Program. All respirator users must be medically qualified, trained, and fit-tested to wear respiratory protection equipment.
* The Chemical Hygiene Officer must approve procurement of respirators.
* Any questions regarding the need for or use of respirators should be directed to the OEHS at 2-7073. The SCSU respirator policy may be found in Appendix D.

1. **Protection of the Respiratory System**

Inhalation hazards can be controlled using ventilation or respiratory protection. Check the label and MSDS for information on a substance's inhalation hazard and special ventilation requirements. When a potential inhalation hazard exists a substance's label or MSDS contains warnings such as:

* Use with adequate ventilation • Avoid inhalation of vapors
* Use in a fume hood • Provide local ventilation

Take appropriate precautions before using these substances. Controlling inhalation exposures via engineering controls (ventilation) is always the preferred method. As with other personal protective equipment, respiratory protection relies heavily on employee work practices and training to be effective.

1. **Types of respiratory protective equipment:**

* Disposable NPR95 or HEPA filter masks (particle-removing respirators)
* Air purifying respirators (vapor, gas and/or particle removing – ½ mask, full face, or powered air purifying (PAPR))
* Atmosphere supplying respirators (air line or SCBA)

Respirators are not to be used except in conjunction with a complete respiratory protection program as required by OSHA. If your work requires the use of a respirator, contact the OEHS and your supervisor. Do not use respiratory protective equipment until you have met all elements of the written SCSU Respiratory Protection Program. Users of respirators must be fitted to the proper size respirator, and thoroughly trained in proper use, maintenance, storage and limitations of this equipment, the nature of the respiratory hazard, and the signals of respirator failure. Medical surveillance to determine your ability to physically wear a respirator must also be conducted. This entails the completion of a medical surveillance questionnaire that is evaluated by the Occupational Health Physician. The physician will determine whether a physical examination is needed before providing medical clearance to wear the respirator. No one is allowed to wear a respirator on campus without medical clearance from the Occupational Health Physician and without approval and training from the Office of Environmental Health and Safety.

1. **Personal Hygiene**

* Avoid direct contact with any chemical. Keep chemicals off your hands, face and clothing, including shoes.
* Never smell, inhale or taste a chemical.
* Do not eat, drink, smoke, chew gum, or apply cosmetics in a laboratory or other chemical use/storage area.
* Remove contaminated clothing and gloves before leaving the laboratory.
* Never pipet by mouth. Use a pipet bulb or other mechanical pipet filling device.
* Never use lab microwaves, refrigerators, freezers, or other equipment which is used for lab operations to store or prepare food or beverages. Do not discard food or beverage wrappers or containers in laboratory trash receptacles. Do not use laboratory glassware or equipment for consuming food or beverages.
* Always wash your hands with soap and water after performing lab operations/experiments, and before consuming food or beverages. Always wash hands before putting on and after removing gloves.
* Loose, skimpy, or torn clothing and unrestrained hair should not be present in the laboratory. Laboratory coats must be worn at all times while working with hazardous chemicals. They are intended to prevent contact of the body with chemical splashes and spills. Laboratory aprons must be worn whenever working with corrosive or dangerous materials. (Appendix to 29 CFR 1910.1450 - The Laboratory Standard, Section "D-Components of the Chemical Hygiene plan, 6(a)). Lab coats or aprons that become contaminated or torn must be removed from use and potentially discarded as hazardous waste depending on the nature of the contamination.
* Shoes must be worn at all times in the laboratory. Perforated shoes, sandals, cloth or fabric sneakers must not be worn in the laboratory. (Appendix to 29 CFR 1910.1450 - The Laboratory Standard, Section "D-Components of the Chemical Hygiene plan, 6(a), And E. Basic Rules and Procedures for Working with Chemicals).

*These recommendations are for work with chemical hazards. They do not address hazards from heat, radiation, or high-dust or high-particulate environments.*

1. **Housekeeping**

* Never block access to emergency equipment, safety showers, eyewashes, and exits, by anything, not even a temporarily parked chemical cart.
* Label all chemical containers with the identity of the contents and any known hazards those contents present to users. Label all intermediate or transferred containers of chemicals.
* Keep all work areas, especially laboratory benches, clear of clutter.
* Keep all aisles, hallways, and stairs clear of all chemicals.
* Place all chemicals in their assigned storage areas at the end of each workday.
* Properly label all chemical waste and keep in appropriate containers. Call the OEHS for removal.
* Promptly clean up all spills, and properly dispose of the spilled chemical and cleanup materials as hazardous waste, if applicable.
* Do not store chemicals on the floor, for any reason.
* Do not store corrosive chemicals above eye level.

1. **Safe Use of Glassware**

* Use adequate hand protection (e.g., proper gloves) when inserting glass tubing into rubber stoppers or corks or when placing rubber tubing on glass hose connections. Tubing should be fire-polished or rounded and lubricated, and hands should be held close together to limit movement of glass should fracture occur. Plastic or metal connectors should be used whenever possible.
* Handle vacuum-jacketed glass apparatus with extreme care to prevent implosions. Equipment such as Dewar flasks should be taped or shielded. Only glassware designed for vacuum work should be used for that purpose.
* Do not pick up broken glass with your hands. Use an extension such as a dust pan and brush, tongs, or forceps.

1. **Extremely** **Hazardous Chemicals/Activities**

Using the following chemicals or conducting the following activities requires prior approval by the OEHS and the Department Chariperson (Appendix A). These extremely hazardous chemicals/activities are subject to all applicable required practices in the CHP and any additional safety practices required by the OEHS.

* The storage or use of compressed pyrophoric gases in flammable concentrations (e.g., silane, germane, dichloroborane, phosphine, stibine \*).
* The storage or use of compressed highly toxic gases or compressed toxic gases with poor or no warning properties (e.g., carbon monoxide, arsine, cyanogen chloride, diborane,fluorine, phosgene, hydrogen cyanide, hydrogen selenide, nitric oxide, nitrogen dioxide, phosphine, stibine \*).
* The storage or use of compressed gases, which are select carcinogens, reproductive toxins, toxic or corrosive: (examples: ammonia, chlorine, hydrogen fluoride, hydrogen sulfide, sulfur dioxide, silicon tetrafluoride, hydrogen chloride, 1,3butadiene, vinyl chloride, ethylene oxide\*).

**OR**

* that are plumbed outside of the source exhausted enclosure (i.e., when all gas use is not inside a fume hood, gas cabinet or exhausted enclosure).
* Trans-filling (transfer of compressed gases from one container to another).
* The storage, use and/or generation of :
  + beryllium or beryllium compounds that involve particles less than 10 microns in size.
  + hydrogen peroxide in concentrations greater than 50%.
  + perchloric acid in concentrations greater than 85%
  + pyrophoric liquids.
* Other chemicals/activities that are difficult to control (e.g., very high vapor pressure or very small particle size) AND, have lethal potential in one low, level exposure (e.g., extremely low exposure limit or IDLH level).
* Other Chemicals/activities that are difficult to control (e.g., very high vapor pressure or very small particle size) AND are difficult to detect (i.e., poor warning properties) AND are known to trigger a life-shortening disease/condition in one high level exposure (e.g., known potent reproductive hazards, known potent carcinogens).
* Other chemicals/activities that have a significant probability (based on accident history in the literature) to cause a lethal event (e.g., explosion).

**\* Examples are not all inclusive. All hazards of a chemical must be considered.**

1. **Prohibited Activities**

* Practical jokes or other behavior that might confuse, startle, or distract another worker are prohibited.
* Do not siphon or pipette by mouth. Use a mechanical device.
* Do not handle or consume food or beverages, including storing food or beverages in laboratory refrigerators or freezers.
* Do not smoke or apply cosmetics in laboratories.
* Open-toed shoes (sandals, flip flops, ectc.) are prohibited.
* Shorts are not to be worn in labs unless a lab coat or other suitable clothing covers the legs.
* Do not work alone in the laboratory if the procedures being conducted are hazardous or dangerous.

1. **SAFETY EQUIPMENT**
2. **Emergency Eyewash Units and Emergency Showers**

Emergency eye wash and shower units are designed to deliver water to rinse contaminants from a user’s eyes, face or body. As such, they are a form of first aid equipment to be used in the event of an accident. However, they are not a substitute for primary protective devices (including eye and face protection and protective clothing) or for safe procedures for handling hazardous materials.

Eyewash stations are required in areas where hazardous chemicals are used. The General Requirements in section 29 CFR (Code of Federal Regulations) 1910.151 states “…where the eyes or body of any person may be exposed to injurious corrosive materials, suitable facilities for quick drenching or flushing of the eyes and body shall be provided within the work area for immediate emergency use.”

The OSHA regulation regarding emergency equipment is vague, in that it does not define what constitutes “suitable facilities” for drenching the eyes or body. In order to provide additional guidance to employers, the American National Standards Institute (ANSI) has promulgated a voluntary standard covering emergency eye wash and shower equipment. This standard - ANSI Z358.1 - is intended to serve as a guideline for the proper design, performance, installation, use and maintenance of emergency equipment.

* Eyewashes must be easily accessible, unobstructed, and clearly labeled.
* Emergency eyewash and shower equipment shall be located on the same level as the hazard, have unobstructed access (a door is considered an obstruction), and require not more than 10 seconds to reach.
* The use of the hands must not be required to activate and maintain the water flow.
* Plumbed eyewashes and showers must be inspected and flushed weekly to ensure proper operation. Eyewash flushing for at least three minutes has been suggested to reduce bacterial and amoebic contamination. *Acanthamoebae* are commonly found in eyewashes and can cause severe eye infections when introduced into traumatized eyes*1*.
* Units must also be inspected on an annual basis to assure conformance with ANSI Z358.1.



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| **Bottle type eyewash stations are regarded as secondary eyewash stations or supplemental eyewash stations under the ANSI standard and do not meet the ANSI Z358.1 Standard. These eyewash stations are NOT approved because they are not primary eyewash stations that flush both eyes for a minimum of 15 minutes. These eyewash stations are intended for immediate use until the injured person can get to a primary eyewash station that provides a full 15 minute flow. These personal eyewash stations should be placed in proximity to a worker's area for immediate flushing.** |

1. **Fire Extinguishers**

Fires are a common type of laboratory accident. Specified laboratory personnel must know the locations of all fire extinguishers in the laboratory, the type of fires for which they are appropriate, and how to operate them correctly. The OEHS will provide fire extinguisher training to all SCSU employees who have been designated to use firefighting equipment as part of an emergency action plan. These designated employees may, but are not required, to use portable fire extinguisher to extinguish a fire during its incipient stage, so long as they do not place themselves or anyone else in danger. Emergency notification or activation of the fire alarm should be done before attempting to fight the fire, unless someone else has already performed the notification.

The types of portable fire extinguishers located within any area of the University are designed for the fire threat within the area. Extinguishers are located in accordance with the requirements of the Connecticut State Fire Code, specifically NFPA 10. At this university, Class ABC are used for normal threats. Fire extinguishers in the laboratory should be the appropriate type for the expected fire emergency.

Fire extinguishers are classified according to a particular fire type. Type A are used on combustible (wood, paper rubber, plastic) fires, Type B are used on flammable liquid fires, Type C are used on energized electrical equipment fires, and Type D are used on combustible metal (lithium, sodium, magnesium, potassium) fires. Multipurpose (Type ABC and Type BC) extinguishers are also available. Fire extinguishers must be easily accessible, mounted properly on a wall, and unobstructed. Fire extinguishers are inspected monthly. Used fire extinguishers must be reported to the OEHS and serviced immediately.

1. **Chemical Storage and Use**

Storage of chemicals and chemical wastes shall be in compliance with this Plan, National Fire Protection Association (NFPA) codes, OSHA, EPA, and Connecticut DEEP standards.

Carefully read the label before storing a hazardous chemical. The MSDS will provide any special storage information as well as information on incompatibilities. *Do not store unsegregated liquid chemicals in* *alphabetical order. Do not store incompatible chemicals in close proximity to each other.*

1. **General Rules**

* Prior to purchasing or using a chemical, obtain a copy of the Material Safety Data Sheets (MSDS).
* Always purchase the smallest amount necessary to perform the experiment or operation.
* Chemicals used in the laboratory must be appropriate to the laboratory’s ventilation system, engineering controls, and PPE.
* Do not store hazardous chemicals above eye level, especially bottles of corrosive chemicals.
* Segregate chemicals by both hazard class and compatibility.
* Storage of chemicals at the lab bench or other work areas shall only be temporary and kept to a minimum.
* Substances of unknown toxicity shall be assumed to be toxic.
* Store organic acids such as acetic acid and acetic anhydride separated from strong oxidizing agents such as sulfuric acid, nitric acid or perchloric acid.
* Segregate acids and bases and keep in a cabinet designed to store corrosive chemicals.
* Store containers of corrosives chemicals on corrosion-resistant shelves and in secondary containment to capture any spills or leaks.
* Store inorganic hydroxides in polyethylene or polyethylene-lined bottles.
* Always use bottle carriers when transporting corrosive materials.
* Store toxic chemicals, including carcinogens, in ventilated storage areas, in unbreakable chemical-resistant secondary containers. These containers shall be labeled "CAUTION: HIGH CHRONIC TOXICITY OR CANCER-SUSPECT AGENT."
* Separate mineral acids from flammable and combustible materials. Separation is defined by NFPA 49 as storage within the same fire area but separated by as much space as practicable or by intervening storage from incompatible materials. Acid resistant trays shall be placed under bottles of mineral acids.
* Separate acid-sensitive materials such as cyanides and sulfides from acids, or protect from contact with acids.
* Strap or chain compressed gas cylinders to a wall or bench top, and cap when not in use. Do not allow ignition sources in the vicinity of compressed gas cylinders. Maintain the storage area free of combustible debris.
* Do not store flammable materials near oxidizers, reducing agents or combustible materials. Vapors may travel to an ignition source and flash back.
* Manage peroxide-forming chemicals in strict accordance with the requirements described in this Plan.

1. **Chemical Segregation**

Separate hazardous chemicals in storage as follows:

**Solids: - oxidizers**

- flammable solids (phosphorus, magnesium, lithium)

- water reactives

- others

**Liquids: - flammable/combustible**

- inorganic acids

- caustics

- oxidizers

**Gases: - toxic**

- oxidizers

- flammable

* Once separated into the above hazard classes, chemicals may be stored alphabetically.
* Use approved storage containers and safety cans for flammable liquids. It is preferable to store flammable chemicals in flammable storage cabinets.
* No greater than 10 gallons of flammable liquids may be kept outside of rated flammable storage cabinets in any laboratory.
* Flammable chemicals requiring refrigeration should be stored only in the refrigerators and freezers specifically designed for flammable storage.
* Hazardous chemicals should not be stored on bench tops, on the floor, or in hoods. Chemicals should also not be stored under sinks, if possible.
* If separate cabinets are not feasible, chemicals of different chemical classes can be segregated by placing them in trays.
* Do not store corrosive or hazardous liquids above eye level.
* Use secondary containers for highly corrosive or toxic chemicals.
* Avoid exposure of chemicals while in storage to heat sources (especially open flames) and direct sunlight.
* Conduct periodic inventories of chemicals stored in the laboratory and dispose of old or unwanted chemicals promptly in accordance with the OEHS’s hazardous chemical waste program.
* Assure all containers are properly labeled with the identity of the contents and any appropriate hazard warnings.

1. **Chemical Stability**

Stability refers to the susceptibility of a chemical to dangerous decomposition. The label and MSDS will indicate if a chemical is unstable.

***Special note: peroxide formers*** *-* *Ethers, liquid paraffins, and olefins form peroxides on exposure to air and light. Peroxides are extremely sensitive to shock, sparks, or other forms of accidental ignition and can be even more sensitive than primary explosives such as TNT. Since many of these chemicals are packaged in an air atmosphere, peroxides can form even though the containers have not been opened. All containers of ether or other peroxide formers must be dated upon receipt and discarded by the expiration date on the container. If the container does not have an expiration date but the chemical is a peroxide former, the container should be discarded after one (1) year of receipt, even if unopened. See this Plan’s Section on Highly Reactive Chemicals and High Energy Oxidizers for additional information on storage limitations and examples of materials which may form explosive peroxides.*

1. **Incompatible Chemicals**

Certain hazardous chemicals should not be mixed or stored with other chemicals because a severe reaction can take place or an extremely toxic reaction product can result. The label and MSDS will contain information on incompatibilities and should always be consulted. The following table contains examples of incompatible chemicals, but is not a complete list:

**Partial List of Incompatible Chemicals**

|  |  |
| --- | --- |
| **CHEMICAL** | **KEEP OUT OF CONTACT WITH** |
| Acetic Acid | Chromic acid, nitric acid hydroxyl compounds, ethylene, glycol, perchloric acid, peroxides, permanganates |
| Acetone | Concentrated nitric and sulfuric acid mixtures |
| Acetylene | Chlorine, bromine, copper, fluorine, silver, mercury |
| Alkali Metals | Water, carbon tetrachloride or other chlorinated hydrocarbons, carbon  dioxide, the halogens |
| Ammonia, anhydrous | Mercury, chlorine, calcium hypochlorite, iodine, bromine, hydrofluoric  acid |
| Ammonium Nitrate | Acids, metal powders, flammable liquids, chlorates, nitrites,  sulfur, finely divided organic or combustible materials |
| Aniline | Nitric acid, hydrogen peroxide |
| Arsenical materials | Any reducing agent |
| Azides | Acids |
| Bromine | Same as chlorine |
| Calcium Oxide | Water |
| Carbon (activated) | Calcium hypochlorite, all oxidizing agents. |
| Carbon tetrachloride | Sodium |
| Chlorates | Ammonium salts, acids, metal powders, sulfur, finely divided organic or combustible materials |
| Chromic Acid, | Acetic acid, naphthalene, camphor, glycerin, turpentine, alcohol, |
| Chlorine | Ammonia, acetylene, butadiene, butane, methane, propane (or other petroleum gases), hydrogen, sodium carbide, turpentine, benzene, finely divided metals |
| Chlorine Dioxide | Ammonia, methane, phosphine, hydrogen sulfide |
| Copper | Acetylene, hydrogen peroxide |
| Cumene Hydro-peroxide | Acids, organic or inorganic |
| Cyanides | Acids |
| Flammable Liquids | Ammonium nitrate, chromic acid, hydrogen peroxide, nitric acid, sodium |
| Hydrocarbons | Fluorine, chlorine, bromine, chromic acid, sodium peroxide |
| Hydrocyanic Acid | Nitric acid, alkali |
| Hydrofluoric Acid | Ammonia, aqueous or anhydrous |
| Hydrogen Peroxide | Copper, chromium, iron, most metals or their salts, alcohols, acetone, organic materials, aniline, nitromethane, flammable liquids, oxidizing gases |
| Hydrogen Sulfide | Hydrogen Sulfide Fuming nitric acid, oxidizing gases, acetylene, ammonia (aqueous or anhydrous), hydrogen |
| Hypochlorites | Acids, activated carbon |
| Iodine | Acetylene, ammonia (aqueous or anhydrous), hydrogen |
| Mercury | Mercury |
| Nitrates | Sulfuric acid |
| Nitric Acid (concentrated) | Acetic acid, aniline, chormic acid, hydrocyanic acid, hydrogen sulfide, flammable liquids, flammable gases |
| Nitrites | Acids |
| Nitroparaffins | Inorganic bases, amines |
| Oxalic Acid | Silver, mercury |
| Oxygen, solids, or gases | Oils, grease, hydrogen; flammable liquids, solids, or gases |
| Perchloric Acid | Acetic anhydride, bismuth and its alloys, alcohol, paper, wood |
| Peroxides | Acids organic Acids (organic or mineral), avoid friction, store cold |
| Phosphorus (white) | Air, oxygen, alkalies, reducing agents |
| Potassium | Carbon tetrachloride, carbon dioxide, water |
| Potassium Chlorate | Sulfuric and other acids |
| Potassium  Permanganate | Glycerin, ethylene glycol, benzaldehyde, sulfuric acid |
| Selenides | Reducing agents |
| Silver | Acetylene, oxalic acid, tartaric acid, ammonium compounds |
| Sodium | Carbon tetrachloride, carbon dioxide, water |
| Sodium nitrite | Ammonium nitrate and other ammonium salts |
| Sodium Peroxide | Ethyl or methyl alcohol, glacial acetic acid, acetic anhydride,  benzaldehyde, carbon disulfide, glycerin, ethylene glycol, ethyl acetate,  methyl acetate, furfural |
| Sulfides | Acids |
| Sulfuric Acid | Potassium chlorate, potassium perchlorate, potassium permanganate (or compounds with similar light metals, such as sodium, lithium, etc.) |
| Tellurides | Reducing agents |

(Source: Manufacturing Chemists' Association, Guide for Safety in the Chemical Laboratory)

1. **HEALTH AND SAFETY INFORMATION FOR WORK WITH CHEMICALS OF A SPECIFIC HAZARD CLASS**
2. **Flammable Liquids**
3. **General Information**

Flammable liquids are among the most common of the hazardous materials found in laboratories. They are usually highly volatile and their vapors, mixed with air at the appropriate ratio, can ignite and burn. By definition, the lowest temperature at which they can form an ignitable vapor/air mixture (the flash point) is less than 37.8°C (100°F) and for many common laboratory solvents (ether, acetone, toluene, acetaldehyde) the flash point is well below room temperature. As with all solvents, their vapor pressure increases with temperature and, therefore, as temperatures increase they become more hazardous.

For a fire to occur, three distinct conditions must exist simultaneously: (1) the concentration of the vapor must be between the upper and lower flammable limits of the substance (the right fuel/air mix); (2) an oxidizing atmosphere, usually air, must be available; and (3) a source of ignition must be present. Removal of any of these three conditions will prevent the start of a fire. Flammable liquids may form flammable mixtures in either open or closed containers or spaces (such as refrigerators), when leaks or spills occur in the laboratory, and when heated.

Using a chemical fume hood to maintain the concentration of flammable vapors below the lower flammability limit and by removing all sources of ignition is a strategy for preventing ignition of flammable vapors. Ignition sources include open flames, hot surfaces, operation of electrical equipment, and static electricity.

The concentrated vapors of flammable liquids are usually heavier than air and can travel away from a source for a considerable distance (across laboratories, into hallways, down elevator shafts or stairways). If the vapors reach a source of ignition a flame can result that may flash back to the source of the vapor. The danger of fire and explosion presented by flammable liquids can usually be eliminated or minimized by strict observance of safe handling, dispensing, and storing procedures.

1. **Special Handling Procedures for Flammable Liquids**

* While working with flammable liquids, wear gloves, protective glasses or goggles, long sleeved lab coats and closed toe shoes. Wear goggles if dispensing solvents or performing an operation that could result in a splash to the eyes.
* Handle large quantities of flammable liquids in a chemical fume hood or under some other type of local exhaust ventilation, as well as in areas free of ignition sources (including spark emitting motors and equipment) using non-sparking tools. Five-gallon containers must be dispensed to smaller containers in a hood or under local exhaust ventilation. When dispensing flammable solvents into small storage containers, use metal or plastic containers or safety cans (avoid glass containers). If splash risk is high wear a face shield in addition to goggles.
* Free flowing liquids generate static electricity that can produce a spark and ignite the solvent. Make sure that metal surfaces or containers through which flammable substances are flowing are properly grounded, discharging static electricity
* Never heat flammable substances by using an open flame. Instead use any of the following heat sources: steam baths, water baths, oil baths, heating mantles or hot air baths. Do not distill flammable substances under reduced pressure.
* Store flammable substances away from ignition sources. Store flammable liquids inside rated flammable storage cabinets. If a flammable storage cabinet is not available, store these substances in a cabinet under the fume hood or a bench. Five-gallon containers should only be stored in a storage cabinet that is rated for flammables. You can store flammable liquids inside the fume hood for short periods of time. However, storage inside chemical fume hoods is not preferred because it reduces hood performance by obstructing air flow.
* The volume of flammable liquids kept outside of rated flammable cabinets must not exceed 10 gallons at any one time in the laboratory.
* Store oxidizing and corrosive materials away from flammable liquids.
* Flammable liquids must not be stored or chilled in domestic refrigerators and freezers, but in units specifically designed for this purpose. It is acceptable to store or chill flammables in ultra-low temperature units.
* If flammable liquids will be placed in ovens make sure they are appropriately designed for flammable liquids (no internal ignition sources and/or vented mechanically). Make sure the auto-ignition temperature of the solvent is above the oven temperature or its internal elements.

1. **Corrosive Materials**
2. **General Information**

The major classes of corrosive chemicals are strong acids and bases, dehydrating agents, and oxidizing agents. These chemicals can erode the skin and the respiratory epithelium and are particularly damaging

to the eyes. Inhalation of vapors or mists of these substances can cause severe bronchial irritation. If your skin is exposed to a corrosive chemical, flush the exposed area with water for at least fifteen

minutes. Then seek immediate medical treatment.

1. **Strong acids:** All concentrated acids can damage the skin and eyes and their burns are very painful. Nitric, chromic, and hydrofluoric acids are especially damaging because of the types of burns they inflict. Seek immediate medical treatment if you have been contaminated with these materials (particularly hydrofluoric acid).



|  |
| --- |
| **Hydrofluoric Acid Exposure Medical Treatment:** |
| Calcium gluconate gel is an effective treatment for hydrofluoric acid exposure. Every laboratory and location where HF is used or stored should have a tube of calcium gluconate readily available. The OEHS will purchase and distribute this gel free-of-charge to all HF user locations. **Please contact the OEHS if you need this gel, at X 2-7073.**  **In the event of an HF spill to the body:**   * If calcium gluconate is available, immediately flood the affected body area with cool water for a minimum of 5 minutes. * If calcium gluconate is not immediately available, continue rinsing the affected area until emergency medical responders arrive, using copious amounts of water. * Remove contaminated clothing and footwear while rinsing. * Call or have a co-worker call for medical assistance (911 from any campus or cell phone). **Be sure to indicate that you were exposed to hydrofluoric acid**. * Gently rub calcium gluconate ointment onto the affected area and continue applying until emergency medical responders arrive. * Inform responders and all others that the exposure involved hydrogen fluoride/hydrofluoric acid. * **Have an MSDS handy to give to emergency medical staff**. |

1. **Strong alkalis:** The common strong bases used in the labs are potassium hydroxide, sodium hydroxide, and ammonia. Burns from these materials are often less painful than acids. However, damage may be more severe than acid burns because the injured person, feeling little pain, may not take immediate action and allow the material to penetrate into the tissue. Ammonia is a severe bronchial irritant and should always be used in a chemical fume hood.
2. **Dehydrating agents:** This group of chemicals includes concentrated sulfuric acid, sodium hydroxide, phosphorus pentoxide, and calcium oxide. Because much heat is evolved on mixing these substances with water, mixing should always be done by adding the agent to water, and not the reverse, to avoid violent reaction and spattering. Because of their affinity for water, these substances cause severe burns on contact with skin. Rinse affected areas promptly with large volumes of water.
3. **Oxidizing agents:** In addition to their corrosive properties, powerful oxidizing agents such as concentrated hydrogen peroxide (>30%), perchloric and chromic acids (sometimes used as cleaning solutions), present fire and explosion hazards on contact with organic compounds and other oxidizable substances. The hazards associated with the use of perchloric acid are especially severe. It should be handled only after thorough familiarization with recommended operating procedures.
4. **Special Handling Procedures**

* Corrosive chemicals should be used in the chemical fume hood or over plastic trays when handled in bulk quantities (> 1 liter), and when dispensing.
* When working with corrosive chemicals wear gloves, goggles, long sleeved lab coat and closed toe shoes.
* Handling of bulk quantities of these chemicals requires use of rubber aprons and the combined use of face shields and goggles.
* An unobstructed, functioning, eyewash and safety shower must be close by in areas where corrosive chemicals are handled.
* Spill materials - absorbent pillows, neutral absorbent materials or neutralizing materials should also available nearby.
* Store corrosive chemicals in corrosive cabinets. If these cabinets are not available, store them under fume hoods or on low shelves, in impervious trays to separate them physically from other groups of chemicals.
* Keep containers not in use in storage areas and off bench tops.
* Use a chemical carrier whenever moving corrosive chemicals from one to another.

1. **Chemicals of High Acute and Chronic Toxicity**
2. **General Information**

Substances that possess the characteristic of high acute toxicity can cause damage after a single or short-term exposure. The immediate toxic effects to human health range from irritation to illness and death. Hydrogen cyanide, phosgene, and nitrogen dioxide are examples of substances with high acute toxicity. The lethal oral dose for an average human adult for highly toxic substances ranges from one ounce to a few drops.

1. **Special Handling Procedures**

The following procedures should be used when the oral LD50 of a substance in the rat or mouse is less than 50 milligrams per kilogram body weight for solid materials or non-volatile liquids and 500 mg/kg body weight for volatile liquids or gases. You can locate the LD50 data for the rat or mouse in the substance's MSDS. On the MSDS, those chemicals with an oral LD50 <50 mg/kg are identified as “Highly Toxic”, and those with an oral LD50 >50 mg/kg but <500 mg/kg is identified as “Toxic”.

* Avoid or minimize contact with these chemicals by any route of exposure. Protect yourself by wearing properly selected gloves, closed toe shoes and a long sleeved laboratory coat.
* Protect your eyes with goggles or safety glasses. If the procedure involving use of these chemicals has a potential for splashing, consider putting on an impermeable apron or coveralls, and a face shield in addition to goggles.
* Use these chemicals in a chemical fume hood or other appropriate containment device if the material is volatile or the procedure may generate aerosols.
* Store chemicals of high acute or chronic toxicity in a designated storage cabinet in unbreakable primary or secondary containers or placed in chemically resistant trays to contain spills. *Do not store toxic* *chemicals on open shelves or counters.*
* Decontaminate working surfaces with wet paper towels after completing procedures. Place the towels in plastic bags and secure. Dispose of them in the normal trash.
* Transport all chemicals between laboratories in durable outer containers or chemical carriers.
* Protect vacuum pumps from contamination by installing two collection flasks in series along with in-line HEPA-like filter.
* If one or more of these substances are used in larger quantities, on a regular basis (three or more separate handling sessions per week), or for long periods of time (4-6 hours) a qualitative and potentially quantitative exposure assessment should be performed. Contact the OEHS.
* Personnel of childbearing age should be informed of any known male and female reproductive toxins used in the lab. An employee who is pregnant, or planning to become pregnant, and who is working with potential reproductive toxins that might affect the fetus, should contact the Chemical Hygiene Officer in the OEHS to evaluate their exposure. T his employee should also inform his or her personal physician of the particular substance being used, as necessary. The Chemical Hygiene Officer can assess potential exposures and work with the supervisor, if necessary, to adjust work practices to minimize the potential risk.

1. **Regulated and Particularly Hazardous Chemicals**
2. **General Information**

This section establishes supplemental work procedures to control the handling of substances that are known to exhibit unusual acute or long-term chronic health hazards (carcinogens, reproductive toxins and toxic pressurized gases). This set of procedures applies to chemical carcinogens listed and regulated by the Department of Labor, Occupational Safety and Health Administration (OSHA), and of human carcinogens listed by the International Agency for Research on Cancer (IARC) and the National Toxicology Program (NTP). Please note that a key component of these procedures is the controlled distribution of these substances. In some instances special authorization is required before purchasing and using these substances.

1. **Pressurized Gases Requiring OEHS Review & Approval**

|  |  |  |
| --- | --- | --- |
| **Compound** | | |
| Arsine and gaseous derivatives  Chloropicrin in gas mixtures  Cyanogen chloride  Cyanogen  Diborane | Germane  Hexaethyltetraphosphate  Hydrogen cyanide  Hydrogen selenide  Nitric oxide | Nitrogen dioxide  Nitrogen Tetroxide  Phosgene  Phosphine |

All of the highly hazardous compressed gases listed above must be approved for purchase and use by the OEHS. These gases should be stored and used under local exhaust ventilation, either in a ventilated gas cabinet or inside a fume hood. A continuous toxic gas monitoring system may be necessary for laboratories where these gases are used or stored.

The substances listed in Table 1: "Regulated Chemicals & Chemicals with High Chronic Toxicity Requiring Special Procedures" must be stored and handled according to the special procedures outlined below when stored or handled in quantities exceeding the exempt quantities listed. If it is not possible to utilize these procedures the proposed alternative procedures must be reviewed and approved by the OEHS prior to initiating the work. See Protocol Review Section and Appendix A for the approval procedure. If you are using any of these substances in quantities less than the exempt amount, use the procedures outlined in Section “Chemicals of High Acute or Chronic Toxicity”.

**Table 1:** **Regulated Chemicals & Particularly Hazardous Chemicals Requiring Special Procedures**

|  |  |  |
| --- | --- | --- |
| **Compound** | **Exempt Quantity (See Note 1)** | **OSHA Regulated Substance** |
| N-Acetoxy-2-acetylaminofluorene | 2 |  |
| 2-Acetylaminofluorene | 2 | Y |
| Acrylonitrile | 1 | Y |
| Aflatoxins | 2 |  |
| o-Aminoazotoluene | 2 |  |
|  |  |  |
| 4-Aminodiphenyl | 3 | Y |
| 2-Aminofluorene | 2 |  |
| Asbestos | 1 | Y |
| Arsenic and arsenic compounds | 2 | Y |
| Azathiopurine | 2 |  |
|  |  |  |
| Benz[a]anthracene | 2 |  |
| Benzene | 1 | Y |
| Benzidine | 3 | Y |
| Benzo[a]pyrene | 2 |  |
| Bromoethyl methanesulfonate | 2 |  |
|  |  |  |
| 1,4-Butanediol dimethanesulfonate (myleran) | 2 |  |
| Carbon tetrachloride | 1 |  |
| Chlorambucil | 2 |  |
| Chlornaphazine | 2 |  |
| Chloroethylene | 2 |  |
|  |  |  |
| Chloroform | 1 |  |
| N,N-bis(2-chloroethyl)-2-naphthylamine | 2 |  |
| bis-Chloromethyl ether | 3 | Y |
| 1-(2-Chloroethyl)-3-(4-methylcyclohexyl)-1-nitrosourea | 2 |  |
| Cyasin | 2 |  |
|  |  |  |
| Cyclophosphamide | 2 |  |
| Diazomethane | 2 |  |
| Dibenz[a,h]anthracene | 2 |  |
| 1,2-Dibromo-3-chloropropane | 1 | Y |
| 3,3'-Dichlorobenzidine (& its salts) | 3 | Y |
|  |  |  |
| Diepoxybutane | 2 |  |
| 4-Dimethylaminoazobenzene | 2 | Y |
| 7,12-Dimethylbenz[a]anthracene | 2 |  |
| 3,3'-Dimethylbenzidine | 2 |  |
| 1,1-Dimethylethylenimine | 1 |  |
|  |  |  |
| l,l-Dimethylhydrazine | 2 |  |
| 1,2-Dimethylhydrazine | 2 |  |
| 1,4-Dinitrosopiperazine | 2 |  |
| p-Dioxane | 1 |  |
|  |  |  |
| Ethylene dibromide | 1 |  |
| Ethylene glycol monoethyl ether and its acetate | 1 |  |
| Ethyleneimine | 2 | Y |
| Ethyl methanesulfonate | 2 |  |
| Ethionine | 1 |  |
| Ethylenimine | 2 |  |
| 2-Ethoxyethanol | 2 |  |
| 2-Ethoxyethylacetate | 2 |  |
|  |  |  |
| Formaldehyde | 1 | Y |
|  |  |  |
| Formamide | 1 |  |
| Hexavalent chromium and chromium compounds | 1 |  |
| Hydrazine | 2 |  |
| N-Hydroxy-2-acetylaminofluorene | 2 |  |
|  |  |  |
| Lead and lead compounds | 1 | Y |
| 2-Methoxyethanol | 2 |  |
| 2-Methoxyethylacetate | 2 |  |
| 3'-Methyl-4-aminoazobenzene | 1 |  |
| Methyl chloromethyl ether | 3 |  |
| 3-Methylcholanthrene | 2 |  |
| 4,4'-Methylene bis(2-chloroaniline) | 2 |  |
| Methylene chloride | 1 | Y |
| Methylhydrazine | 2 |  |
| Alkyl mercury compounds | 3 |  |
| Methyl methanesulfonate | 2 |  |
| 1-Methyl-3-nitro-1-nitrosoguanidine | 2 |  |
|  |  |  |
| alpha-Naphthylamine | 2 | Y |
| beta-Naphthylamine | 3 | Y |
| Nickel and nickel compounds | 2 |  |
| 4-Nitrobiphenyl | 3 | Y |
| N-[4-(5-nitro-2-furyl)-2-thiazoyl]-formamide | 2 |  |
| 4-Nitroquinoline-1-oxide | 2 |  |
| N-Nitrosodiethylamine | 2 |  |
| N-Nitrosodi-n-butylamine | 2 |  |
| N-Nitrosodi-n-propylamine | 2 |  |
| N-Nitroso-N-ethylurea | 2 |  |
| N-Nitroso-N-ethylurethane | 2 |  |
| N-Nitroso-N-methylurea | 2 |  |
| N-Nitroso-N-methylurethane | 2 |  |
| N-Nitrosopiperidine | 2 |  |
| Polyclorinated biphenyls | 2 |  |
| Procarbazine | 2 |  |
| 1,3-Propane sulfone | 2 |  |
| beta-Propiolactone | 2 | Y |
| Propylenimine | 1 |  |
|  |  |  |
| Thorium dioxide | 2 |  |
| m-Toluenediamine | 2 |  |
| Uracil mustard | 2 |  |
| Urethane | 1 |  |
| Vinyl chloride | 2 | Y |

**Note 1 - The exempt quantities are defined as:**

**Exempt Quantities**

Number For Laboratory Storage For Laboratory Use

1 < 1 liter or 1000 grams < 50 milliliters or 50 grams

2 < 0.1 liter or 100 grams < 5 milliliters or 5 grams

3 None None

1. **Special Handling Procedures**

* Use these chemicals only in a chemical fume hood or other appropriate containment device, such as a glove box. If a chemical fume hood is used it should be evaluated to confirm that it is performing adequately (a face velocity of at least 100 linear feet per minute (±20%) with the sash at the operating height).
* Store volatile chemicals in a vented storage area in an unbreakable, primary or secondary container or placed in a chemically resistant tray to contain spills. Store non-volatile hazardous chemicals in cabinets or in drawers. *Do not store these chemicals on open shelves or counters.* Access to all of these chemicals must be restricted.
* All hazardous chemicals must be transported between laboratories in durable outer containers or chemical carriers
* All procedures with these chemicals must be performed in designated areas. A chemical fume hood can be considered a designated area. Inform other employees working in the area of the particular hazards associated with these substances and the appropriate precautions that are necessary for preventing exposures. Post all designated areas with a sign which reads:

|  |
| --- |
| **WARNING**  **DESIGNATED AREA FOR HANDLING THE FOLLOWING**  **SUBSTANCES WITH HIGH ACUTE OR CHRONIC TOXICITY:**  **[list of substances - identify acute or chronic hazard]**  **[Example: Benzene - carcinogen]**  **AUTHORIZED PERSONNEL ONLY** |

* Protect vacuum pumps used in procedures from contamination by installing two collection flasks in series along with an in-line HEPA like filter.
* Analytical instruments or other laboratory equipment generating vapors and/or aerosols during their operation should be locally exhausted or vented in a chemical fume hood.
* Personal protective equipment to protect skin surfaces, the eyes and mucous membranes must be worn when exposed to these substances.
* Remove all personal protective equipment when leaving the designated area and decontaminate or, if disposable, place in a plastic bag and secure before disposal. Wash skin surfaces - hands, forearms, face and neck - immediately.
* Cover work surfaces on which these substances will be handled with an easily decontaminated surface or protect from contamination with plastic trays or plastic backed paper. Call the OEHS for substance-specific decontamination and disposal procedures. Place materials that will be disposed of in plastic bags and secure.
* Place chemical wastes from procedures using these substances in containers, tag and dispose of them through the hazardous chemical waste program. Store wastes in the designated area until picked up by the OEHS.
* Normal laboratory work should not be conducted in a designated area until it has been decontaminated or determined to be acceptable by the laboratory supervisor or OEHS.

If one or more of these substances are used in large quantities, on a regular basis (three or more separate handling sessions per week), or for long periods of time (4-6 hours) a qualitative and potentially quantitative exposure assessment should be performed. Contact the Chemical Hygiene Officer in the OEHS to perform this assessment. The OEHS in conjunction with the Employee Health Physician will determine if it is appropriate to establish an ongoing medical surveillance program.

1. **Reproductive Toxins**

Health problems that can result from exposure to reproductive hazards include:

• Infertility in women and men

• Miscarriage and stillbirths

• Birth defects

• Low birth weight and premature birth

• Developmental disorders such as hyperactivity and learning disabilities

• Childhood cancer

The link between reproductive hazards and these health problems is not fully understood, so there is no way to predict how a person may be affected by an exposure. Not all exposures lead to reproductive health problems, but potential hazards are known. For example, certain chemicals have been identified as potential reproductive hazards. Prevent reproductive health problems from hazardous materials by taking these precautions:

* Read and follow the instructions on material safety data sheets (MSDSs) for the chemical substances you use.
* Review warning labels on any hazardous substances you handle, and follow instructions.
* Store chemicals in sealed containers when they are not in use, and avoid skin contact when using them.

Radiation is another reproductive hazard affecting both females and males. Workers who could be exposed to ionizing radiation on the job must take these precautions:

* Follow time and distance rules for radiation procedures.
* Enter X-ray rooms only if specifically assigned.
* Wear lead aprons, gloves, and goggles when there is a risk of exposure.
* Wear thyroid shields and leaded glasses as needed.
* Follow all established procedures for handling and storing radioactive materials.
* In addition, pregnant women should avoid any exposure to radiation, including X-rays and radioactive materials.

|  |
| --- |
| ***Note to Personnel of Childbearing Age:*** *All persons of childbearing age must be informed of any known male and female reproductive toxins used in the laboratory. An employee who is pregnant, or planning to become pregnant, and who is working with potential reproductive toxins that might affect the fetus, should contact the OEHS to evaluate their exposure. This employee should also inform her or her personal physician of the particular substance being used, as necessary. The Chemical Hygiene Officer can assess potential exposures and work with the supervisor, if necessary, to adjust work practices to minimize the potential risk.* |

1. **Cryogenic Materials**

Cryogenic liquids are liquids that exist between -66°C and -266°C. The most common cryogens used in the laboratory are liquid nitrogen, liquid helium, and solid carbon dioxide (dry ice), although there are others including liquid oxygen, liquid hydrogen and liquid argon. Table 1 lists the physical properties of common cryogens. By definition, cryogenic liquids have boiling points below minus 130° F (minus 90° C). Common cryogenic liquids of concern include nitrogen (N), helium (He), argon (Ar), hydrogen (H), methane and carbon dioxide (CO2). Table 1 lists the physical properties of common cryogens.

***Table 1. Physical Properties of Common Cryogens***

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | **Boiling Point (K)** | **Liquid to Gas Expansion Ratio** | **Gas Specific Density** | **Critical Temp (K)** | **Critical Pressure (atm)** | **Liquid Density (g/L)** |
| Air | -------- | ---------------- | 1.00 | ---------------- | ---------------- | ---------------- |
| Argon | 87.3 | 860 | 1.39 | 150.9 | 48.3 | 1402 |
| Carbon Dioxide | 194.7 | 790 | 1.70 | 304.2 | 72.8 | 1560 |
| Helium | 4.2 | 780 | 0.14 | 5.2 | 2.2 | 125 |
| Hydrogen | 20.3 | 865 | 0.07 | 33.0 | 12.8 | 71 |
| Nitrogen | 77.3 | 710 | 0.97 | 126.3 | 33.5 | 808 |
| Oxygen | 90.2 | 875 | 1.11 | 154.8 | 50.1 | 1410 |
| R-12 Refigerant | 243.4 | 294 | 4.35 | 385 | 40.6 | 1487 |

Hazards associated with cryogenic fluids include personnel exposure (cold burns, frostbite), material and construction compatibility, high pressure gases, explosions, implosions, toxicity, and asphyxiation.

**General Safety Practices**

**a. Personnel Safety**

* Face shields and goggles shall be worn during the transfer and normal handling of cryogenic fluids.
* Loose fitting, heavy leather, or other insulating protective gloves shall be worn at all times when handling cryogenic fluids. Shirt sleeves shall be rolled down and buttoned over glove cuffs, or an equivalent protection such as a lab coat shall be worn in order to prevent liquid from spraying or spilling inside gloves. Pants without cuffs shall be worn.

1. **Safety Practices**

* Cryogenic fluids must be handled and stored only in containers and systems specifically designed for these products and in accordance with applicable standards, procedures, or proven safe practices.
* Transfer operations involving open cryogenic containers, such as Dewars, must be conducted slowly to minimize boiling and splashing of the cryogenic fluid. Transfer of cryogenic fluids from open containers must occur below chest level of the person pouring liquid. Such operations shall be conducted only in well ventilated areas to prevent the possible gas or vapor accumulation, which may produce an oxygen-deficient atmosphere and lead to asphyxiation.
* Equipment and systems designed for the storage, transfer, and dispensing of cryogenic fluids shall be constructed of materials compatible with the products being handled and the temperatures encountered.
* All cryogenic systems, including piping, must be equipped with pressure-relief devices to prevent excessive pressure build-up. Pressure-reliefs must be directed to a safe location. It should be noted that two closed valves in a line form a closed system. The vacuum insulation jacket should also be protected by an over-pressure device if the service is below 77° Kelvin. In the event a pressure-relief device fails, do not attempt to remove the blockage; instead call the OEHS immediately (203-392-7073/203-619-3858).
* If liquid nitrogen or helium traps are used to remove condensable gas impurities from a vacuum system that may be closed off by valves, the condensed gases will be released when the trap warms up. Adequate means for relieving the resultant build-up of pressure must be provided.
* Avoid contact with cold unprotected pipes and vessels when working with cryogenic liquids**.**
* Wear proper protective equipment:
* Cryogenic gloves must be worn to avoid cold burns. The gloves must be loose fitting so that they can be removed easily.
* Goggles or a face shield must be worn to protect the eyes and face.
* Wear closed-toed shoes and long pants while handling cryogens to protect feet and legs from accidental spills.
* Remove metallic objects (e.g. jewelry) from those parts of the body that may come into contact with the cryogenic liquid.
* To limit the asphyxiation hazard, liquid nitrogen, liquid helium, and other asphyxiants must onlybe handled in wellventilated areas.
* Keep cryogen-use areas free of combustible materials (paper, cardboard, machine oil, etc) and eliminate any sources of ignition.
* When transferring cryogenic liquids, always direct the flow away from others.
* Never enclose cryogenic liquids within a vessel that can build up pressure (has no pressure release mechanism). The expansion of the cryogenic liquid can build sufficient pressure to cause an explosion.

1. **Transport of Cryogenic Liquids** **Including Dry Ice,**

Special precautions must be taken to prevent a spill while transporting cryogens in addition to minimizing exposures from liquids and vapors. The high liquid to vapor expansion ratio could rapidly displace all oxygen in a room and result in asphyxiation. Implement the following procedures to minimize exposures:

* Wear all required personal protective equipment.
* Use no fewer than two personnel to transport cryogenic liquids and use handcarts equipped with brakes for large Dewars and cylinders.
* Never transport an open container of cryogenic liquid, no matter how small.
* Plan the route of transport. The BEST PRACTICE IS TO AVOID USING AN ELEVATOR. In event of an elevator failure or spill, the space may quickly undergo oxygen displacement. If this is not avoidable, send your partner to the receiving floor. Next, load the Dewar. Remain on the sending floor while you send the Dewar to the receiving floor in an empty elevator. After your partner unloads the Dewar, join him/her for the rest of the transport. If the transport by elevator takes place over multiple floors, clearly label the Dewar with a warning to anyone who may want to use the elevator between the sending and receiving floors to wait until the transport process is complete.
* If there is no other option to using an elevator, NEVER accompany large quantities of cryogens in the elevator. If the elevator were to malfunction, the expanding gas could fill the elevator and pose a serious risk of asphyxiation.
  + Attach a sign to the Container that states: “Asphyxiation Hazard”. Place the Container in the elevator with the sign clearly visible, select the floor and close the elevator.
  + Post a sign on the exterior elevator door that reads “Asphyxiation Hazard, DO NOT ENTER ELEVATOR”.
  + Retrieve the material after using a separate route (stairs or another elevator).
* When at all possible, do not hand-carry cryogenic liquids. For larger Dewars use a stable wheeled base designed for the Dewar transport. Check to ensure stability before commencing transport.

1. **Liquid Nitrogen and Helium Filling**

* Leave the door open while attaching fill and vent hoses between the Dewar and the fill station. If the fill sequence is automated, immediately exit the room, and close the door.
* Do not enter the room until the fill operation is complete, and the oxygen monitor indicates there is a safe level of oxygen (>19.5%) in the room. The oxygen sensor will sound an audible alarm if there is insufficient oxygen within the room.
* If the fill sequence is manual, pay close attention to the oxygen sensor. Immediately evacuate the room if the oxygen sensor audible alarm sounds (when oxygen level falls below 19.5%).

1. **Magnet Quenches and Oxygen Sensors**

The greatest chance of a low-oxygen condition occurs during the quench of a magnet. The expansion of nitrogen and helium poses an asphyxiation risk due to the displacement of oxygen. An oxygen monitor is located in room JE 312, which is where the Chemistry Departments, NMR machine is located. The oxygen level should read approximately 20.9% and vary within a few tenths of a percent. The OSHA standard for minimum oxygen content is 19.5%. When the oxygen level drops below 19.5%, a potentially hazardous oxygen-depletion condition exists, and the sensor’s audible alarm sounds. **Upon hearing the sensor alarm, all room occupants must immediately exit.** The alarm will reset (alarm silencing) as the oxygen level is restored.

**In the event of a quench or oxygen sensor alarm:**

* The loud release of gas from the top of the magnet indicates that a quench is occurring. Also, the oxygen sensor’s audible alarm indicates a low oxygen (<19.5%) level.
* **Leave the room immediately and close the doors.**
* Post signs on the doors stating –MAGNET QUENCH and/or LOW OXYGEN DO NOT ENTER.
* Re-assess the oxygen level after some time has passed, and assure it is restored to normal (20.9%) before re-entering the room.

1. **Compressed Gas Safety for Cryogenic Liquids**

* Most cylinders are made of steel, and because of their size, can be violently attracted to the magnets. Gas cylinders and gas carts should be kept out of the 5 Gauss lines of the magnets at all times. Also, use extreme caution when changing cylinder regulators with ferromagnetic wrenches. Do not bring ferromagnetic wrenches within the 5 Gauss line for this purpose.
* Cylinders must be stored in upright positions and immobilized by non-combustible restraints (chains) to prevent being knocked over.
* Cylinder valve caps must be in place when not in use.
* Cylinders must be moved only by a suitable hand truck.
* A gas regulator must be attached and in good working order before use.
* During use make sure that there are no leaks at the regulator. After use, make sure that the main valve is closed tightly and that there are no leaks.

1. **Other potential hazards**

* **Fire:** Pull the nearest fire alarm and exit the building. *Do not try to fight the fire!* In the event of smoke or fire in a console, turn off the unit by pressing the emergency-shutoff switch on the console.
* **Floods, ceiling water leaks:** Floods and ceiling water leaks can present a danger of electric shock to the operator if the floor or electronics becomes wet. Immediately press the emergency-off switch on the console.
* **Electric shock:** Consoles contain amplifiers and other electronic equipment that operate at high voltage (120 V and 208 V). They pose a hazard of RF burns and electrocution. Do not reach inside electronics consoles. If you receive any kind of electrical shock, seek medical attention immediately (call 911). Even minor shocks can cause injuries that are not immediately apparent.
* **Obstacles:** Tripping hazards exist in NMR rooms due to cabling between the magnet and consoles. Be careful when moving around in the lab.

1. **Compressed Gas Cylinder Safety**
2. **General Information**

Compressed gases present both a physical and a potential chemical hazard, depending on the particular gas. Gases contained in cylinders may be from any of the hazard classes described in this section (flammable, reactive, corrosive, or toxic). Because of their physical state (gaseous), concentrations in the laboratory can increase instantaneously if leaks develop at the regulator or piping systems, creating the potential for a toxic chemical exposure or a fire/explosion hazard. Even inert gases such as nitrogen or argon can displace room oxygen if accidentally released. Often there is little or no indication that leaks have occurred or are occurring. Finally, the large amount of potential energy resulting from compression of the gas makes a compressed gas cylinder a potential rocket or fragmentation bomb if the tank or valve is physically broken.

1. **Special Handling Procedures**

* The contents of any compressed gas cylinder must be clearly identified.
* Never accept a cylinder that does not legibly identify its contents by name. Color coding is not a reliable means of identification, and labels on caps have no value as caps are interchangeable.
* All gas cylinders must be clearly marked with appropriate tags indicating whether they are “in use”, “full”, or “empty”.
* Do not store empty and full cylinders in the same place.
* All cylinders, including empty ones, must be stored securely with the regulator removed and valve

protection cap in place. Use suitable racks, straps, chains or stands to support cylinders, and keep them away from heat sources. Store as few cylinders as possible in your laboratory.

* Carefully read the label before using or storing compressed gas. The MSDS will provide any special hazard information.
* Transport gas cylinders in carts one or two at a time only while they are secured and capped. Do not move gas cylinders by rolling them.
* All gas lines leading from a remote compressed gas supply must be clearly labeled identifying the gas and the laboratory served.
* Place gas cylinders in such a way that the cylinder valve is accessible at all times. The main cylinder valve should be closed as soon as the gas flow is no longer needed.
* Do not store gas cylinders with pressure on the regulator. Use the wrenches or other tools provided by the cylinder supplier to open a valve if necessary. Pliers should not be used to open a cylinder valve or attach a regulator or pigtail.
* Use a leak check solution to detect leaks. Leak test the regulator, pigtail connections, and any piping system after performing maintenance or modifications which could affect the integrity of the system.
* Always use a leak check solution that is approved for oxygen whenever leak checking oxygen or nitrous oxide cylinders.
* Oil or grease on the high pressure side of an oxygen cylinder can cause an explosion. Do not lubricate an oxygen regulator.
* Cylinders of toxic, flammable or reactive gases should be purchased in the smallest quantity possible and stored/used in a ventilated gas cylinder storage cabinet, fume hood or under local exhaust ventilation.
* Use the smallest returnable sized cylinder.
* In general, avoid the purchase of lecture bottles. These cylinders are not returnable and it is difficult and costly to dispose of them. Small refillable cylinders may be an available alternative. Any purchase of lecture bottles must be approved by the OEHS.
* Wear safety goggles, gloves, long sleeved lab coat and closed toe shoes when handling compressed gases.
* Keep regulators in a bag and safe from damage when not in use. Do not use any regulator that appears damaged, dirty, or in otherwise questionable condition. Regulators greater than 10 years old should be not be used unless they have been tested and certified.
* Use only Compressed Gas Association standard combinations of valves and fittings for compressed gas installations. Never use a regulator adaptor. The CGA number should be visible on all regulators. Do not use any regulator that does not have a CGA number marking. The following table lists the CGA connections for gases commonly used in laboratories. A complete list of gases and their corresponding CGA numbers is available from your gas supplier and from OEHS.

**Compressed Gas Association Standard Combinations of Valves and Fittings**

|  |  |  |  |
| --- | --- | --- | --- |
| **Compressed Gas** | **CGA Number** | **Compressed Gas** | **CGA Number** |
| Argon | 580 | Freon | 660 |
| Carbon Dioxide | 320 | Helium | 580 |
| Carbon Monoxide | 350 | Hydrogen | 350 |
| Chlorine | 660 | Hydrogen Chloride | 330 |
| Ethane | 350 | Nitrogen | 580 |
| Ethylene | 350 | Oxygen | 540 |

1. **Special Precautions for Hydrogen**

Hydrogen gas has several unique properties that make it a potential danger with which to work. It is extremely flammable and should be treated with extreme caution. It has an extremely wide flammability range (Lower Explosive Limit (LEL) 4%, Upper Explosive Limit (UEL) 74.5%) making it easier to ignite than most other flammable gases. Unlike most other gases, hydrogen's temperature increases during expansion. If a cylinder valve is opened too quickly the static charge generated by the escaping gas may cause it to ignite.

Hydrogen burns with an invisible flame. Caution should therefore be exercised when approaching a suspected hydrogen flame. A piece of paper can be used to tell if the hydrogen is burning. Hydrogen embrittlement can weaken carbon steel, therefore cast iron pipes and fittings must not be used. Seamless tubes should be used. Those precautions associated with other flammable substances identified above also apply to Hydrogen.

Areas of use should be restricted, clearly marked and well ventilated. No naked flames, electrical ignition sources, sources of static electricity, or potentially combustible materials should be allowed within the restricted area as any of these could result in an explosion if gas has escaped.

1. **HIGHLY REACTIVE CHEMICALS & HIGH ENERGY OXIDIZERS**
2. **General Information**

Highly reactive chemicals include those which are inherently unstable and susceptible to rapid decomposition as well as chemicals which, under specific conditions, can react alone or with other substances in a violent uncontrolled manner, liberating heat, toxic gases, or leading to an explosion. Reaction rates almost always increase dramatically as the temperature increases. Therefore, if heat evolved from a reaction is not dissipated, the reaction can accelerate out of control and possibly result in injuries or costly accidents.

Air, light, heat, mechanical shock (when struck, vibrated or otherwise agitated), water, and certain catalysts can cause decomposition of some highly reactive chemicals, and initiate an explosive reaction.

Hydrogen and chlorine react explosively in the presence of light. Alkali metals, such as sodium, potassium and lithium, react violently with water liberating hydrogen gas. Examples of shock sensitive materials include acetylides, azides, organic nitrates, nitro compounds, and many peroxides.

1. **Organic peroxides** are a special class of compounds that have unusual stability problems, making them among the most hazardous substances normally handled in the laboratories. As a class, organic peroxides are low powered explosives. Organic peroxides are extremely sensitive to light, heat, shock, sparks, and other forms of accidental ignition; as well as to strong oxidizing and reducing materials. All organic peroxides are highly flammable.
2. **Peroxide formers** can form peroxides during storage and especially after exposure to the air (once opened). Peroxide forming substances include: aldehydes, ethers (especially cyclic ether), compounds containing benzylic hydrogen atoms, compounds containing the allylic structure (including most alkenes), vinyl and vinylidine compounds.
3. **Special Handling Procedures**

* Before working with a highly reactive material or high energy oxidizer, review available reference literature to obtain specific safety information. Always minimize the amount of material involved in the experiment; the smallest amount sufficient to achieve the desired result should be used. Scale-ups should be handled with extreme care, giving consideration to the reaction vessel size and cooling, heating, stirring, and equilibration rates.
* Excessive amounts of highly reactive compounds should not be purchased, synthesized, or stored in the laboratories or storage areas. The key to safely handling reactive chemicals is to keep them isolated from the substances that initiate their violent reactions. Discard unused peroxides as hazardous waste and do not return to the original container.
* Do not work alone. All operations where highly reactive and explosive chemicals are used should be performed during the normal work day or when other employees are available either in the same laboratory or in the immediate area.
* Perform all manipulations of highly reactive or high energy oxidizers in a chemical fume hood. (Some factors to be considered in judging the adequacy of the hood include its size in relation to the reaction and required equipment, the ability to fully close the sash, and the composition of the sash.)
* Make sure that the reaction equipment is properly secured. Support reaction vessels from beneath with tripods or lab jacks. Use shields or guards which are clamped or secured.
* If possible, use remote controls for controlling the reaction (including cooling, heating and stirring controls). These should be located either outside the hood or at least outside the shield.
* Handle shock sensitive substances gently. Avoid friction, grinding, and all forms of impact. Do not use glass containers that have screw-cap lids or glass stoppers. Polyethylene bottles that have screw-cap lids may be used. Handle water-sensitive compounds away from water sources.
* Light-sensitive chemicals should be used in light-tight containers. Handle highly reactive chemicals away from the direct light, open flames, and other sources of heat. Oxidizing agents should only be heated with fiberglass heating mantles or sand baths.
* High energy oxidizers, such as perchloric acid, must only be handled in a wash down hood if the oxidizer will volatilize and potentially condense in the ventilation system. Inorganic oxidizers such as perchloric acid can react violently with most organic materials. Work with large volumes of perchloric

acid can only be done in a specially designed perchloric acid wash down hood. Notify the OEHS if you are planning on heating perchloric acid or using large volumes.

* When working with highly reactive compounds and high energy oxidizers always wear the following personal protection equipment: long sleeved lab coats, gloves, closed toe shoes and protective glasses/goggles. During the reaction, a face shield long enough to give throat protection should be worn.
* A face shield or body shield should be worn in addition to protective eyewear based on the scale of the reaction.
* Labels on peroxide forming substances must contain the date the container was received, first opened and the initials of the person who first opened the container. These containers must be checked for the presence of peroxides before using, and quarterly while in storage. If peroxides are found, the materials should be disposed of by way of the University’s Hazardous Waste Management Plan. Place the results of any testing on the container label. Never distill substances contaminated with peroxides. Peroxide forming substances that have been opened for more than one year must be discarded.
* ***Never use a metal* *spatula with peroxides. Contamination by metals can lead to explosive decompositions****.*
* Store highly reactive chemicals and high-energy oxidizers in closed cabinets segregated from the materials with which they react, inside secondary containment. You can also store them in the cabinet under a hood. Do not store these substances above eye level or on open shelves.
* Store peroxides and peroxide forming compounds at the lowest possible temperature. If you use a refrigerator for storage, make sure it is appropriately designed for the storage of flammable substances.
* Shock sensitive materials must be discarded after one year if in a sealed container and within six months of opening unless an inhibitor was added by the manufacturer.

Refer to Appendix H for procedures for detecting and removing peroxide contamination.

1. **List of Shock Sensitive Chemicals**

Shock sensitive refers to the susceptibility of the chemical to decompose rapidly or explode when struck, vibrated or otherwise agitated. The following are examples of materials that can be shock sensitive:

* Acetylides of heavy metals
* Aluminum ophrite explosive
* Amatol
* Ammonal
* Ammonium nitrate
* Ammonium perchlorate
* Ammonium picrate
* Ammonium salt lattice
* Butyl tetryl
* Calcium nitrate
* Copper acetylide
* Cyanuric triazide
* Cyclotrimethylenetrinitramine
* Cyclotetramethylenetranitramine
* Dinitroethyleneurea
* Dinitroglycerine
* Dinitrophenol
* Dinitrophenolates
* Dinitrophenyl hydrazine
* Dinitrotoluene
* Dipicryl sulfone
* Dipicrylamine
* Erythritol tetranitrate
* Fulminate of mercury
* Fulminate of silver
* Fulminating gold
* Fulminating mercury
* Fulminating platinum
* Fulminating silver
* Gelatinized nitrocellulose
* Germane
* Guanyl nitrosamino guanyl-tetrazene
* Guanyl nitrosaminoguanylidene
* hydrazine
* Heavy metal azides
* Hexanite
* Hexanitrodiphenylamine
* Hexanitrostilbene
* Hexogen
* Hydrazinium nitrate
* Hyrazoic acid
* Lead azide
* Lead mannite
* Lead mononitroresorcinate
* Lead picrate
* Lead salts
* Lead styphnate
* Trimethylolethane
* Magnesium ophorite
* Mannitol hexanitrate
* Mercury oxalate
* Mercury tartrate
* Mononitrotoluene
* Nitrated carbohydrate
* Nitrated glucoside
* Nitrated polyhydric alcohol
* Nitrogen trichloride
* Nitrogen tri-iodide
* Nitroglycerin
* Nitroglycide
* Nitroglycol
* Nitroguanidine
* Nitroparaffins
* Nitronium perchlorate
* Nitrourea
* Organic amine nitrates
* Organic nitramines
* Organic peroxides
* Picramic acid
* Picramide
* Picratol
* Picric acid
* Picryl chloride
* Picryl fluoride
* Polynitro aliphatic
* compounds
* Potassium
* nitroaminotetrazole
* Silver acetylide
* Silver azide
* Silver styphnate
* Silver tetrazene
* Sodatol
* Sodium amatol
* Sodium dinitro-orthocresolate
* Sodium nitrate-potassium
* Sodium picramate
* Styphnic acid
* Tetrazene
* Tetranitrocarbazole
* Tetrytol
* Trimonite
* Trinitroanisole
* Trinitrobenzene
* Trinitrobenzoic acid
* Trinitrocresol
* Trinitro-meta-cresol
* Trinitronaphtalene
* Trinitrophenetol
* Trinitrophloroglucinol
* Trinitroresorcinol
* Tritonal
* Urea nitrate

1. **List of High Energy Oxidizers**

The following are examples of materials which are powerful oxidizing reagents:

* Ammonium perchlorate
* Ammonium permanganate
* Barium peroxide
* Bromine
* Calcium chlorate
* Calcium hypochlorite
* Chlorine trifluoride
* Chromium anhydride or
* chromic acid
* Dibenzoyl peroxide
* Fluorine
* Hydrogen peroxide
* Magnesium perchlorate
* Nitric acid
* Nitrogen peroxide
* Perchloric acid
* Potassiumbromate
* Potassium chlorate
* Potassium perchlorate
* Potassium peroxide
* Propyl nitrate
* Sodium chlorate
* Sodium chlorite
* Sodium perchlorate
* Sodium Peroxide

**List of Peroxide Formers:** The following are examples of the materials commonly used in laboratories that may form explosive Peroxides. **Note that Class III peroxide formers must be used within 3 months of receipt.** **NOTE: This table is not all inclusive.**

|  |  |  |
| --- | --- | --- |
| **Class I**  Unsaturated materials, especially those of low molecular weight, that may polymerize violently and  hazardously due to peroxide  initiation. | **Class II**  Chemicals which are a peroxide hazard upon concentration  (distillation/evaporation). | **Class III**  Peroxides derived from the  following compounds may  explode without concentration. |
| Acrylic acid | Acetal | Divinyl ether |
| Acrylonitrile | Cumene | Divinyl acetylene |
| Butadiene | Cyclohexene | Isopropyl Ether |
| Chlorobutadiene (chloroprene) | Cyclooctene | Vinylidene |
| Methyl methacrylate | Cyclopentene | Potassium metal |
| Styrene | Diacetylene | Potassium amide |
| Tetrafluoroethylene | Dicyclopentadiene | Sodium amide (sodamide) |
| Vinyl acetate | Ditheylene glycol dimethyl ether(diglyme) |  |
| Vinyl acetylene | Diethyl ethere |  |
| Vinyl choride | Dioxane (p-dioxane) |  |
| Vinyl pryidine | Ethylene glycol dimethyl ether (glyme) |  |
| Vinylidene chloride | Furan |  |
|  | Methyl acetylene |  |
|  | Methyl cylcopentane |  |
|  | Methyl-i-butyl ketone |  |
|  | Tetrahydrofuran |  |
|  | Tetrahydronaphtalene |  |
|  | Vinyl ethers |  |
| **Recommended Maximum Storage Time: 12 months** | **Recommended Maximum Storage Time: 12 months** | **Recommended Maximum Storage Time: 3 months** |

1. **CHEMICAL TOXICOLOGY OVERVIEW**

**Toxicology** is the study of the nature and action of poisons.

**Toxicity** is the ability of a chemical substance or compound to produce injury once it reaches a susceptible site in, or on, the body.

A material's **hazard potential** is the probability that injury will occur after consideration of the conditions under which the substance is used.

1. **Dose-Response Relationships**

The potential toxicity (harmful action) inherent in a substance is exhibited only when that substance comes in contact with a living biological system. The potential toxic effect increases as the exposure increases. All chemicals will exhibit a toxic effect given a large enough dose. The toxic potency of a chemical is thus ultimately defined by the dose (the amount) of the chemical that will produce a specific response in a specific biological system.

1. **Routes of Entry into the Body**

There are three main routes by which hazardous chemicals enter the body:

1. Absorption through the **respiratory tract** via inhalation.
2. Absorption through the **skin** via dermal contact.
3. Absorption through the **digestive tract** via ingestion. (Ingestion can occur through eating or smoking with contaminated hands or in contaminated work areas.)

Most exposure standards, such as the Threshold Limit Values (**TLVs**) and Permissible Exposure Limits

(**PELs**), are based on the inhalation route of exposure. These limits are normally expressed in terms of either parts per million (ppm) or milligrams per cubic meter (mg/m3) concentration in air. If a significant route of exposure for a substance is through skin contact, the MSDS, PEL and/or TLV will have a "skin" notation. Examples of substances where skin absorption may be a significant factor include: pesticides, carbon disulfide, carbon tetrachloride, dioxane, mercury, thallium compounds, xylene and hydrogen cyanide.

1. **Types of Effects**

* **Acute poisoning** is characterized by sudden and severe exposure and rapid absorption of the substance. Normally, a single large exposure is involved. Adverse health effects are often reversible. Examples: carbon monoxide or cyanide poisoning.
* **Chronic poisoning** is characterized by prolonged or repeated exposures of a duration measured in days, months or years. Symptoms may not be immediately apparent. Health effects are often irreversible. Examples: lead or mercury poisoning.
* A **Local** effect refers to an adverse health effect that 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.
* **Systemic** effect refers to an adverse health effect that takes place at a location distant from the body's initial point of contact and presupposes absorption has taken place. Examples: arsenic affects the blood, nervous system, liver, kidneys and skin; benzene affects bone marrow.
* **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. Example: heavy metals.
* **Substances in combination:** When two or more hazardous materials are present at the same time, the resulting effect can be greater than the effect predicted based on the additive effect of the individual substances. This is called a **synergistic** or **potentiating effect.** Example: exposure to alcohol and chlorinated solvents; or smoking and asbestos.

1. **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 exposure*** can lead to tolerance, increased sensitivity or make no difference.
* ***State of health, physical condition and life style*** can affect the toxic response.
* ***Pre-existing disease*** can result in increased sensitivity.
* ***Environmental factors*** such as temperature and pressure.
* Host factors including ***genetic predisposition*** and the ***sex*** of the exposed individual.

1. **Physical Classifications**

* **Gas** applies to a substance which is in the gaseous state at room temperature and pressure.
* A **Vapor** is the gaseous phase of a material which is ordinarily a solid or a liquid at room temperature and pressure.
* When considering the toxicity of gases and vapors, the solubility of the substance is a key factor. Highly soluble materials, like ammonia, irritate the upper respiratory tract. On the other hand, relatively insoluble materials, like nitrogen dioxide, penetrate deep into the lung. Fat soluble materials, like pesticides, tend to have longer residence times in the body and be cumulative poisons.
* An **aerosol** is composed of solid or liquid particles of microscopic size dispersed in a gaseous medium. The toxic potential of an aerosol is only partially described by its airborne concentration. For a proper assessment of the toxic hazard, the size of the aerosol's particles must be determined. A particle's size will determine if a particle will be deposited within the respiratory system and the location of deposition. Particles above 10 micrometers tend to deposit in the nose and other areas of the upper respiratory tract. Below 10 micrometers particles enter and are deposited in the lung. Very small particles (<0.2 micrometers) are generally not deposited but exhaled.

1. **Physiological Classifications**

* **Irritants** are materials that cause inflammation of mucous membranes with which they come in contact. Inflammation of tissue results from exposure to concentrations far below those needed to cause corrosion. Irritants can also cause changes in the mechanics of respiration and lung function. 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 far in excess of any systemic toxic action. Example: dilute hydrogen chloride.
* A **secondary irritant's** effect on mucous membranes is overshadowed by a systemic effect resulting from absorption. Examples: Hydrogen sulfide, Aromatic hydrocarbons.
* **Asphyxiants** have the ability to deprive tissue of oxygen.
* **Simple asphyxiants** are inert gases that displace oxygen. Examples: Nitrogen, Helium, Carbon dioxide.
* **Chemical asphyxiants** reduce the body’s ability to absorb, transport, or utilize inhaled oxygen. They are often active at very low concentrations (a few ppm). Examples: Carbon monoxide, Cyanides.
* **Primary anesthetics** have a depressant effect upon the central nervous system, particularly the brain. Examples: Halogenated hydrocarbons, Alcohols.
* **Hepatotoxic agents** cause damage to the liver. Examples: Carbon tetrachloride, Tetrachloroethane, Nitrosamines.
* **Nephrotoxic agents** damage the kidneys. Examples: Halogenated hydrocarbons, Uranium compounds.
* **Neurotoxic agents** damage the nervous system. The nervous system is especially sensitive to organometallic compounds and certain sulfide compounds. Examples include:
  + Trialkyl tin compounds
  + Tetraethyl lead
  + Methyl mercury
  + Carbon disulfide

- Organic phosphorus insecticides

- Thallium

- Manganese

Some toxic agents act on the **blood** or **hematopoietic system.** The blood cells can be affected directly or the bone marrow (which produces the blood cells) can be damaged. Examples: 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.** Examples: Coal dust, Cotton dust, Wood dust.

A **carcinogen** is an agent that can initiate or increase the proliferation of malignant neoplastic cells or the development of malignant or potentially malignant tumors. A chemical is considered a **carcinogen** or **potential carcinogen** if it is listed in any of the following publications:

* National Toxicology Program, Annual Report on Carcinogens (latest edition) – listed under the

category of “known to be carcinogens”

* International Agency for Research on Cancer, Monographs (latest edition) – listed as either

Group 1, Group 2A or Group 2B

* Regulated by OSHA as a carcinogen under 29 CFR 1910 Subpart Z, Toxic and Hazardous

Substances

**Known human carcinogens include:**

- Asbestos - 4-nitrobiphenyl

- Alpha-napthylamine - Methyl chloromethyl ether

- 3,3'-Dichlorobenzidine - Bis-chloromethyl ether

- Vinyl chloride - Inorganic arsenic

- Ethylene oxide - 1,2-Dibromo-3-chloropropane (DBCP)

- N-nitrosodimethylamine - Coal tar pitch volatiles

A **mutagen** causes heritable changes (mutations) in the genetic material (DNA) of exposed cells. If germ cells are involved, the effect may be inherited and become part of the genetic pool passed onto future generations.

A **teratogen** (embryotoxic or fetotoxic agent) is an agent which interferes with normal embryonic development without causing a lethal effect to the fetus or damage to the mother. Effects are not

inherited. Examples: Lead, Thalidomide.

A **sensitizer** is a chemical which can cause an allergic reaction in normal tissue after repeated exposure to the chemical. The reaction may be as mild as a rash (allergic dermatitis) or as serious as anaphylactic shock. Examples: Epoxy compounds, Toluene diisocyanate, Nickel compounds, Chromium compounds, Poison ivy, Formaldehyde, d-Limonene.

1. **Target Organ Effects**

The following is a categorization of some target organ effects which may occur from chemical exposure. Signs and symptoms of these effects and examples of chemicals which have been found to cause such effects are listed.

|  |  |  |  |
| --- | --- | --- | --- |
| **Toxins** | **Target organ effect** | **Signs and symptoms** | **Example chemicals** |
| Hepatotoxins | Cause liver damage | Jaundice; liver enlargement | Nitrosamines, chloroform, toluene, perchloro-ethylene, cresol, dimethylsulfate |
| Nephrotoxins | Cause kidney damage | Edema; proteinuria | Halogenated hydrocarbons, uranium, chloroform, mercury, dimethylsulfate |
| Neurotoxins | Affect the nervous  system | Narcosis; behavior  changes; decreased  muscle coordination | Mercury, carbon disulfide, benzene, carbon tetrachloride, lead, mercury, nitrobenzene |
| Hematopoietic  toxins | Decrease blood  function | Cyanosis; loss of  consicousness | Carbon monoxide, cyanides,  nitro-benzene, aniline, arsenic, benzene, toluene |
| Pulmonary  toxins | Irritate or damage the  lungs | Cough; tightness in  chest, shortness of  breath | Silica, asbestos, ozone, hydrogen sulfide,  chromium, nickel, alcohols |
| Reproductive  toxins | Affect the  reproductive system | Birth defects; sterility | Lead, 2-ethoxyethanol, dibromodichloropropane |
| Skin hazards | Affect the dermal layer of the body | Defatting of skin; rashes; irritation | Ketones, Ketones, chlorinated compounds, alcohols,  nickel, phenol, trichloroethylene |
| Eye hazards | Affect the eye or  vision | damage | Organic solvents, acids, cresol, quinone, hydroquinone, benzol, chloride, butyl  alcohol, methanol, bases |

1. **OCCUPATIONAL HEALTH STANDARDS**

**TLV:** The **threshold limit value** is a recommended occupational exposure guideline published by the American Conference of Governmental Industrial Hygienists (ACGIH). TLVs are expressed as parts of vapor or gas per million parts of air by volume (ppm) or as approximate milligrams of particulate per cubic meter of air (mg/M3). The TLV is the average concentration of a chemical that most people can be exposed to for a working lifetime with no ill effects. The TLV is an advisory guideline. If applicable, a **ceiling** **concentration (C)** that should not be exceeded or a **skin** absorption notation (S) will be indicated with the TLV.

**PEL:** The **permissible exposure limit** is a legal standard issued by OSHA. Unless specified, the PEL is

a time weighted average **(TWA)**. **TWA:** Most exposure standards are based on **time weighted averages**. The TWA is the average exposure over an eight (8) hour work day. Some substances have short term exposure limits (STELs). These levels are time weighted over a 15 minute period, and exposures should not exceed the STEL in any 15 minute period over the course of an 8 hour work day. Some substances have Ceiling (C) limits. Ceiling limits are concentrations that should never be exceeded.

The MSDS will list the occupational health standard(s) for the hazardous chemical or each component of

a mixture. If you would like to conduct a more thorough review of a particular compound, contact the OEHS.

1. **PERSONAL CONTAMINATION AND INJURY**
2. **Chemical Exposures on the Body or to the Eyes or Mucous Membranes:**
3. **General Information**

* Know the locations of the nearest safety shower and eye wash fountain.
* Get medical attention promptly, even after rinsing the exposed area(s), by dialing 911. Obtain the MSDS for the chemical that came into contact with the exposed person.
* Do not move an injured person unless they are in further danger (from inhalation or skin exposure).
* Cover the person with a blanket, jacket, etc. to protect the victim from shock and exposure.
* Report all incidents and injuries to your supervisor and the OEHS.
* Remove all contaminated clothing and footwear.
* Immediately flood the exposed area with cold water for at least 15 minutes. Use the emergency shower or eyewash station.
* Remove jewelry as it may be contaminated.
* Do not use neutralizing chemicals, creams, etc. to wash off chemicals from the body. USE WATER.

1. **Chemical Splash in the Eye(s):**

Use eyewash to irrigate the eyeball and inner surface of eyelid with plenty of water for at least 15 minutes. Forcibly hold eyelids open to ensure effective wash.

* Check for and remove contact lenses.
* Get medical attention promptly.

1. **Chemicals Spills on the Body:**

* Quickly remove all contaminated clothing and footwear.
* Get to a safety shower and immediately flood the affected body area for at least 15 minutes. Remove jewelry to facilitate removal of any residual material.
* Yell for assistance as soon as incident occurs.
* Do not hesitate, and get prompt medical attention. Dial 911 from any University phone, or ask someone nearby to call. Be sure to indicate specifically what chemical was involved and have an MSDS available.
* It should be noted that some chemicals (eg. phenol, aniline) are rapidly adsorbed through the skin. If a large enough area of skin is contaminated an adverse health effect (systemic toxicological reaction) may occur immediately to several hours after initial exposure depending on the chemical.

1. **Ingestion of Hazardous Chemicals:**

* Identify the chemical ingested.
* Call 911 for an ambulance.
* Cover the injured person to prevent shock.
* Provide the ambulance crew and physician with the chemical name and any other relevant information. If possible, send the MSDS or container the label with the victim.

1. **Inhalation of Smoke, Vapors and Fumes:**

* Anyone overcome with smoke or chemical vapors or fumes should be removed to uncontaminated air as soon as possible.
* Do not enter the area if you expect that a life threatening condition still exists -oxygen depletion,

explosive vapors or highly toxic gases (cyanide gas, hydrogen sulfide, nitrogen oxides, carbon

monoxide)

* If CPR certified, follow standard CPR protocols.
* Get immediate medical attention.

1. **CHEMICAL SPILLS**

Promptly clean up spills, using appropriate protective apparel and equipment and disposal methods, per University Policy

on Spills and Exposures, Appendix E.

1. **Cleaning Up Chemical Spills**

If you are cleaning up a small spill yourself, make sure that you are aware of the hazards associated with the materials spilled, have adequate ventilation (open windows, chemical fume hood on) and are wearing proper personal protective equipment (minimum - gloves, goggles, and lab coat). Consider all residual chemical and cleanup materials (adsorbent, gloves, etc.) as hazardous waste. Place these materials in sealed containers (plastic bags), label, and store in a satellite accumulation area for hazardous waste.. Contact the OEHS for disposal instructions and pickup.

1. **Minor Chemical Spill**

* Alert people in the immediate area of spill.
* Increase ventilation in the area of spill (open windows, turn on hoods).
* Wear protective equipment, including safety goggles, gloves, long-sleeve lab coat and closed toe shoes.
* Avoid breathing vapors from spill.
* Use the appropriate kit to neutralize and absorb inorganic acids and bases. Collect residue and place in a container. Dispose of spilled material and associated clean up materials as hazardous chemical waste. Call the OEHS for disposal information, if necessary.
* For other chemicals, use appropriate kit or absorb spill with vermiculite, dry sand, diatomaceous

Earth, spill pads, or paper towels. Collect residue, place in container, and dispose as chemical waste.

* Clean the spill area with water.

1. **Major Chemical Spill**

* Attend to injured or contaminated persons and remove them from exposure, while not exposing yourself to the chemical. Put on PPE before coming into contact with an exposed person.
* Alert people in the laboratory to evacuate.
* If spilled material is flammable, turn off ignition and heat sources. Place spill cleanup material over the spill to keep substance from volatilizing.
* Call the OEHS Emergency Coordinator at 203-392-7073/203-619-3858 during normal working hours. Call University Police at 203-392-5375 at all other times.
* Close doors to the affected area.
* Have a person with knowledge of the incident and laboratory available to answer questions from responding emergency personnel.

1. **Mercury Spills**

* Mercury spill kits are available from the OEHS. Contact the OEHS if you require one.
* Immediately contact the OEHS (2-7073) regarding the spill.
* Do **not** use a domestic or commercial vacuum cleaner.
* Use a disposable pipette to pick up mercury droplets.
* Cover small droplets in inaccessible areas with powdered sulfur or zinc.
* Place residue in a labeled container and call the OEHS for disposal information.
* For a spill that exceeds the quantity found in a normal laboratory thermometer, the OEHS will call a hazardous waste spill response company.

1. **Alkali Metal Spills**

* Smother with powdered graphite, sodium or calcium carbonate or "Met-L-X", call for assistance.

1. **White Phosphorus**

* Smother with wet sand or wet "noncombustible" absorbent, call for assistance.

1. **FIRE AND FIRE RELATED EMERGENCIES**

If you discover a fire or fire-related emergency such as abnormal heating of material, a flammable gas leak, a flammable liquid spill, smoke, or odor of burning, immediately follow these procedures:

* Activate the building alarm (fire pull station). If not available or operational, verbally notify people in the building.
* Isolate the area by closing windows and doors.
* If safe to do so, shut down equipment in the immediate area.
* Evacuate the building
* If trained to do so, use a portable fire extinguisher to: assist your own evacuation; assist another to evacuate; and control a small fire, if possible.
* Provide the fire/police teams with the details of the problem upon their arrival. Special hazard information you might know is essential for the safety of the emergency responders.

**If the fire alarms are ringing in your building:**

* You must evacuate the building and stay out until notified to return.
* Move upwind from the building and stay clear of streets, driveways, sidewalks and other access ways to the building.
* If you are a supervisor, try to account for your employees. Keep them together and report any missing persons to the emergency personnel at the scene.

1. **HAZARDOUS CHEMICAL WASTE STORAGE AND DISPOSAL**
2. **General Information**

The intent of the hazardous waste program is to provide a cradle-to-grave management system for hazardous wastes to ensure that these wastes are not mismanaged in a way that will impact human health or the environment. All chemicals used at SCSU, with the exception of biochemicals such as amino acids, sugars and starches, nutrient solutions, and vitamins, regardless of hazard class, are considered hazardous, and must be disposed of through this Program.

* State and federal laws regulate disposal of toxic and hazardous chemicals.
* Sink drains, hood drains or the sewer system must never be used as a means to dispose of hazardous chemicals**.**
* Chemical waste will be removed from laboratory’s Satellite Accumulation Areas (SAA), a designated Waste Storage Area where chemicals that have been used in a process or experiment, or are no longer needed in a process or experiment, can be temporarily stored, on a periodic basis and/ or more frequently through coordination with the OEHS.
* The hazardous waste removal process collects the waste from SAAs and stores it in the Main Accumulation Area (MAA) for hazardous waste storage area on campus before scheduling removal off-site by the hazardous waste removal contractor.

The University's waste management practices are designed to ensure maintenance of a safe and healthful environment for employees and the surrounding community without adversely affecting the environment. This is accomplished through regular removal of chemical waste from University facilities and disposal of these wastes in compliance with local, state, and federal regulations.

The following guidelines will assist waste collection:

* Disposal of chemicals by way of the sanitary sewer system is prohibited.
* To determine if the chemical you want removed from your laboratory or work area is a regulated hazardous waste, contact the OEHS, or consult the EPA regulation 40 CFR 261-Identification and Listing of Hazardous Waste (http://www.wbdg.org/ccb/EPA/40cfr261.pdf).
* Waste containers must remain closed except when actually adding waste. Open containers violate state and federal waste regulations. Note: A container with a funnel left in it is considered an open container.
* Waste chemicals must not be placed or left for removal in hallways.
* To request a waste pickup, call the OEHS or send an e-mail to Agentist1@southernct.edu.
* Disposal of radioactive materials and etiologic agents or cultures require special procedures. Contact the OEHS before proceeding.

1. **Hazardous Waste Determination**

It is the responsibility of all generators to determine whether their waste is hazardous. The procedure for this is called a "hazardous waste determination." You may assume a waste is hazardous based on its characteristics or on past laboratory analysis provided there is no change in how the waste was generated. In some cases, you may use your knowledge of a waste to make a determination as to whether the waste is a characteristic hazardous waste. If you use such information to classify a waste as nonhazardous, you must maintain documentation supporting this determination. If you are not sure, contact the OEHS to have the waste tested. Keep in mind that a non-hazardous waste may become hazardous if contaminated or mixed with other materials and re-testing would be needed.

Hazardous waste management plans generally separate waste into three broad groups: radioactive, chemical and biological. This guide addresses only chemical waste.

A waste is considered hazardous if it meets any of the conditions below.

* It is listed as a hazardous waste.
* It is mixed with a listed waste.
* It exhibits the characteristic of ignitability, corrosivity, reactivity, or toxicity.

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| **PLEASE NOTE: THE EPA DEFINES A SOLID WASTE AS BEING IN ANY PHYSICAL STATE, SOLID, LIQUID, OR GAS.** |

By definition, the EPA determined that some specific wastes are hazardous. These wastes are incorporated into lists published by the Agency. In regulatory terms, a hazardous waste is a waste that appears on one of the four RCRA (Resource Conservation and Recovery Act) hazardous wastes lists (the F-list, K-list, P-list, or U-list) or that exhibits one of the four characteristics of a hazardous waste - ignitability, corrosivity, reactivity, or toxicity. However, materials can be hazardous wastes even if they are not specifically listed or don't exhibit any characteristic of a hazardous waste.

1. **Listed Wastes**

By regulation, some specific wastes are hazardous wastes. These wastes are incorporated into four lists.

1. **The F-list (non-specific source wastes):** This list identifies wastes from many common manufacturing and industrial processes, such as solvents that have been used for cleaning or degreasing. Since the processes producing these wastes occur in many different industry sectors, the F-listed wastes are known as wastes from non-specific sources. (Non-specific meaning they don't come from one specific industry or one specific industrial or manufacturing process.)
2. **The K-list (source-specific wastes):** This list includes certain wastes from specific industries, such as petroleum refining or pesticide manufacturing. Also, certain sludges and wastewaters from treatment and production processes in these specific industries are examples of source-specific wastes. The F-listed wastes can be found in the federal regulations at:
3. **The P-list and the U-list (discarded commercial chemical products):** These lists include specific commercial chemical products that have not been used, but that will be (or have been) discarded. Industrial chemicals, pesticides, and pharmaceuticals are example of commercial chemical products that appear on these lists and become hazardous waste when discarded.

The F, K, P, and U - listed wastes can be found in the federal regulations at:

<http://ecfr.gpoaccess.gov/cgi/t/text/textidx?c=ecfr&sid=e5c593bfda76b7b92b1f7c263a156c8a&rgn=div8&view=text&node=40:26.0.1.1.2.4.1.2&idno=40>

1. **Characteristic Hazardous Wastes**

By regulations, a waste is considered hazardous if it exhibits any one or more of the following four characteristics:

1. **Ignitability** – Ignitable wastes can create fires under certain conditions or undergo spontaneous combustion. A liquid which has a flash point of less than 60°C (140 °F) 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).
2. **Corrosivity** – Corrosive wastes are materials, including solids, that are acids or bases, or that produce acidic or alkaline solutions. Aqueous wastes with a pH less than or equal to 2.0 or greater than or equal to 12.5 are corrosive. A liquid waste may also be corrosive if it is able to corrode metal containers, such as storage tanks, drums, and barrels. Spent battery acid is an example. Test methods that may be used to determine if a waste exhibits the characteristic of corrosivity are pH Electronic Measurement and Corrosivity Towards Steel (U.S. EPA Test Methods, SW-846 Methods: 9040 and 1110 respectively.)
3. **Reactivity** – Reactive wastes are unstable under normal conditions. They can cause explosions or release toxic fumes, gases, or vapors when heated, compressed, or mixed with water. 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).
4. **Toxicity** – Toxic wastes are harmful or fatal when ingested or absorbed (e.g., wastes containing mercury, lead, DDT, PCBs, etc.). When toxic wastes are disposed, the toxic constituents may leach from the waste and pollute ground water. A waste that contains one of the constituents in concentrations equal to or greater than the values listed in EPA regulation 40 CFR 261. Toxicity is defined through application of a laboratory test procedure called the Toxicity Characteristic Leaching Procedure (TCLP - U.S. EPA Test Method 1311).
5. **Used Oil**

Used oil includes used crankcase (engine) oil, used liquid and semi-solid gear, chain, and ball bearing lubricants, oil used in pumps, and used hydraulic fluid. Materials that contain or are contaminated with used oil can also fall under the definition of used oil, such as used oil filters, oily rags and wipers, used absorbents, and oily wastewater. In Connecticut, used oil is a regulated waste, not a hazardous waste, unless it has been mixed with a hazardous waste such as a chlorinated solvent, [RCSA §22a-449(c)-119 and 40 CFR 279], and must be recycled [RCSA §22a-241b-2(1)(I)].

Collect and store used oil in a secure collection tank or drum, separate from other wastes, and label the container “Used Oil”, and store in the SAA. Keep the container closed at all times. This waste will be removed from the SAA, during a hazardous waste removal.

1. **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.

1. **Mixtures of listed wastes and other wastes and Derived-From Rules**

A waste mixture that includes a RCRA-listed hazardous waste is automatically a RCRA-listed hazardous waste and carries the listing with the mixture. The chemical concentrations in the waste are irrelevant. The “One Drop Rule”: One drop of RCRA listed hazardous waste makes the entire mixture a RCRA listed hazardous waste.

A waste mixture that includes a RCRA-listed hazardous waste is automatically a RCRA-listed hazardous waste Unlike the RCRA listed waste rule, wastes mixed with a RCRA characteristic hazardous waste are hazardous wastes **only** if the resulting mixture still exhibits a hazardous characteristic. However, intentionally mixing (diluting) to avoid regulation is considered “treatment” and requires authorization and permits.

The **derived-from rule** governs residues resulting from the treatment, storage, or disposal of hazardous waste. Similar rules apply to wastes that are derived from listed or characteristic hazardous wastes as residues from waste treatment processes. Since most university facilities are not hazardous waste Treatment, Storage, and Disposal (TSD) sites, this consideration is unlikely to apply to them.

A mixture containing a non-hazardous solid waste and any amount of a listed hazardous waste is considered a hazardous waste. For example, if a pint of spent solvent such a toluene or benzene (an F listed hazardous waste) is mixed with a 55 gallon drum of water, the entire mixture (e.g., 55 gallons plus one pint) is considered a hazardous waste (as opposed to only one pint being a hazardous waste had the two wastes not been mixed). Hence, it is very important to keep wastes segregated. Not only is it better for the environment, but it will reduce disposal costs.

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| **Generator Status** |
| SCSU falls under the Small Quantity Generator (SQG) classification of hazardous waste generator, because in each and every calendar month, SCSU generates less than:   * 100 kg (220 lbs.) of hazardous waste; * 1 kg (2.2 lbs.) of an acutely hazardous waste; and * 100 kg (220 lbs.) of any residue or contaminated soil, waste, or other debris resulting from thecleanup of a spill of any acutely hazardous waste. |

1. **Requirements for Hazardous Waste Management in the Laboratory**

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 Connecticut Hazardous Waste Management Regulations. Every generator site (laboratory, shop, or studio) is subject to inspection by the EPA and CT DEEP. The steps necessary for compliance are summarized below.

* Waste containers must be labeled in accordance with the Plan.
* Segregation and Containment — the wastes must be separated by chemical compatibility groups. Each group of containers must be provided with appropriate secondary containment. Containment trays and tubs are available from the OEHS.
* Storage — only one container per waste stream (type of waste) is allowed in an area, i.e., one container for halogenated solvents, one container for non-halogenated solvents.
* Keep Waste Containers Closed — all containers must be closed at all times except when actually adding waste. A funnel left in a container defines that container as open, in the eyes of the inspector.

1. **Hazardous Waste Container Labeling**

Reagents in their original containers with legible manufacturer's labels require no additional labeling or packaging, however, regardless of original or transferred containers, each container must be labeled with the SCSU Hazardous Waste Label/Tag.

The waste label shall have the following information:

1. Contents
2. Percentage, percentage refers to the percentages of the individual constituents of mixtures or

solutions (e.g. phenol 50%, chloroform 10%, in the same waste container)

1. Associated hazards
2. Necessary precautions
3. Generator identification

When the container is full place the date when full on the label. Plan ahead and contact the OEHS to arrange for a waste pick-up. ***NOTE: Containers include bags, barrels, boxes, bottles, cans, cylinders, drums, etc***.

* Hazardous waste that is not properly labeled can delay removal from areas until the labeling requirements are met. Label chemical waste as soon as it is generated to avoid having “unknowns” in the lab. The cost of disposing of unknown chemicals is extremely high.
* If it’s determined that the incidents or quantities of unknowns is excessive, the producing Department or Section will be responsible for all cost associated with the testing, identifying and disposing of all unknown wastes.
* Hazardous waste container labels are available from the OEHS.

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**SCSU HAZARDOUS WASTE TAG**

1. **Waste Minimization**

Each faculty member or supervisor should evaluate methods to reduce waste volume and toxicity by investigating the possibility to substitute non-hazardous or less toxic materials whenever possible. Purchase only the amount of chemical that is actually needed.

Excess chemicals often become waste and any purchase savings are outweighed by disposal costs. Check with other laboratories in your department to see if they may be able to use any chemicals that you no longer need and vice versa.

1. **Storage of Hazardous Wastes/Satellite Accumulation Areas (SAA)**

Storage of waste chemicals needs to meet certain standards for safety, visibility, and spill prevention set forth by the United States Environmental Protection Agency (EPA), OSHA, The National Fire Protection Association (NFPA), and the Connecticut Department of Energy and Environmental Protection (CT DEEP).

A Satellite Accumulation Area (SAA) is a designated Waste Storage Area where chemicals that have been used in a process or experiment, or are no longer needed in a process or experiment, can be temporarily stored.

Each laboratory or other generator of hazardous waste must maintain a satellite accumulation area (SAA) that is under the control of the operator **and** at or near the point of waste generation.

1. **SAA Regulations**

* The Satellite Accumulation Area SAA must be located at or near the original point of waste generation.
* The SAA must be labeled with an SAA designation sign.
* The SAA must be under the control of a designated, trained individual.
* The SAA must be secure from unauthorized use or accessibility (lab locked when not in use).
* The maximum capacity of any and all containers in the SAA must not exceed 55-gallons. If acutely hazardous waste is accumulated, the maximum amount of that waste stream that can be accumulated is one quart**.**  Any quantity of hazardous waste in an SAA in excess of the total volume of 55 gallons or 1 quart of acutely hazardous waste must be removed from the satellite storage area within seventy-two (72) hours. Contact the OEHS for removal of this waste**.**
* Each container must have a label. The label must be written in English. Each container must be tagged with the SCSU hazardous waste tag or “Non Hazardous Waste” label, and must show all constituents and percentages (i.e. 30% acetone, 70% water). Formulas, trade names, or abbreviations cannot be used. A separate tag must accompany each individual hazardous waste container. Old labels that do not accurately describe the contents of the waste container (i.e., the original label for a toluene bottle now being used to store waste xylene) must be defaced. Pre-made labels with explicit instructions for completing them are available for your convenience.
* The container holding the hazardous waste must be closed AT ALL TIMES. The exception is when waste is being added to, or removed from the container. Never leave funnels, except the self-closing type, in chemical waste receptacles. A container with a funnel inserted, is considered an open container.
* Waste containers shall not be filled more than 90% full to allow for the headspace required to avoid pressure build up that may occur with expansion.
* Incompatible wastes must NOT be stored together. Store incompatible waste in separate secondary containers
* Hazardous waste must be stored in containers (including lids) made of materials that are compatible with the waste, and must be in good condition, without cracks, rust, leaks or any residue on the outside of the container. **Unacceptable containers** include household chemical/cleaner and food or beverage containers. The best container for your hazardous waste is the original chemical container.
* Hazardous waste containers must be stored within secondary containment, such as a plastic bin and shall be of a volume capable of containing the volume of the largest waste container within. The primary container must be compatible with the waste
* Containers must always be stored away from sources of ignition.

**Storage Time and Deterioration**

Many chemicals deteriorate over time. Chemical manufacturers usually list an expiration date and specific storage precautions (for a given chemical). Therefore it is important that the date of receipt and the date of initial opening of each chemical container be indicated on its label.

**Chemicals must be disposed of if any of the following indications are present:**

* Chemicals that are changing color (e.g. darkening), Cloudy liquids, spotting on solids,
* Caking of anhydrous material
* Existence of solids in liquids or liquids in solids
* Pressure build-up in containers
* Evidence of reaction with water
* Chemicals kept beyond their appropriate shelf life
* Containers that are corroded or leaking

Chemicals that have any of the above indications must be disposed of in accordance with the Hazardous/ Chemical Waste Policy, as outlined in this Plan.

1. **Empty Chemical Containers/Laboratory Glassware Disposal**

Generally, empty chemical containers are not considered hazardous waste. For disposal, the following conditions must be met:

* 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 and DEEP as

“Acutely Hazardous Wastes". Empty containers of acutely toxic hazardous waste containers may still contain residual amounts of the acutely toxic chemical and as such cannot be disposed in the normal trash.

The most common laboratory chemicals found on this list are:

* Acrolein
* Allyl alcohol
* Compounds containing Arsenic
* Carbon Disulfide
* Compounds containing Cyanide
* 2,4, Dinitrophenol
* Nitric oxide
* Nitrogen dioxide
* p-Nitroaniline
* Osmium Tetroxide
* Phosgene
* Phosphine
* Sodium Azide
* Vanadium pentoxide

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.

Glassware must be free of liquids prior to disposal. Glassware that has been used for biological work or that may be contaminated with a biohazardous/infectious material, must be disposed of in properly labeled, approved sharps containers.

All aspects of this procedure shall be performed by lab personnel.

These instructions do not cover Regulated Medical Waste (RMW), biohazardous contaminated containers/glassware, or containers/glassware that once held acutely hazardous chemicals. These instructions do not include glass, aluminum, or plastic food and beverage containers.

EPA regulations stipulate that empty containers must meet the following requirements:

* Containers must not contain free liquid or solid residue.
* Containers must be triple rinsed.
* Product labels must be defaced or removed.
* Container lids or caps must be removed.

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| **IMPORTANT: Containers that do not meet the requirements listed here, must be treated as hazardous waste.** |

1. **Rinse procedure:**

* Chemical containers that have been emptied (generally this means drained of their contents by normal methods including pouring, pumping, aspirating, etc.) are not regulated as hazardous waste, unless the chemical is on the list of acutely hazardous wastes or if the material is known to have high acute toxicity, however they should not necessarily be disposed of in the regular solid waste dumpsters. Generally, the primary container (the container that actually held the chemical, as opposed to a container that the primary chemical was packed in), must be triple rinsed with water or other suitable solvent and air-dried before disposal. **NOTE:** If the chemical is on the list of acutely hazardous wastes or if the material is known to have high acute toxicity, the washings must be collected for disposal through the hazardous waste disposal program.
* Completely remove or deface all labels on the containers and remove the lids. If any material can still be poured from the container then it must be either used, or managed under the Facility’s Chemical Waste Management Program as outlined in the Chemical Hygiene Plan. If a container held an acutely hazardous waste it must be managed as a hazardous waste.
* All hazardous chemical containers, liquid or solid, must be rinsed 3 times before being discarded. A rinse should consist of a minimal amount of water being sloshed around the container. The first rinse must be collected as chemical waste, it can be put into any waste container of compatible chemicals, the second and third rinses can then go down the drain. **If the chemical is on the list of acutely hazardous waste (Appendix B) then all 3 rinses must be collected**.
* Ensure that plenty of water is used to flush the material down the drain. After the containers are rinsed they can be discarded appropriately as described below. All caps should be left off of the discarded containers, and the chemical name should be crossed or blacked out prior to being discarded. Caps may be discarded into the regular trash.
* Empty glass bottles and broken or unbroken laboratory glassware that did not contain hazardous chemicals should be rinsed to remove residual chemicals.
* All rinsed containers should be turned upside down and placed on paper towels to dry before being discarded.

1. **Reuse/ Recycle/ Disposal of Cleaned Containers:**

* The OEHS supports the use of empty chemical containers as chemical waste containers as a form of recycling.
* All chemical containers must follow the above rinse procedure before being discarded in any form.
* Metal containers or any plastic containers, plastic tubing, or plastic beakers that do not meet the recycling criteria (see below) can be discarded into the regular trash.
* Glass containers, glass tubing, or glass beakers that do not meet the recycling criteria (see below) or that are broken must be placed into a leak proof and puncture-proof container, and labeled “broken glass”.
* Plastic or glass containers that meet the recycling criteria should be placed into the appropriate recycling containers that are found in the labs.

**The following criteria must be met for containers to be recycled:**

**Glass (brown or clear):**

* Glassware must be triple rinsed according to procedure (see above).
* Glassware must be dry and uncapped.
* Non-Pyrex or non-borosilicate (Heat-resistant glass like Pyrex or borosilicate glass must not be disposed of in the recyclable glass container as even a single piece of such material will alter the viscosity of the fluid in the furnace at re-melt.
* Do not recycle glass tubing.
* Glassware must not be plastic-coated
* There must not be any visible chemical residue or stains on containers.

**Plastic:**

* Containers must triple rinsed according to procedure (see above).
* Containers must be dry.
* Containers must be uncapped.
* Containers must be listed as grades 1- 7 on the bottom of the container.
* Do not recycle glass tubing.
* There must not be any visible chemical residue or stains on containers.

1. **HAZARD COMMUNICATION**
2. **Chemical Inventory**

Each department at Southern Connecticut State University shall perform an inventory of all materials/chemicals for which a Material Safety Data Sheet, or MSDS is required by OSHA. An initial inventory will be performed immediately, and updated annually by September 30th or as changes occur. The inventory will list the materials by name (abbreviations or chemical formulae are not acceptable), manufacturer, building name and room, storage location, and amount on hand. The inventory shall include all chemicals stored or used on this campus for teaching, research, cleaning, maintenance operations, and pest control.

Material Safety Data Sheets shall be forwarded to the EH&S Coordinator with the first inventory. New or updated MSDS shall be submitted with subsequent inventories and as new materials are brought into the campus.

The same "identity" that is found on the appropriate MSDS and container label shall appear on the inventory list.

Each department will maintain a current inventory and insure the availability of the inventory to personnel in the department. A copy must be sent to the OEHS at 615 Fitch Street, Hamden, CT 06514 or to [Agentist1@southernct.edu](mailto:Agentist1@southernct.edu).

The Environmental, Health, and Safety Officer will ensure that:

* The list of hazardous materials present in the workplace is compiled annually.
* The current inventory is filed on an annual basis.
* Annual audits of the inventory are performed, and any changes or corrections are made.
* The inventory is readily accessible to facility employees and applicable regulatory agencies.
* Copies of the Campus wide inventory are maintained at University Police Headquarters, the OEHS, and Facilities Operations and Planning.

1. **Inventory arrangement:**

* Chemicals shall be listed alphabetically according to the name listed on the Material Safety Data Sheet (MSDS).
* A manufacturer name is required.
* A catalog number is useful but not required.
* The physical state (e.g., solid, liquid, or gas) of the chemical is required.
* Further identify the chemical's location (e.g., under the sink, third shelf in the flammable cabinet,etc.).
* A chemical inventory form is available from the OEHS.

1. **Accessibility:**

* Chemical inventories will be computerized whenever possible to provide the capability of sorting according to manufacturer or location.
* A complete chemical inventory is located in the OEHS at 615 Fitch Street, room 305, Hamden, CT, and University Police Headquarters at 10 Wintergreen Ave., New Haven, CT.

1. **Material Safety Data Sheets (MSDS)**

Often referred to by its acronym MSDS, a Material Safety Data Sheet is a detailed informational document prepared by the manufacturer or importer of a hazardous chemical which describes the physical and chemical properties of the product.

Information included in a Material Safety Data Sheet aids in the selection of safe products, helps employers and employees understand the potential health and physical hazards of a chemical and describes how to respond effectively to exposure situations.

It should be noted that the health and safety guidance in the Material Safety Data Sheet often addresses the worst case situation which would be more relevant to a major industrial accident or tank car spill than to a laboratory.

You can find additional information about the hazardous materials you work with in what is called a Material Safety Data Sheet, or MSDS. You should take time to read and understand the MSDS describing the hazardous materials present in your work area.

If you do not have an MSDS for a hazardous material, you must contact the manufacturer to obtain one. Keep a copy for your work area and forward a copy to the OEHS.

A Material Safety Data Sheet (MSDS) provides detailed information about a specific hazardous material.

At a minimum, an MSDS contains the following information:

* Identity (name of substance)
* Physical Hazards (target organ)
* Health Hazards
* Routes of Body Entry
* Permissible Exposure Limits (PEL)
* Carcinogenic Factors (cancer causing)
* Safe-Handling Procedures
* Date of Sheet Preparation
* Control Measures (personal protective equipment)
* Emergency First Aid Procedures (emergency telephone number)
* Contact Information (for the preparer of the sheet)
* Special Instructions

1. **Chemical Container Labeling**

Requirements for labeling of chemical containers come from the OSHA Hazard Communication and Laboratory Standards. All hazardous chemicals are required to be properly labeled (full chemical name) unless they are exempted by the Standard.

* **All** chemical containers must be labeled. The only exception is portable containers under the explicit control of the user at all times. If the container will be left alone for any reason, then it **must** be labeled.
* Per the OSHA Hazard Communication Standard 29 CFR 1910.1200, the primary information on an OSHA-required label is the identity of the material, appropriate hazard warnings and the manufacturer name.
* Labels on purchased hazardous chemicals must not be removed or defaced except when empty.
* The label and information must be in English and clearly and fully identify the contents.
* Labels frequently contain other information, such as precautionary measures ("do not use near open flame"), but this information is provided voluntarily and is not required.
* Read the label each time you use a newly purchased chemical. It is possible the manufacturer may have added new hazard information or reformulated the product since your last purchase, and thus altered the potential hazards you face while working with the product.
* All employees involved in unpacking chemicals are responsible for inspecting each incoming container to insure that it is labeled with the information outlined above. The OEHS should be notified if containers do not have proper labels.

1. **Labeling Dram Vials and Other Small Containers**

Dram vials and other small containers can be difficult to label because of their size. In this instance, it is recommended that you place these items in test tube racks, boxes or other containers, and label the holding container instead. Labeling a shelf or draw where these chemicals are located is also possible, however any chemicals removed that do not have a full chemical name, must remain under your direct control and supervision.

Each container of and/or apparatus with hazardous chemical contents shall be labeled with the following information:

1. Identity of the hazardous chemical(s), and
2. Hazard warnings in words, pictures, symbols, or a combination thereof, which provide at least general information regarding the hazards of the chemical(s)
3. **Signs**

Prominent signs of the following types must be posted in each laboratory:

1. Signs identifying locations for safety showers, eyewash stations, other safety and first aid equipment, and exits.
2. Emergency contact numbers, which shall be prominently located on or near the laboratory phone.
3. Chemical or biological hazard signs which must be displayed at laboratory door entrances, sinks, benches, hoods, lab refrigerators, etc, as appropriate.
4. Warnings at areas or equipment where special or unusual hazards exist shall be posted.
5. **Laboratory Door Identification Cards**

Laboratory Door Identification Cards (Appendix F) listing the names and telephone numbers of the Principal Faculty member and other responsible laboratory personnel, shall be posted outside each laboratory. These cards must be kept updated and are used by emergency responders in the event of an off-hours emergency in the laboratory. Door ID cards must be updated at least annually, and any time hazardous or potentially hazardous conditions or personnel in charge change.

A complete and current copy of the safety information posted at all lab doors will be will be maintained in a master file (updates will replace existing master file information) with the OEHS.

1. **ENGINEERING AND ADMINISTRATIVE CONTROLS**
2. **Engineering Controls**

As general lab ventilation cannot be relied upon to protect personnel from localized exposures to hazardous levels of airborne chemicals, engineering controls such as laboratory fume hoods, glove boxes and other local exhaust systems are often necessary to provide additional exposure control. In general, laboratory fume hoods are recommended whenever using hazardous chemicals that:

* Have high acute toxicity, or which are carcinogens, or reproductive toxins except where there is very low risk of exposure (e.g., use of minimal quantities in a closed system).
* Have a permissible exposure limit of less than 50 parts per million (ppm) (or 0.25 mg/m3 for particulate matter).
* Are appreciably volatile (e.g., solvents) or are easily dispersible in air (e.g., dust).

All employees are responsible for notifying management of any deficiencies in the proper operation of engineering controls. If at any time, any employee does not understand the operation of an exposure control mechanism, or suspects the equipment isn’t working properly, he or she should contact the Chemical Hygiene Officer without delay.

1. **Chemical Fume Hoods**

* Chemical fume hoods are one of the most important items of equipment used for the protection of workers in the laboratory.
* A standard fume hood is a chemical and fire resistant enclosure with a movable window (sash) at the front to allow the user access to the interior.
* Chemical fume hoods capture, contain, and expel chemical emissions. In addition, chemical fume hoods (with the sash down) provide a protective barrier between laboratory personnel and chemicals or chemical processes.
* A properly functioning hood draws between 60-100 linear feet per minute of air at full-open sash.
* The storage of large numbers of chemical bottles or other items within the hood can dramatically impair this functioning.
* Notify the OEHS of any hoods that are not functioning properly. They will be taken out of service and repaired as quickly as possible.
* Using a fume hood that you either know or suspect is not working properly can result in chemical exposure to the end-user. Do Not Use an improperly working hood. Contact the OEHS for repair.

Chemical hoods shall be utilized for all chemical procedures which might result in release of hazardous vapors, fumes, or dusts. As a general rule, hoods shall be used for all procedures involving substances which are appreciably volatile and have a permissible exposure limit (PEL) less than 50 ppm. All fume hoods will be certified annually in accordance with OSHA, AIHA/ANSI, SEFA, and ASHRAE. Any hood not passing inspection will be "Locked-Out" of service immediately and not used until the hood has passed inspection.

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| **WORK PRACTICES TO APPLY WITH THE USE OF CHEMICAL FUME HOODS**     * Confirm adequate ventilation in accordance with the manufacturers or installers specifications or by holding a strip of paper at the face of the hood and observing the movement of the paper, prior to opening chemical containers inside the hood. * Keep the sash of the hood closed at all times except when adjustments within the hood are being made. At these times, maintain the sash height as low as possible. * Minimize interference with the inward flow of air in the hood at all times. * Leave the hood operating when it is not in active use if hazardous chemicals are contained inside the hood, or if it is uncertain whether adequate general laboratory ventilation will be maintained when the hood is non-operational. * Under no circumstances use the hood as a means to dispose of volatile chemicals (i.e. do not allow chemicals to evaporate inside the hood). |

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| **COMMENT ON THE USE OF DUCTLESS FUME HOODS** |
| Ductless chemical fume hoods (hoods which recycle air to the laboratory after passing it through a filter) are offered by a variety of manufacturers. Manufacturers claim that these devices are safe and extremely energy efficient because no air is exhausted from the laboratory. These systems typically have a particulate filter and/or a charcoal filter for the removal of organic vapors. These systems must be used with extreme caution. Contact the OEHS before purchasing or using one of these ductless hood systems to control chemical exposures. These hoods cannot be purchased without approval from OEHS.  The primary safety concern with these devices is their filtering mechanism. Charcoal filters are not 100% efficient at removing organic vapors and some organic vapor will always be returned to the laboratory atmosphere. Charcoal filters have a limited ability to adsorb organic vapors and often become saturated in a matter of months. Most hoods do not have a method for detecting when the filters are saturated and breakthrough of organic vapors begins. Those that have monitors depend on non-specific chemical sensors that will respond at different concentrations for different substances. Some substances will not be detected.  Charcoal filter replacements are extremely expensive (approximately 20-25% of the hoods initial cost) and studies have shown that (when operated over several years) ductless hoods may actual be more expensive (as well as less protective) to operate than ducted hoods. Applications where ductless chemical fume hoods might be appropriate include the control of particulate and nuisance odors. Ductless hoods should not be used to protect laboratory workers from toxicologically significant concentrations of hazardous chemicals. Where ductless hoods are installed their use must be monitored to ensure that flow rates and capture effectiveness do not change over time and include procedures using hazardous chemicals as outlined above. |

1. **Building ventilation:** Building ventilation provides SCSU laboratories with at least 10 air changes per hour (ACH) of fresh (outside) air. This airflow reduces employee exposure to airborne contaminants and removes excess heat. It also directs the airflow from areas of lower hazard to areas of higher hazard, which helps keep odors and hazardous gases, dusts, and vapors out of hallways and other public areas.
2. **Biological Safety Cabinets (BSCs):** Biosafety cabinets use HEPA filters to protect lab workers and the environment from aerosols or droplets that could spread biohazardous material.
3. **Glove boxes:** Glove boxes are airtight boxes with 2 or more heavy rubber gloves and an airlock. Use them when working with known carcinogens and highly toxic substances, or to provide an inert atmosphere for compounds that are sensitive to water or air. Glove bags are an economic alternative for short-term uses.
4. **Administrative Controls**

Administrative controls include written procedures, employee training, establishing designated or restricted areas, chemical procurement procedures, and preventive maintenance.

Some examples of the administrative controls used in labs are:

1. The Chemical Hygiene Plan
2. Lab Security
3. Lab-Specific Training
4. Standard Operating Procedures
5. Chemical Labeling

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| **Laboratory Security**   * Control access to areas where hazardous materials are used and stored. * Know who is in your laboratory area. * Know what materials are being brought into your lab. * Know what materials are being removed from your lab. * Have a site-specific emergency plan.   **Report security incidents to University Police, immediately.** |

1. **Work Practice Controls**

Work practice controls include pre-planning work, practicing good housekeeping and personal hygiene, and using common sense to minimize exposure to hazardous materials.

* 1. **Work Planning**
* Pre-plan work: Stage tools, equipment, and materials in advance of the activity to be performed.
* Establish designated areas for work involving particularly hazardous substances.
* Stay upwind, or use exhaust ventilation for operations that emit vapors, gases, fumes, dusts, mists or aerosols.
* Limit the amount of hazardous materials procured, used, and stored, to the minimum needed for an operation.
* Keep drip pans, secondary containment and cleanup materials readily available.
* Be familiar with the use, limitations and location of emergency equipment such as emergency eyewashes, safety showers, fire alarms, exits, and fire extinguishers.
* Keep containers covered when not being used.
* Remove jewelry to prevent contact with electrical sources and chemicals and from catching on laboratory or shop equipment.
* Confine long hair and loose clothing when working.
  1. **Housekeeping**
* Keep work areas clean and free of obstructions. Clean surfaces (countertops, bench tops, fume hoods, and floors) of all drips and residues. Clean the work area at the completion of an operation or at the end of the day.
* Wipe drips and residues from containers of hazardous materials to avoid skin contact which may cause dermal absorption, chemical burns, skin irritation, and possible accidental ingestion as a result of hand-to-mouth transfer.
* Clean spilled chemicals immediately, and dispose of all wastes properly. Dispose of chemical wastes in accordance with SCSU Hazardous Waste Management Policies and Procedures.
* Maintain access to exits, emergency equipment, and other control equipment by not using stairways and hallways as storage areas.
  1. **Personal Hygiene**
* Wash promptly whenever a chemical has come in contact with the skin.
* Avoid inhalation of chemicals; do not "sniff" to test chemicals.
* Never use mouth suction to pipet anything; use suction bulbs.
* Wash hands well with soap and water after removing personal protective equipment (including gloves), and before leaving the laboratory; NEVER wash with solvents.
* After handling chemicals, wash hands with soap and water before leaving the laboratory/shop area and prior to breaks and consumption of food/beverages.
* Always remove gloves before touching common use items such as phones, door knobs and computers. This will prevent contamination of unprotected individuals.
* Since every employee or visitor to this facility is not familiar with the work being conducted by an individual who wears gloves and a lab coat outside of the laboratory, concerns have been raised regarding laboratory personnel who enter common use areas such as offices and the cafeteria while wearing them.

1. **Food, Beverage, Cosmetics and Medicine in Laboratory Areas**

The Occupational Safety and Health Administration (OSHA) Standard titled Occupational Exposure to Bloodborne Pathogens” 29CFR 1910.1030 prohibits eating, drinking, smoking and applying cosmetics in laboratories where chemicals, biological agents or radiological agents are used, handled or stored. Food and beverages (including water, gum, and medicines) may not be consumed, prepared, or stored in Laboratory Areas.

This prohibition applies to an entire laboratory including offices and other areas that are not physically separated from the work area by floor-to-ceiling walls with doors that close, even if the space is not used for work with hazardous materials.

* Food or drink may be moved through a laboratory only if the food or beverage is wrapped or in a covered container.
* Food and beverages (including empty containers) may not be stored in laboratories, including refrigerators, freezers and cold rooms. Do not dispose of food wrappers or beverage containers in laboratory trash receptacles. Their presence in these receptacles implies eating and/or drinking in the laboratory, which is a safety violation.
* Do not keep medications, cough drops, eye drops, etc. in laboratory drawers, including desk drawers. Cosmetics, ointments, skin cream, and similar items may not be applied or stored in Laboratory Area.
* Do not use laboratory equipment such as refrigerators, freezers, microwave ovens, etc. to store or prepare food or beverages.
* Do not use laboratory glassware or utensils to prepare or consume food or beverages.

1. **MEDICAL SURVEILLANCE PROGRAM**

All University employees who work with hazardous chemicals will be provided the opportunity to receive medical attention and follow up examinations by, or under the supervision of, a licensed physician whenever they develop signs and symptoms of chemical overexposure for an OSHA regulated substance. This medical consultation will be provided at no cost to the employee and will be provided to the employee under the following circumstances:

1. Whenever an employee develops signs or symptoms associated with a hazardous chemical to which the employee may have been overexposed in the lab.
2. Where monitoring reveals an exposure level routinely above the action level or Permissible Exposure Limit for an OSHA-regulated substance.
3. Whenever an event such as a spill, leak, or explosion takes place in the workplace and results in the likelihood of an overexposure.
4. At the request of the Chemical Hygiene Officer.

**Procedures to follow if the above circumstances occur:**

1. Emergency: Call 911 for immediate help.
2. Non­emergency: To assess what action should be taken, contact the person who directly supervises the laboratory where the situation occurred.
3. Follow­up with call to the OEHS.

This University will request that the physician provide a written opinion that will not reveal a specific

finding of diagnosis unrelated to the exposure, but will include:

* Recommendation for further medical follow-up.
* Results of the medical examination and any associated tests.
* Any medical conditions that may be revealed in the course of the examination that may place the employee at increased risk as a result of exposure to a hazardous chemical found in the workplace.
* A statement by the physician that the employee has been informed of the consultation/examination results and any medical condition that may require further examination or treatment.

1. **Exposure Monitoring**

For laboratory uses of OSHA regulated substances (See APPENDIX G) SCSU shall assure that laboratory employees' exposures to such substances do not exceed the permissible exposure limits (PEL) specified in 29 CFR part 1910, subpart Z.

Additional employee protection will be considered for work with particularly hazardous substances. These include select carcinogens, reproductive toxins and substances which have a high degree of acute toxicity. Laboratory supervisors and principal investigators are responsible for assuring that laboratory procedures involving particularly hazardous chemicals have been evaluated for the level of employee protection required. Specific consideration will be given to the need for inclusion of the following provisions:

* Planning
* Establishment of a designated area
* Access control
* Special precautions such as:
* use of containment devices such as fume hoods or glove boxes;
* use of personal protective equipment;
* isolation of contaminated equipment;
* practicing good laboratory hygiene; and
* prudent transportation of toxic chemicals.
* Planning for accidents and spills
* Special storage and waste disposal practices

1. **Employee exposure determination**.
2. Initial Monitoring

SCSU shall measure the employee's exposure to any substance regulated by a

standard which requires monitoring if there is reason to believe that exposure levels

for that substance routinely exceed the action level (or in the absence of an action

level, the PEL).

1. Periodic Monitoring

SCSU shall do everything possible to ensure our employees are not exposed to levels exceeding any recommended action level, or PEL. If the initial monitoring discloses employee exposure over the action level (or in the absence of an action level, the PEL), SCSU shall immediately comply with the exposure monitoring provisions of the relevant standard.

1. Termination of monitoring

Monitoring may be terminated in accordance with the relevant OSHA standard.

1. Employee notification of monitoring results

Within 15 working days after the receipt of any monitoring results, SCSU will notify the employee of these results in writing either individually or by posting results in an appropriate location that is accessible to employees.

1. Known chemicals that require monitoring

Certain chemicals will be routinely monitored by SCSU. Other chemicals not routinely used will be monitored as the requirement arises.

1. **Recordkeeping**

The laboratory or Department will establish and maintain an accurate record for each employee. All records will be kept, transferred, and made available in accordance with 29 CFR 1910.1020. Exposure records for hazardous chemicals and harmful physical agents will be maintained for 30 years. Medical records for employees exposed to hazardous chemicals and harmful physical agents will be maintained for the duration of employment plus 30 years. The following categories will be annotated as required: Environmental monitoring, medical consultations, and examinations, including any tests or written opinions.

**APPENDIX A - CHEMICAL SAFETY PROTOCOL REVIEW/PRIOR APPROVAL FORM**

*Note: if you require assistance in completing this form, call the Office of Environmental Health and Safety at 203-392-7073. Please copy and use additional pages as necessary.*

Date of Request: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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**SUBSTANCE(S) TO BE USED**

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Storage Location/Conditions\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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Period (Dates) /Frequency of Use\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**PERSONNEL PROPOSED FOR THIS PROJECT**

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**EXPERIMENTAL PROCEDURES**

Briefly describe the procedures that will involve the use of this substance:

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**SAFETY PRECAUTIONS**

Briefly describe the safety precautions you plan to implement while using this chemical or chemicals, and any associated equipment. Attach any Standard Operating Procedures you may use.

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Return this completed form to the Office of Environmental Health and Safety615 Fitch Street, Hamden, CT 06514 or Mailstop FOP 305.**

**APPENDIX B**

**Environmental Protection Agency’s P List - (Acutely Hazardous Chemicals)**

|  |  |
| --- | --- |
| **CAS Number** | **Chemical Name** |
| 107-20-0 | Acetaldehyde, chloro- |
| 591-08-2 | Acetamide, N-(aminothioxomethyl)- |
| 640-19-7 | Acetamide, 2-fluoro- |
| 62-74-8 | Acetic acid, fluoro-, sodium salt |
| 591-08-2 | 1-Acetyl-2-thiourea |
| 107-02-8 | Acrolein |
| 116-06-3 | Aldicarb |
| 309-00-2 | Aldrin |
| 107-18-6 | Allyl alcohol |
| 20859-73-8 | Aluminum phosphide |
| 2763-96-4 | 5-(Aminomethyl)-3-isoxazolol |
| 504-24-5 | 4-Aminopyridine |
| 131-74-8 | Ammonium picrate |
| 7803-55-6 | Ammonium vanadate |
| 506-61-6 | Argentate (1-), bis(cyano-C)-, potassium |
| 7778-39-4 | Arsenic acid |
| 1327-53-3 | Arsenic oxide |
| 1303-28-2 | Arsenic pentoxide |
| 1327-53-3 | Arsenic trioxide |
| 692-42-2 | Arsine, diethyl- |
| 696-28-6 | Arsonous dichloride, phenyl- |
| 151-56-4 | Aziridine |
| 75-55-8 | Aziridine, 2-methyl- |
| 542-62-1 | Barium cyanide |
| 106-47-8 | Benzeneamine, 4-chloro- |
| 100-01-6 | Beneneamine, 4-nitro- |
| 100-44-7 | Benzene, (chloromethyl)- |
| 51-43-4 | 1, 2-Benzenediol, 4-[1-hydroxy-2-(methylamino)ethyl]- |
| 12-09-8 | Benzeneethanamine, alpha, alpha-dimethyl- |
| 108-98-5 | Benzenethiol |
| 81-81-2 | 2H-1-Benzopyran-2-one, 4-hydroxy-3-(3-oxo-1-phenylbutyl)-, and salts |
| 100-44-7 | Benzyl chloride |
| 7440-41-7 | Beryllium powder |
| 598-31-2 | Bromoacetone |
| 357-57-3 | Brucine |
| 39196-18-4 | 2-Butanone, 3, 3-dimethyl-1-(methylthio)-O-[(methylamino)carbonyl]oxime |
| 592-01-8 | Calcium cyanide |
| 75-15-1 | Carbon disulfide |
| 75-44-5 | Carbonic dichloride |
| 107-20-0 | Chloroacetaldehyde |
| 106-47-8 | p-Chloroaniline |
| 5344-82-1 | 1-(o-Chlorophenyl)thiourea |
| 542-76-7 | 3-Chloropropionitrile |
| 544-92-3 | Copper cyanide |
|  | Cyanide salts (soluble) |
| 460-19-5 | Cyanogen |
| 506-77-4 | Cyanogen chloride |
| 131-89-5 | 2-Cyclohexyl-4, 6-dinitrophenol |
| 542-88-1 | Dichloromethyl ether |
| 696-28-6 | Dichlorophenylarsine |
| 60-57-1 | Dieldrin |
| 692-42-2 | Diethylarsine |
| 311-45-5 | Diethyl-p-nitrophenyl phosphate |
| 297-97-2 | O, O-Diethyl O-pyrazinyl phosphorothioate |
| 55-91-4 | Diisopropylfluorophosphate (DFP) |
| 309-00-2 | 1, 4, 5, 8-Dimethanonaphthalene, 1, 2, 3, 4, 10, 10-hexa- chloro-1, 4, 4a, 5, 8, 8a, -hexahydro-, (1alpha, 4alpha, 4abeta, 5alpha, 8alpha, 8abeta)- |
| 465-73-6 | 1, 4, 5, 8-Dimethanonaphtahalen, 1, 2, 3, 4, 10, 10, hexa- chloro-1, 4, 4a, 5, 8, 8a-hexahydro-, (1alpha, 4alpha, 4abeta, 5beta, 8beta, 8abeta)- |
| 60-57-1 | 2, 7:3, 6-Dimethanonaphth[2, 3-b]oxirene, 3, 4, 5, 6, 9, 9-hexa- chloro- 1a, 2, 2a, 3, 6, 6a, 7, 7a-octahydro-, (1aalpha, 2beta, 2aalpha, 3beta, 6beta, 6aalpha, 7beta, 7aalpha)- |
| 72-20-8 | 2, 7:3, 6-Dimethanonaphth[2, 3-b]oxirene, 3, 4, 5, 6, 9, 9-hexachloro- 1a, 2, 2a, 3, 6, 6a, 7, 7a-octahydro-, (1aalpha, 2beta, 2abeta, 3alpha, 6alpha, 6abeta, 7beta, 7aalpha)- and metabolites |
| 60-51-5 | Dimethoate |
| 122-09-8 | alpha, alpha-Dimethylphenethylamine |
| 534-52-1 | 4, 6-Dinitro-o-cresol, and salts |
| 51-28-5 | 2, 4-Dinitrophenol |
| 88-85-7 | Dinoseb |
| 152-16-9 | Diphosphoramide, octamethyl- |
| 107-49-3 | Diphosphoric acid, tetratethyl ester |
| 298-04-4 | Disulfoton |
| 541-53-7 | Dithiobiuret |
| 115-29-7 | Endosulfan |
| 145-73-3 | Endothall |
| 72-20-8 | Endrin and metabolites |
| 51-43-4 | Epinephrine |
| 460-19-5 | Ethanedinitrile |
| 16752-77-5 | Ethanimidothioic acid, N[[(methylamino)carbonyl] oxy]-, methyl ester |
| 107-12-0 | Ethyl cyanide |
| 151-56-4 | Ethyleneimine |
| 52-85-7 | Famphur |
| 7782-41-4 | Fluorine |
| 640-19-7 | Fluoroacetamide |
| 62-74-8 | Fluoroacetic acid, sodium salt |
| 628-86-4 | Fulminic acid, mercury(2+) salt |
| 76-44-8 | Heptachlor |
| 757-58-4 | Hexaethyl tetraphosphate |
| 79-19-6 | Hydrazinecarbothioamide |
| 60-34-4 | Hydrazine, methyl- |
| 74-90-8 | Hydrocyanic acid |
| 74-90-8 | Hydrogen cyanide |
| 7803-51-2 | Hydrogen phosphide |
| 465-73-6 | Isodrin |
| 2763-96-4 | 3(2H)-Isoxazolone, 5-(aminomethyl)- |
| 62-38-4 | Mercury, (aceto-O)phenyl- |
| 628-86-4 | Mercury fulminate |
| 62-75-9 | Methanamine, N-methyl-N-nitroso- |
| 624-83-9 | Methane, isocyanato- |
| 542-88-1 | Methane, oxybis(chloro- |
| 509-14-8 | Methane, tetranitro- |
| 75-70-7 | Methanethiol, trichloro- |
| 115-29-7 | 6, 9-Methano-2, 4, 3-benzodioxathiepin, 6, 7, 8, 9, 10, 10-hexacloro- 1, 5, 5a, 6, 9, 9a-hexahydro-, 3-oxide |
| 76-44-8 | 4, 7-Methano-1H-indene, 1, 4, 5, 6, 7, 8, 8-heptachloro-3a, 4, 7, 7a-tetrahydro- |
| 16752-77-5 | Methomyl |
| 60-34-4 | Methyl hydrazine |
| 624-83-9 | Methyl isocyanate |
| 75-86-5 | 2-Methyllactonitrile |
| 298-00-0 | Methyl parathion |
| 86-88-4 | alpha-Naphthylthiourea |
| 13463-39-3 | Nickel carbonyl |
| 557-19-7 | Nickel cyanide |
| 54-11-5 | Nicotine and salts |
| 10102-43-9 | Nitric oxide |
| 100-01-6 | p-Nitroaniline |
| 10102-44-0 | Nitrogen dioxide |
| 10102-43-9 | Nitrogen oxide |
| 55-63-0 | Nitroglycerine |
| 62-75-9 | N-Nitrosodimethylamine |
| 4549-40-0 | N-Nitrosomethylvinylamine |
| 152-16-9 | Octamethylpyrophosphoramide |
| 20816-12-0 | Osmium oxide |
| 20816-12-0 | Osmium tetroxide |
| 145-73-3 | 7-Oxabicyclo(2, 2, 1)heptane-2, 3-dicarboxylic acid |
| 56-38-2 | Parathion |
| 131-89-5 | Phenol, 2-cyclohexyl-4, 6-dinitro- |
| 51-28-5 | Phenol, 2, 4-dinitro- |
| 534-52-1 | Phenol, 2-methyl-4, 6-dintro-, and salts |
| 88-85-7 | Phenol, 2-(1-methylpropyl)-4, 6-dinitro- |
| 131-74-8 | Phenol, 2, 4, 6-trinitro-, ammonium salt |
| 62-38-4 | Phenylmercury acetate |
| 103-85-5 | Phenylthiourea |
| 298-02-2 | Phorate |
| 75-44-5 | Phosgene |
| 7803-51-2 | Phosphine |
| 311-45-5 | Phosphoric acid, diethyl 4-nitrophenyl ester |
| 298-04-4 | Phosphorodithioic acid, O, O-diethyl S-[2-(ethylthio)ethyl] ester |
| 298-02-2 | Phosphorodithioic acid, O, O-diethyl S-[2-(ethylthio)methyl] ester |
| 60-51-5 | Phosphorodithioic acid, O, O-dimethyl S-[2-(methylamino)-2-oxoethyl]ester |
| 55-91-4 | Phosphorofluoridic acid, bis(1-methylethyl) ester |
| 56-38-2 | Phosphorothioic acid, O, O-diethyl O-(4-nitrophenyl) ester |
| 297-97-2 | Phosphorothioic acid, O, O-diethyl O-pyrazinyl ester |
| 52-85-7 | Phosphorothioic acid, O-[4-[(dimethylamino)sulfonyl]phenyl] O, O-dimethyl ester |
| 298-00-0 | Phosphorothioic acid, O, O, -dimethyl O-(4-nitrophenyl) ester |
| 78-00-2 | Plumbane, tetraethyl- |
| 151-50-8 | Potassium cyanide |
| 506-61-6 | Potassium silver cyanide |
| 116-06-3 | Propanal, 2-methyl-2-(methylthio)-O-[(methylamino)carbonyl] oxime |
| 107-12-0 | Propanenitrile |
| 542-76-7 | Propanenitrile, 3-chloro |
| 75-86-5 | Propanenitrile, 2-hydroxy-2-methyl |
| 55-63-0 | 1, 2, 3-Propanetriol, trinitrate |
| 598-31-2 | 2, Propanone, 1-bromo |
| 107-19-7 | Propargyl alcohol |
| 107-02-8 | 2-Propenal |
| 107-18-6 | 2-Propen-1-ol |
| 75-55-8 | 1, 2-Propylenimine |
| 107-19-7 | 2-Propyn-1-ol |
| 504-24-5 | 4-Pyridinamine |
| 54-11-5 | Pyridine, 3-(1-methyl-2-pyrrolidinyl)- and salts |
| 12039-52-0 | Selenious acid, dithallium (1+) salt |
| 630-10-4 | Selenourea |
| 506-64-9 | Silver cyanide |
| 26628-22-8 | Sodium azide |
| 143-33-9 | Sodium cyanide |
| 57-24-9 | Strychnidin-10-one, and salts |
| 357-57-3 | Strychnidin-10-one, 2, 3-dimethoxy- |
| 57-24-9 | Strychnine, and salts |
| 7446-18-6 | Sulfuric acid, dithallium (1+) salt |
| 3689-24-5 | Tetraethyldithiopyrophosphate |
| 78-00-2 | Tetraethyl lead |
| 107-49-3 | Tetraethyl pyrophosphate |
| 509-14-8 | Tetranitromethane |
| 757-58-4 | Tetraphosphoric acid, hexaethyl ester |
| 1314-32-5 | Thallic oxide |
| 12039-52-0 | Thallium(I) selenite |
| 7446-18-6 | Thallium(I) sulfate |
| 3689-24-5 | Thiodiphosphoric acid, tetraethyl ester |
| 39196-18-4 | Thiofanox |
| 541-53-7 | Thioimidodicarbonic diamide |
| 108-98-5 | Thiophenol |
| 79-19-6 | Thiosemicarbazide |
| 5344-82-1 | Thiourea, (2-chlorphenyl)- |
| 86-88-4 | Thiourea, 1-naphthalenyl- |
| 103-85-5 | Thiourea, phenyl- |
| 8001-35-2 | Toxaphene |
| 75-70-7 | Trichloromethanethiol |
| 7803-55-6 | Vanadic acid, ammonium salt |
| 1314-62-1 | Vandium oxide |
| 1314-62-1 | Vanadium pentoxide |
| 4549-40-0 | Vinylamine, N-methyl-N-nitroso- |
| 81-81-2 | Warfarin, and salts, greater than 0.3% |
| 557-21-1 | Zinc cyanide |
| 1314-84-7 | Zinc phosphide |

**APPENDIX C - REPRODUCTIVE TOXINS**

*OSHA Laboratory Standard Definition:* Reproductive toxin means chemicals which affect the reproductive capabilities including chromosomal damage (mutations) and effects on fetuses (teratogenesis).

**CHEMICAL NAME CAS NUMBER**

Acetohydroxamic acid 546-88-3

Actinomycin D 50-76-0

All-trans retinoic acid 302-79-4

Alprazolamm 8981-97-7

Amikacin sulfate 3983-55-5

Aminoglutethimide 125-84-8

Aminoglyosides

Aminopterin 54-62-6

Angiotensin converting enzyme (ACE inhibitors)

Anisindione 117-37-3

Aspirin 50-78-2

Barbiturates

Benomyl 17804-35-2

Benzphetamine hydorchloride 5411-22-3

Benzodiazepines

Bischloroethyl nitrosurea (BCNU) (carmustine) 154-93-8

Bromoxynil 1689-84-5

Butabarbital sodium 143-81-7

1,4-Butanediol dimethylsulfonate (busulfan) 55-98-1

Carbon disulfide 75-15-0

Carbon monoxide 630-08-0

Carboplatin 41575-94-4

Chenodiol 474-25-9

Chlorcyclizine hydrochloride 1620-21-9

Clorambucil 305-03-3

Chlordecone (kepone) 143-50-0

Chlordiazepoxide 58-25-3

Chlordiazepoxide hydorchloride 438-41-5

1-(2-Chloroethyl)-3-cyclohexyl-1-nitrosourea 13010-47-4

Clomiphene citrate 50-41-9

Chlorazepate dipotassium 57109-90-7

Cocaine 50-36-2

Colchicine 64-86-8

Conjugated estrogens

Cyanazine 21715-46-2

Cycloheximide 66-81-9

Cyclophosphamide (anhydrous) 50-18-0

Cyclophosphamide (hydrated) 6055-19-2

Cyhexatin 13121-70-5

Cytarabine 147-94-4

Danazol 17230-88-5

Daunorubicin hydrochloride 23541-50-6

Demeclocycline hydrochloride (internal use) 64-73-3

Dicumarol 66-76-2

Diethylstilbestrol (DES) 56-53-1

Dinocap 39300-45-3

Dinoseb 88-85-7

Diphenylhydantoin (phenytoin) 57-41-0

Doxycycline (internal use) 564-25-0

Doxycycline calcium (internal use) 94088-85-4

Doxycycline hyclate (internal use) 24390-14-5

Doxycycline monohydrate (internal use) 17086-28-1

Ergotamine tartrate 379-79-3

Ethylene glycol monoethyl ether 110-80-5

Ethylene glycol monomethyl ether 109-86-4

Ethylene glycol monoethyl ether acetate 111-15-9

Ethylene glycol monomethyl ether acetate 110-49-6

Ethylene thiourea 96-45-7

Etoposide 33419-42-0

Etratinate 54350-48-0

Fluorouracil 51-21-8

Fluoxymesterone 76-43-7

Flurazepam hydorchloride 1172-18-5

Flutamide 13311-84-7

Halazepam 23093-17-3

Hexachlorobenzene 118-74-1

Ifosfamide 3778-73-2

Iodine-131 24267-56-9

Isotretinoin 4759-48-2

Lead 7439-92-1

Lithium carbonate 554-13-2

Lithium citrate 919-16-4

Lorazapam 846-49-1

Lovastatin 75330-75-5

Medroxyprogesterone acetate 71-58-9

Megestrol acetate 595-33-5

Melphalan 148-82-3

Menotropins 9002-68-0

Meprobamate 57-53-4

Mercaptopurine 6112-76-1

Methacycline hydorchloride 3963-95-9

Methimazole 60-56-0

Methotrexate 59-05-2

Tethotrexate sodium 15475-56-6

Methyl bromide 74-83-9

Methyl mercury 22967-92-6

Methyltestosterone 58-18-4

Midazolam hydrochloride 59467-96-8

Minocycline hydrochloride (internal use) 13614-98-7

Misoprostol 62015-39-8

Mitoxantrone hydrochloride 70476-82-3

Nafgarelin acetate 86220-42-0

Neomycon sulfate (internal use) 1405-10-3

Netilmicin sulfate 56391-57-2

Nitrogen mustard (mechlorethamine) 51-75-2

Nitrogen mustard hydorchloride 55-86-7

Norethisterone (norethindrone) 68-22-4

Norethisterone acetate (norethindrone acetate) 51-98-9

Norethisterone (norethindrone)/ethinyl estradiol 68-22-4/57-63-6

Norethisterone (norethindrone)/mestranol 68-22-4/72-33-3

Norgrestrel 6533-00-2

Oxazepam 604-75-1

Oxytetracycline (internal use) 79-57-2

Oxytetracycline hydrochloride (internal use) 2058-46-0

Paramethadione 115-67-1

Penicillamine 52-67-5

Phenacemide 63-98-9

Phenprocoumon 435-97-2

Pipobroman 54-91-1

Plicamycin 18378-89-7

Polychlorinated biphenyls

Procarbazine hydrochloride 366-70-1

Propylthiouracil 51-52-5

Ribarvirin 36791-04-5

Secobarbital sodium 309-43-3

Streptomycin sulfate 3810-74-0

Tamoxifen citrate 54965-24-1

Temazepam 846-50-4

Testosterone cypionate 58-20-8

Testosterone enanthate 315-37-7

2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD) 1746-01-6

Tetracycline (internal use) 60-54-8

Thalidomide 50-35-1

Thioguanine 154-42-7

Tobacco smoke (primary)

Tobramycin sulfate 49842-07-1

Toluene 108-88-3

Triazolam 28911-01-5

Trilostane 13647-35-3

Uracil mustard 66-75-1

Urofollitropin 26995-91-5

Valproate (valproic acid) 99-66-1

**APPENDIX D Respirator Policy (Truncated). The complete Respirator Policy is available at the OEHS and must be consulted in coordination with the OEHS for all respirator and dust mask users.**

**I. INTRODUCTION**

As part of a continuing effort to provide a safe and healthful workplace for University employees, this policy has been developed to ensure that employees are adequately protected from air contaminants and other respiratory hazards including:

* Gas and vapor contaminants;
* Airborne particulate matter;
* Oxygen deficiency; or
* Any combination of the above.

While the proper respirator may offer suitable protection against the above hazards, a respirator must not be considered the first choice for offering protection. The primary method for controlling exposure to respiratory hazards in the workplace must be through engineering controls such as ventilation, enclosure of an operation, or substitution with less toxic materials. However, when workers may be exposed above recognized exposure limits, respirators must be used if:

1. Engineering controls are not feasible;
2. Engineering controls alone cannot reduce exposures to acceptable levels; or
3. Respirators are used as an interim measure while engineering controls are in the process of being implemented.

This policy incorporates the requirements of the Occupational Safety and Health Administration’s (OSHA’s) Respiratory Protection Standard (29 CFR 1910.134) and serves as the University’s written respiratory protection program, as required by the Standard. The Coordinator for Environmental Health and Safety is the designated Program Administrator for the University.

**II. SCOPE**

This policy covers **the use of any type of respirator** by SCSU employees, including:

1. **Mandatory use**: when a respirator is necessary to protect the health of an employee from exposure to air contaminants above an exposure limit or otherwise necessary to protect employee health; or when an employee is directed to wear a respirator as a condition of employment.
2. **Voluntary use**: when a respirator is worn for comfort or other reasons by an employee, though conditions do not exist (as described in item 1, above) that mandate its use.
3. **Use of Dust Masks**: filtering face piece respirators, otherwise known as dust masks, are considered respirators by OSHA and are covered by this policy and by the OSHA Respiratory Protection Standard.

**III. RESPIRATOR SELECTION**

1. Only respirators certified by the National Institute for Occupational Safety and Health (NIOSH) may be used.
2. Respirators must be selected on the basis of the potential hazard to which the worker is exposed. The following factors must be considered in making this selection.
3. The identity of the substance(s) and environment for which protection is needed;
4. The physical state of the contaminant (dust, mist, vapor, etc., or a combination thereof);
5. The permissible exposure limit or toxicity of the substance;
6. Exposure assessments indicating the concentration likely to be encountered;
7. The protection factor listed for the respirator type;
8. The possibility of oxygen deficiency or other environments that are immediately dangerous to life or health (IDLH); **and**
9. Any limitations or restrictions applicable to the types of respirators being considered which could make them unsafe in the environment involved.
10. Assessments to determine or predict the potential exposure concentrations and proper respirator selection must be made in consultation with the Office of Environmental Health and Safety (OEHS).
11. Respirator Types and Acceptable Use Criteria
12. **Air-Purifying Respirators (APRs)** cleanse contaminated air as it passes through an air-purifying device (such as a filter, cartridge, or canister). The respirator will not offer protection unless the proper air-purifying device made for specific air contaminants (such as gases, vapors, dusts, mists and fumes) is used. Contact the OEHS for assistance in selecting the proper air-purifying device.
13. *Dust Masks*
14. *Full-face piece and half-mask negative pressure respirators*
15. *Powered Air-Purifying Respirators* (PAPR)

2. **Atmosphere-Supplying Respirators** provide a supply of breathable air to the wearer from an uncontaminated source, independent of the ambient air. The OSHA Respiratory Protection standard requires employers to provide workers who are wearing atmosphere-supplying respirators with breathing air of high purity. Two types of atmosphere-supplying respirators are:

1. *Air-line Respirators*
2. *Self-contained Breathing Apparatus (SCBA)*
3. **Combination Respirators**
4. *SCBA/Air-line combination units*
5. *Air-Purifying/Air-line* combination *units*

**IV. VOLUNTARY USE OF RESPIRATORS**

On occasion employees may desire to use dust masks voluntarily, though conditions do not exist that mandate their use. In such cases, medical evaluations and fit testing are not required and the employer may provide dust masks at the request of the employees or permit them to use their own if:

* the use of the dust mask is not required by the employer;
* the dust mask is used for comfort purposes only and not to protect the health of the employee;
* the employer determines that such dust mask use will not in itself create a hazard; AND
* Pertinent selection, maintenance, and training requirements outlined in this policy are met.

1. Voluntary use of dust masks: When dust masks will be used voluntarily, supervisors must ensure that:
2. Employees receive dust mask awareness training.
3. The respirator maintenance and care provisions of this policy are followed.
4. Voluntary use of all other respirators
5. If other types of respirators will be used voluntarily, supervisors must ensure that employees are medically evaluated, trained, and fit-tested annually, as outlined below.

**V. MEDICAL EVALUATIONS**

An initial medical evaluation must be conducted by a physician or other licensed licensed health care professional before an employee is assigned tasks requiring the use of a respirator, or before an employee is allowed to voluntarily use a respirator. Voluntary use of dust masks does not require this medical evaluation. The licensed health care professional will make a written determination of whether the employee is able to use a respirator. The medical evaluation may be conducted by means of a physical examination or by a health care practitioner’s review of the Medical Evaluation Questionnaire completed by the employee. Upon review of the questionnaire, the health care practitioner may request to conduct a follow-up physical examination of the employee at his/her discretion.

**VI. MEDICAL RECORDS**

An accurate record for each employee subject to medical surveillance must be established and maintained. The record must include at least the following information:

1. The name of the employee;
2. The health care practitioner’s written recommendation;
3. A copy of the employee's medical evaluation results, including the Medical Evaluation Questionnaire, and results of any tests or follow-up physical examinations; and
4. Any employee medical complaints related to exposure to any respiratory hazards.

The University is responsible for ensuring that this record is maintained for the duration of employment plus thirty (30) years, in accordance with 29 CFR 1910.1020. University Health Services will maintain these records. The OEHS will maintain only the current copy of the employee’s name and the health care practitioner’s written recommendation, for training and fit test purposes. In addition, University Health Services and the OEHS will maintain a current copy of the University’s Respirator Policy.

**VII. TRAINING**

All employees must receive training prior to using any respirator, including dust masks. For users of air purifying respirators (APRs), training will be conducted by the Program Administrator in the OEHS or his/her authorized designee. Departments must make special arrangements for SCBA and Air-line Respirator users to receive training from a qualified instructor. Departments may contact the OEHS for referrals.

**Supervisors must ensure that employees receive training as follows:**

1. **Initially**—prior to being assigned a respirator.
2. **Annually**
3. **Whenever retraining appears necessary because:**
4. Changes in the workplace or the type of respirator render the previous training obsolete.
5. Inadequacies in the employee’s knowledge or use of the respirator indicate that the employee has not retained the necessary understanding or skill.
6. Any other situation arises in which retraining appears necessary to ensure safe respirator use.

Employees who **voluntarily** wear dust masks must be scheduled for an awareness level of training conducted by their supervisor, using the Voluntary Use of Filtering Face piece Respirators training record or by the Program Administrator in Environmental Health and Safety or his/her authorized designee. The employee must receive a copy of OSHA’s Appendix D. This training is only required once.

**VIII. RESPIRATOR FIT**

A properly fitting respirator is essential if employees are to receive adequate protection**. Supervisors must ensure that each employee is Fit Tested to his/her assigned respirator prior to its first use**. In addition, User Seal Checks must be performed by the employee prior to each use of the respirator. Procedures for Fit Tests and User Seal Checks and other considerations to ensure fit are as follow:

1. Fit Tests

### User Seal Checks

### Other Considerations for Proper Fit

**IX. RESPIRATOR MAINTENANCE AND CARE**

#### Cleaning and Disinfecting

#### Procedures for Cleaning Respirators

1. **Storage**
2. **Inspections**

**XI. PROGRAM EVALUATION** The Program Administrator in the OEHS will conduct periodic workplace evaluations to ensure that this policy is being effectively implemented. The evaluations will include site inspections, a review of records, and regular consultations with employees who use respirators and their supervisors. A report identifying problems will be forwarded to the employee’s supervisor, and will include recommended corrective action and target dates for the implementation of those corrections.

**APPENDIX E - University Policy for Chemical Spills and Exposures**

**Purpose**

This procedure outlines the requirements for the management of chemical spills in the workplace to minimize effects to health and safety from exposure to chemical spills and reduce the impact on the environment. The procedure applies to all University staff students and contractors in all areas of the University where chemical substances are transported, purchased, stored, handled, or used, including vehicles of visitors or suppliers who bring substances into the University that are potentially hazardous

The procedure provides general guidance and therefore each laboratory or other work area that use chemical substances should have specific procedures for the particular types of substances used within the workplace or brought onto the premises.

**Definitions**

* **OSHA** – Occupational Safety and Health Administration
* **Personal Protective Equipment (PPE)** - equipment to protect a person working in a hazardous environment.
* **Berm** – is an embankment or wall of brick, stone, concrete, or other impervious material, which may form part of or the entire perimeter of a compound and provides a barrier to retain liquid. The berm is designed to contain spills and leaks from liquids used, stored or processed above ground and to facilitate cleanup operations.
* **Hazardous Chemical** – A **hazardous chemical** is defined by OSHA as any chemical that is a health hazard or a physical hazard.
  + **Health Hazard -** OSHA defines a **health hazard** as a chemical for which there is statistically significant evidence based on at least one study conducted in accordance with established scientific principles that acute or chronic health effects may occur in exposed employees. Chemicals covered by this definition include carcinogens, toxic or highly toxic agents, reproductive toxins, irritants, corrosives, sensitizers, hepatotoxins, nephrotoxins, neurotoxins, agents that act on the hematopoietic system, and agents that damage the lungs, skin, eyes, or mucous membranes.
  + **Physical Hazard -** OSHA defines a **physical hazard** as a chemical for which there is scientifically valid evidence that it is a combustible liquid, a compressed gas, explosive, flammable, an organic peroxide, an oxidizer, pyrophoric, unstable (reactive), or water-reactive.
* **Additional Hazardous Chemicals -** The broad definition OSHA uses to define hazardous chemicals includes not only generic chemicals but also paints, cleaning compounds, inks, dyes, and many other common substances. Chemical manufacturers and importers are required to determine if the chemicals they produce or repackage meet the definition of a hazardous chemical. A chemical mixture may be considered as a whole or by its ingredients to determine its hazards. It may be considered as a whole if it has been tested as a whole and an MSDS has been issued accordingly. Otherwise the mixture must be evaluated by its components. If the mixture contains 1.0 percent or more of a hazardous chemical or 0.1 percent of an ingredient listed as a carcinogen or suspected carcinogen, the whole mixture is assumed to have the same health and/or carcinogenic hazards as its components.
* **Hazardous Substance** – Any biological agent and other disease-causing agent which after release into the environment and upon exposure, ingestion, inhalation, or assimilation into any person...will or may reasonably be anticipated to cause death, disease, behavioral abnormalities, cancer, genetic mutation, physiological malfunctions...or physiological deformations in such persons or their offspring.
* **Material Safety Data Sheet (MSDS)** – Formal document mandated by the Occupational Safety and Health Administration (OSHA) which contains important information about the characteristics and actual or potential hazards of a substance. It identifies the manufacturer of the material (with name, address, phone, and FAX number), and usually includes (1) chemical identity (2) hazardous ingredients (3) physical and chemical properties (4) fire and explosion data (5) reactivity data (6) health hazards (7) exposure limits (8) precautions for safe storage and handling (9) personal protective equipment information (10) spill control, cleanup, and disposal procedures.
* **OEHS** – Office of Environmental Health and Safety

**Roles and Responsibilities**

1. **Supervisors are responsible for ensuring that:**
2. This policy is implemented within their area of responsibility
3. All necessary equipment is available and maintained in the case of a chemical spill, and is clearly labeled
4. Risk assessments are carried out to identify risk control measures to protect the health and safety of people and potential harm to the environment
5. All staff receive appropriate training to deal with chemical spills where identified as necessary
6. Appropriate personnel are informed of any chemical spills and external providers contracted to clean up where necessary
7. Information is provided to all relevant staff and students to safely clean up spilled chemical substances. This should include emergency services contact details and other staff as appropriate, building evacuation information, location of equipment and spill cleanup materials and personal protective equipment
8. All new area staff are included in chemical spill management procedures and training
9. **Staff are responsible for ensuring that:**
10. They do not place themselves or others at risk of injury
11. They place personal safety first - keep clear of a spill unless trained in spill control and clean up
12. Immediately reporting a chemical spill to their supervisor and the OEHS
13. They know where MSDS’s are kept, or how they can be accessed
14. Completing chemical spill management and exposure training
15. Following written procedures for spill control
16. Ensuring that spill control equipment is used in the proper manner
17. Ensuring that equipment is stored and maintained as appropriate

**Procedure and Guidelines**

1. **Preparation for** **Chemical Spills**

Staff that use or manage chemical substances must have an understanding of the Material Safety Data Sheet including the special requirements for spill control such as the type of fire extinguisher required, incompatible substances, and reactivity with substances such as water or air. Where a substance is unknown, or is an experimental substance that does not have an MSDS always treat as HIGH RISK.

Wherever practicable, the storage and use of the chemicals should be in an area which can contain or restrict the flow from a spill site. On benches, this can be assisted by a raised lip at the front of the bench, or by the use of spill trays.

1. **Spill Kits**

Spill kits should be available for use where assessed as required. Your laboratory or work area should have access to sufficient quantity of absorbents or other types of materials to control any spill that can be reasonably anticipated. 5-gallon pails and limited spill control materials are available at main hazardous waste storage area at Jennings building. Additional materials may be found in certain laboratories and the Facilities Operations building.

The contents of the spill kit should be relevant to the area and the potential spill; this may include such things as:

**Personal Protective Equipment**

* 2 pairs chemical splash goggles
* 2 pairs of gloves (recommend Nitrile or Silver Shield)
* 2 pairs of shoe covers
* 2 plastic or Tyvek aprons and/or Tyvek suits

**Absorption Materials**

* (4) 3M POWERSORB spill pillows (or equivalent)
* (2) 3M POWERSORB spill sock
* D.O.T. pail (5 gallon) with polyethylene liner

Ensure that the spill kit is clearly labeled and located in an easily accessible position for all staff. Ensure that all staff are aware of and can access and know how to use the spill kit in case of an emergency. Spill kits must be restocked following use and the contents should be checked on a monthly basis.

The primary concern is to protect health and safety no action should be taken during an emergency response that directly or indirectly puts human health and safety at risk.

1. **Circumstances Requiring Evacuation**

* Uncontrolled open flame
* Uncontrolled compressed gas release
* Any situation which poses imminent threat to human health or safety

When an evacuation alarm sounds, all persons must immediately exit the building and report to their assigned assembly area. Attempting to control potential sources of ignition should only occur if it can be accomplished without personal risk, and you have been trained in the use of a fire extinguisher.

1. **Minor Chemical Spill:** If you have a minor chemical spill, you must:

* Alert people in the immediate area of the spill.
* Increase ventilation in the area of the spill (open a window, turn on fume hood).
* Wear protective equipment, including safety goggles or face shield, gloves and long-sleeve lab coat.
* Avoid breathing vapors from the spill.
* Confine the spill to a small area, with adsorbent materials.
* Use the appropriate kit to neutralize and adsorb inorganic acids and bases. For other chemicals, use the appropriate kit or adsorb the spill with vermiculite, dry sand, diatomaceous earth or paper towels. Collect the residue, place in a container, label the container, and call the Office of Environmental Health and Safety (OEHS) at (2-7073) for disposal information. Do not throw these materials into the trash can.
* Clean the spill area with soap and water.

1. **Major Chemical Spill or Spill of an Extremely Hazardous Substance**

***Note:*** *Employees are not to attempt to clean up Major or High Risk spills unless they have had specific training in HIGH RISK spill cleanup. Specific personnel with training or external contractors will manage the spills.*

Some spills are large (> 1 liter) or involve very hazardous or unknown substances. You should not attempt to clean them by yourself! Examples of very hazardous substances include: bromine, hydrazine, cyanides, Class 1 A flammable solvents, alkali metals and white phosphorus.

If you have a major spill you must:

* Immediately call the OEHS 203-392-7073 or 203-619-3858 or the University Police at 911.
* Alert people in the surrounding area to evacuate.
* Attend to injured or contaminated persons and remove them from exposure. In case of personal contamination, remove affected clothing and flush contaminated skin with water for at least fifteen minutes. Use an emergency shower if available. Seek medical attention immediately.
* If it will not place your health or safety at risk, turn off ignition and heat sources, maintain fume hood ventilation and open windows to increase ventilation.
* Close doors to affected areas as you leave.
* Have a person with knowledge of the incident and laboratory assist emergency personnel upon arrival.

1. **Mercury Spill Cleanup**

Mercury is a metal that occurs naturally in the environment in several forms. The most common form, metallic or elemental mercury, is a silvery, odorless heavy metal that is liquid at room temperature, and is the form commonly found in household thermometers. Elemental mercury can evaporate at room temperature to form a vapor. Mercury can escape to the environment when items containing mercury are broken or improperly discarded. Mercury is toxic by inhalation, absorption through the skin, and ingestion.

Although SCSU has taken measures to significantly reduce the amount of mercury on the campus, we are not mercury-free. Therefore, in the case of a small mercury spill in your laboratory, such as a broken thermometer, one option is to clean up the spill yourself.  This option should only be exercised if you have been trained to do so.  If your laboratory decides to clean up the mercury spill on their own, follow the clean-up procedure below.  The other option is to contact the OEHS to clean up the mercury spill.

1. **What NEVER to do in the Event of a Mercury Spill**

Remember that mercury is a very toxic chemical. Prolonged exposure to mercury vapor will cause damage to the human nervous system. It is important to clean up all mercury spills completely. If the mercury spilled on a porous surface such as a rug or cloth chair, do not attempt to clean it yourself. Contact the OEHS for assistance.

1. **Never** walk around an area that is contaminated with mercury.  Mercury is easily spread and the spill area may not be easily identified.  Contaminated clothing can also spread mercury around.
2. **Never** use an ordinary vacuum cleaner to clean up mercury. The vacuum will put mercury vapor into the air and increase exposure. The vacuum cleaner will be contaminated and will have to be disposed of as hazardous waste.
3. **Never** use a broom to clean up mercury. It will break the mercury into smaller droplets and spread them.
4. **Never** wash mercury-contaminated items in a washing machine. Mercury may contaminate the machine and/or pollute the water system.
5. **What to do if a Mercury Thermometer Breaks in Your Laboratory:** In the event of an elemental mercury spill of any size:
6. Evacuate room occupants (including animals.).
7. Secure the area, to keep people from walking through and tracking the mercury outside of the spill area. Close any doors that may help to isolate the incident room as long as you can do so without walking through the spill.
8. Turn off the heat. Heat volatilizes mercury, creating airborne mercury vapors.
9. Turn off the ventilation. The ventilation system could distribute mercury vapors throughout the building.
10. Open the window(s) to help remove any vapors. If mercury is visible on any article of clothing or shoes, or if anyone has walked through the spill area remove the articles from the person and keep the articles in the incident room.
11. If you or any other person has come in contact with the mercury or suspect that you have been contaminated, do not leave the area, so you don’t spread the contamination.  Call the OEHS at x27073 or 911 from a campus phone for assistance in decontaminating the exposed individuals.
12. Notify the Office of Environmental Health & Safety at 2-7073. Mercury spills larger than the quantity found in a thermometer will be cleaned by a HAZMAT spill contractor.

**Note:** The Connecticut DEEP requires notification of all mercury spills, regardless of the quantity. Notification to the National Response Center (EPA) is required for spills in excess of 1 pound (two tablespoons). Spill notification is the responsibility of the Director of the OEHS.

1. **Preparation and Cleaning a Mercury Spill**
2. If you have been trained and it is your laboratory policy to clean small mercury spills (usually the quantity found in a thermometer or less), you can proceed to clean up the spill. The spill has to be in your lab or shop area for you to clean it up on your own.  You must contact the OEHS for assistance if the spill occurs in a common area, corridor, and/or if the amount of mercury spilled is larger than is typically found in a thermometer.
3. Put on rubber, nitrile, or latex gloves.
4. Put on disposable, non-porous shoe covers (plastic bags may work for this).
5. Perform a visual inspection to determine the extent of the contamination.
6. Use a flashlight to look for mercury beads. Shine the flashlight at many low, different angles on the spill area. The light will reflect off of the shiny mercury beads to make it easier to see them.  Start at least one foot behind where you believe the contamination starts.  If you cannot find the mercury, contact OEHS for assistance.
7. Contain the mercury spill to as small of an area as possible.  Prevent the mercury beads from spreading into drains, cracks or crevices, on to sloped or porous surfaces, or any other inaccessible areas.
8. Work from the outside of the spill area to the center of the spill area. Push the mercury beads together with a 3 X 5 index card or stiff paper to form larger droplets. Mercury beads roll very quickly, so be careful!  Push the mercury beads into a plastic dustpan or use a pipette to pick up the beads.  You can also use tape to pick up the little beads of mercury, but be careful because they might not always stick. Collect all mercury into a sealable plastic bag.
9. If the mercury spill involves glass pieces, such as from a glass thermometer, pick them up with care, as they may be sharp.  Place all broken glass on a small paper towel.  Fold up the paper towel and place it in the same sealable plastic bag as the mercury droplets.
10. When you think you’ve picked up all of the mercury, shine a flashlight (at many different, low angles) on the area to help find any remaining mercury beads or glass. The light will reflect off the shiny mercury beads and glass.
11. Contact the OEHS at x27073 for mercury vapor monitoring to ensure that there is no further contamination.
12. Remove shoe covers and gloves and place into a waste bag.
13. Seal the bag and place it into a second plastic bag.  Seal the outer bag as well.
14. Create a hazardous waste tag.  Affix the tag to the outer bag and bring it to the satellite accumulation area in the lab or shop area.
15. Inspect your shoes and clothing for mercury before exiting the area.
16. After you are completely finished with the mercury clean up, wash your hands. If other parts of your body may have come in contact with mercury, shower or bathe.
17. **Mercury Spill Kit Recommendations**
18. 4-5 zip lock-type bags (1-gallon size)
19. 4-5 trash bags (30-gallon size)
20. At least 6 pairs of rubber, nitrile or latex gloves
21. Paper towels
22. 3 X 5 index card or stiff paper
23. Duct tape
24. Flashlight with spare batteries
25. Non-porous shoe covers
26. Plastic dust pan or plastic tray
27. Emergency contact information (OEHS Office- x27073)
28. **Post Spill Cleanup**

* All spill control supplies shall to be restocked.
* All damaged or used equipment must be repaired or refilled.
* When the area is deemed clear, it can be re-opened for normal operations.

1. **Training and** **Awareness**

The University has developed online learning programs that deal with Environmental Awareness and Chemical Spill Management to provide staff with general information and awareness relating to the management of chemical substances. It is required that any staff member who is responsible for the use, storage or management of chemical substances complete the online learning programs.

Specific training for chemical spill management is to be coordinated with the OEHS, and recorded.

**APPENDIX F - Emergency Door Card**

**Equipment Available in this Room:**

□ Eyewash

□ Safety Shower

□ Drench Hose

□ Fire Extinguisher

□ Radiation Detection Equipment

□ Spill Kit

□ Other: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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**Occupant Emergency Contact Numbers:**

(Contact in order listed)

Name:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Emergency phone: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Name:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Emergency phone: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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Emergency phone: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Additional Instructions/Information:**

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**Pull to Remove**

**SAFETY INFORMATION CARD**

**Entry Requirements/Restrictions: see inside**

□ If checked, pull and open card for additional information.

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Building Room

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_

Lab Director or Supervisor Phone

**Room Type:**

□ Research Lab □ Animal Facility

□ Clinical Lab □ Instrumentation

□ Teaching Lab □ Storage

□ Shop □ Other: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Room Hazards**

**Biological Safety Level (BSL)**

□ None □ BSL-1 (Low Risk)

□ BSL – 2 (Moderate Risk) □ BSL-3 (Higher Risk)

Agents Used or Stored in this room: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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**Chemical**

□ Flammable Liquids (>5 gal. total)

□ Cryogenic Liquids

□ Compressed Gas Cylinder(s):

- Toxic/Corrosive: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

- Flammable:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

□ Special Hazard(s): \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Radiation Sources**

□ **NONE** □ C-14 □ H-3 □ I-125 □ P-32 □ S-35 □ Other: \_\_\_\_\_\_\_\_\_

□ Sealed Sources: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Radionuclide

□ X-Ray Producing Equipment: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Description

**Non-Ionizing Sources** □ Laser □ Microwave

□ High Magnetic Fields

**EMERGENCY NUMBERS:**

**Ambulance/Fire/Police: 911**

**Office of Environmental Health and Safety:**

**203-392-7073 (8 a.m. – 4 p.m.) 203-619-3858 (after 4 p.m., holidays and weekends).**

**EMERGENCY RESPONDER GUIDELINES**

**FIRE DEPARTMENT:**

* **Wear self-contained breathing apparatus along with proper protective clothing as recommended by a hazard and risk assessment.**
* **If these precautions are followed, no exposures to potentially hazardous material should occur.**
* **If a radioactive materials label is on the door, you must remain at the scene, in the immediate area, until cleared to leave by the Environmental Health and Safety Personnel.**
* **See below for any special precautions or clean up procedures for this room.**

**Entry Requirements/Restrictions:**

**\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

**Additional Precautions:**

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**Special Cleanup/Decontamination Procedures:**

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**To contact the Office of Environmental Health and Safety, call University Police at 203-392-5375 (203-392-JERK) and leave a phone number where you can be reached at the site of the emergency.**

**Appendix G - OSHA List of Regulated Substances**

|  |  |
| --- | --- |
| **Chemical Name** | **CAS No.** |
| Acetaldehyde | 75-07-0 |
| Acetone | 67-64-1 |
| Acetonitrile | 75-05-8 |
| Acetylaminofluorene, 2- | 53-96-3 |
| Acetylene tetrabromide | 79-27-6 |
| Acrolein | 107-02-8 |
| Acrylamide | 79-06-1 |
| Acrylonitrile | 107-13-1 |
| Aldrin | 309-00-2 |
| Allyl chloride | 107-05-1 |
| Aluminum metal | 7429-90-5 |
| Aminodiphenyl, 4- | 92-67-1 |
| Ammonia | 7664-41-7 |
| Aniline | 62-53-3 |
| Anisidine (o-,p-isomers) | Varies |
| Antimony and compounds | Varies |
| Arsenic, inorganic and compounds | Varies |
| Arsine | 7784-42-1 |
| Asbestos | Varies |
| Azinphos-methyl (Guthion®) | 86-50-0 |
| Acetaldehyde | 75-07-0 |
| Acetone | 67-64-1 |
| Acetonitrile | 75-05-8 |
| Acetylaminofluorene, 2- | 53-96-3 |
| Acetylene tetrabromide | 79-27-6 |
| Acrolein | 107-02-8 |
| Acrylamide | 79-06-1 |
| Acrylonitrile | 107-13-1 |
| Aldrin | 309-00-2 |
| Allyl chloride | 107-05-1 |
| Aluminum metal | 7429-90-5 |
| Aminodiphenyl, 4- | 92-67-1 |
| Ammonia | 7664-41-7 |
| Aniline | 62-53-3 |
| Anisidine (o-,p-isomers) | Varies |
| Antimony and compounds | Varies |
| Arsenic, inorganic and compounds | Varies |
| Arsine | 7784-42-1 |
| Asbestos | Varies |
| Azinphos-methyl (Guthion®) | 86-50-0 |
| Barium and compounds | Varies |
| Benomyl | 17804-35-2 |
| Benzene | 71-43-2 |
| Benzidine | 92-87-5 |
| Benzyl chloride | 100-44-7 |
| Beryllium and compounds | Varies |
| Bis(chloromethyl) ether | 542-88-1 |
| Boron trifluoride | 7637-07-2 |
| Bromine | 7726-95-6 |
| Butadiene, 1, 3- | 106-99-0 |
| Cadmium dust and fume | Varies |
| Camphor, synthetic | 76-22-2 |
| Carbaryl (Sevin®) | 63-25-2 |
| Carbon black | 1333-86-4 |
| Carbon disulfide | 75-15-0 |
| Carbon monoxide | 630-08-0 |
| Carbon tetrachloride | 56-23-5 |
| Chlordane | 57-74-9 |
| Chlorinated diphenyl oxide | 55720-99-5 |
| Chlorine | 7782-50-5 |
| Chlorine dioxide | 10049-04-4 |
| Chlorine trifluoride | 7790-91-2 |
| Chlorobenzene | 108-90-7 |
| Chloroform (Trichloromethane) | 67-66-3 |
| Chloromethyl methyl ether | 107-30-2 |
| Chloropicrin | 76-06-2 |
| Chloroprene, beta- | 126-99-8 |
| Chromic acid and chromates | Varies |
| Chromium, metal and compounds | Varies |
| Coal dust | 68131-74-8 |
| Coal tar pitch volatiles | 65996-93-2 |
| Coke oven emissions | Varies |
| Copper dust and mist | 7440-50-8 |
| Cotton dust | Varies |
| Cresol, p-isomer | 106-44-5 |
| Cumene | 98-82-8 |
| Cyanide | 57-12-5 |
| Cyclohexane | 110-82-7 |
| Cyclohexanone | 108-94-1 |
| Demeton (Systox®) | 8065-48-3 |
| Diacetone alcohol | 123-42-2 |
| Diazomethane | 334-88-3 |
| Diborane | 19287-45-7 |
| Dibromo-3-chloropropane, 1,2- (DBCP) | 96-12-8 |
| Dibutyl phosphate | 107-66-4 |
| Dichlorodiphenyltrichloroethane (DDT) | 50-29-3 |
| Dichlorophenoxyacetic acid,2,4- (2,4-D) | 94-75-7 |
| Dichlorobenzene, o- | 95-50-1 |
| Dichlorobenzene, p- | 106-46-7 |
| Dichlorobenzidine, 3,3'- | 91-94-1 |
| Dichloro-5,5-dimethyl hydantoin, 1,3- | 118-52-5 |
| Dichloroethyl ether | 111-44-4 |
| Dichlorvos (DDVP) | 62-73-7 |
| Dieldrin | 60-57-1 |
| Diglycidyl ether (DGE) | 2238-07-5 |
| Diisobutyl ketone | 108-83-8 |
| Dimethyl acetamide | 127-19-5 |
| Dimethyl sulfate | 77-78-1 |
| Dimethylaminoazobenzene, 4- | 60-11-7 |
| Dimethylaniline (N,N-Dimethylaniline) | 121-69-7 |
| Dimethyl-1,2-dibromo-2,2-dichloroethyl phosphate (Naled) | 300-76-5 |
| Dimethylformamide (DMF) | 68-12-2 |
| Dimethylhydrazine, 1,1- | 57-14-7 |
| Dinitrobenzene, (all isomers) | Varies |
| Dinitro-o-cresol | 534-52-1 |
| Dinitrotoluene, 2,4- | 121-14-2 |
| Diphenyl | 92-52-4 |
| Dioxane (Diethylene dioxide) | 123-91-1 |
| Endrin | 72-20-8 |
| Epichlorohydrin | 106-89-8 |
| EPN | 2104-64-5 |
| Ethoxyethanol, 2- | 110-80-5 |
| Ethyl alcohol (Ethanol) | 64-17-5 |
| Ethyl benzene | 100-41-4 |
| Ethyl ether (Ether) | 60-29-7 |
| Ethyl mercaptan | 75-08-1 |
| Ethylene chlorohydrin | 107-07-3 |
| Ethylene dibromide | 106-93-4 |
| Ethylene dichloride | 107-06-2 |
| Ethylene glycol dinitrate | 628-96-6 |
| Ethylene oxide | 75-21-8 |
| Ethyleneimine | 151-56-4 |
| Ferrovanadium dust | 12604-58-9 |
| Fluoride, inorganic | 16984-48-8 |
| Fluorine | 7782-41-4 |
| Formaldehyde | 50-00-0 |
| Furfural | 98-01-1 |
| Furfuryl alcohol | 98-00-0 |
| Graphite, natural | 7782-42-5 |
| Hexachloronaphthalene (Halowax 1014) | 1335-87-1 |
| Hexane, n- | 110-54-3 |
| Hydrazine | 302-01-2 |
| Hydrogen chloride (Hydrochloric acid) | 7647-01-0 |
| Hydrogen cyanide (Hydrocyanic acid) | 74-90-8 |
| Hydrogen fluoride (Hydrofluoric acid) | 7664-39-3 |
| Hydrogen sulfide | 7783-06-4 |
| Hydroquinone | 123-31-9 |
| Iodine | 7553-56-2 |
| Iron oxide fume | 1309-37-1 |
| Isophorone | 78-59-1 |
| Isopropyl alcohol (Isopropanol) | 67-63-0 |
| Isopropyl glycidyl ether (IGE) | 4016-14-2 |
| Ketene | 463-51-4 |
| Lead, inorganic | 7439-92-1 |
| Lindane | 58-89-9 |
| Lithium hydride | 7580-67-8 |
| Magnesium oxide fume | 1309-48-4 |
| Malathion | 121-75-5 |
| Maleic Anhydride | 108-31-6 |
| Manganese and compounds | Varies |
| Mercury, inorganic and compounds | Varies |
| Mercury, organo alkyl compounds | Varies |
| Methyl alcohol (Methanol) | 67-56-1 |
| Methyl n-amyl ketone | 110-43-0 |
| Methyl bromide | 74-83-9 |
| Methyl n-butyl ketone (MBK) | 591-78-6 |
| Methyl cellosolve | 109-86-4 |
| Methyl chloride | 74-87-3 |
| Methyl chloroform | 71-55-6 |
| Methyl ethyl ketone (MEK) | 78-93-3 |
| Methyl hydrazine | 60-34-4 |
| Methyl isobutyl ketone (MIBK) | 108-10-1 |
| Methyl isocyanate | 624-83-9 |
| Methyl mercaptan | 74-93-1 |
| Methyl propyl ketone | 107-87-9 |
| Methyl Styrene, alpha- | 98-83-9 |
| Methylene bisphenyl isocyanate (MDI) | 101-68-8 |
| Methylene chloride | 75-09-2 |
| Methylene dianiline, 4,4'- | 101-77-9 |
| Mica | 12001-26-2 |
| Molybdenum and compounds | Varies |
| Monomethyl aniline | 100-61-8 |
| Naphthalene | 91-20-3 |
| Naphthylamine, alpha- | 134-32-7 |
| Naphthylamine, beta- | 91-59-8 |
| Nickel carbonyl | 13463-39-3 |
| Nickel, metal and compounds | Varies |
| Nicotine | 54-11-5 |
| Nitric acid | 7697-37-2 |
| Nitric oxide | 10102-43-9 |
| Nitroaniline, p- | 100-01-6 |
| Nitrobiphenyl, 4- | 92-93-3 |
| Nitrochlorobenzene, p- | 100-00-5 |
| Nitrogen dioxide | 10102-44-0 |
| Nitrogen trifluoride | 7783-54-2 |
| Nitroglycerine | 55-63-0 |
| Nitropropane, 2- | 79-46-9 |
| Nitrosodimethylamine, N- | 62-75-9 |
| Nitrotoluene (all isomers) | Varies |
| Octachloronaphthalene | 2234-13-1 |
| Oxalic acid | 144-62-7 |
| Oxygen difluoride | 7783-41-7 |
| Ozone | 10028-15-6 |
| Paraquat | 4685-14-7 |
| Parathion | 56-38-2 |
| Pentachloronaphthalene | 1321-64-8 |
| Pentachlorophenol | 87-86-5 |
| Perchloroethylene (Tetrachloroethylene) | 127-18-4 |
| Perchloromethyl mercaptan | 594-42-3 |
| Perchloryl fluoride | 7616-94-6 |
| Phenol | 108-95-2 |
| Phenyl glycidyl ether (PGE) | 122-60-1 |
| Phenylhydrazine | 100-63-0 |
| Phosdrin (Mevinphos®) | 7786-34-7 |
| Phosgene (Carbonyl chloride) | 75-44-5 |
| Phosphine | 7803-51-2 |
| Phosphorus (Yellow) | 7723-14-0 |
| Phosphorus pentachloride | 10026-13-8 |
| Phosphorus pentasulfide | 1314-80-3 |
| Phosphorus trichloride | 7719-12-2 |
| Phthalic anhydride | 85-44-9 |
| Picric acid | 88-89-1 |
| Pindone (2-pivalyl-1,3-indandione) | 83-26-1 |
| Platinum, metal, and compounds | Varies |
| Polychlorobiphenyl (42% Chlorine) (PCB) | 53469-21-9 |
| Polychlorodiphenyl (54% Chlorine) (PCB) | 11097-69-1 |
| Portland Cement | 65997-15-1 |
| Propiolactone, beta- | 57-57-8 |
| Propyl nitrate, n- | 627-13-4 |
| Propyleneimine | 75-55-8 |
| Pyridine | 110-86-1 |
| Quinone | 106-51-4 |
| Selenium compounds, except SeF6 | Varies |
| Selenium hexafluoride (SeF6) | 7783-79-1 |
| Silica, amorphous, diatomaceous earth | 61790-53-2 |
| Silica, crystalline cristobalite | 14464-46-1 |
| Silicates--Soapstone | Varies |
| Silicates--Talc (without asbestos) | 14807-96-6 |
| Silver, metal and compounds | Varies |
| Sodium fluoroacetate | 62-74-8 |
| Sodium hydroxide | 1310-73-2 |
| Stibine | 7803-52-3 |
| Stoddard solvent | 8052-41-3 |
| Strychnine | 57-24-9 |
| Styrene | 100-42-5 |
| Sulfur dioxide | 7446-09-5 |
| Sulfur monochloride | 10025-67-9 |
| Sulfur pentafluoride | 5714-22-7 |
| Sulfuric acid | 7664-93-9 |
| Sulfotep (TEDP) | 3689-24-5 |
| Tellurium hexafluoride | 7783-80-4 |
| Tetraethyl pyrophosphate (TEPP) | 107-49-3 |
| Tetrachloroethane, 1,1,2,2- | 79-34-5 |
| Tetrachloronaphthalene | 1335-88-2 |
| Tetraethyl lead | 78-00-2 |
| Tetramethyl lead | 75-74-1 |
| Tetranitromethane | 509-14-8 |
| Tetryl | 479-45-8 |
| Thallium and compounds | Varies |
| Tin, inorganic compounds (exc oxide) | Varies |
| Tin, organic compounds | Varies |
| Toluene | 108-88-3 |
| Toluene-2,4-diisocyanate (TDI) | 584-84-9 |
| Toluidine, o- | 95-53-4 |
| Trichloroethane, 1,1,2- | 79-00-5 |
| Trichloroethylene | 79-01-6 |
| Trichlorofluoromethane | 75-69-4 |
| Trichloronaphthalene | 1321-65-9 |
| Trinitrotoluene, 2,4,6- (TNT) | 118-96-7 |
| Trichlorophenoxyacetic acid (2,4,5-T) | 93-76-5 |
| Trichloropropane, 1,2,3- | 96-18-4 |
| Uranium and compounds | 7440-61-1 |
| Vanadium fume (pentoxide) | 1314-62-1 |
| Vinyl chloride | 75-01-4 |
| Warfarin | 81-81-2 |
| Xylene, all isomers | Varies |
| Xylidine | 1300-73-8 |
| Zinc chloride fume | 7646-85-7 |
| Zinc oxide fume | 1314-13-2 |
| Zirconium and compounds, except ZrCl4 | Varies |

**Appendix H – Procedures for Detecting and Removing Peroxide Contamination**

Detection of Peroxides

Before distilling or purifying any known or suspected peroxide-former, check it carefully for the presence of peroxides. Either of the following tests will detect most (but not all) peroxy compounds including all hydroperoxides:

1. Add 1-3 ml of the liquid to be tested to an equal volume of acetic acid, add a few drops of 5% aqueous KI solution, and shake. The appearance of a yellow to brown color indicates the presence of peroxides.
2. Add 0.5 ml of the liquid to be tested to a mixture of 1 ml of 10% aqueous KI solution and 0.5 ml of dilute HCl to which has been added a few drops of starch solution just prior to the test. The appearance of a blue or blue-black color within a minute indicates the presence of peroxides.
3. The easiest method of detecting peroxides in common solvents is to use peroxide test strips that are semi-quantitative and give readings in the range from 0 - 25 ppm. These strips are available from any number of scientific supply distributors.

Test Results

>03-30 parts per million (ppm) - Expired compounds testing within this range offer little or no threat of violent reaction on the given test date. For compounds testing in this range, the investigator should consider the addition of fresh inhibitor to retard the auto-oxidation process and the container should be tightly sealed to prevent air and light exposure.

>30 and <80 ppm - Expired or mismanaged compounds originally inhibited by the supplier which test within this range may well be on the way to posing a threat to the operations of the laboratory. Several documented major exothermic reactions have occurred during the reduction of peroxides in drums, bottles, cans and laboratory ware within this range.

>80 ppm - Any suspect container testing in excess of t he limits of standard peroxide test strips must be considered to be potentially shock sensitive. High peroxide concentrations may occur without the presence of visible crystals. Leave this container alone and call the OEHS at 2-7073, immediately for safe removal.

Removal of Peroxides

Low concentrations of peroxides can generally be removed by filtering the contaminated material through a column of chromatography-grade basic alumina. Several methods are available for the "deperoxidation" of ether solvents; for a discussion, see Burfield, D. R. J. Org. Chem. 1982, 47, 3821.