

SUNY

SCHENECTADY

COUNTY COMMUNITY COLLEGE

Chemical Hygiene Plan

Spring 2025

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SUNY Schenectady thanks Suffolk County Community College for allowing the use of their Chemical Hygiene Plan as a guide.

Purpose

SUNY Schenectady is committed to providing a healthy and safe working environment for the College community. This Chemical Hygiene Plan (CHP) establishes proper usage, handling, and procedures to protect laboratory users (both students and employees) from potentially hazardous chemicals, processes, and scenarios. This plan is based upon best practices identified in, among other sources, “Prudent Practices for Handling Hazardous Chemicals in Laboratories” by the National Research Council.¹

Scope

The Chemical Hygiene Plan (CHP) applies to all laboratories, classrooms and storage areas and their surroundings where potentially hazardous chemicals are used, stored or otherwise handled. The information within the CHP applies to all personnel who work in these areas (including students) to ensure minimal risk of exposure to potentially hazardous chemicals. The information presented in the CHP represents best practices and provides a broad overview necessary for the safe operation of laboratories that utilize potentially hazardous chemicals.

The CHP is required by OSHA Occupational Exposure to Hazardous Chemicals standard, (29 1910.1450).²

Changes to the CHP are subject to approval by a Chemical Hygiene Officer and Campus Safety Council. The Campus Safety Council must include: the Division Dean and the Chemical Hygiene Officer (CHO). The Chemical Hygiene Officer represents College Facilities and laboratory personnel.

Regulatory Requirements

Implementation of the necessary work practices, procedures, and policies outlined in this CHP is required by:

- New York State Law: 6 NYCRR Parts 370, 371, 372, 373, 374 and 376
- U.S. Environmental Protection Agency Regulations 40 CFR, enforced by the New York State Department of Environmental Conservation (NYSDEC)
- U.S. Occupational Health and Safety Agency Regulations: 29 CFR, enforced by the New York State Department of Labor Public Employees Safety and Health Division (PESH)
- Schenectady County Code, enforced by the Schenectady County Department of Health (SCDOH)
- U.S. Department of Labor: 29 CFR 1910.1450 "Occupational Exposure to Hazardous Chemicals in Laboratories."

These regulations require that the CHP be readily available wherever potentially hazardous chemicals are used, handled, or stored. The Campus Safety Council will review the CHP annually, with recommendations from the CHO, to ensure the effectiveness of the CHP under the current risk assessment. The CHP should be amended whenever at least one of the following occurs:

- A safety issue regarding an accident that required an emergency response.
- Purchase or use of any chemicals listed on appendix F.
- When required by law due to regulatory updates by EPA, OSHA, NYSHS, NYSDEC, or SCDOH policies.
- Upon request due to a majority vote by the Campus Safety Council.

Section 1: Personnel and Facilities

Rights and Responsibilities

Employees and other personnel who work in laboratories have the right to be informed about the potential health hazards of the chemicals in their work areas and to be properly trained to work safely with these substances. This includes custodial staff and other personnel who work to clean and maintain laboratories. All personnel working with potentially hazardous chemicals are encouraged to report (anonymously, if preferred) any concerns about unsafe work conditions to their supervisor, the Chemical Hygiene Officer (CHO), and/or the Associate Vice President of Campus Safety/Peace Officer.

The employee or their supervisor should fill out a safety concern form and promptly submit it to the Chemical Hygiene Officer (CHO) for processing. The CHO will review and evaluate the reported safety concern. The initial evaluation will determine the proper mitigation if any is necessary.

The Dean of Math, Science, Technology, and Health is responsible for establishing and maintaining programs in their areas and for providing a safe and healthy work environment. Daily management of laboratory safety and adherence to safe laboratory practices rests with the faculty member within individual laboratory course S/he are teaching. All personnel have a duty to fulfill their obligations with respect to maintaining a safe work environment.

All employees and other personnel working with potentially hazardous chemicals have the responsibility to conscientiously participate in training classes on general laboratory safety and review and be familiar with the contents of the Chemical Hygiene Plan (CHP). Those working with chemicals are responsible for staying informed about the chemicals in their work areas, safe work practices and proper personal protective equipment (PPE) required for the safe performance of their job. Failure to comply with these requirements could result in progressive disciplinary action in accordance with college policy, and may result in suspension of laboratory activities until corrective action is implemented.

General Principles for Work with Laboratory Chemicals

There are some general principles that should always be taken into account when individuals are working with chemical substances. Chemicals are an integral part of any laboratory. Safety must be incorporated into the laboratory environment. The following principles have been incorporated in SUNY Schenectady's Chemical Hygiene Plan.

Minimize chemical exposure. There are few laboratory chemicals that are not hazardous. Specific chemicals will not be addressed individually, but, will be identified by classes of chemicals. Information regarding hazards and precautions can be found on the Safety Data Sheet (SDS) for each chemical. In order to minimize risk, instructors should choose the most innocuous chemicals possible when designing their laboratory exercises.

It is critical that individuals working with chemicals never underestimate the risk. Even if a substance has no significant hazard, exposure should still be minimized. One should always assume that any mixture will be more toxic than its most toxic component. If a substance's toxicity is unknown, consider it toxic.

Chemical Hygiene Responsibilities:

Responsibilities of the Faculty Member in Charge of the Laboratory Course:

The Faculty member is responsible for the health and safety of all individuals working in his or her laboratory. The Faculty member may delegate safety duties, but remains responsible for ensuring that

delegated safety duties are adequately performed. The Faculty member in charge of the laboratory course is responsible for:

- Complete the Vector Training Modules required by Human Resources;
- Knowing all applicable health and safety rules and regulations, training and reporting requirements, and standard operating procedures associated with the safety of their laboratory;
- Identifying hazardous conditions or operations in the laboratory or other facility containing hazardous chemicals and determining safe procedures and controls, and implementing and enforcing standard safety procedures;
- Establishing standard safety operating procedures (general and protocol specific) and performing literature searches relevant to health and safety for laboratory-specific work;
- Providing approval for the use of hazardous chemicals in the laboratory;
- Consulting with the Chemical Hygiene Officer (CHO) for use of higher risk materials, such as use of particularly hazardous substances in Appendix F;
- Ensuring laboratory or other personnel under their supervision have access to and are familiar with the appropriate Personal Protective Equipment (PPE) and Safety Materials;
- Training all students to work safely with hazardous materials and ensuring that students are utilizing proper PPE during laboratory courses.
- Promptly notifying CHO should they become aware that workplace engineering controls (e.g., fume hoods) and safety equipment (e.g., emergency showers/eyewashes, fire extinguishers, etc.) become non-operational;
- Ensures all students are wearing/using the proper PPE in the correct manner at the correct times;
- Promptly reporting of accidents and injuries to CHO and Campus Safety;
- Informing facilities personnel, other non-laboratory personnel and any outside contractors of potential laboratory-related hazards when they are required to work in the laboratory environment.

Responsibilities of Personnel Who Handle Chemicals:

All personnel in laboratories that use, handle, or store potentially hazardous chemicals (including Physical Sciences Laboratory Technician, Biological Laboratory Technician, Federal Work Study or Student Worker) are responsible for:

- Following all laboratory safety rules, regulations, and standard operating procedures required for the tasks assigned;
- Developing good personal chemical hygiene habits, including but not limited to, keeping the work areas clean and uncluttered;
- Understanding the hazards of materials and processes in their laboratory work prior to commencing;
- Utilizing appropriate measures to control identified hazards, including consistent and proper use of engineering controls, personal protective equipment, and administrative controls;
- Understanding the capabilities and limitations of PPE used by them;
- Gaining prior approval from the Faculty member in charge for the use of chemicals and other materials;
- Immediately reporting all accidents and unsafe conditions to the Faculty member in charge of the laboratory course;
- Completing all required health, safety, and environmental trainings, such as or Training Modules required by Human Resources;
- Working with administrators and other employees to develop and implement effective and appropriate chemical hygiene practices and policies.
- Monitoring procurement, use, and disposal of chemicals in the laboratories;
- Advising the CHO regarding program needs, which may include improvements to the CHP or PPE Requirements;
- Knowing and understanding the current legal requirements concerning regulated substances being used;

- Coordinating safety information to all areas within the Division;
- Performing weekly chemical hygiene inspections and maintaining of all Division laboratories and stockrooms.

Academic Dean of the Division of Mathematics, Science, Technology, and Health (MSTH):

The Academic Dean or an individual designated by the Academic Dean shall be responsible for their laboratories as covered under the chemical hygiene plan. They will have complete authority (subject to appeal and review by AVP of Campus Safety, supervisor, Executive Vice President of Administration and Finance, and the President or their designee), and be responsible for the College's compliance with this mandated CHP as required in 29 CFR 1910.1450.

The Academic Dean of MSTH shall have the following responsibilities:

- Will serve as the chemical hygiene officer (CHO) or appoint an appropriate designee.
- Be responsible for compliance of required actions as written in the CHP applicable to their Division.
- Advise the Campus Safety Council and superior if any additional program needs or improvements to the CHP.
- Ensure that employees know and follow the CHP and that PPE is available and in good condition.
- Schedule required training and make sure it has been provided to all affected employees.
- Review inspection records annually.
- Assure that each laboratory course reviews Laboratory Safety Rules with the students during Week 1 of the semester.
- Supervise chemical procurement and disposal operations.
- Ensure chemical inventory, SDS's, and CHP are readily available to lab personnel that are working with hazardous substances.
- Shall develop and maintain specific chemical spill protocols for the most likely spill risks. For example, if mercury is a spill risk in your laboratory, a plan for spill cleanup of mercury and a spill kit for a mercury spill must be available.

Chemical Hygiene Officer (CHO):

A Chemical Hygiene Officer (CHO) is responsible for ensuring a safe working environment in laboratories and other areas where hazardous chemicals are used. Their primary duties include:

- Establish, maintain, and revise CHP;
- Create and revise rules and regulations;
- Serve on the Campus Safety committee
- Monitor procurement, use, storage, and disposal of all chemicals;
- Conduct regular inspections of laboratories, prep rooms, and storage rooms;
- Oversee chemical inventory and maintain an online inventory system;
- Know current legal requirements concerning regulated substances;
- Seek ways to improve the effectiveness of the CHP;
- Attend CHO training.

Facilities Personnel:

Facilities personnel are essential for maintaining a functional laboratory. Facilities personnel working in and around laboratories have the following responsibilities:

- Complete training on CHP awareness;
- Understand where to find and read SDS's;
- Understands the hazards of chemicals in their work area;
- Obtain information and awareness of hazards in their work area before any work is performed;
- Conform to general safety rules as instructed by CHO.

Section 2: The Laboratory Facility

According to OSHA Standard 29 CFR 1910.1450, a laboratory is defined as: "a facility where the 'laboratory use of hazardous chemicals' occurs. It is a workplace where relatively small quantities of hazardous chemicals are used on a non-production basis."

This definition emphasizes that a laboratory is a place where:

- The primary characteristic of a laboratory is the use of hazardous chemicals.
- The quantities of chemicals used are of laboratory scale and not for production purposes.
- The work conducted in a laboratory is research, development, or testing, or education where the amount of chemicals and equipment can be handled by one person.

It's important to note that the specific definition of a laboratory can vary depending on the context and regulatory framework. However, OSHA's definition provides a clear and concise understanding of what constitutes a laboratory for the purposes of chemical safety regulations. This context applies to all spaces where hazardous chemicals are used and handled.

A laboratory space where hazardous chemicals are used and handled must have the following conditions met under OSHA Standard (29) 1910.1450:

- Chemical manipulations are carried out in laboratory scale. Work with substances where containers used for reactions, transfers, and other handling of substances are designed to be easily and safely manipulated by one person.
- Multiple chemicals or chemical procedures are used.
- The procedures used are not in any part of a production process nor in any way simulate a production process.
- "Protective laboratory practices and equipment" are available for common use to minimize human exposure to hazardous substances. "protective laboratory equipment and practices" means those laboratory procedures, practices, and equipment accepted by laboratory health and safety experts as effective in minimizing exposure to hazardous chemicals. Examples of expert guidelines can be found in "Prudent Practices in the Laboratory: Handling and Management of Chemical hazards, 2011 edition," reference 1.

Wet laboratories and other spaces

Laboratories often share spaces used for non-laboratory function. The shared spaces include wet laboratory, instrument rooms, computer rooms, and office spaces. Maintaining a positive culture of safety is imperative. Prudent laboratory practice is to separate wet laboratories from other work areas physically with a wall or enclosure.

A **wet laboratory** is a specialized space designed for scientific research or work that involves working with liquids, chemicals, and biological materials. It's characterized by the following:

- Fume hoods, safety showers, eyewash stations, biosafety cabinets, centrifuges, incubators, autoclaves, and various analytical instruments.

Laboratory Facility

OSHA Standard 29 CFR 1910.1450, also known as the Laboratory Standard, is directly related to the principles outlined in "Prudent Practices in the Laboratory: Handling and Management of Chemical Hazards" (referred to as

Prudent Practices for now on). This guide, published by the National Research Council, provides a comprehensive set of recommendations for safe laboratory practices, including the laboratory design.

This section outlines the following concepts according to Prudent Practices:

- Laboratory Design
- Laboratory Maintenance
- Laboratory Usage
- Ventilation Requirements

1. **Design.** The laboratory facility should have: (a) An appropriate general ventilation system (see below) with air intakes and exhausts located so as to avoid intake of contaminated air; (b) Adequate, well-ventilated stockrooms/storerooms; (c) Laboratory hoods and sinks; (d) Other safety equipment including eyewash fountains and drench showers; (e) Arrangements for waste disposal.

2. **Maintenance.** All laboratory equipment will be continually evaluated, and periodic calibration of equipment will be performed. Equipment checks will be the responsibility of the laboratory technicians who will also keep a record of all maintenance, deficiencies and corrective actions. Facilities will be responsible for maintenance, repair and general cleaning of the lab and prep rooms. ***Custodial personnel are not responsible for cleaning countertops and upper laboratory surfaces, this shall be done by the laboratory technician.*** All required repairs should be documented by the Facilities work order ticketing system.

3. **Usage.** The work conducted and its scale must be appropriate to the physical facilities available and, especially, to the quality of ventilation. The goal of a culture of safe practices aims to minimize exposure to hazardous chemicals, as outlined in OSHA Standard 29 CFR 1910.1450, which mandates that employers ensure employee exposure to regulated substances does not exceed permissible exposure limits (PELs).

4. **Ventilation.** The laboratory ventilation shall have:

(a) Laboratory ventilation system separate from the rest of the building that will:

- Provide a source of air for breathing and for input to local ventilation devices;
- it should not be relied on for protection from toxic substances released into the laboratory;
- ensure that laboratory air is continually replaced, preventing increase of air concentrations of toxic substances during the working day;
- direct air flow into the laboratory from non-laboratory areas and out to the exterior of the building.

(b) A laboratory hood with 2.5 linear feet of hood space per person should be provided for every 2 individuals if they spend most of their time working with chemicals;

- Each hood should have a continuous monitoring device to allow convenient confirmation of adequate hood performance before use. If this is not possible, work with substances of unknown toxicity should be avoided or other types of local ventilation devices should be provided (see table 9.5 in Prudent Practices) and Chapter 9 in Prudent Practices for a discussion of hood design, construction, and evaluation.

(c) Other local ventilation devices. Ventilated storage cabinets, canopy hoods, and snorkels should be provided as needed. Each canopy hood and snorkel should have a separate duct.

(d) Special ventilation areas. Exhaust air from glove boxes and isolation rooms should be passed through scrubbers or other treatment before release into the regular exhaust system. Cold rooms and warm rooms should have provisions for rapid escape in the event of electrical failure.

(e) Modifications of the ventilation system only if thorough testing indicates that worker protection from airborne toxic substances will continue to be adequate.

(f) A performance rate of 4-12 room air changes/hour is normally adequate general ventilation if local exhaust systems such as hoods are used as the primary method of control.

(g) General air flow that is not turbulent and should be relatively uniform throughout the laboratory, with no high velocity or static areas; airflow into and within the hood should not be excessively turbulent; hood face velocity should be adequate (typically 60-100 lfm [linear feet per minute]) .

(h) Evaluations. Quality and quantity of ventilation should be evaluated on installation, regularly monitored (at least every 3 months), and reevaluated whenever a change in local ventilation devices is made.

Machine Guarding

All mechanical equipment shall be adequately furnished with guards that prevent access to electrical connections or moving parts, i.e. belts and pulleys. All laboratory employees shall inspect equipment prior to using it to ensure that the guards are in place and functioning.

- Safety shielding should be used for any operation having the potential for explosion. Centrifuges that are not fitted with an interlocking lid shall not be used.
- Gas hose connectors are allowed to be used for laboratory equipment, such as Bunsen burners, provided the following items are met:
 1. A shut-off valve is installed where the connector is attached.
 2. The connector shall not exceed 6 feet.
 3. The connector shall not be concealed nor shall it pass from room to room or through walls, ceilings or floors.
 4. Only listed gas hose connectors shall be used. According to the National Fuel Gas Code, latex tubing is not allowed to be used as a connector between a gas source and a Bunsen burner.

Centrifuges

Centrifuges will be operated according to the manufacturer's instructions. If vibration occurs, stop the centrifuge immediately and check the counterbalance load.

Section 3: Chemical Hazard Communications

Regulatory Requirements

SUNY Schenectady has an established Hazard Communication Program that complies with 29 CFR 1910.1200, the Federal Hazard Communication Standard. The purpose of SUNY Schenectady's Hazard Communication Program is to ensure that all employees have the right to receive information regarding the hazardous substances being used in and around the area where they work. SUNY Schenectady is responsible for providing information about the hazardous substances in our workplace, the associated hazards, and the

control of these hazards, through a comprehensive hazard communication program that is summarized briefly below.

List of Hazardous Substances

All labs are required to keep an updated copy of their chemical inventory on file, which must be made available upon request. An on-line inventory system will be posted on the SUNY SCHENECTADY website for all to view. For each hazardous substance in the online inventory, the following information must be available:

- name of substance, amount, concentration (if applicable), form (solid, liquid, aqueous, etc.), container size (original or secondary)
- SDS/ MSDS associated with the chemical
- Location of the chemical
- Primary hazards associated with the chemical

Hazard Determination

The lab technicians are responsible for verifying if any items on their chemical inventory are subject to the requirements of the hazard communication regulation. The chemical's signal word and classification as hazardous can be found in its SDS. Hazardous substances include, but are not limited to, those chemicals that pose either a physical or health hazard:

Physical hazard means 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.

Health hazard means 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 system, and agents which damage the lungs, skin, eyes, or mucous membranes

Inventory items found to meet the above are subject to the requirements outlined below.

Safety Data Sheets (SDS) and Material Safety Data Sheets (MSDS)

A SDS/MSDS contains all of the necessary information needed to safely use a chemical. An SDS must be available for each hazardous substance in a laboratory's chemical inventory. Lab Specialists are responsible for keeping SDSs current and making them available to all laboratory employees throughout the workday. SDS's will be available on the online inventory system which is available on the SUNY Schenectady website and is accessible to anyone.

Labels and Safety Hazard

Labeling requirements for all hazardous substances are summarized as follows:

- All containers of hazardous materials must be labeled with the identity of the hazardous substance, its form (*s, l, aq.*), and concentration (if applicable).
- The label must contain all applicable hazard warning statements.
- On original containers, the name and address of the chemical manufacturer or other responsible party must be present. Manufacturer's product labels must remain on all containers, and must not be defaced in any way.
- Labels must be legible, in English, and prominently displayed.

- Secondary containers must be labeled with the identity of the substance (concentration if applicable) and appropriate hazard statements. GHS pictograms should be used on all secondary containers.
- Newly synthesized compounds must be labeled with the appropriate hazard warnings based on the knowledge of the chemical and physical properties of that substance with appropriate GHS pictograms.
- Additional information on container labeling is provided in Appendix B.

GLOBAL HARMONIZATION SYSTEM (HAZARD COMMUNICATION STANDARD PICTOGRAMS)

Health Hazard  Carcinogen Mutagenicity Reproductive Toxicity Respiratory Sensitizer Target Organ Toxicity Aspiration Toxicity	Flame  Flammables Pyrophorics Self-Heating Emits Flammable Gas Self-Reactives Organic Peroxides	Exclamation Mark  Irritant (skin and eye) Skin Sensitizer Acute Toxicity Narcotic Effects Respiratory Tract Irritant
Gas Cylinder  Gases Under Pressure	Flame Over Circle  Oxidizers	Skull and Crossbones  Acute Toxicity (fatal or toxic)
Corrosion  Skin Corrosion/Burns Eye Damage Corrosive to Metals	Environment  Aquatic Toxicity	Exploding Bomb  Explosives Self-Reactives Organic Peroxides

Note: OSHA has adopted GHS pictograms system for identifying specific hazards

Employee Information and Training

Employee training on specific workplace hazards must be provided at the time of initial assignment. Additional employee training is required whenever a new hazard is introduced into the work environment, and must be provided within 30 days of receiving the SDS or other safety information. All training must be in the appropriate language, educational level, and vocabulary for laboratory personnel. Employees must be given the opportunity to ask questions. At a minimum all employees who work in laboratories or with chemicals must be trained in the following:

Personal Protective Equipment (PPE) - selection, location and use and care of same.

Laboratory Safety- does and don't in the laboratory (see appendix A).

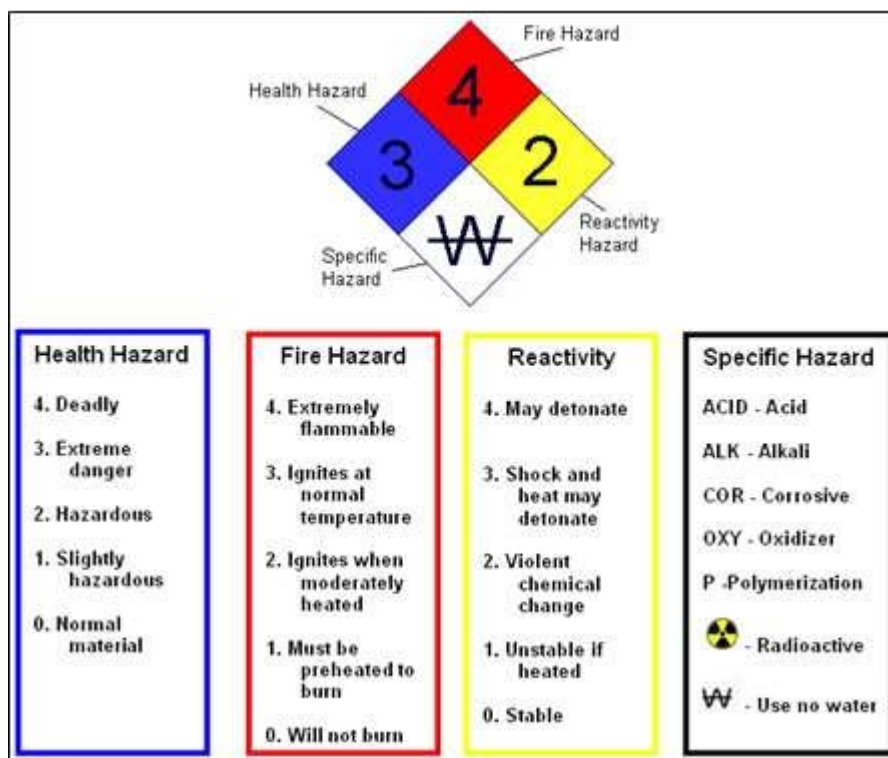
Spill Control - procedures and protocols (see Section 10).

Section 4: Classes of Hazardous Chemicals

Identification and Classification of Hazardous Chemicals

Chemicals can be divided into several different hazard classes. The hazard class will determine how these materials should be stored and handled and what special equipment and procedures are needed to use them safely. Each chemical container, whether supplied by a vendor or produced in the laboratory, must include labels that clearly identify the hazards associated with that chemical. In addition to specific chemical labels, hazard information for specific chemicals can be found by referencing the Safety Data Sheet (SDS) for that chemical. Note that products regulated under the Food and Drug Administration are not covered under the Hazard Communication Standard. This includes pharmaceuticals and drugs in solid form. Rooms containing hazardous chemicals must be labeled with a National Fire Prevention Association (NFPA) door placard that gives an overview of the key chemical hazards contained within that room. These postings have the familiar four colors, 0-4 number rating that quickly supplies the hazard information broken down into four hazard classes, with 0 indicating a low level of hazard and 4 indicating a high hazard level. The four chemical hazard types correspond to the four-color areas: red indicates a flammability hazard, yellow indicates a reactive hazard, blue indicates a health hazard and the white area is reserved for special hazards that are identified by hazard symbols or labels to indicate hazards such as radioactivity, biohazard, water reactive chemicals, etc. Each of these hazards has a different set of safety precautions associated with them. Figure 4.1 illustrates the NFPA rating system.

Figure 4.1



It is essential that all laboratory workers understand the types of hazards, recognize the routes of exposure, and are familiar with the major hazard classes of chemicals. In many cases, the specific hazards associated with new compounds and mixtures will not be known, so it is recommended that all chemical compounds be treated as if they were potentially harmful and to use appropriate eye, inhalation and skin personal protective equipment.

Fire Hazards

A number of highly flammable substances are in common use in campus laboratories. These materials must be stored in flammable storage cabinets. Flame-resistant laboratory coats must be worn when working with flammable materials and/or with procedures where a significant fire risk is present (e.g., when working with open flame, etc.). These materials can constitute a significant immediate threat and should be treated with particular care, even though the use of these materials is fairly common in the laboratory setting. Particular attention should be given to preventing contact with heat, flames, or ignition sources such as static electricity and sparks when handling flammable liquids.

Classification of Flammable liquids

Definition: Flammable Liquids

Class 1A = Flash Point <73°F and Boiling Point <100°F

Class 1B = Flash Point <73°F and Boiling Point >100°F

Class 1C = Flash Point >73°F and Boiling Point <100°F

Combustible Liquids

Class II = Flash Point - Between 100 and 140°F

Class IIIA = Flash Point - Between 140° and 200°F

Class IIIB = Flash Point - 200°F +

The maximum container size for class 1A and 1B flammable liquids is 1pt; unless it is a ACS analytical grade, then the maximum size is 1 gallon. The maximum size container for class 1C and class II flammable liquids is 1 gallon. The maximum size container for class III flammable liquid is 5 gallons.

The maximum storage for flammable liquids inside a flammable storage cabinet is 10 gallons. Flammable storage cabinets must have a 2-hour fire rating. The storage cabinet cannot be stored in a classroom where students congregate. Flammable storage cabinets must have a 3-hour fire barrier between its storage room and all other adjacent spaces. Only one container of a single type of flammable liquid is to be used in laboratory experiments or demonstrations when students are present. The exception is class III; only 1 gallon of class III flammable liquid is allowed in a classroom when students are present.

1. **Flammable substances** stored in the laboratory shall be in minimal quantities and segregated. The material is considered flammable if it can generate sufficient vapors to ignite at temperatures below 100 degrees Fahrenheit. Precautions: flammables may not be stored in any refrigerator except those certified as explosion proof. All other refrigerators in the chemistry lab will be labeled with "Do Not Store Flammables in This Refrigerator." Signs can be requested from the College sign shop. Domestic refrigerators shall only be purchased if they will not be used for flammable storage and there is at least one explosion safe refrigerator within the immediate area. Large amounts of flammables shall be kept in an approved flammable storage cabinet. When transferring flammable liquids from bulk, the containers shall be bonded and grounded. All flammable storage cabinets are to be properly vented to allow proper vapor dissipation.

2. **Combustible Materials:** Materials that can generate sufficient vapors to ignite at temperatures at or above 100 degrees Fahrenheit. Follow the same handling precautions as flammable products.

Reactivity Hazards

Reactive and explosive substances are materials that decompose under conditions of mechanical shock, elevated temperature, or chemical action, and release of large volumes of gases and heat. Some materials,

such as peroxide formers, may not be explosive, but may form explosive substances over time. These substances pose an immediate potential hazard and procedures which use them must be carefully reviewed. These materials must also be stored in a separate flame-resistant storage cabinet or, in many cases, in laboratory grade refrigerator or freezer that are designed for flammable and reactive chemicals (unless they are peroxide formers). Pyrophoric chemicals are a special classification of reactive materials that spontaneously combust when in contact with air and require laboratory- specific training. These substances should only be handled with permission from the CHO.

Health Hazards

OSHA uses the following definition for “health hazards”: 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.

The major classes of “hazardous” and “particularly hazardous substances or acute hazardous substances” and their related health and safety risks are detailed below.

Corrosive Substances

As a health hazard, corrosive substances cause destruction of, or alterations in, living tissue by chemical action at the site of contact.

Major classes of corrosive substances include:

- Strong acids – e.g., sulfuric, nitric, hydrochloric and hydrofluoric acids
- Strong bases – e.g., sodium hydroxide, potassium hydroxide and ammonium hydroxide
- Dehydrating agents – e.g., sulfuric acid, sodium hydroxide, phosphorus pentoxide and calcium oxide
- Oxidizing agents – e.g., hydrogen peroxide, chlorine and bromine.

They can be solid, liquid or gas and act on the body tissue through direct contact, inhalation or ingestion. Corrosive liquids are responsible for most corrosive based injuries. Corrosive gases are the most serious because they can be readily absorbed into the body through inhalation.

Precautions: Eye protection and rubber gloves should always be worn when handling corrosives. Strong oxidizing agents should always be stored in glass or other inert material (preferably unbreakable). In most cases, these materials should be segregated from other chemicals and require secondary containment when in storage. Safety rubber bottle carriers or non-breakable bottles shall be used for the transport of strong acids and bases from one location to another. Containers and equipment used for storage shall be corrosion resistant. Acids and bases shall be stored separately. Organic acids shall be stored separate from oxidizers including oxidizing acids.

Irritants

Irritants are defined as chemicals that cause reversible inflammatory effects on living tissue by chemical action at the site of contact. All corrosive and caustic substances are irritants. A wide variety of organic and inorganic compounds, including many chemicals that are in a powder or crystalline form, are irritants. The most common example of an irritant may be ordinary smoke which can irritate the nasal passages and respiratory system. Consequently, eye and skin contact with all laboratory chemicals should always be avoided. Symptoms of exposure can include reddening or discomfort of the skin and irritation to respiratory systems.

Sensitizers

A sensitizer, or allergen, is a substance that causes exposed people to develop an allergic reaction in normal tissue after repeated exposure to the substance. Examples of sensitizers include diazomethane, chromium, nickel, formaldehyde, isocyanates, arylhydrazines, benzylic and allylic halides, and many phenol derivatives. Sensitizer exposure can lead to all of the symptoms associated with allergic reactions, or can increase an individual's existing allergies.

Hazardous Substances with Toxic Effects on Specific Organs

Substances included in this category include:

- **Hepatotoxins** – substances that produce liver damage, such as nitrosamines and carbon tetrachloride
- **Nephrotoxins** – agents causing damage to the kidneys, such as certain halogenated hydrocarbons
- **Neurotoxins** – substances which produce their primary toxic effects on the nervous system, such as mercury, acrylamide and carbon disulfide
- **Agents which act on the hematopoietic system** – carbon monoxide and cyanides which decrease hemoglobin function and deprive the body tissues of oxygen.
- **Agents which damages lung tissue** – asbestos and silica.

Symptoms of exposure to these materials vary. Staff working with these materials should review the SDS for the specific material being used and should take special note of the associated symptoms of exposure.

Hazardous, Particularly Hazardous, and Extremely Hazardous Chemicals

OSHA recognizes that some classes of chemical substances pose a greater health and safety risk than others. There are generally three categories: Hazardous, Particularly Hazardous, and Extremely Hazardous. While OSHA doesn't explicitly define "particularly hazardous" and "extremely hazardous," these terms are often used to categorize chemicals based on their potential risks. Here's a breakdown to help differentiate them:

Hazardous:

- Encompasses a wide range of substances that can pose risks to health, safety, or the environment.
- Can include physical hazards (flammability, reactivity, corrosivity), health hazards (toxicity, irritation, sensitization), and environmental hazards.
- Often regulated by OSHA's Hazard Communication Standard (HCS) and other relevant regulations.
- Examples: acids, bases, solvents, certain pesticides, and many industrial chemicals.

Particularly Hazardous or “p-listed” substances:

- A more specific category within hazardous substances.
- Typically refers to substances with severe health effects, such as:
 - **Carcinogens:** Chemicals known to cause cancer. Carcinogens are chemical or physical agents that cause cancer. Generally they are chronically toxic substances; that is, they cause damage after repeated or long-duration exposure, and their effects may only become evident after a long latency period. Chronic toxins are particularly insidious because they may have no immediately apparent harmful effects.
 - **Reproductive toxins:** Chemicals that can harm reproductive organs or fertility. Reproductive toxins include any chemical that may affect the reproductive capabilities, including chromosomal damage (mutagens) and effects on fetuses (teratogens).
 - **Substances with high acute toxicity:** Chemicals that can cause immediate harm if ingested, inhaled, or absorbed through the skin. Substances that have a high degree of acute toxicity are interpreted by OSHA as being substances that "may be fatal or cause damage to target organs as the result of a single exposure or exposures of short duration." These chemicals, associated

chemical waste, and storage containers must be handled with care to prevent cross contamination of work areas and unexpected contact. These chemicals must be labeled as “Toxic.” Empty containers of these substances must be packaged and disposed of as hazardous waste without rinsing trace amounts into the sanitary sewer system.

- Often requires additional safety measures, such as specialized training, engineering controls, and personal protective equipment (PPE).
- Examples: certain heavy metals, asbestos, and some organic compounds.

Extremely Hazardous:

- A subset of particularly hazardous substances that pose an immediate and severe threat to life or health.
- These substances can cause rapid and severe harm, such as:
 - **Highly reactive chemicals:** Substances that can react violently with other chemicals or water.
 - **Toxic gases:** Gases that can cause immediate respiratory distress or death.
 - **Flammable liquids and gases:** Substances that can easily ignite and cause fires or explosions.
- Requires specialized emergency response plans and procedures.
- Examples: chlorine gas, hydrogen cyanide, and certain highly reactive metals.

NOTE: Use of EHS’s is prohibited on SUNY Schenectady campus without written consent from Chemical Hygiene Officer.

Key Differences:

Feature	Hazardous	Particularly Hazardous	Extremely Hazardous
Risk Level	Moderate to high	High	Very high
Health Effects	Various health effects	Severe health effects (carcinogenicity, reproductive toxicity, acute toxicity)	Immediate and severe health effects (toxicity, reactivity)
Regulatory Control	General hazard communication and safety practices	Specific controls for high-risk chemicals	Strict controls and emergency response plans

Specific classification of a chemical can vary depending on factors like exposure limits, handling procedures, and emergency response protocols. Always refer to the Safety Data Sheet (SDS) for a chemical to determine its hazards and appropriate handling procedures. OSHA title 29 1910 subpart Z lists toxic and hazardous chemicals, exposure limits and specific controls such as monitoring and PPE. A link to this document is in Appendix N.

H-codes, also known as hazard statements, are a standardized way to communicate the specific hazards associated with a chemical. They are part of the Globally Harmonized System of Classification and Labeling of Chemicals (GHS). Each H-code corresponds to a specific hazard class and category, and provides a clear and concise description of the potential risks.

Here are some examples of H-codes and their corresponding hazards:

- **H220:** Extremely flammable gas
- **H301:** Toxic if swallowed
- **H314:** Causes severe skin burns and eye damage
- **H317:** May cause an allergic skin reaction
- **H336:** May cause drowsiness or dizziness

P-codes are precautionary statements used in the Globally Harmonized System of Classification and Labeling of Chemicals (GHS). They provide instructions on how to minimize or prevent the adverse effects of a chemical. Each precautionary statement is assigned a unique code starting with the letter "P" followed by three digits.

There are several categories of P-codes:

- **P1xx:** General precautionary statements
- **P2xx:** Prevention precautionary statements
- **P3xx:** Response precautionary statements
- **P4xx:** Storage precautionary statements
- **P5xx:** Disposal precautionary statements

Here are some examples of P-codes and their corresponding precautionary statements:

- **P101:** If medical advice is needed, have product container or label at hand.
- **P210:** Keep away from heat/sparks/open flames/hot surfaces. - No smoking.
- **P301+P310:** IF SWALLOWED: Immediately call a poison control center and doctor
- **P403:** Store in a well-ventilated place.
- **P501:** Dispose of contents/container to...

Appendix M provides detailed information about H-codes and P-codes.

To differentiate these different risk characteristics, OSHA identifies two categories of hazardous chemicals:

Substances that pose such significant threats to human health are classified as "particularly hazardous substances" (PHSs). The OSHA Laboratory Standard and PESH regulation require that special provisions be established to prevent the harmful exposure of employees to PHSs, including the establishment of designated areas for their use. A list of these substances is found in Appendix N.

Compressed gases is a term which represents three different types of gas products: compressed gases, liquefied gases, and cryogenic gases. Compressed gases may be grouped into various hazard classifications based on their physical or health properties. A gas could be corrosive, flammable, toxic or an oxidizer. An additional hazard is due to the fact that gases are stored under pressure. Cryogens create unique hazards including embrittlement of materials and skin or eye burns upon contact with the liquid. Pressure is a hazard because of the large expansion ratio from liquid to gas, causing pressure to build up in containers.

Precautions: Gas cylinders shall always be transported using a hand truck and with the valve cap in place. All cylinders must be secured in a cart or chained in place against a wall. Exposure of compressed gas cylinders to excessive heat or direct sunlight shall be avoided. Never drop cylinders or permit them to strike each other. Never tamper with safety devices in valves or cylinders. No part of a cylinder shall be subjected to temperatures higher than 125 degrees Fahrenheit. A flame shall never be permitted to come in contact with any part of a compressed gas cylinder. Do not store full and empty gas cylinders together. Bond and ground all cylinders, lines and equipment used with flammable gases. Use compressed gases only in a well-ventilated area. Toxic, flammable and corrosive gases should be handled in a hood. Gas cylinders not actively in use must have valve cap in place. When a gas cylinder is empty, place any valve outlet and protective caps originally shipped with cylinder. Mark or label an empty cylinder "empty" and store in a designated area.

Peroxidizables: materials which react with oxygen to form peroxides, which can explode on impact, heat or friction. Peroxide-forming compounds can be divided into three categories:

- 1.) Compounds forming peroxides that can spontaneously decompose during storage. Maximum storage time is three (3) months. Examples are potassium metal, vinylidene chloride, sodium amide.
- 2.) Compounds forming peroxides that require the addition of a certain amount of energy (distillation, shock) to explosively decompose. Maximum storage time is twelve (12) months. Examples are cyclohexene, diacetylene, ether, dioxane, methyl acetylene, methyl isobutyl ketone, tetrahydrofuran.
- 3.) Compounds that have the potential to form peroxide polymers, a highly dangerous form of peroxide, which precipitate from solution easily and are extremely heat and shock-sensitive. Maximum storage time is twelve (12) months. Examples are acrylic acid, acrylonitrile, butadiene, styrene, methyl methacrylate, vinyl acetate, vinyl chloride, vinyl pyridine, and chloroprene.

Precautions: all peroxidizable shall be dated upon receipt and opening. **Do not open any container that has crystal formation around the lid.**

Section 5: How to Reduce Exposure to Hazardous Chemicals

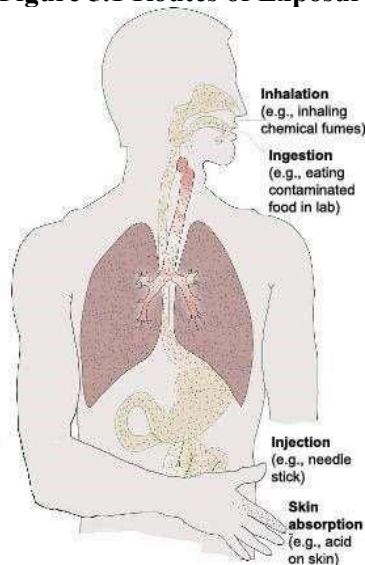
Introduction

Hazardous chemicals require a carefully considered, multi-tiered approach to ensure safety. There are four primary routes of exposure for chemicals which have associated health hazards (illustrated in Figure 5.1):

1. Inhalation;
2. Absorption (through the skin or eyes);
3. Ingestion; and
4. Injection (skin being punctured by a contaminated sharp object or uptake through an existing open wound).

Of these, the most likely route of exposure in the laboratory is by inhalation. Many hazardous chemicals may affect people through more than one of these exposure modes, so it is critical that protective measures are in place for each of these uptake mechanisms.

Figure 5.1 Routes of Exposure



Hierarchy of Controls to prioritize methods for minimizing or eliminating workplace hazards. This system, developed by occupational safety experts, ranks hazard prevention methods from most to least effective:

1. Elimination: physically removing the hazard from the workplace;
2. Substitution: replacing the hazardous substance or process with a safer alternative;
3. Engineering Controls: isolating employees from the hazard through physical changes to the workplace, such as ventilation systems or machine guarding;
4. Administrative Controls: changing work practices and procedures to reduce exposure, such as implementing work rotation or establishing safety procedures;
5. Personal Protective Equipment (PPE): providing workers with equipment like gloves, masks, or respirators to protect them from hazards when other controls are not feasible.

Engineering Controls

Engineering controls include all “built in” safety systems. These controls offer the first line of protection and are highly effective in that they generally require minimal special procedures or actions on the part of the user except in emergency situations. Additionally, engineering controls often involve the replacement or elimination of hazards for a work environment. A fundamental and very common example is the laboratory fume hood which is very effective at containing chemical hazards and protecting users from inhalation hazards. Other examples of engineering controls include general room ventilation, flammable material storage units, and secondary containment.

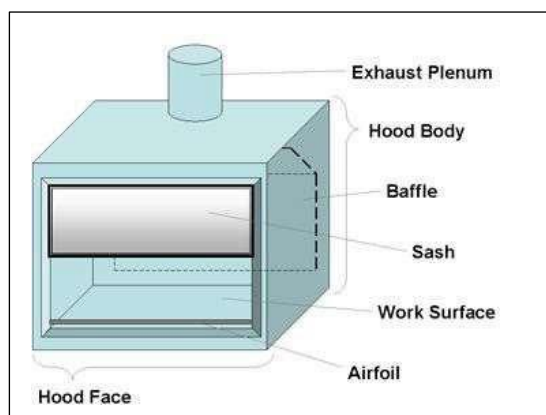
General Laboratory Ventilation

All laboratory rooms in which hazardous materials are used must have fresh air ventilation with 100% of the exhaust venting to the outside; laboratory rooms should not be part of recycled air systems. In cases where this is not desirable, a formal hazard evaluation will be made by PESH to determine what work can be done in the space and under what special conditions or limitations.

Fume Hoods

Fume hoods are the most commonly used local exhaust system on campus. Other methods include vented enclosures for large pieces of equipment or chemical storage, and portable exhaust systems for capturing contaminants near the point of release. Some systems are equipped with air cleaning devices (HEPA filters or carbon absorbers). Figure 5.2 displays the key components of a fume hood.

Figure 5.2 – Fume Hood



It is advisable to use a laboratory hood when working with all hazardous substances. In addition, a laboratory hood or other suitable containment device must be used for all work with "particularly

hazardous substances." A properly operating and correctly used laboratory hood can reduce or eliminate volatile liquids, dusts, and mists. Fume hoods are evaluated for operation and certified by Office of Facilities on an annual basis. These annual evaluations check the fume hood air flow velocity to ensure that the unit will contain hazardous vapors. Data on annual fume hood monitoring will be maintained by Office of Facilities. A complete report of fume hood monitoring data must be kept for one year; summary data must be maintained for 5 years.

Each fume hood should have a current calibration sticker and a marker indicating the highest sash height to be used when working with hazardous materials. Contact the Office of Facilities for a hood evaluation if these labels are missing. Testing will follow federal and state requirements for procedure and results.

When hazardous materials are in a fume hood, but it is not under active use (e.g., during an unattended reaction or experiment), the sash should be closed. Fume hoods are not designed for storage of hazardous materials.

Routine maintenance and repairs of fume hoods are coordinated by Office of Facilities. Hood users may route requests for hood repair directly to the Office of Facilities.

General Rules for fume hood use:

1. Fume hoods should not be used for work involving hazardous substances unless they have a certification label that confirms certification has occurred within the past year.
2. Always keep hazardous chemicals >6 inches behind the plane of the sash.
3. **Never** put your head inside an operating laboratory hood. The plane of the sash is the barrier between contaminated and uncontaminated air
4. Work with the hood sash in the **lowest practical position**. The sash acts as a physical barrier in the event of an accident. Keep the sash closed when not conducting work in the hood.
5. Do not clutter your hood with unnecessary bottles or equipment. Keep it clean and clear. Only materials actively in use should be in the hood.
6. Do not make any modifications to hoods, duct work, or the exhaust system.
7. Do not use large equipment in laboratory hoods unless the hood is dedicated for this purpose, as large obstructions can change the airflow patterns and render the hood unsafe.
8. Shut your sash. For energy efficiency, make sure to shut your sash when the hood is not in use.

Laboratory fume hoods are one of the most important pieces of equipment used to protect laboratory and other workers from exposure to hazardous chemicals. Chemical fume hoods should be inspected upon installation, renovation, when a deficiency is reported, or a change has been made to the operating characteristics of the hood.

Other Engineering Controls In addition to the elements listed above, consideration must be given to providing sufficient engineering controls for the storage and handling of hazardous materials. No more than 10 gallons of flammable chemicals may be stored outside of an approved flammable storage cabinet. For refrigerated or frozen storage, flammable and explosive materials must be kept in refrigeration units specifically designed for storing these materials. Generally, these units do not have internal lights or electronic systems that could spark and trigger an ignition; additionally, the cooling elements are external to the unit. These units should be labeled with a rating from the certifying organization.

Secondary containment must be provided for corrosive and reactive chemicals and is recommended for all other hazardous chemicals. Secondary containment should be made of chemically resistant materials and should be sufficient to hold the volume of at least the largest single bottle stored in the container.

Laboratories that use hazardous materials must contain a sink, kept clear for hand washing to remove any final residual contamination. Hand washing is recommended whenever a staff member who has been working with hazardous materials plans to exit the laboratory or work on a project that does not involve hazardous materials.

Administrative Controls

The next layer of safety controls are Administrative Controls. These controls consist of policies and procedures; they are not generally as reliable as engineering controls in that the user has to carefully follow the appropriate procedures and must be fully trained and aware in order to do so.

Here are some examples of administrative controls:

- **Training and Education:** Providing workers with comprehensive training on the hazards of chemicals, safe handling procedures, emergency response protocols, and the use of personal protective equipment (PPE).
- **Standard Operating Procedures (SOPs):** Developing and implementing detailed SOPs for all tasks involving hazardous chemicals, ensuring consistency and adherence to safety guidelines.
- **Work Practices:** Establishing work practices that minimize exposure, such as limiting the quantity of chemicals used, avoiding unnecessary handling, and using enclosed systems whenever possible.
- **Evaluating:** Evaluating risk is a systematic process that involves identifying potential hazards, assessing the likelihood of exposure, and determining action levels and PEL's.
- **Monitoring Exposure:** Monitoring exposure to hazardous chemicals is a crucial component of a comprehensive safety program. It helps identify potential exposure risks, evaluate the effectiveness of control measures, and ensure compliance with regulatory standards.
- **Restricted Access:** Limiting access to areas where hazardous chemicals are stored or used to authorized personnel only.
- **Maintenance and Inspection Programs:** Implementing regular maintenance and inspection programs for equipment and facilities to ensure they are functioning properly and minimizing the risk of leaks or spills.
- **Emergency Procedures:** Developing and practicing emergency procedures, including evacuation plans, spill response protocols, and first aid procedures.
- **Medical Surveillance:** Implementing a medical surveillance program to monitor workers' health and identify potential health effects from chemical exposure.
- **Posting signs and posters:** Posting signs and posters is a crucial administrative control for enhancing workplace safety and reducing exposure to hazardous chemicals. By effectively utilizing signs and posters, organizations can create a safer and more informed work environment.

PESH requires that each laboratory have safety procedures, which include safety practices, for any work that involves hazardous materials. These safety procedures should be laboratory specific and communicated via lab specific trainings, Lab Safety Rules, or Job Safety Analyses and properly documented.

Laboratory Safety Rules

Laboratory Safety Rules (LSR) (*Appendix A*) relevant to safety and health considerations must be developed and followed when laboratory work involves the use of hazardous chemicals. LSRs are written instructions that detail the steps that will be performed during a given experimental procedure and include information about potential hazards and how these hazards will be

mitigated. LSRs should be written by laboratory personnel who are most knowledgeable and involved with the experimental process. The development and implementation of LSRs is a core component of promoting a strong safety culture in the laboratory and helps ensure a safe work environment.

While general guidance regarding laboratory work with chemicals is contained in this plan, Laboratory Instructors are required to develop and implement laboratory-specific LSRs for certain hazardous chemicals and PHS that are used in their laboratories. The instructors and all personnel responsible for performing the procedures detailed in the LSR shall sign the LSR acknowledging the contents, requirements and responsibilities outlined in the LSR. The LSRs shall be reviewed by qualified personnel and shall be amended and subject to additional review and approval by the instructors where changes or variations in conditions, methodologies, equipment, or use of the chemical occurs. For certain hazardous chemicals, PHS, or specialized practices, consideration must be given to whether additional consultation with safety professionals is warranted or required. When drafting an LSR, consider the type and quantity of the chemical being used, along with the frequency of use. The Safety Data Sheet (SDS) for each hazardous chemical or PHS that will be addressed in the LSR should be referenced during LSR development. The SDS lists important information that will need to be considered, such as exposure limits, type of toxicity, warning properties, and symptoms of exposure. If a new chemical will be produced during the experiment a SDS will not necessarily be available. In these cases, the toxicity is unknown, and it must be assumed that the substance is particularly hazardous, as a mixture of chemicals will generally be more toxic than its most toxic component.

Chemical Monitoring

Regular monitoring of airborne concentrations is not usually justified, but shall be instituted in select cases when deemed necessary by responsible faculty and implemented by the safety officer:

- 1) There is any reason to believe that exposure levels routinely exceed the TLV, PEL or STEL values.
- 2) There is a redesign of ventilation or hoods.
- 3) A highly toxic substance is used regularly in the lab
- 4) Personal exposure has occurred.
- 5) Formaldehyde is used (initial monitoring is required).
- 6) Anesthetic gases are used (initial monitoring is required).
- 7) Monitoring reveals an exposure level above what is allowed.

The safety officer will notify the chemical hygiene officer in writing of the monitoring results. The department head will then notify the affected employees of the results.

Personal Protective Equipment (PPE)

Personal protective equipment (PPE) serves as a person's last line of defense against chemical exposures and is required by everyone entering a laboratory containing hazardous chemicals.

The PPE policy outlines the basic PPE requirements, which include but are not limited to:

- Full length pants and close-toed shoes, or equivalent
- Protective gloves, laboratory coats, & eye protection when working with, or adjacent to, hazardous chemicals
- Flame resistant laboratory coats for high hazard materials, pyrophorics, and flammables.

The primary goal of basic PPE is to mitigate, at a minimum, the hazard associated with exposure to hazardous substances. In some cases, additional, or more protective, equipment must be used. If a

project involves a chemical splash hazard, chemical goggles are required; face shields may also be required when working with chemicals that may cause immediate skin damage. Safety goggles differ from safety glasses in that they form a seal with the face, which completely isolates the eyes from the hazard. If a significant splash hazard exists, heavy gloves, protective aprons and sleeves may also be needed. Gloves should only be used under the specific condition for which they are designed, as no glove is impervious to all chemicals. It is also important to note that gloves degrade over time, so they should be replaced as necessary to ensure adequate protection.

How to Use and Maintain PPE

Personal protective equipment should be kept clean and stored in an area where it will not become contaminated. Personal protective equipment should be inspected prior to use to ensure it is in good condition. It should fit properly and be worn properly. If it becomes contaminated or damaged, it should be cleaned or repaired when possible, or discarded and replaced.

Contaminated Clothing/PPE

In cases where spills or splashes of hazardous chemicals on clothing or PPE occur, the clothing/PPE should immediately be removed and placed in a closed container that prevents release of the chemical. Heavily contaminated clothing/PPE resulting from an accidental spill should be disposed of as hazardous waste. Non-heavily contaminated laboratory coats should be cleaned and properly laundered, as appropriate. Laboratory personnel should **never** take contaminated items home for cleaning or laundering. Persons or companies hired to clean contaminated items must be informed of potentially harmful effects of exposure to hazardous chemicals and must be provided with information to protect themselves.

Respiratory Protection

Typically, respiratory protection is not needed in a laboratory. Under most circumstances, safe work practices, small scale usage, and engineering controls (fume hoods, biosafety cabinets, and general ventilation) adequately protect laboratory workers from chemical and biological hazards. If a College employee suspects a respirator may be necessary for work, they are required to contact PESH **before** the work in question is performed.

If PESH recommends respirator use for a task, the employee must first go through Respirator Training and Fit Testing. Because wearing respiratory equipment places a physical burden on the user, laboratory workers must be medically evaluated prior to wearing respiratory equipment. Certain individuals (e.g., persons with severe asthma, heart conditions, or claustrophobia) may not be medically qualified to wear a respirator. After successful completion of the medical evaluation, the employee will be trained and fit tested by PESH.

An annual refresher is required for the medical evaluation, respirator training, and fit testing. In addition to the annual training refresher, a more frequent re-training, fit testing or medical evaluation must be performed when any of the following occur:

- Changes in the workplace or the type of respirator render previous training obsolete
- Inadequacies in the employee's knowledge or use of the respirator indicate that the employee has not retained the requisite understanding or skill
- Any other situation arises in which reevaluation appears necessary to ensure safe respirator use
- Facial scarring, dental changes, cosmetic surgery, or an obvious change in body weight
- An employee reports medical signs or symptoms related to their ability to use a respirator

Documentation of PPE issuance

All Divisions are required to document the issuance of appropriate PPE to their personnel. New personnel must be instructed in the location of fire extinguishers, safety showers, and other safety equipment *before* they begin work in the laboratory. This training is considered part of the laboratory specific training that all staff members must receive.

Fire Extinguishers

All laboratories working with combustible or flammable chemicals must be outfitted with appropriate fire extinguishers. All extinguishers should be mounted on a wall in an area free of clutter or stored in a fire extinguisher cabinet. Personnel should be familiar with the location, use and classification of the extinguishers in their laboratory.

Laboratory personnel are not required to extinguish fires that occur in their work areas and should not attempt to do so unless:

- It is a small fire (i.e., small trash can sized fire)
- Appropriate training has been received
- It is safe to do so

Any time a fire extinguisher is used, no matter for how brief a period, the Instructor, or most senior laboratory personnel present at the time of the incident, must immediately report the incident to Campus Safety (x1308).

Safety Showers and Eyewash Stations

All laboratories using hazardous chemicals must have immediate access to safety showers with eye wash stations.

In the event of an emergency, individuals using the safety shower should be assisted by an uninjured person to aid in decontamination and should be encouraged to stay in the safety shower for 15 minutes to remove all hazardous material. Safety shower/eyewash stations are tested by Office of Facilities on an annual basis. If an eyewash or safety shower needs repair, call Office of Facilities and give the specific location of the defective equipment.



Fire Doors

Many areas of College buildings may contain critical fire doors as part of the building design. These doors are an important element of the fire containment system and should remain closed unless they are on a magnetic self-closing or other automated self-closing system.

Safe Laboratory Habits

As detailed above, a safety program must include layers of policies and protective equipment to allow for a safe working environment, but to achieve effectiveness, a number of fundamental elements must become basic working habits for the research community. Some of these elements are detailed below:

Personal Protective Equipment (PPE):

- Wear closed-toe shoes and full-length pants, or equivalent, at all times when in the laboratory
- Utilize appropriate PPE while in the laboratory and while performing procedures that involve the use of hazardous chemicals or materials
- Confine long hair and loose clothing
- Remove laboratory coats or gloves immediately on significant contamination, as well as before leaving the

laboratory

- Avoid use of contact lenses in the laboratory unless necessary. If they are used, inform supervisor so special precautions can be taken
- Use any other protective and emergency apparel and equipment as appropriate. Be aware of the locations of first aid kits and emergency eyewash and shower station

Chemical Handling:

- Properly label and store all chemicals. Use secondary containment at all times
- Deposit chemical waste in appropriately labeled receptacles and follow all other waste disposal procedures of the Chemical Hygiene Plan
- Do not smell or taste chemicals
- Never use mouth suction for pipetting or starting a siphon
- Do not dispose of any hazardous chemicals through the sewer system
- Be prepared for an accident or spill and refer to the emergency response procedures for the specific material. Procedures should be readily available to all personnel. Information on minor chemical spill mitigation may also be referenced in *Appendix D*. For general guidance, the following situations should be addressed:
 - Eye Contact: Promptly flush eyes with water for a prolonged period (15 minutes) and seek medical attention
 - Skin Contact: Promptly flush the affected area with water and remove any contaminated clothing. If symptoms persist after washing, seek medical attention

Equipment Storage and Handling:

- Store laboratory glassware with care to avoid damage. Use extra care with Dewar flasks and other evacuated glass apparatus; shield or wrap them to contain chemicals and fragments should implosion occur
- Use certified fume hoods, glove boxes, or other ventilation devices for operations which might result in release of toxic chemical vapors or dust. Preventing the escape of these types of materials into the working atmosphere is one of the best ways to prevent exposure
- Keep hood closed when you are not working in the hood
- Do not use damaged glassware or other equipment
- Do not use uncertified fume hoods or glove boxes for hazardous chemical handling
- Avoid storing materials in hoods
- Do not allow the vents or air flow to be blocked

Laboratory Operations:

- Keep the work area clean and uncluttered
Seek information and advice about hazards, plan appropriate protective procedures, and plan positioning of equipment before beginning any new operation
- If unattended operations are unavoidable, and have been approved by the instructor, place an appropriate sign on the door, leave lights on, and provide for containment of toxic substances in the event of failure of a utility service (such as cooling water)
- Be alert to unsafe conditions and ensure that they are corrected when detected
- Research staff and students should never work alone on procedures involving hazardous chemicals, biological agents, or other physical hazards
- Do not engage in distracting behavior such as practical jokes in the laboratory. This type of conduct may confuse, startle, or distract another worker

Food and Drink:

- No food or drink may be present or consumed in a laboratory or any other space in which hazardous materials are stored or handled.
- Do not smoke, chew gum, or apply cosmetics in areas where laboratory chemicals are present; wash hands before conducting these activities
- Do not store, handle, or consume food or beverages in storage areas, refrigerators, glassware or utensils which are also used for laboratory operations
- Wash areas of exposed skin well before leaving the laboratory.

Section 6: Inventory, Labeling, Storage and Transport

Chemical Inventories

Procurement: All purchases of new hazardous chemical substances must have prior consultation with the chemical hygiene officer. **Chemicals will only be acquired through the College purchasing system.** Chemicals may not be brought in from home, nor may a department accept a gift of chemicals without permission of PESH. The chemical hygiene officer will be provided with safety concerns and required engineering controls related to a particular chemical. No substance described in 42 CFR 73.4 or 73.5 (“Select Agents and Toxins”) <http://www.gpo.gov/fdsys/granule/CFR-2010-title42-vol1/CFR-2010-title42-vol1-sec73-4> will be permitted on College property.

When a hazardous substance is received, information on the proper handling, storage and disposal will be disseminated to those individual employees that will be handling the material. A Safety Data Sheet (SDS) will be filed in the laboratory’s SDS binder. A copy of the SDS will be forwarded to the safety officer and maintained in a central file. No container shall be accepted from a vendor without a proper identification label and a SDS unless one is already on file. Toxic substances shall be segregated in a well-identified area with local exhaust ventilation. Any chemicals that are highly toxic shall be placed in unbreakable secondary containers. Open containers shall be stored on spill trays. Each stockroom shall be under the control of one person. Keys to all chemical storage areas must be returned to the responsible chemical hygiene officer when a faculty member leaves his/her position at the College.

Biology and Physical Science Technicians are required to maintain a current chemical inventory that lists the chemicals and compressed gases used and stored in the labs and the quantity of these chemicals. Chemical inventories are used to ensure compliance with storage limits and fire regulations and can be used in an emergency to identify potential hazards for emergency response operations. The current inventory will be made available by QR code.

The chemical inventory list should be reviewed prior to ordering new chemicals and only the minimum quantities of chemicals necessary should be purchased. As new chemicals are added to the inventory, each Department must confirm that they have access to the Safety Data Sheets (SDS) for those chemicals. Where practical, each chemical should be dated so that expired chemicals can be easily identified for disposal. Inventory the materials in your laboratory frequently (at least annually) to avoid overcrowding with materials that are no longer useful and note the items that should be replaced, have deteriorated, or show container deterioration. Unneeded items should and compromised items should be discarded as chemical waste.

Indications for disposal include:

- Cloudiness in liquids
- Color change
- Evidence of liquids in solids, or solids in liquids
- "Puddling" of material around outside of containers
- Pressure build-up within containers
- Obvious deterioration of containers

Access to hazardous chemicals, including toxic and corrosive substances, should be restricted at all times. These materials must be stored in laboratories or storerooms that are kept locked when laboratory personnel are not present. Locked storage cabinets or other precautions are always recommended, and in some cases may be required in the case of unusually toxic or hazardous chemicals. Unusually toxic chemicals may include those that are associated with very low immediately dangerous to life or health (IDLH) conditions. For guidance on locked storage requirements, please contact the Director of Facilities. On termination or transfer of laboratory personnel, all related hazardous materials should be properly disposed of, or transferred to the laboratory supervisor or a designee.

OSHA Title 8 Section 5194 (e) (1) requires that employers develop and maintain a list of the hazardous chemicals known to be present in the workplace. This is a long standing regulatory requirement and is an important component of our lab safety inspections. In order for SUNY SCHENECTADY to remain in compliance of this regulation, each Department will submit a chemical inventory to the Director of Campus Safety annually.

Chemical Labeling

Every chemical found in the laboratory must be properly labeled. Most chemicals come with a manufacturer's label that contains the necessary information, so care should be taken to not damage or remove these labels. Each chemical bottle, including diluted chemical solutions, must be labeled with its contents and the hazards associated with this chemical. It is recommended that each bottle also be dated when received and when opened to assist in determining which chemicals are expired and require disposal. When new chemicals and compounds are generated by laboratory operations, these new chemical bottles must be labeled with the name, date, and hazard information; the generator or other party responsible for this chemical should be named on the container so that they may be contacted if questions arise about the container's contents.



Since the four colored diamond label used by the GHS system looks identical to but directly contradicts the legally required NFPA diamond, the GHS diamond **will not be used** on secondary labels at the College. If it comes on a chemical container it will be crossed out.

It is important that labels on products be read and reviewed by the individuals who will be working with the product. Directions for safe handling should be followed.

Containers don't require a label if the product transferred into the container will be used immediately by the employee who is transferring the product. For example, a bucket with floor

cleaner, a beaker used in a lab experiment.

Peroxide forming chemicals (e.g., ethers) must be labeled with a date on receipt and on first opening the bottle. These chemicals are only allowed a one-year shelf life and should be disposed of as waste in one year. These chemicals can degrade to form shock sensitive, highly reactive compounds and should be stored and labeled very carefully. See below for more information.

Particularly Hazardous Substances (see *Section 4*) require additional labeling. These chemicals should be segregated from less hazardous chemicals to help with proper access control and hazard identification.

Signs

Signs can be obtained from the SUNY SCHENECTADY sign shop located on the Ammerman campus or from a commercial vendor. Written request for signs and labels must be forwarded to the Ammerman Office of Facilities Director. These requests will then be forwarded directly to the sign shop. The specialist assigned to each laboratory will be responsible for assuring that all signs and labels are posted prominently and are present in all required areas. Contact the safety officer with any questions concerning the type of signs or labels required in your laboratory.

Other postings that are required are:

- Emergency phone numbers: Health Services, Security, College Safety Officer, Department Head, Specialist, Director of Office of Facilities.
- Post location signs for all emergency equipment: safety showers, eyewash stations, first aid supplies, spill kits, exits.
- Post signs for restricted areas.

Chemical Storage and Segregation

Establish and follow safe chemical storage & segregation procedures for your laboratory. Storage guidelines are included for materials that are flammable, oxidizers, corrosive, water reactive, explosive and highly toxic. The specific Safety Data Sheet (SDS) should always be consulted when doubts arise concerning chemical properties and associated hazards. All procedures employed must comply with OSHA, Fire Code and building code regulations. Always wear appropriate personal protective equipment (e.g., laboratory coat, safety glasses, gloves, safety goggles, apron) when handling hazardous chemicals. Be aware of the locations of the safety showers and emergency eyewash stations. Each laboratory is required to provide appropriate laboratory-specific training on how to use this equipment **prior** to working with hazardous chemicals.

Chemical Storage Safety Priorities:

Keep in mind that most chemicals have multiple hazards and a decision must be made as to which storage area would be most appropriate for each specific chemical. First you have to determine your priorities:

1. **Flammability.** When establishing a storage scheme, the number one consideration should be the flammability characteristics of the material. If the material is flammable, it should be stored in a flammable cabinet.
2. **Isolate.** If the material will contribute significantly to a fire (e.g., oxidizers), it should be isolated from the flammables. If there were a fire in the laboratory and response to the fire with water would exaggerate the situation, isolate the water reactive material away from contact with water.
3. **Corrosivity.** Next look at the corrosivity of the material, and store accordingly.
4. **Toxicity.** Finally, consider the toxicity of the material, with particular attention paid to

regulated materials. In some cases, this may mean that certain chemicals will be isolated within a storage area. For example, a material that is an extreme poison but is also flammable, should be locked away in the flammable storage cabinet to protect it against accidental release.

Each chemical in the laboratory must be stored in a specific location and returned there after each use. Acceptable chemical storage locations may include corrosive cabinets, flammable cabinets, laboratory shelves, or appropriate refrigerators or freezers. Fume hoods should not be used as general storage areas for chemicals, as this may seriously impair the ventilating capacity of the hood. Figure 6.2 depicts improper fume hood storage. Chemicals should not be routinely stored on bench tops or stored on the floor. Additionally, bulk quantities of chemicals (i.e., larger than one-gallon) should be stored in a separate storage area, such as a stockroom or supply room.

Figure 6.2 – Improper Fume Hood Storage



Laboratory shelves should have a raised lip along the outer edge to prevent containers from falling. Hazardous liquids or corrosive chemicals should not be stored on shelves above eye-level and chemicals which are highly toxic or corrosive should be in unbreakable secondary containers.

Chemicals must be stored at an appropriate temperature and humidity level and should **never** be stored in direct sunlight or near heat sources, such as laboratory ovens. Incompatible materials should be stored in separate cabinets, whenever possible. If these chemicals must be stored in one cabinet, due to space limitations, adequate segregation and secondary containment must be ensured to prevent adverse reactions. All stored containers and research samples must be appropriately labeled and tightly capped to prevent vapor interactions and to alleviate nuisance odors. Flasks with cork, rubber or glass stoppers should be avoided because of the potential for leaking.

Laboratory refrigerators and freezers must be labeled appropriately with “No Food or Drink” and must **never** be used for the storage of consumables. Freezers should be defrosted periodically so that chemicals do not become trapped in ice formations. *Never store peroxide formers (e.g., ether) in a refrigerator!*

Flammable and combustible liquids

Large quantities of flammable or combustible materials should not be stored in the laboratory. The maximum total quantity of flammable and combustible liquids must not exceed **60 gallons** within a flammable storage cabinet. The

maximum quantity allowed to be kept outside a flammable storage cabinet, safety can, or approved refrigerator/freezer is **10 gallons**. Only the amounts needed for the current procedure should be kept on bench tops and the remainder should be kept in flammable storage cabinets, explosion proof refrigerators/freezers that are approved for the storage of flammable substances, or approved safety cans or drums that are grounded. Always segregate flammable or combustible liquids from oxidizing acids and oxidizers. Flammable materials must **never** be stored in domestic-type refrigerators/freezers and should not be stored in a refrigerator/freezer if the chemical has a flash point below the temperature of the equipment.

Flammable or combustible liquids must not be stored on the floor or in any exit access.

Handle flammable and combustible substances only in areas free of ignition sources and use the chemical in a fume hood whenever practical. Only the amount of material required for the experiment or procedure should be stored in the work area. Always transfer flammable and combustible chemicals from glass containers to glassware or from glass container/glassware to plastic. Transferring these types of chemicals between plastic containers may lead to a fire hazard due to static electricity. The transfer of flammable liquid from 5 gallon or larger metal containers should **not** be done in the laboratory.

Pyrophoric and water reactive substances

Because pyrophoric substances can spontaneously ignite on contact with air and/or water, they must be handled under an inert atmosphere and in such a way that rigorously excludes air and moisture. Some pyrophoric materials are also toxic and many are dissolved or immersed in a flammable solvent. Other common hazards include corrosivity, teratogenicity, or peroxide formation.

Only minimal amounts of reactive chemicals should be used in experiments or stored in the laboratory. These chemicals must be stored as recommended in the SDS. Reactive materials containers must be clearly labeled with the correct chemical name, in English, along with a hazard warning.

Suitable storage locations may include inert gas-filled desiccators or glove boxes; however, some pyrophoric materials must be stored in a flammable substance approved freezer. If pyrophoric or water reactive reagents are received in a specially designed shipping, storage or dispensing container, ensure that the integrity of that container is maintained. Ensure that sufficient protective solvent, oil, kerosene, or inert gas remains in the container while pyrophoric materials are stored. Never store reactive chemicals with flammable materials or in a flammable liquids storage cabinet.

Never return excess reactive chemical to the original container. Small amounts of impurities introduced into the container may cause a fire or explosion. For storage of excess chemical, prepare a storage vessel in the following manner:

1. Dry any new empty containers thoroughly;
Insert the septum into the neck in a way that prevents atmosphere from entering the clean dry (or reagent filled) flask;
2. Insert a needle to vent the flask and quickly inject inert gas through a second needle to maintain a blanket of dry inert gas above the reagent;
3. Once the vessel is fully purged with inert gas, remove the vent needle then the gas line. To introduce the excess chemical, use the procedure described in the handling section, below;
4. For long-term storage, the septum should be secured with a copper wire;
5. For extra protection a second same-sized septa (sans holes) can be placed over the first; and
6. Use parafilm around the outer septa and remove the parafilm and outer septum before

accessing the reagent through the primary septum.

Oxidizers

Oxidizers (e.g., hydrogen peroxide, ferric chloride, potassium dichromate, sodium nitrate) should be stored in a cool, dry place and kept away from flammable and combustible materials, such as wood, paper, Styrofoam, plastics, flammable organic chemicals, and away from reducing agents, such as zinc, alkaline metals, and formic acid.

Peroxide forming chemicals

Peroxide forming chemicals (e.g., ethyl ether, diethyl ether, cyclohexene) should be stored in airtight containers in a dark, cool, and dry place and must be segregated from other classes of chemicals that could create a serious hazard to life or property should an accident occur (e.g., acids, bases, oxidizers). The containers should be labeled with the date received and the date opened. This information, along with the chemical identity should face forward to minimize container handling during inspection. These chemicals must also be tested and documented for the presence of peroxides periodically. Minimize the quantity of peroxide forming chemicals stored in the laboratory and dispose of peroxide forming chemicals before peroxide formation.

Carefully review all cautionary material supplied by the manufacturer prior to use. evaporation or distillation, as distillation defeats the stabilizer added to the solvents. Ensure that containers are tightly sealed to avoid evaporation and that they are free of exterior contamination or crystallization. **Never** return unused quantities back to the original container and clean all spills immediately.

If old containers of peroxide forming chemicals are discovered in the laboratory, (greater than two years past the expiration date or if the date of the container is unknown), **do not handle the container**. If crystallization is present in or on the exterior of a container, **do not handle the container**. Secure it and contact the Director of Facilities for pick-up and disposal.

Corrosives

Store corrosive chemicals (i.e., acids, bases) below eye level and in secondary containers that are large enough to contain at least 10% of the total volume of liquid stored or the volume of the largest container, whichever is greater. Acids must always be segregated from bases and from active metals (e.g., sodium, potassium, magnesium) at all times and must also be segregated from chemicals which could generate toxic gases upon contact (e.g., sodium cyanide, iron sulfide).

Specific types of acids require additional segregation. Mineral acids must be kept away from organic acids and oxidizing acids must be segregated from flammable and combustible substances. Perchloric acid should be stored by itself, away from other chemicals. Picric Acid is reactive with metals or metal salts and explosive when dry and must contain at least 10% water to inhibit explosion.

Special Storage Requirements:

Compressed Gas Cylinders

Compressed gas cylinders must be stored with the safety cap in place when not in use. Cylinders must be stored either chained to the wall or chained within in a cylinder storage rack. The cylinders must be restrained by two chains; one chain must be placed at one third from the top of the cylinder, and the other placed at one third from the bottom of the cylinder (see Figure 6.3). For wall storage, no more than three cylinders may be chained together in the laboratory. Bolted “clam shells” may be used in instances where gas cylinders must be stored or used away from the wall. Store liquefied fuel-gas cylinders securely in the upright position. **Cylinders containing certain gases are prohibited from being stored in a horizontal position, including those which contain a water volume of more than 5 liters.** Do not expose cylinders to excessive dampness, corrosive chemicals or fumes.

Certain gas cylinders require additional precautions. Flammable gas cylinders must use only flame-resistant gas lines and hoses which carry flammable or toxic gases from cylinders and must have all connections wired. Compressed oxygen gas cylinders must be stored at least 20 feet away from combustible materials and flammable gases.

Figure 6.3 – Cylinders Stored & Chained Correctly



Gas cylinder connections must be inspected frequently for deterioration and must never be used without a regulator. Never use a leaking, corroded or damaged cylinder and never refill compressed gas cylinders. When stopping a leak between cylinder and regulator, always close the valve before tightening the union nut. The regulator should be replaced with a safety cap when the cylinder is not in use. Move gas cylinders with the safety cap in place using carts designed for this purpose.

Liquid Nitrogen

Because liquid nitrogen containers are at low pressure and have protective rings mounted around the regulator, they are not required to be affixed to a permanent fixture such as a wall. However, additional protection considerations should be addressed when storing liquid nitrogen in a laboratory. The primary risk to laboratory personnel from liquid nitrogen is skin or eye thermal damage caused by contact with the material. In addition, nitrogen expands 696:1 when changing from a cryogenic liquid to a room temperature gas. The gases usually are not toxic, but if too much oxygen is displaced, asphyxiation is a possibility. Always use appropriate thermally insulated gloves when handling liquid nitrogen. Face shields may be needed in cases where splashing can occur.

Laboratory Security

Recently regulatory agencies have been implementing rules to ensure chemical security. While many of these rules are for large manufacturing facilities, it is critical that chemicals be secured to prevent theft from campus laboratories. Numerous federal agencies are involved in the maintenance of laboratory security, including the Drug Enforcement Agency (www.deadiversion.usdoj.gov/schedules), Federal Bureau of Investigations (www.fbi.gov/about-us/investigate/terrorism/wmd), and Department of Homeland Security (www.dhs.gov/xlibrary/assets/chemsec_appendixa-chemicalofinterestlist.pdf). Doors to laboratories should be closed at all times and locked if not occupied by an employee.

Labs can increase their security by simply keeping lab doors closed and locked when unoccupied, maintaining a current and accurate chemical inventory, training personnel on security procedures, and controlling access to keys. Labs should report any suspicious activity to Campus Safety (x1308).

On Campus Distribution of Hazardous Chemicals

Precautions must be taken when transporting hazardous substances between laboratories. Chemicals must be transported between stockrooms and laboratories in break-resistant, secondary containers such as commercially available bottle carriers made of rubber, metal, or plastic, that include carrying handle(s) and which are large enough to hold the contents of the chemical container in the event of breakage.

When transporting cylinders of compressed gases, always secure the cylinder with straps or chains onto a suitable hand truck and protect the valve with a cover cap. Avoid dragging, sliding, or rolling cylinders and use a freight elevator when possible. Figure 6.4 illustrates correct cylinder transport.

Figure 6.4



Off-Campus Distribution of Hazardous Chemicals

The transportation of hazardous chemicals and compressed gases over public roads, or by air, is strictly governed by international, federal, and state regulatory agencies, including the U.S. Department of Transportation (DOT) and the International Air Transport Association (IATA). Any person who prepares and/or ships these types of materials must ensure compliance with pertinent regulations regarding training, quantity, packaging, and labeling. Without proper training, it is illegal to ship hazardous materials. Those who violate the hazardous materials shipment regulations are subject to criminal investigation and penalties. Individuals who wish to ship or transport hazardous chemicals or compressed gases off-campus, even when using SUNY SCHENECTADY or personal vehicles, must contact the Director of Campus Safety and Director of Facilities for assistance.

Section 7: Training

Introduction

Effective training is critical to facilitate a safe and healthy work environment and prevent laboratory accidents. Department Heads must ensure that all their employees have appropriate safety training before working in a laboratory. PESH provides both classroom and online training to help meet this requirement.

Types of Training:

All laboratory personnel must complete general safety training before:

1. Beginning work in the laboratory;
2. Prior to new exposure situations; and
3. As work conditions change.

Annual refresher training is also required for all laboratory personnel. PESH offers general classroom and online training, plus resource materials to assist laboratories in implementing laboratory-specific training.

General Laboratory Safety Training

Anyone working in a laboratory is required to complete General Laboratory Safety training, which includes:

- Review of laboratory rules and regulations
- Recognition of laboratory hazards
- Use of engineering controls, administrative controls and personal protective equipment to mitigate hazards
- Review of reference materials (e.g., SDS) on hazards, handling, storage and disposal of hazardous chemicals
- Procedures for disposing of hazardous chemical waste
- Fire safety and emergency procedures

All employees must take the following basic laboratory classes annually as appropriate for their employment status:

- **Hazard Communications (Right to Know Law)** – for anyone working in a laboratory
- **Fire Prevention and Response**- all employees

Instructors must also provide laboratory-specific training. Topics that require specific training include:

- Review locations of emergency equipment and exit routes
- Specialized equipment
- Standard Operating Procedures
- Specialized procedures and protocols
- Particularly Hazardous Substances including physical and health hazards, potential exposure, medical surveillance, and emergency procedures

PESH can provide additional assistance in planning laboratory-specific training upon request.

Documentation of Training: Accurate recordkeeping is a critical component of health and safety training. Per OSHA regulations, departments or laboratories are responsible for documenting health and safety training, including safety meetings, one-on-one training, and classroom and online training. Documentation should be maintained in the laboratory safety manual. Additional information on recordkeeping can be found in Section 8 (below).

Section 8: Inspections, Housekeeping and Maintenance

Chemical Safety Inspections

Inspections

Formal housekeeping and chemical hygiene inspections will be conducted by a specialist who is responsible for each designated laboratory and designated by the chemical hygiene officer. These inspections will be performed during the months of October and April of each year. A written report will be generated and sent to the chemical hygiene officer and the safety officer. Any deficiencies will require an immediate corrective action.

PESH has the ability to assist laboratories and Office of Facilities that use, handle or store hazardous chemicals to maintain a safe work environment. This program helps to ensure compliance with regulations and to fulfill SUNY SCHENECTADY's commitment to protecting the health and safety of the campus community.

As part of this chemical safety program, PESH conducts random inspections of laboratories and other areas with hazardous chemicals to ensure the laboratory is operating in a safe manner and to ensure compliance with all federal, state and College safety requirements. The primary goal of inspection is to identify both existing and potential accident- causing hazards, actions, faulty operations and procedures that can be corrected **before** an accident occurs.

The chemical safety inspection is comprehensive in nature and looks into all key aspects of working with hazardous chemicals. While inspections are a snapshot in time and cannot identify every accident-causing mistake, they do provide important information on the overall operation of a particular laboratory. They can also help to identify weaknesses that may require more systematic action across a broader spectrum of laboratories, and strengths that should be fostered in other laboratories. Specific inspection compliance categories include:

- Documentation and Training;
- Hazard Communication (including review of SOPs);
- Emergency and Safety Information;
- Fire Safety;
- General Safety;
- Use of personal protective equipment (PPE);
- Housekeeping;
- Chemical Storage;
- Fume Hoods;
- Chemical Waste Disposal and Transport;
- Mechanical and Electrical Safety.

Once the inspection is completed, PESH issues a Laboratory Inspection Report via email. The report identifies deficiencies in the laboratory, both serious and non-serious. Serious deficiencies are those that have the potential to lead to serious injuries or be of critical importance in the event of an emergency. These deficiencies must be immediately corrected. Non-serious deficiencies must be corrected within 30-days.

Record keeping requirements

Accurate recordkeeping demonstrates a commitment to the safety and health of the SUNY SCHENECTADY community, as well as the protection of the environment. PESH is responsible for maintaining records of inspections, accident investigations, and training conducted by PESH staff. Per OSHA regulations, departments or laboratories must document health and safety training, including safety meetings, one- on-one training, and classroom and online training. Additionally, the following records must be retained in accordance with the requirements of state and federal regulations:

1. Accident records;

2. Measurements taken to monitor employee exposures;
3. Inventory and usage records for high-risk substances should be kept;
4. Medical records must be retained in accordance with the requirements of state and federal regulations.

Housekeeping:

Cleaning. Floors shall be cleaned regularly (once/week) by custodial staff. Counters and lab benches will be cleaned after each use by laboratory staff. **Custodial personnel are not responsible for cleaning countertops and upper laboratory surfaces.** Stairwells, aisles and hallways shall remain free from obstruction and debris. Custodial personnel are not permitted to clean up any type of spill. If laboratory staff is not available, contact the SUNY SCHENECTADY Department of Campus Safety at x1308.

Maintenance:

Safety showers and eyewash stations shall be tested annually by Office of Facilities. All tests shall be documented. The following information should be included: location; date of inspection; type of inspection; type of equipment; deficiencies in operation; corrective action taken; name of inspector. Fire extinguishers shall be inspected annually by the fire equipment service company that is on county contract. A copy of any safety related work orders shall be sent to the Director of Facilities.

Section 9: Chemical Disposal

Regulation of Hazardous Waste

In New York, hazardous waste is regulated by the Department of Environmental Conservation (NYSDEC). Federal EPA regulations also govern certain aspects of hazardous waste management, since most of our waste is treated and disposed out of state. These hazardous waste regulations are part of the Resource Conservation and Recovery Act, or RCRA.

Chemical Disposal Program

Each Department manages the shipment and disposal of all spent chemicals and hazardous waste generated by their operations. Each employee must comply with the campus Hazardous Waste Management Program requirements and all applicable regulations. Laboratory personnel are responsible for identifying waste, labeling it, storing it properly in the laboratory, and transporting waste to their designated pick-up location. The Director of Facilities is responsible for coordinating the disposal of all chemicals from his/her laboratories prior to closing down laboratory operations.



Upon the termination or leave of an employee, for whatever reason, all chemicals for which that person had responsibility for shall be accounted for and inventoried. These chemicals will be returned to the stockroom, transferred to another individual or designated for disposal. This process shall be activated by the department head immediately upon knowledge of the leave or termination.

Broken glass must be placed in the designated glass waste container located in each laboratory. Disposal of broken glass in the regular trash is prohibited.

Definition of Spent Chemicals

Spent chemicals are those substances that have been entirely used up during the course of their intended purpose (i.e. if you use all of dilute sodium azide in the course of experiments, the sodium azide gathered from the experimental glassware is spent chemical, NOT hazardous waste). Note that the chemical will still be *hazardous*, but it will not be *waste*.

Definition of Hazardous Waste

The Environmental Protection Agency (EPA) defines solid waste as any garbage or refuse, sludge from a wastewater treatment plant, water supply treatment plant, or air pollution control facility and other discarded material, including solid, liquid, semi-solid, or contained gaseous material resulting from industrial, commercial, mining, and agricultural operations, and from community activities. Hazardous wastes fall into two categories, **Listed** and **Characteristic Waste**.

Listed Waste

Listed wastes are wastes the EPA has determined are hazardous. The lists include:

- **F-list (wastes from common manufacturing and industrial processes – non-specific source wastes).** Examples include such as solvents that have been used in cleaning or degreasing operations.
- **K-list (wastes from specific industries),** such as petroleum refining or pesticide manufacturing wastes.
- **P- and U-lists (wastes from commercial chemical products)** such as specific commercial chemical products in an unused form, some pesticides and some pharmaceutical products when discarded.

Characteristic Waste

Waste that has not been specifically listed may still be considered a hazardous waste if exhibits one of the four characteristics defined in 40 CFR Part 261 Subpart C:

- **Ignitability (D001).** Ignitable wastes can create fires under certain conditions, are spontaneously combustible, or have a flash point less than 60 °C (140 °F). Examples include waste oils and used solvents.
- **Corrosivity (D002).** Corrosive wastes are acids or bases (pH less than or equal to 2, or greater than or equal to 12.5) that are capable of corroding metal containers, such as storage tanks, drums, and barrels. Battery acid is an example.
- **Reactivity (D003).** Reactive wastes are unstable under "normal" conditions. They can cause explosions, toxic fumes, gases, or vapors when heated, compressed, or mixed with water. Examples include lithium-sulfur batteries and explosives.
- **Toxicity (D004 - D043).** Toxic wastes are harmful or fatal when ingested or absorbed (e.g., containing mercury, lead, etc.). When toxic wastes are land disposed, contaminated liquid may leach from the waste and pollute ground water posing a hazard to the environment.

The EPA's definition of hazardous waste also extends to the following items:

- Abandoned chemicals
- Unused or unwanted chemicals
- Chemicals in deteriorating containers
- Empty containers that have visible residues
- Containers with conflicting labels
- Unlabeled or unknown chemicals

Chemicals not in frequent use must be carefully managed to prevent them from being considered a hazardous waste. This is especially true for certain compounds that degrade and destabilize over time and require careful management so that they do not become a safety hazard (see the section below titled “Wastes that Require Special Handling”).

Acutely Hazardous Waste

Certain compounds meet an additional definition known as “acutely hazardous waste” (P-listed waste). This list of compounds includes carcinogens, pesticides, and reactive compounds, among others (e.g., cyanides, sodium azide, and hydrofluoric acid). You can find the list at: <http://ecfr.gpoaccess.gov/cgi/t/text/text-idx?c=ecfr&sid=e5c593bfda76b7b92b1f7c263a156c8a&rgn=div8&view=text&node=40:26.0.1.1.2.4.1.4&idno=40>),

Waste Identification

All the chemical constituents in each hazardous waste stream must be accurately identified by knowledgeable laboratory personnel. This is a critical safety issue for both laboratory employees and the waste technicians that handle the waste. Mixing of incompatible waste streams has the potential to create violent reactions and is a common cause of laboratory accidents. If there is uncertainty about the composition of a waste stream resulting from an experimental process, laboratory workers must consult the instructor and the Chemical Hygiene Officer. In most cases, careful documentation and review of all chemical products used in the experimental protocol will result in accurate waste stream characterization. The manufacturer’s SDS provides detailed information on each hazardous ingredient in laboratory reagents and other chemical products, and also the chemical, physical, and toxicological properties of that ingredient.

Labeling

Used chemicals vs Hazardous waste- Chemicals that are entirely used in laboratory experiments, demonstrations or processes are *spent* chemicals. Chemicals that pose some danger to humans or the environment that were *not* used in any of the above ways are hazardous waste. Used chemicals and Hazardous waste shall *not* be mixed. Putting used chemicals and hazardous waste together makes the entire container hazardous waste.

Spent chemical disposal- When disposing of chemicals, one basic principle applies: Keep each different class of chemical in a separate clearly labeled disposal container. The generator space designated on the label must be filled in with the name of the faculty member who generated the material. A container of used chemical cannot be placed on the shelf in the designated chemical removal storage area unless a label with the following information is on the container:

SPENT CHEMICALS (in large, bold letters)

“All of the chemicals in this container were used in experiments prior to disposal, therefore are NOT hazardous waste under 40 CFR 261”

Contents:

(name)

PH:

State: (solid/liquid/gas)

SUNY Schenectady County Community College- (518)381-1308

Start and end dates

Hazard Class (es)

Generator's name

Hazardous Waste Disposal

Hazardous Waste disposal- All hazardous waste must be disposed of within 180 days of being designated *hazardous waste*. Under no circumstances may any campus store more than 13200 pounds (6000 kg) of hazardous waste at any given time (Universal waste does not apply towards this limit). When disposing of chemicals, one basic principle applies: Keep each different class of chemical in a separate clearly labeled disposal container. The generator space designated on the label must be filled in with the name of the faculty member who generated the waste material. A container of chemical waste cannot be placed on the shelf in the designated chemical removal storage area unless a label with the following information is on the container:

HAZARDOUS WASTE (in large, bold letters)

Contents: (name)

PH:

State: (solid/liquid/gas)

SUNY Schenectady County Community College- (518)381-1308

Start and end dates

Hazard Class (es)

Generator's name

Storage

All chemicals to be removed must be numbered and logged onto the chemical removal inventory sheet located on a clipboard in the designated storage area for each department. The storage area shall be under the control of one person. The name of the designated specialist shall be posted at the entrance of each storage area. No chemicals can be placed in the storage area without their approval. Note that as a Small Quantities Generator, the College may not store more than 2.2 pounds (1 kilo) of P-listed waste (see above) and no more than 13200 pounds (6000 kilos) of total waste on any campus (excluding universal waste). Waste may not be kept for more than 180 days in any case. Each designated lab technician will check the container integrity, the label and the entry on the inventory sheet.

1. Hazardous waste containers must be clearly labeled at all times
2. Waste must be collected and stored at or near the point of generation (Satellite Accumulation Area (SAA) (see below)
3. The maximum amount of flammable solvents allowed to be stored in a laboratory is 60 gallons; this figure also includes waste solvents
4. All hazardous waste containers in the laboratory must be kept closed when not in used.
5. Hazardous waste streams must have compatible constituents, and must be compatible with the containers that they are stored in
6. Hazardous waste containers must be stored in secondary containment at all times.
7. Containers must be in good condition with leak proof lids
8. Containers must be less than 90% full
9. Dry wastes must be double-bagged in clear, 3-mil plastic bags (these do not require secondary containment).

180-day Container Storage

- Containers of hazardous waste must be marked with the date accumulation began and the words **HAZARDOUS WASTE**. NOTE: The start date is when the first waste is poured/placed into the waste container at the 180-day accumulation point OR, the date the

- container is filled at a satellite accumulation point.
- Weekly inspections must be conducted and logged.
- There must be sufficient aisle space to allow unobstructed movement of personnel, fire protection equipment, spill control equipment, and decontamination equipment to any area of the operation.
- Required equipment is easily accessible and in working condition and is tested to ensure it is in working condition.
- There is internal communications or alarm system capable of providing immediate emergency instruction to personnel.
- There is a telephone or hand-held two-way radio capable of contacting local and emergency responders.
- There are portable fire extinguishers and fire control equipment, including special extinguishing equipment (foam, inert gas, or dry chemicals).
- There is spill control equipment.
- There is decontamination equipment available (eye-wash, emergency showers, etc.).
- There are fire hydrants or other source of water (reservoir, storage tank, etc.) with adequate volume and pressure, foam producing equipment, automatic sprinklers, or water spray systems.
- When waste leaves the 180-day storage area, it either is going for disposal, treatment, or recycle.

Satellite Accumulation Areas

- SQGs may keep waste at a satellite accumulation areas (SAA) and meet less stringent storage and labeling requirements. A SAA is defined as at or near the point of generation where wastes initially accumulate and is under the control of the operator of the waste generating process.
- Containers must be in good condition and compatible with the waste stored in them.
- Containers must be kept closed except when waste is being added or removed.
- Containers must be marked **HAZARDOUS WASTE** or other words that identify contents.
- There should be no more than 55 gal of hazardous waste [this is the total of all the hazardous waste stored at the SAA] or 1 qt of acutely hazardous waste in containers.
- When waste is accumulated in excess of quantity limitations, the excess container must be marked with the date the excess amount began accumulating and the excess waste is transferred to a 180-day or permitted storage area within 3 days.
- When a facility has equipment that discharges hazardous wastes to attached containers (i.e. photo processing), the containers that collect such wastes have to be in compliance with the SAA regulations even if the discharging unit is not regulated under RCRA, the attached containers that collect hazardous wastes from the equipment must be in compliance with the SAA regulations, if those containers collect wastes that are listed or characteristic hazardous wastes.

Training

- Personnel must be thoroughly familiar with waste handling and emergency procedures relevant to their responsibilities during normal facility operation and emergencies.
- NOTE: Regulations do not require training of personnel working in SAAs. Personnel that have access to or work in central accumulation areas, including those that move hazardous waste from a SAP to the 180-day storage area, must be trained. As the ones actually generating hazardous waste, however, personnel working in SAAs need to be familiar enough with the chemicals with which they are working to know when they have generated a hazardous waste so that it will be managed in accordance with the RCRA regulations.

Segregation

All hazardous materials must be managed in a manner that prevents spills and uncontrolled reactions. Stored chemicals and waste should be segregated by hazard class. Examples of proper segregation are:

- Segregate acids from bases
- Segregate oxidizers from organics
- Segregate cyanides from acids
- Segregate flammables

Segregation of waste streams should be conducted in a similar manner to segregation of chemical products. Refer to *Appendix C* for chemical segregation guidelines.

Incompatible Waste Streams

Mixing incompatible waste streams, or selecting a container that is not compatible with its contents, is a common cause of accidents in laboratories and waste storage areas. Reactive mixtures can rupture containers and explode, resulting in serious injury and property damage. All chemical constituents and their waste byproducts must be compatible for each waste container generated. Waste tags must be immediately updated when a new constituent is added to a mixed waste container, so that others in the laboratory will be aware and manage it accordingly.

- Oxidizers added to any fuel can create an exothermic reaction and explode. The most frequent is acids oxidizing flammable liquids. For this reason, all flammable liquids are pH tested before they are consolidated

Wastes that Require Special Handling

Unknowns

Unlabeled chemical containers and unknown/unlabeled wastes are considered unknowns, and additional fees must be paid to have these materials analyzed and identified. These containers must be labeled with the word “unknown”.

Peroxide Forming Chemicals

Peroxide forming chemicals, or PFCs, include a number of substances that can react with air, moisture or product impurities, and undergo a change in their chemical composition during normal storage. The peroxides that form are highly reactive and can explode upon shock or spark.

Peroxides are not particularly volatile and thus tend to precipitate out of liquid solutions. It is particularly dangerous to allow a container of these materials to evaporate to dryness, leaving the crystals of peroxide on the surfaces of the container.

Each container of peroxide forming chemicals should be dated with the date received and the date first opened. There are three classes of peroxide forming chemicals, with each class having different management guidelines. Review the safety information provided by the manufacturer for any chemicals you purchase.

Ensure containers of PFCs are kept tightly sealed to avoid unnecessary evaporation, as this inhibits the stabilizers that are sometimes added. Visually inspect containers periodically to ensure that they are free of exterior contamination or crystallization. PFC containers must be disposed of prior to expiration date. If old containers of peroxide forming chemicals are discovered in the laboratory, (greater than two years past the expiration date or if the date of the container is unknown), **do not handle the container**. If

crystallization is present in or on the exterior of a container, **do not handle the container**. Secure it and contact the Director of Campus Safety and the Director of Facilities for pick-up and disposal.

Dry Picric Acid

Picric acid (also known as trinitrophenol) must be kept hydrated at all times, as it becomes increasingly unstable as it loses water content. When dehydrated, it is not only explosive but also sensitive to shock, heat and friction. Picric acid is highly reactive with a wide variety of compounds (including many metals) and is extremely susceptible to the formation of picrate salts. Be sure to label all containers that contain picric acid with the date received, and then monitor the water content every 6 months. Add distilled water as needed to maintain a consistent liquid volume.

If old or previously unaccounted for bottles of picric acid are discovered, **do not touch the container**. Depending on how long the bottle has been abandoned and the state of the product inside, even a minor disturbance could be dangerous. Visually inspect the contents of the bottle without moving it to evaluate its water content and look for signs of crystallization inside the bottle and around the lid. If there is even the slightest indication of crystallization, signs of evaporation, or the formation of solids in the bottle, **do not handle the container** and contact **Campus Safety (x1308) immediately**. Secure the area and restrict access to the container until it can be evaluated by PESH personnel.

Explosives and Compounds with Shipping Restrictions

NO EXPLOSIVES MAY BE USED ON SUNY SCHENECTADY without approval of the Chemical Hygiene Officer and Director of Facilities.

Health. If approval for use of these substances is given, a special procedure for disposal will be worked out in writing. A variety of other compounds that are classified as water or air reactive are used in laboratories. These compounds often have shipping restrictions and special packaging requirements. When disposing of these compounds, employees must ensure that they are stored appropriately for transport. Flammable metals must be completely submerged in oil before they are brought to a waste pick-up. Many pyrophoric and reactive compounds can be stabilized using a quenching procedure prior to disposal. Chemicals classified by the Department of Transportation (DOT) as explosives (e.g., many nitro- and azo- compounds) will require special packaging and shipping, and may require stabilization prior to disposal. Consult with the Chemical Hygiene Officer for disposal considerations of these compounds.



Managing Empty Containers

Empty containers that held Extremely Hazardous waste must be managed as hazardous waste and brought to the waste pick-up. Do not rinse or reuse these containers.

All other hazardous waste containers, if they are less than 5 gallons in size, should either be reused for hazardous waste collection, or should be cleaned and discarded or recycled. Proper cleaning involves triple rinsing the container, with the first rinse collected as hazardous waste. Then the labels should be completely defaced (remove it or mark it out completely). Dispose or recycle rinsed plastic or glass containers as regular trash or in a campus recycling bin.

Transportation

When transporting waste to the pick-up location, inspect all containers to make sure that they are safe to transport. Verify that each container has an accurate waste tag, and the containers are clean and free

of residue and do not show any signs of bulging, fuming, or bubbling. Use only a stable, heavy-duty cart for transporting waste. Containers should be segregated on carts, and carts should be equipped with secondary containment. Do not overload a cart or stack containers more than one level high. Never leave the waste unattended once departing the laboratory. Employees must wear long pants and closed toe shoes (and carry gloves with them) when transporting chemicals. An appropriate lab coat, gloves and eye protection must be carried as a spill response measure but should not be worn while transporting chemicals.

Disposal

Frequent disposal will ensure that waste accumulation areas in labs are managed properly, and that maximum storage volumes are not exceeded. SUNY SCHENECTADY policy states that hazardous chemical waste can be stored for up to 180 days. Once a waste container is 90% full or it is near the 180 day time limit, it should be brought in for pick-up. Once an experiment or process is completed, all partially filled containers should be brought to the next scheduled pick-up for that campus. Laboratory chemical waste shall be removed from the laboratory to the central storage area at least once a month unless the quantities stored in the lab warrant more frequent transfer to the central waste storage area. Disposal of chemicals down the drain is prohibited. Fume Hoods shall not be used as a means for disposal of volatile organics.

Chemical pickups shall be scheduled at least every 180 days. A TSDF (Treatment, Storage or Disposal Company) on College contract shall be used. Once a pickup of chemicals has occurred, all manifests must be forwarded to the Director of Facilities. Each Division will maintain a copy of the manifest for their own records.

Hazardous Waste Minimization

SUNY SCHENECTADY is a small quantity generator of hazardous waste. In order to meet our permit obligations and our sustainability mission, PESH has developed a Hazardous Waste Minimization Program, in an effort to minimize the costs, health hazards, and environmental impacts associated with the disposal of hazardous waste.

Administrative Controls

In order to reduce the amount of chemicals that become waste, administrative and operational waste minimization controls can be implemented. Usage of chemicals in the laboratory areas should be reviewed to identify practices which can be modified to reduce the amount of hazardous waste generated.

Purchasing Control: when ordering chemicals, be aware of any properties that may preclude long term storage, and order only exact volumes to be used.

Inventory Control: Rotate chemical stock to keep chemicals from becoming outdated. Locate surplus/unused chemicals and attempt to redistribute these to other users, or investigate returning unused chemicals to the vendor.

Operational Controls: Review your experimental protocol to ensure that chemical usage is minimized. Reduce total volumes used in experiments; employ small scale procedures when possible. Instead of wet chemical techniques, use instrumental methods, as these generally require smaller quantities of chemicals. Avoid mixing hazardous and non-hazardous waste streams. Use less hazardous or non-hazardous substitutes when feasible. Some examples include:

- Specialty detergents can be substituted for sulfuric acid/chromic acid cleaning solutions
- Gel Green and Gel Red are recommended in place of ethidium bromide

Drain Disposal

SUNY SCHENECTADY does not permit drain disposal of chemical wastes, unless a specific dilution and/or neutralization method for a consistent waste stream has been reviewed and approved by PESH. This applies to weak acid and base solutions. As indicated in previous sections, EPA hazardous waste definitions specify that materials with a pH between 2 and 12.5 are not hazardous wastes. However, drain disposal of these materials is still not permitted, because local industrial waste water discharge requirements have more restrictive pH thresholds. In addition, acid and base neutralization is considered waste treatment, a process that is strictly regulated by the EPA (see “Bench Top Treatment” below). Contact PESH for specific questions about drain disposal variances.

Bench Top Treatment

EPA regulations allow some limited bench top treatment of certain chemical waste streams in laboratories provided that specific procedures are followed. Due to the stringent nature of these requirements, any treatment of hazardous waste in labs must be reviewed and approved by PESH. The EPA requirements for treating hazardous waste in laboratories generally follow the “Prudent Practices” National Research Council procedures, or other peer-reviewed scientific publications. The quantity of waste treated in one batch cannot exceed 5 gallons of liquid or 18 kilograms of solid/semi-solid waste. As treatment may result in residuals which may have to be managed as hazardous waste, all residual hazardous waste must be handled according to SUNY SCHENECTADY’s Hazardous Waste Program requirements.

Section 10: Accidents and Chemical Spills

Overview

Laboratory emergencies may result from a variety of factors, including serious injuries, fires and explosions, spills and exposures, and natural disasters. All laboratory employees should be familiar with and aware of the location of their laboratory’s emergency response plans and safety manuals.

Before beginning any laboratory task, know what to do in the event of an emergency situation.

Identify the location of safety equipment, including first aid kits, eye washes, safety showers, fire extinguishers, fire alarm pull stations, and spill kits. Plan ahead and know the location of the closest fire alarms, exits, and telephones in your laboratory.

Emergency equipment (fire extinguishers, fire blankets, eyewash stations, shower stations, and core shutoff doors) should never be blocked.

Special Needs

Faculty and instructors should discuss evacuation procedures with all mobility-impaired persons in the laboratory to determine their needs for assistance at the beginning of each semester. The Disabilities Services Coordinator should be included in such discussions as needed.

What to do in the event of an Accident or Emergency

The first priority in an emergency response is the protection of life and health. **The following basic steps apply to ALL emergency situations:**

1. Make sure everyone in the immediate vicinity is aware of the problem and stays a safe distance away from the incident.
2. Contain the emergency if it can be done safely without causing harm to you.
3. Pull the fire alarm to evacuate the building if the emergency cannot be contained or if there is any doubt as to the severity of the situation.
4. For all incidents requiring emergency response, call x1308 from a campus phone or (518)381-1308 from off-campus or cell phones.
5. After the event, the Chemical Hygiene Officer and Director of Facilities will investigate the incident and complete a report for the Campus Safety Council.

Accidents

Instructors are responsible for ensuring that their students receive appropriate medical attention in the event of an occupational injury or illness. All accidents and near misses must be reported to the Director of Campus Safety. PESH will conduct an accident investigation and develop recommendations and corrective actions to prevent future accidents. At a minimum, each laboratory must have the following preparations in place:

1. Fully stocked first aid kit
2. Posting of emergency telephone numbers and locations of emergency equipment
3. SDS for all chemicals in use or storage on hand

Accident Prevention Methods	
Do	Don't
• Always wear appropriate eye protection • Always wear appropriate laboratory coat • Always wear appropriate gloves • Always wear closed-toe shoes and long pants • Always confine long hair and loose clothing • Always use the appropriate safety controls (e.g., certified fume hoods) • Always label and store chemicals properly	• Never enter the laboratory wearing inappropriate clothing (e.g., open-toe shoes and shorts) • Never work alone on procedures involving hazardous chemicals, biological agents, or other physical hazards • Never eat, drink, chew gum or tobacco, smoke, or apply cosmetics in the laboratory • Never use damaged glassware

If an employee/student has a severe or life-threatening injury, call for emergency response. Employees/students with minor injuries should be treated with first aid kits as appropriate, and sent to the Nurse's Office for further evaluation and treatment. After normal business hours, treatment can be obtained at designated medical centers and emergency rooms.

Exposure Incident:

- Eye Contact: Promptly flush with water for at least 15 minutes. Contact Campus Safety (x1308).
- Skin Contact: Promptly flush with water. If body is exposed to a chemical product, use the safety shower to adequately flush. Remove contaminated clothing. Contact Campus Safety.
- Ingestion: Consult the Safety Data Sheet (SDS). Contact Campus Safety.

Serious occupational injuries, illnesses, and exposures to hazardous substances must be reported to the Director of Campus Safety. Campus Safety will report the event to PESH,

investigate the accident, and complete exposure monitoring if necessary. Serious injuries include those that result in permanent impairment or disfigurement, or require hospitalization. Examples include amputations, lacerations with severe bleeding, burns, concussions, fractures and crush injuries. As soon as a CHO becomes aware of a potentially serious incident, they must contact PESH.

Fire-Related Emergencies

If you encounter a fire, or a fire-related emergency (e.g., abnormal heating, smoke, burning odor), immediately follow these instructions:

1. Pull the fire alarm pull station and call 911;
2. Evacuate and isolate the area
 - Use portable fire extinguishers to facilitate evacuation and/or control a small fire (i.e., size of a small trash can), if safe to do so
 - If possible, shut off equipment before leaving
 - Close doors;
3. Remain safely outside the affected area to provide details to emergency responders; and Evacuate the building when the alarm sounds. *It is against state law to remain in the building when the alarm is sounding.* If the alarm sounds due to a false alarm or drill, you will be allowed to re-enter the building as soon as the Fire Department determines that it is safe to do so. *Do not go back in the building until the alarm stops and you are cleared to reenter.*

If your clothing catches on fire, go to the nearest emergency shower immediately. If a shower is not immediately available, then stop, drop, and roll. A fire extinguisher may be used to extinguish a fire on someone's person. Report any burn injuries to the supervisor immediately and seek medical treatment. You are required to inform Campus Safety (within 8 hours) every time a fire extinguisher is discharged.

Fire Extinguishers

Faculty members, with the assistance of the Director of Environmental Health and Safety, should review the hazards in their laboratory on an ongoing basis to determine if the fire extinguisher(s) present are appropriate. If additional or different class extinguishers are needed, the faculty member should notify the Director of Environmental Health and Safety. Classes and types of extinguishers are described in following table:

TYPES and CLASSES OF FIRE EXTINGUISHERS	
Class (Type)*	Use
A (Water)	For ordinary combustibles (e.g., paper, wood)
B (CO ₂)	For flammable liquids or electrical equipment (e.g., computers, ovens, instruments)
ABC (Dry Chemical)	For all types of fire, including flammable liquids other than paper, metal and grease fires
K (Chemical)	Grease fires

* = Classes:

Class A - wood, cloth, paper, rubber, and plastic.

Class B - flammable liquids, oils, greases, tars, oil-based paints, and flammable gases. Class C - energized electrical equipment.

Class D - combustible metals such as magnesium, titanium, zirconium, sodium, lithium, and potassium.

Class K- kitchen grease fires

Chemical Spills

Chemical spills can result in chemical exposures and contaminations. Chemical spills become emergencies when:

- The spill results in a release to the environment
- The material or its hazards are unknown
- Laboratory staff cannot safely manage the hazard because the material is too hazardous or the quantity is too large

Effective emergency response to these situations is imperative to mitigate or minimize adverse reactions when chemical incidents occur. After emergency procedures are completed, all personnel involved in the incident should follow SUNY SCHENECTADY chemical exposure procedures as appropriate.

In the event of a significant chemical exposure or contamination, immediately try to remove or isolate the chemical if safe to do so.

Factors to Consider Before Spill Clean-Up

- Size of spill area
- Quantity of chemical
- Toxicity
- Volatility
- Clean up materials available

When skin or eye exposures occur, remove contaminated clothing and flush the affected area using an eye wash or shower for at least 15 minutes. If a chemical is ingested, drink plenty of water. Obtain medical assistance as indicated. Remember to wear appropriate PPE before helping others. Instructors/Department Heads must review all exposure situations, make sure affected students/employees receive appropriate medical treatment and/or assessment, and arrange for containment and clean-up of the chemical as appropriate.

Small chemical spills can be cleaned up by laboratory personnel who have been trained in spill clean-up and with the appropriate materials. A small spill is generally defined as < 1 liter of chemical that is not highly toxic, does not present a significant fire or environmental hazard, and is not in a public area such as a common hallway. **Large chemical spills** include spills of larger quantities, spills of any quantity of highly toxic chemicals, or chemicals in public areas or adjacent to drains. Large spills require emergency response. Call x**1308** from a campus phone or **(518)381-1308** from an off-campus or cell phone for assistance.

What to do with a small chemical spill (less than one Liter)

- Evacuate all non-essential persons from the spill area
- If needed, call for medical assistance by dialing **x1308** from a campus phone or **(518)381-1308** from an off-campus or cell phone
- Help anyone who may have been contaminated. Use emergency eyewashes/showers by flushing the skin or eyes for *at least 15 minutes*
- Post someone just outside the spill area to keep people from entering. Avoid walking through contaminated areas



You must have the proper protective equipment and clean-up materials to clean-up spills. Check the chemical's Safety Data Sheet (SDS) in your laboratory for spill clean-up procedures, or call the Director of Campus Safety for advice

- Turn off sources of flames, electrical heaters, and other electrical apparatus, and close valves on gas cylinders if the chemical is flammable
- Confine the spill to a small area. Do not let it spread
- Avoid breathing vapors from the spill. If the spill is in a non-ventilated area, do not attempt to clean it up. Call for emergency personnel to respond and clean up the spill
- Wear personal protective equipment, including safety goggles, gloves, and a laboratory coat or other protective garment to clean-up the spill
- Work with another person to clean-up the spill. Do not clean-up a spill alone
- **DO NOT ADD WATER TO THE SPILL**
- Use an appropriate kit to neutralize and absorb inorganic acids and bases. For other chemicals, use the appropriate kit or absorb the spill with sorbent pads, paper towels, vermiculite, dry sand, or diatomaceous earth. For specific procedures for all other spills see *Appendix D*.
- Collect the residue and place it in a clear plastic bag. Double bag the waste and label the bag with the contents.

What to do with a large chemical spill (greater than one Liter)

Large chemical spills require emergency response. Call **x1308** from a campus phone or **(518)381-1308** from an off-campus or cell phone. If the spill presents a situation that is immediately dangerous to life or health (IDLH) or presents a significant fire risk, activate a fire alarm, evacuate the area and wait for emergency response to arrive.

- Remove the injured and/or contaminated person(s) and provide first aid
- Call for emergency medical response
- As you evacuate the laboratory, close the door behind you, and:
 - Post someone safely outside and away from the spill area to keep people from entering
 - Confine the spill area if possible and safe to do so
 - Leave on or establish exhaust ventilation
 - If possible, turn off all sources of flames, electrical heaters, and other electrical equipment if the spilled material is flammable

- Avoid walking through contaminated areas or breathing vapors of the spilled material
- Any student/employee with known contact with a particularly hazardous chemical must shower, including washing of the hair as soon as possible unless contraindicated by physical injuries

Highly Toxic Chemical Spills

Do not try to clean up spills of any size. All Highly Toxic chemical spills require emergency response.

Appendix A: General Rules for Laboratory Work with Chemicals

PRUDENT LABORATORY PRACTICES

It is prudent to minimize all chemical exposures. Few laboratory chemicals are without hazards, and general precautions for handling all laboratory chemicals should be adopted, in addition to specific guidelines for particular chemicals. Exposure should be minimized even for substances of no known significant hazard, and special precautions should be taken for work with substances that present special hazards. One should assume that any mixture will be more toxic than its most toxic component and that all substances of unknown toxicity are toxic.

Avoid inadvertent exposures to hazardous chemicals by developing and encouraging safe habits and thereby promoting a strong safety culture.

SAFE LABORATORY HABITS

Personal Protective Equipment:

- Wear closed-toe shoes and full-length pants, or equivalent, at all times when in the laboratory
- Utilize appropriate PPE while in the laboratory and while performing procedures that involve the use of hazardous chemicals or materials. These items may include laboratory coats, gloves, and safety glasses or goggles.
- Confine long hair and loose clothing
- Wear appropriate gloves when the potential for contact with toxic materials exists; inspect the gloves before each use, and replace them often
- Remove laboratory coats or gloves immediately on significant contamination, as well as before leaving the laboratory
- Avoid use of contact lenses in the laboratory unless necessary; if they are used, inform supervisor so special precautions can be taken
- Ensure that appropriate PPE is worn by all persons, including visitors, where chemicals are stored or handled
- Use any other protective and emergency apparel and equipment as appropriate. Be aware of the locations of first aid kits and emergency eyewash and shower stations

Chemical Handling:

- Use only those chemicals for which the quality of the available ventilation system is appropriate
 - Do not smell or taste chemicals.
 - Never use mouth suction for pipetting or starting a siphon
 - Vent apparatus which may discharge toxic chemicals (vacuum pumps, distillation columns, etc.) into local exhaust devices
 - Properly label and store all chemicals. Use secondary containment at all times
 - Deposit chemical waste in appropriately labeled receptacles and follow all other waste disposal procedures of the Chemical Hygiene Plan
- In the case of an accident or spill, refer to the emergency response procedures for the specific material. These procedures should be readily available to all personnel. Information on minor chemical spill mitigation may also be referenced in *Appendix D*. For general guidance, the following situations should be addressed:
- Eye Contact: Promptly flush eyes with water for a prolonged period (15 minutes) and seek medical attention
 - Skin Contact: Promptly flush the affected area with water and remove any contaminated clothing. If symptoms persist after washing, seek medical attention
 - Clean-up: Promptly clean up spills, using appropriate protective apparel and equipment, and proper disposal

Equipment Storage and Handling:

- Use equipment only for its designed purpose
- Do not use damaged glassware or other equipment, under any circumstances.
- Store laboratory glassware with care to avoid damage. Use extra care with Dewar flasks and other evacuated glass apparatus; shield or wrap them to contain chemicals and fragments should implosion occur
- Use certified fume hoods, glove boxes, or other ventilation devices for operations which might result in release of toxic chemical vapors or dust. Preventing the escape of these types of materials into the working atmosphere is one of the best ways to prevent exposure
- Keep hood closed at all times, except when adjustments within the hood are being made
- Leave the fume hood "on" even when it is not in active use if toxic substances are in the fume hood or if it is uncertain whether adequate general laboratory ventilation will be maintained when it is "off"
- Do not use uncertified fume hoods or glove boxes for hazardous chemical handling

Laboratory Operations:

- Keep the work area clean and uncluttered
- Seek information and advice about hazards, plan appropriate protective procedures, and plan positioning of equipment before beginning any new operation
- Avoid unattended operations, if at all possible. Unattended operations require prior approval from the Department Head
- If there is the need for a laboratory project to be left unattended, the individual responsible for the project must notify the appropriate specialist, the Director of Office of Facilities and Campus Safety. The lights in the room will remain on and an appropriate sign will be placed on the door. The individual responsible for the setup will need to provide for

containment of the chemicals involved in the event of an unforeseen accident.

- Be alert to unsafe conditions and ensure that they are corrected when detected
- Never work alone on procedures involving hazardous chemicals, biological agents, or other physical hazards
- Do not engage in distracting behavior such as practical joke playing in the laboratory. This type of conduct may confuse, startle, or distract another person
- Do not eat, drink, smoke, chew gum, or apply cosmetics in areas where laboratory chemicals are present; wash hands before conducting these activities
- Do not store, handle, or consume food or beverages in storage areas, refrigerators, glassware or utensils which are also used for laboratory operations
- Wash areas of exposed skin well before leaving the laboratory

Once the building is locked, NO STUDENTS are allowed to remain in the building.

Appendix B: Container Labeling

Chemical container labels are a good resource for information on chemical hazards. All containers of hazardous chemicals must have labels attached. Figure C.1 displays the label requirements.

The warning may be a single word (e.g. Danger, Caution, Warning) or may identify the primary hazards, including both physical (e.g. water reactive, flammable, or explosive) and health (e.g. carcinogen, corrosive or irritant), such as what is found on an NFPA diamond and hazard warnings from the label or SDS.

Most labels provide additional safety information to help workers protect themselves from the substance. This information may include protective measures and/or protective clothing to be used, first aid instructions, storage information and emergency procedures.

Chemical Labeling – What are Laboratory Personnel Responsible for?

- Inspecting incoming containers to be sure that labels are attached and are in good condition and contain the information outlined above
- Reading the container label each time a newly purchased chemical is used. It is possible that the manufacturer may have added new hazard information or reformulated the product since the last purchase
- Ensuring that chemical container labels are not removed or defaced, except when containers are empty
- Labeling any secondary containers used in the laboratory, to prevent unknown chemicals or inadvertent reaction
- Verifying that chemical waste containers have complete and accurate chemical waste labels

Labeling is important for the safe management of chemicals, preventing accidental misuse, inadvertent mixing of incompatible chemicals, and facilitating proper chemical storage. Proper labeling helps ensure quick response in the event of an accident, such as a chemical spill or chemical exposure incident. Finally, proper labeling prevents the high costs associated with disposal of “unknown” chemicals.

With the exception of transient containers that will contain chemicals for immediate use, all containers of chemicals being used or generated at SUNY SCHENECTADY must be labeled

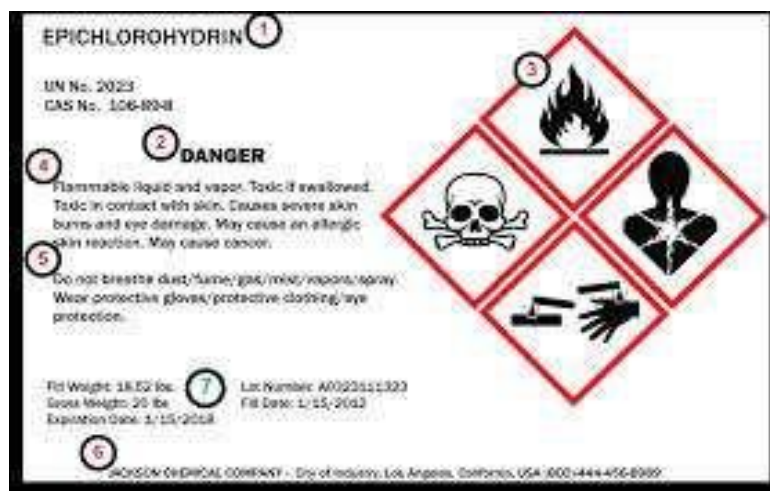
sufficiently to indicate the contents of the container. On original containers, the label must not be removed or defaced in any way until the container is emptied of its original contents. Incoming containers must be inspected to make sure the label is in good condition. It is also advisable to put a date on new chemicals when they are received in the laboratory, and to put a date on containers of chemicals generated in the laboratory, as well as the initials of the responsible person.

Abbreviations or other acronyms may be used to label containers of chemicals generated in the laboratory as long as all personnel working in the laboratory understand the meaning of the label, or know the location of information, such as a laboratory notebook or log sheet that contains the code associated with content information. In addition, small containers, such as vials and test tubes, can be labeled as a group by labeling the outer container (e.g., rack or box). Alternatively, a placard can be used to label the storage location for small containers (e.g., shelf, refrigerator, etc.). This information must be provided to Facilities staff as part of their hazard communication training.

Containers of practically non-toxic and relatively harmless chemicals must also be labeled with content information, including containers such as squirt bottles containing water.

With respect to chemical labeling, all potentially hazardous chemicals transferred from their original container to a second container must be labeled with the chemical name and the principal hazards found on the primary container label or SDS. For more information on labeling, see Section 6: Inventory, Labeling, Storage, and Transport.

Figure B.1. – Example of proper Container Labeling



- 1) Chemical Name (required)
- 2) Level of hazard (required)
- 3,4) Type of hazard type (required- note it can be word, pictogram or both)
- 5,6,7) Additional information (optional)

Appendix C: Segregation of Incompatible Chemicals

Table M.1 contains a list of incompatible chemicals. The following chemicals, listed in the left column, should not be used with chemicals listed in the right column, except under specially controlled conditions. Chemicals in the left column should not be stored in the immediate area with chemicals in the right column. Incompatible chemicals should always be handled, stored or packed so that they cannot accidentally come into contact with one another. This list is representative of chemical incompatibilities and is not complete, nor are all incompatibilities shown.

Table C1. Common Incompatible Chemical Combinations

Acetic acids	Chromium oxide, nitric acid, perchloric acid, peroxides, permanganates, alcohol, ethylene glycol
Acetic anhydride	Hydroxyl-containing compounds e.g. ethylene glycol, perchloric acid
Acetone	Concentrated nitric acid and sulfuric acid mixtures, hydrogen peroxide
Acetylene	Chlorine, bromine, fluorine, copper, silver
Activated carbon	Calcium hypochlorite, oxidizing agents
Alkali metals	Water, carbon tetrachloride and other halogenated alkanes, carbon dioxide, halogens. (Do not use water or foam extinguishers for fires involving these metals use the appropriate Class D extinguisher.
Aluminum	All oxidizing agents, acids, alkalis, halogenated hydrocarbons, peroxides
Aluminum alkyls	Water
Ammonia, liquid or gas	Chlorine, calcium hypochlorite, iodine, bromine, hydrogen fluoride
Ammonium nitrate	Acids, powdered metals, flammable liquids, chlorates, nitrates, sulfur, fine-particulate organic or combustible materials
Aniline	Nitric acid, hydrogen peroxide
Arsenic materials	Any reducing agent
Azides	Acids

Bromine	See Chlorine
Calcium carbide	Water, ethanol
Calcium oxide	Water
Carbon activated	Calcium hypochlorite, other oxidants
Carbon tetrachloride	Sodium
Chlorates	Ammonium salts, acids, powdered metals, sulfur, fine-particulate organic or combustible substances
Chlorine	Ammonia, acetylene, butadiene, butane, methane, propane, hydrogen, petroleum benzene, benzene, powdered metals
Chlorine dioxide	Ammonium, methane, phosphine, hydrogen sulfide
Chromium (VI) oxide, Chromic acid	Acetic acid, naphthalene, camphor, glycerol, petroleum benzene, alcohols, flammable liquids
Copper	Acetylene, hydrogen peroxide
Cumene Hydroperoxides	Acids, both organic and inorganic
Cyanides	Acids
Flammable liquids	Ammonium nitrate, chromium (VI) oxide, hydrogen peroxide, nitric acid, sodium peroxide, halogens, chromic acid.
Fluorine	Extremely aggressive; store separately! Isolate from everything!
Hydrazine	Hydrogen peroxide, nitric acid, any other oxidant
Hydrocarbons, butane, propane, benzene etc.	Fluorine, chlorine, bromine, chromium (VI) oxide, sodium peroxide
Hydrocyanic acid	Nitric acid, alkali
Hydrogen fluoride (hydrofluoric acid)	Ammonia (laboratory gas or solutions)
Hydrogen peroxide	Copper, chromium, iron, metals and metal salts, alcohols, acetone, organic substances, aniline, nitromethane, combustible substances (solid or liquid)
Hydrogen sulphide	Fuming nitric acid, oxidizing gases
Hypochlorites	Acids, activated carbon
Iodine	Acetylene, ammonia (laboratory gas or solutions)
Mercuric oxide	Sulfur
Nitrates and nitrites	Acids
Nitric acid	Acetic acid, aniline, chromium (VI) oxide, prussic acid, hydrogen sulfide, flammable liquids and gases
Nitrites ⁷	Acids
Nitroparaffins	Inorganic bases, amines
Oxalic acid	Silver, mercury salts

Oxygen	Oils, grease, hydrogen; flammable liquids, solids, or gases
Perchloric acid	Acetic anhydride, bismuth and its alloys, alcohols, paper, wood, grease, oil, (all organics)
Peroxides, organic	Acids (organic and inorganic), avoid friction, store cold
Phosphorus	Sulfur, compounds containing oxygen, e.g. chlorates, air, oxygen
Phosphorus (white)	Air, oxygen, alkalis, reducing agents, carbon tetrachloride, carbon dioxide, water, alcohols, acids
Phosphorus pentoxide	Alcohols, strong bases, water
Potassium	Air, oxygen, reducing agents, Carbon tetrachloride, carbon dioxide, water, alcohols, acids
Potassium chlorates	See Chlorates
Potassium perchlorate	See Chlorates
Potassium permanganate	Glycerol, ethylene glycol, benzaldehyde, sulfuric acid
Selenides	Reducing agents
Silver	Acetylene, oxalic acid tartaric acid, ammonium compounds
Sodium	See Alkali metals
Sodium Nitrate	Ammonium salts
Sodium Nitrite ⁷	Ammonium nitrate and other ammonium salts
Sodium peroxide	Methanol, ethanol, glacial acetic acid, acetic anhydride, benzaldehyde, carbon disulfide, glycerol, ethylene glycol, ethyl acetate, methyl acetate, furfural
Sulfides (sulphides)	Acids
Sulfuric acid	Potassium chlorate, potassium perchlorate, potassium permanganate (or compounds with similar light metals, such as sodium, lithium)
Sulphur	Metals, all oxidizing agents
Tellurides	Reducing agents
Zinc	All oxidizing agents, acids, alkalis, halogenated hydrocarbons, peroxides

Table C2. Possible Reactions That May Occur Due to Improper Storage of Incompatible Chemicals

Acetic acid & acetaldehyde	Small amounts of acetic acid will cause the acetaldehyde to polymerize, releasing heat
Acetic anhydride & acetaldehyde	Reaction can be violently explosive
Aluminum metal & ammonium nitrate	A potential explosive
Aluminum & bromine vapor	Aluminum foil reacts with bromine vapor at room temperature and combusts
Ammonia vapor & bromine vapor	Unstable nitrogen tribromide is formed, explosion may result

Ammonium nitrate & acetic acid	A mixture may result in ignition, especially if acetic acid is concentrated
Cupric sulfide & cadmium chlorate	Will explode on contact
Hydrogen peroxide & ferrous sulfide	Forms a vigorous, highly exothermic reaction
Hydrogen peroxide & lead II or IV oxide	Violent, possibly explosive reaction
Lead perchlorate & methyl alcohol	Forms an explosive mixture if agitated
Lead sulfide & hydrogen peroxide	Vigorous, potentially explosive reaction
Mercury II nitrate & methanol	May form mercury fulminate - an explosive
Nitric acid & phosphorus	Phosphorus burns spontaneously in the presence of nitric acid
Potassium cyanide & potassium peroxide	A potentially-explosive mixture if heated
Sodium nitrate & sodium thiosulfate	A mixture of the dry materials can result in an explosion

Table C3. Potentially Explosive Combinations of Common Reagents

Acetylene + Copper, Silver, Mercury salts
Carbon Disulfide + Sodium Azide
Chlorine + an Alcohol
Chloroform or Carbon Tetrachloride + Powdered Aluminum or Magnesium
Decolorizing Carbon + an Oxidizing Agent
Diethyl Ether + Chlorine (including a chlorine atmosphere)
Dimethyl Sulfoxide + Chromium Trioxide
Ethanol + Calcium Hypochlorite
Ethanol + Silver Nitrate
Nitric Acid + Acetic Anhydride or Acetic Acid
Picric Acid + a heavy metal salt such as Lead, Mercury, or Silver Oxide + Ammonia + Ethanol
Sodium + a Chlorinated Hydrocarbon
Sodium Hypochlorite + an Amine

Appendix D: Minor Spill Cleanup

Laboratory personnel can clean up small spills if trained and competent to do so. Small spills include chemical spills that are up to 1 liter in size and of limited toxicity, flammability and volatility. If respiratory protection is needed for spill clean-up, the spill is too large to be handled by laboratory personnel – dial 311 from a campus phone or (518)381-1308 from an off-campus or cell phone. Commercial chemical and mercury spill kits are available, which include protective equipment such as goggles and gloves, neutralizing and absorbing materials, bags, and scoops. You can also make your own spill kits to include the materials described below:

- Sodium Bicarbonate
- Citric Acid
- Vermiculite or other diking material
- pH paper
- 1 pair neoprene or nitrile gloves
- 1 pair goggles
- 1 scoop
- Spill pillows, sorbent pads
- Disposable shoe covers (plastic bags may work)

Weak Inorganic Acid or Base Spill Clean Up Procedure

1. Wear gloves, goggles, laboratory coat and shoe covers.
2. To clean-up a spill of weak inorganic acid or base, neutralize the spilled liquid to pH 5 to 8 using a **Neutralizing Agent** such as:

Sodium bicarbonate	Soda ash
Sodium bisulfate	Citric acid

3. Absorb the neutralized liquid with an **Absorbent** such as:

Sorbent pads	Diatomaceous earth	Dry sand
Sponges	Paper towels	Vermiculite
4. Rinse the absorbent pads or sponges in a sink with water. Scoop or place the other absorbent materials into a clear plastic bag. Double bag and tag the bag with a chemical waste tag.

Solvent Spill Clean up

1. Absorb the spill with a non-reactive material such as:
 - Vermiculite
 - Dry sand
 - Paper towels
 - Sponges
2. Package as described above. Do not rinse or dispose of any chemicals down the sink or into any

drain.

Appendix E: Glossary of Terms

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

ACTION LEVEL - A concentration designated in Title 8, California Code of Regulations 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.

AEROSOL - Liquid droplets or solid particles dispersed in air that are of fine enough size (less than 100 micrometers) to remain dispersed for a period of time.

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

ACUTE HAZARDOUS WASTE (aka "P-Waste")- chemicals listed in 40 CFR §261.33

"C" OR CEILING - A description usually seen in connection with a published exposure limit. It refers to the concentration that should not be exceeded, even for an instant. It may be written as TLV-C or Threshold Limit Value - Ceiling. (See also Threshold Limit Value).

CARCINOGEN - A cancer-producing substance or physical agent in animals or humans. A chemical is considered a carcinogen or potential carcinogen if it is so identified in any of the following:

- National Toxicology Program, "Annual Report of Carcinogens" (latest edition)
- International Agency for Research on Cancer, "Monographs" (latest edition)
- OSHA, 29 CFR 1910, Subpart Z, Toxic and Hazardous Substances

CFR - Code of Federal Regulations

CHEMICAL HYGIENE OFFICER - An employee who is designated by the employer and who is qualified by training or experience to provide technical guidance in the development and implementation of the provisions of the Chemical Hygiene Plan.

CHEMICAL HYGIENE PLAN - A written program developed and implemented by the employer which sets forth procedures, equipment, personal protective equipment, and work practices that (1) are capable of protecting employees from the health hazards presented by hazardous chemicals used in that particular workplace and (2) meets the requirements of OSHA regulation 29 CFR 1910.1450.

CHEMICAL NAME - The scientific designation of a chemical in accordance with the nomenclature system developed by the International Union of Pure and Applied Chemistry (IUPAC) or the Chemical Abstracts Service (CAS) rules of nomenclature, or a name which will clearly identify the chemical for the purpose of conducting a hazard evaluation.

COMBUSTIBLE LIQUID - Any liquid having a flashpoint at or above 100°F (37.8°C) but below 200°F (93.3°C) except any mixture having components with flashpoints of 200°F or higher, the total volume of which make up 99% 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°F (21.1°C), or; a gas or mixture of gases having, in a container, an absolute pressure exceeding 104 psi at 130°F (54.4°C) regardless of the pressure at 70°F (21.1°C), or; a liquid having a vapor pressure exceeding 40 psi at 100°F (37.8°C) as determined by ASTM D-323-72.

COMMON NAME - Any designation or identification such as code name, code number, trade name, brand name, or generic name used to identify a chemical other than by its chemical name.

CONTAINER - Any bag, barrel, bottle, box, can, cylinder, drum, reaction vessel, storage tank, or the like that contains a hazardous chemical. For purposes of this section, pipes or piping systems, and engines fuel tanks or other operating systems in a vehicle are not considered to be containers.

CORROSIVE - A substance that, according to the DOT, causes visible destruction or permanent changes in human skin tissue at the site of contact or is highly corrosive to steel.

DESIGNATED AREA - An area which has been established and posted with signage for work involving hazards (e.g., "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.

EMERGENCY - Any potential occurrence, such as, but not limited to, equipment failure, rupture of containers, or failure of control equipment which could result in an uncontrolled release of a hazardous chemical into the workplace.

EPCRA - Emergency Planning and Community Right-To-Know Act (Title III or SARA)

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

FLAMMABLE - A chemical that falls into one of the following categories:

1. Flammable aerosol - an aerosol that, when tested by the method described in 16 CFR 1500.45, yields a flame projection exceeding 18 inches at full valve opening, or a flashback (a flame extending back to the valve) at any degree of valve opening;
2. Flammable gas - a gas that, at ambient temperature and pressure, forms a flammable mixture with air at a concentration of 13% by volume or less; or a gas that, at ambient temperature and pressure, forms a range of flammable mixtures with air wider than 12% by volume, regardless of the lower limit;
3. Flammable liquid - any liquid having a flashpoint below 100°F (37.8°C), except any mixture having components with flashpoints of 100°F (37.8°C) or higher, the total of which make up 99% or more of the total volume of the mixture; or
4. Flammable solid - a solid, other than a blasting agent or explosive as defined in 1910.109(a), 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, when tested by the method described in 16 CFR 1500.44, it ignites and burns with a self-sustained flame at a 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 in the presence of an ignition source or when tested as follows:

1. Tagliabue Closed Tester (See American National Standard Method of Test for Flashpoint by Tag Closed Tester, Z11.24-1979 (ASTM D-56-79) for liquids with a viscosity of less than 45 Saybolt Universal Seconds (SUS) at 100°F (37.8°C) or that contain suspended solids and do not have a tendency to form a surface film under test;

2. Pensky-Martens Closed Tester (See American National Standard Method of Test for Flashpoint by Pensky-Martens Closed Tester, Z11.7-1979 (ASTM D-73-79) for liquids with a viscosity equal to or greater than 45 SUS at 100°F (37.8°C), or that contain suspended solids, or that have a tendency to form a surface film under test; or,
3. Setaflash Closed Tester (See American National Standard Method of Test for Flashpoint of Setaflash Closed Tester (ASTM D-3278-78)). Organic peroxides, which undergo auto accelerating thermal decomposition, are excluded from any flashpoint determination methods specified above.

GENERAL VENTILATION - Also known as general exhaust ventilation, this is a system of ventilation consisting of either natural or mechanically induced fresh air movements to mix with and dilute contaminants in the workroom air. This is not the recommended type of ventilation to control contaminants that are highly toxic, when there may be corrosion problems from the contaminant, when the worker is close to where the contaminant is being generated, and where fire or explosion hazards are generated close to sources of ignition. (See Local Exhaust Ventilation)

GLOBALLY HARMONIZED SYSTEM (GHS) - The GHS is a system for standardizing and harmonizing the classification and labeling of chemicals. It is a logical and comprehensive approach to: defining health, physical and environmental hazards of chemicals; creating classification processes that use available data on chemicals for comparison with the defined hazard criteria; and communicating hazard information, as well as protective measures, on labels and Safety Data Sheets (SDS).

HAZARD ASSESSMENT - A formal procedure undertaken by the supervisor in which occupational hazards for all employees are described per procedure or task, and by affected body part(s) or organ(s), and which is documented and posted in the workplace with all personal protective equipment requirements.

HAZARD WARNING - Any words, pictures, symbols or combination thereof appearing on a label or other appropriate form of warning which convey the hazards of the chemical(s) in the container(s).

HAZARDOUS MATERIAL (DOT) - A substance or material capable of posing an unreasonable risk to health, safety, and property when transported including, but not limited to, compressed gas, combustible liquid, corrosive material, cryogenic liquid, flammable solid, irritating material, material poisonous by inhalation, magnetic material, organic peroxide, oxidizer, poisonous material, pyrophoric liquid, radioactive material, spontaneously combustible material, an water-reactive material.

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 system, and agents which damage the lungs, skin, eyes or mucous membranes. A chemical is also considered hazardous if it is listed in any of the following:

1. OSHA, 29 CFR 1910, Subpart Z, Toxic and Hazardous Substances; (appendix N)
2. "Threshold Limit Values for Chemical Substances and Physical Agents in the Work Environment," ACGIH (latest edition);
3. "The Registry of Toxic Effects of Chemical Substances," NIOSH (latest edition);

HIGHLY TOXIC - A substance falling within any of the following categories:

1. A substance that has a median lethal dose (LD50) of 50 milligrams or less per kilogram of body weight when administered orally to albino rats weighing between 200 and 300 grams each;
2. A substance that has a median lethal dose (LD50) of 200 milligrams or less per kilogram 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 two and three kilograms each; or
3. A substance that has a median lethal concentration (LC50) in air of 200 parts per million by volume or less of gas or vapor, or 2 milligrams per liter or less of mist, fume, or dust, when administered by continuous inhalation for one hour (or less if death occurs within one hour) to albino rats weighing between 200 and 300 grams each.

IARC - International Agency for Research on Cancer.

IGNITABLE - A solid, liquid or compressed gas waste that has a flashpoint of less than 140°F. Ignitable material may be regulated by the EPA as a hazardous waste as well.

INCOMPATIBLE - The term applies to two substances to indicate that one material cannot be mixed with the other without the possibility of a dangerous reaction.

IRRITANT - A substance which, by contact in sufficient concentration for a sufficient period of time, will cause an inflammatory response or reaction of the eye, skin, nose or respiratory system. The contact may be a single exposure or multiple exposures. Some primary irritants: chromic acid, nitric acid, sodium hydroxide, calcium chloride, amines, metallic salts, chlorinated hydrocarbons, ketones and alcohols.

LABEL - Any written, printed or graphic material displayed on or affixed to containers of chemicals, both hazardous and non-hazardous.

LABORATORY- A facility where the "laboratory use of hazardous chemicals" occur. It is a workplace where relatively small quantities of hazardous chemicals are used on a non-production basis. Chemicals can generally be managed by one person.

LABORATORY TYPE HOOD - A device located in a laboratory, enclosed on five sides with a movable sash or fixed partial enclosure 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; and allows chemical manipulations to be conducted in the enclosure without insertion of any portion of the employee's body other than hands and arms.

LABORATORY USE OF HAZARDOUS CHEMICALS - Handling or use of such chemicals in which all of the following conditions are met:

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

LD50 - Lethal dose needed to kill 50% of the test population.

LOCAL EXHAUST VENTILATION (Also known as exhaust ventilation) – A ventilation system that captures and removes the contaminants at the point they are being produced before they escape into the workroom air. The system consists of hoods, ductwork, a fan, and possibly an air- cleaning device. Advantages of local exhaust ventilation over general ventilation include: it removes the contaminant rather than dilutes it, requires less airflow and, thus, is more economical over the long term; and the system can be used to conserve or reclaim valuable materials; however, the system must be properly designed with the correctly shaped and placed hoods, and correctly sized fans and ductwork.

LSRs – Lab Safety Rules

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.

MIXTURE - Any combination of two or more chemicals if the combination is not, in whole or in part, the result of a chemical reaction.

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

NFPA - The National Fire Protection Association; a voluntary membership organization whose aims are to promote and improve fire protection and prevention. NFPA has published 16 volumes of codes known as the National Fire Codes. Within these codes is Standard No. 705, "Identification of the Fire Hazards of Materials". This is a system that rates the hazard of a material during a fire. These hazards are divided into health, flammability, and reactivity hazards and appear in a well-known

diamond system using from zero through four to indicate severity of the hazard. Zero indicates no special hazard and four indicates severe hazard.

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

NTP - National Toxicology Program

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

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

PERMISSIBLE EXPOSURE LIMIT (PEL) - An exposure, inhalation or dermal permissible exposure limit specified in 8 CCR 5155. PELs may be a time-weighted average (TWA) exposure limit (8- hour), a 15-minute short-term limit (STEL), or a ceiling (C).

PERSONAL PROTECTIVE EQUIPMENT (PPE)- Any devices or clothing worn by the worker to protect against hazards in the environment. Examples are respirators, gloves, and chemical splash goggles.

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.

PYROPHORIC - A chemical that will spontaneously ignite in the air at a temperature of 130oF (54.4oC) or below.

RCRA - Resource Conservation and Recovery Act

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

REPRODUCTIVE TOXINS - Chemicals which affect the reproductive capabilities including chromosomal damage (mutations) and effects on fetuses (teratogenesis).

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

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

Responsible party is defined as any individual employed by the College.

SAFETY DATA SHEET (SDS) - Written or printed material concerning a hazardous chemical which is prepared in accordance with paragraph (g) of 29 CFR 1910.1200. Formerly known as Material Safety Data Sheet (MSDS)

SARA- Superfund Amendments and Reauthorization Act of 1986

SELECT CARCINOGENS - Any substance which meets one of the following:

1. It is regulated by OSHA as a carcinogen; or
2. 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
3. It is listed under Group 1 ("carcinogen to humans") by the International Agency for Research on Cancer Monographs (IARC)(latest editions); or
4. It is listed in either Group 2A or 2B by IARC or under the category, "reasonably anticipated to be carcinogens" by NTP.

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

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

SIC - Standard Industrial Code.

SIGNIFICANT HAZARD is any hazard, which left untreated, will result in injury or harm to life or property.

SIGNIFICANT SPILL is any hazard, which left untreated, will result in injury or harm to life or property.

SOLVENT - A substance, commonly water, but in industry often an organic compound, which dissolves another substance.

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

TOXICITY - A relative property of a material to exert a poisonous effect on humans or animals and a description of the effect and the conditions or concentration under which the effect takes place.

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

UNIVERSAL WASTE- items and conditions listed in 6 NYCRR 374-3. Normally things like batteries, lamps, ballasts etc.

Appendix F: Extremely Hazardous Substance and Threshold Planning Quantities**The List of Extremely Hazardous Substances and Their Threshold Planning Quantities**

[Alphabetical Order]

CAS No.	Chemical name	Notes	Reportable quantity * (pounds)	Threshold planning quantity (pounds)
75-86-5	Acetone Cyanohydrin		10	1,000
1752-30-3	Acetone Thiosemicarbazide		1,000	1,000/10,000
107-02-8	Acrolein		1	500
79-06-1	Acrylamide	f	5,000	1,000/10,000
107-13-1	Acrylonitrile	f	100	10,000
814-68-6	Acrylyl Chloride	d	100	100
111-69-3	Adiponitrile	f	1,000	1,000
116-06-3	Aldicarb	b	1	100/10,000
309-00-2	Aldrin		1	500/10,000
107-18-6	Allyl Alcohol		100	1,000
107-11-9	Allylamine		500	500
20859-73-8	Aluminum Phosphide	a	100	500

54-62-6	Aminopterin		500	500/10,000
78-53-5	Amiton		500	500
3734-97-2	Amiton Oxalate		100	100/10,000
7664-41-7	Ammonia	f	100	500
300-62-9	Amphetamine		1,000	1,000
62-53-3	Aniline	f	5,000	1,000
88-05-1	Aniline, 2,4,6-Trimethyl-		500	500
7783-70-2	Antimony Pentafluoride		500	500
1397-94-0	Antimycin A	b	1,000	1,000/10,000
86-88-4	ANTU		100	500/10,000
1303-28-2	Arsenic Pentoxide		1	100/10,000
1327-53-3	Arsenous Oxide	d	1	100/10,000
7784-34-1	Arsenous Trichloride		1	500
7784-42-1	Arsine		100	100
2642-71-9	Azinphos-Ethyl		100	100/10,000
86-50-0	Azinphos-Methyl		1	10/10,000
98-87-3	Benzal Chloride		5,000	500
98-16-8	Benzenamine, 3-(Trifluoromethyl)-		500	500
100-14-1	Benzene, 1-(Chloromethyl)-4-Nitro-		500	500/10,000
98-05-5	Benzenearsonic Acid		10	10/10,000
3615-21-2	Benzimidazole, 4,5-Dichloro-2-(Trifluoromethyl)-	c	500	500/10,000

98-07-7	Benzotrichloride		10	100
100-44-7	Benzyl Chloride		100	500
140-29-4	Benzyl Cyanide	d	500	500
15271-41-7	Bicyclo[2.2.1]Heptane-2-Carbonitrile, 5-Chloro-6-(((Methylamino)Carbonyl)Oxy)Imino)-, (1s-(1-alpha,2-beta,4-alpha,5-alpha,6E))-		500	500/10,000
534-07-6	Bis(Chloromethyl) Ketone		10	10/10,000
4044-65-9	Bitoscanate		500	500/10,000
10294-34-5	Boron Trichloride		500	500
7637-07-2	Boron Trifluoride		500	500
353-42-4	Boron Trifluoride Compound With Methyl Ether (1:1)		1,000	1,000
28772-56-7	Bromadiolone		100	100/10,000
7726-95-6	Bromine	f	500	500
1306-19-0	Cadmium Oxide		100	100/10,000
2223-93-0	Cadmium Stearate	b	1,000	1,000/10,000
7778-44-1	Calcium Arsenate		1	500/10,000
8001-35-2	Camphechlor		1	500/10,000
56-25-7	Cantharidin		100	100/10,000
51-83-2	Carbachol Chloride		500	500/10,000
26419-73-8	Carbamic Acid, Methyl-, O-(((2,4-Dimethyl-1,3-Dithiolan-2-yl)Methylene)Amino)-		100	100/10,000
1563-66-2	Carbofuran		10	10/10,000
75-15-0	Carbon Disulfide	f	100	10,000

786-19-6	Carbophenothion		500	500
57-74-9	Chlordane		1	1,000
470-90-6	Chlorfenvinfos		500	500
7782-50-5	Chlorine		10	100
24934-91-6	Chlormephos		500	500
999-81-5	Chlormequat Chloride	d	100	100/10,000
79-11-8	Chloroacetic Acid		100	100/10,000
107-07-3	Chloroethanol		500	500
627-11-2	Chloroethyl Chloroformate		1,000	1,000
67-66-3	Chloroform	f	10	10,000
542-88-1	Chloromethyl Ether	d	10	100
107-30-2	Chloromethyl Methyl Ether	b	10	100
3691-35-8	Chlorophacinone		100	100/10,000
1982-47-4	Chloroxuron		500	500/10,000
21923-23-9	Chlorthiophos	d	500	500
10025-73-7	Chromic Chloride		1	1/10,000
62207-76-5	Cobalt, ((2,2'-(1,2-Ethanediybis (Nitrilomethylidyne)) Bis(6-Fluorophenolato))(2-)-N,N',O,O')-		100	100/10,000
10210-68-1	Cobalt Carbonyl	d	10	10/10,000
64-86-8	Colchicine	d	10	10/10,000
56-72-4	Coumaphos		10	100/10,000
5836-29-3	Coumatetralyl		500	500/10,000

95-48-7	Cresol, o-		100	1,000/10,000
535-89-7	Crimidine		100	100/10,000
4170-30-3	Crotonaldehyde		100	1,000
123-73-9	Crotonaldehyde, (E)-		100	1,000
506-68-3	Cyanogen Bromide		1,000	500/10,000
506-78-5	Cyanogen Iodide		1,000	1,000/10,000
2636-26-2	Cyanophos		1,000	1,000
675-14-9	Cyanuric Fluoride		100	100
66-81-9	Cycloheximide		100	100/10,000
108-91-8	Cyclohexylamine	f	10,000	10,000
17702-41-9	Decaborane(14)		500	500/10,000
8065-48-3	Demeton		500	500
919-86-8	Demeton-S-Methyl		500	500
10311-84-9	Dialifor		100	100/10,000
19287-45-7	Diborane		100	100
111-44-4	Dichloroethyl ether		10	10,000
149-74-6	Dichloromethylphenylsilane		1,000	1,000
62-73-7	Dichlorvos		10	1,000
141-66-2	Dicrotophos		100	100
1464-53-5	Diepoxybutane		10	500
814-49-3	Diethyl Chlorophosphate	d	500	500

71-63-6	Digitoxin	b	100	100/10,000
2238-07-5	Diglycidyl Ether		1,000	1,000
20830-75-5	Digoxin	d	10	10/10,000
115-26-4	Dimefox		500	500
60-51-5	Dimethoate		10	500/10,000
2524-03-0	Dimethyl Phosphorochloridothioate		500	500
77-78-1	Dimethyl sulfate		100	500
75-78-5	Dimethyldichlorosilane	d	500	500
57-14-7	Dimethylhydrazine		10	1,000
99-98-9	Dimethyl-p-Phenylenediamine		10	10/10,000
644-64-4	Dimetilan		1	500/10,000
534-52-1	Dinitrocresol		10	10/10,000
88-85-7	Dinoseb		1,000	100/10,000
1420-07-1	Dinoterb		500	500/10,000
78-34-2	Dioxathion		500	500
82-66-6	Diphacinone		10	10/10,000
152-16-9	Diphosphoramidate, Octamethyl-		100	100
298-04-4	Disulfoton		1	500
514-73-8	Dithiazanine Iodide		500	500/10,000
541-53-7	Dithiobiuret		100	100/10,000
316-42-7	Emetine, Dihydrochloride	d	1	1/10,000

115-29-7	Endosulfan		1	10/10,000
2778-04-3	Endothion		500	500/10,000
72-20-8	Endrin		1	500/10,000
106-89-8	Epichlorohydrin	f	100	1,000
2104-64-5	EPN		100	100/10,000
50-14-6	Ergocalciferol	b	1,000	1,000/10,000
379-79-3	Ergotamine Tartrate		500	500/10,000
1622-32-8	Ethanesulfonyl Chloride, 2-Chloro-		500	500
10140-87-1	Ethanol, 1,2-Dichloro-, Acetate		1,000	1,000
563-12-2	Ethion		10	1,000
13194-48-4	Ethoprophos		1,000	1,000
538-07-8	Ethylbis(2-Chloroethyl)Amine	d	500	500
371-62-0	Ethylene Fluorohydrin	b, d	10	10
75-21-8	Ethylene Oxide	f	10	1,000
107-15-3	Ethylenediamine		5,000	10,000
151-56-4	Ethyleneimine		1	500
542-90-5	Ethylthiocyanate		10,000	10,000
22224-92-6	Fenamiphos		10	10/10,000
115-90-2	Fensulfothion	d	500	500
4301-50-2	Fluenetil		100	100/10,000
7782-41-4	Fluorine	e	10	500

640-19-7	Fluoroacetamide		100	100/10,000
144-49-0	Fluoroacetic Acid		10	10/10,000
359-06-8	Fluoroacetyl Chloride	b	10	10
51-21-8	Fluorouracil		500	500/10,000
944-22-9	Fonofos		500	500
50-00-0	Formaldehyde	f	100	500
107-16-4	Formaldehyde Cyanohydrin	d	1,000	1,000
23422-53-9	Formetanate Hydrochloride	d	100	500/10,000
2540-82-1	Formothion		100	100
17702-57-7	Formparanate		100	100/10,000
21548-32-3	Fosthietan		500	500
3878-19-1	Fuberidazole		100	100/10,000
110-00-9	Furan		100	500
13450-90-3	Gallium Trichloride		500	500/10,000
77-47-4	Hexachlorocyclopentadiene	d	10	100
4835-11-4	Hexamethylenediamine, N,N'-Dibutyl-		500	500
302-01-2	Hydrazine		1	1,000
74-90-8	Hydrocyanic Acid		10	100
7647-01-0	Hydrogen Chloride (gas only)	f	5,000	500
7664-39-3	Hydrogen Fluoride		100	100
7722-84-1	Hydrogen Peroxide (Conc >52%)	f	1,000	1,000

7783-07-5	Hydrogen Selenide		10	10
7783-06-4	Hydrogen Sulfide	f	100	500
123-31-9	Hydroquinone	f	100	500/10,000
13463-40-6	Iron, Pentacarbonyl-		100	100
297-78-9	Isobenzan		100	100/10,000
78-82-0	Isobutyronitrile	d	1,000	1,000
102-36-3	Isocyanic Acid, 3,4-Dichlorophenyl Ester		500	500/10,000
465-73-6	Isodrin		1	100/10,000
55-91-4	Isofluorophate	b	100	100
4098-71-9	Isophorone Diisocyanate	g	500	500
108-23-6	Isopropyl Chloroformate		1,000	1,000
119-38-0	Isopropylmethyl-pyrazolyl Dimethylcarbamate		100	500
78-97-7	Lactonitrile		1,000	1,000
21609-90-5	Leptophos		500	500/10,000
541-25-3	Lewisite	b, d	10	10
58-89-9	Lindane		1	1,000/10,000
7580-67-8	Lithium Hydride	a	100	100
109-77-3	Malononitrile		1,000	500/10,000
12108-13-3	Manganese, Tricarbonyl Methylcyclopentadienyl	d	100	100
51-75-2	Mechlorethamine	b	10	10
950-10-7	Mephosfolan		500	500

1600-27-7	Mercuric Acetate		500	500/10,000
7487-94-7	Mercuric Chloride		500	500/10,000
21908-53-2	Mercuric Oxide		500	500/10,000
10476-95-6	Methacrolein Diacetate		1,000	1,000
760-93-0	Methacrylic Anhydride		500	500
126-98-7	Methacrylonitrile	d	1,000	500
920-46-7	Methacryloyl Chloride		100	100
30674-80-7	Methacryloyloxyethyl Isocyanate	d	100	100
10265-92-6	Methamidophos		100	100/10,000
558-25-8	Methanesulfonyl Fluoride		1,000	1,000
950-37-8	Methidathion		500	500/10,000
2032-65-7	Methiocarb		10	500/10,000
16752-77-5	Methomyl	d	100	500/10,000
151-38-2	Methoxyethylmercuric Acetate		500	500/10,000
80-63-7	Methyl 2-Chloroacrylate		500	500
74-83-9	Methyl Bromide	f	1,000	1,000
79-22-1	Methyl Chloroformate	d	1,000	500
60-34-4	Methyl Hydrazine		10	500
624-83-9	Methyl Isocyanate		10	500
556-61-6	Methyl Isothiocyanate	a	500	500
74-93-1	Methyl Mercaptan	f	100	500

3735-23-7	Methyl Phenkapton		500	500
676-97-1	Methyl Phosphonic Dichloride	a	100	100
556-64-9	Methyl Thiocyanate		10,000	10,000
78-94-4	Methyl Vinyl Ketone		10	10
502-39-6	Methylmercuric Dicyanamide		500	500/10,000
75-79-6	Methyltrichlorosilane	d	500	500
1129-41-5	Metolcarb		1,000	100/10,000
7786-34-7	Mevinphos		10	500
315-18-4	Mexacarbate	d	1,000	500/10,000
50-07-7	Mitomycin C		10	500/10,000
6923-22-4	Monocrotophos		10	10/10,000
2763-96-4	Muscimol		1,000	500/10,000
505-60-2	Mustard Gas	d	500	500
13463-39-3	Nickel Carbonyl		10	1
54-11-5	Nicotine	b	100	100
65-30-5	Nicotine Sulfate		100	100/10,000
7697-37-2	Nitric Acid		1,000	1,000
10102-43-9	Nitric Oxide	b	10	100
98-95-3	Nitrobenzene	f	1,000	10,000
1122-60-7	Nitrocyclohexane		500	500
10102-44-0	Nitrogen Dioxide		10	100

62-75-9	Nitrosodimethylamine	d	10	1,000
991-42-4	Norbormide		100	100/10,000
	Organorhodium Complex (PMN-82-147)		10	10/10,000
630-60-4	Ouabain	b	100	100/10,000
23135-22-0	Oxamyl		100	100/10,000
78-71-7	Oxetane, 3,3-Bis(Chloromethyl)-		500	500
2497-07-6	Oxydisulfoton	d	500	500
10028-15-6	Ozone		100	100
1910-42-5	Paraquat Dichloride		10	10/10,000
2074-50-2	Paraquat Methosulfate		10	10/10,000
56-38-2	Parathion	b	10	100
298-00-0	Parathion-Methyl	b	100	100/10,000
12002-03-8	Paris Green		1	500/10,000
19624-22-7	Pentaborane		500	500
2570-26-5	Pentadecylamine		100	100/10,000
79-21-0	Peracetic Acid		500	500
594-42-3	Perchloromethylmercaptan		100	500
108-95-2	Phenol		1,000	500/10,000
4418-66-0	Phenol, 2,2'-Thiobis(4-Chloro-6-Methyl)-		100	100/10,000
64-00-6	Phenol, 3-(1-Methylethyl)-, Methylcarbamate		10	500/10,000
58-36-6	Phenoxarsine, 10,10'-Oxydi-		500	500/10,000
696-28-6	Phenyl Dichloroarsine	d	1	500

59-88-1	Phenylhydrazine Hydrochloride		1,000	1,000/10,000
62-38-4	Phenylmercury Acetate		100	500/10,000
2097-19-0	Phenylsilatrane	d	100	100/10,000
103-85-5	Phenylthiourea		100	100/10,000
298-02-2	Phorate		10	10
4104-14-7	Phosacetim		100	100/10,000
947-02-4	Phosfolan		100	100/10,000
75-44-5	Phosgene	f	10	10
13171-21-6	Phosphamidon		100	100
7803-51-2	Phosphine		100	500
2703-13-1	Phosphonothioic Acid, Methyl-, O-Ethyl O-(4-(Methylthio) Phenyl) Ester		500	500
50782-69-9	Phosphonothioic Acid, Methyl-, S-(2-(Bis(1Methylethyl)Amino)Ethyl) O-Ethyl Ester		100	100
2665-30-7	Phosphonothioic Acid, Methyl-, O-(4-Nitrophenyl) O-Phenyl Ester		500	500
3254-63-5	Phosphoric Acid, Dimethyl 4-(Methylthio)Phenyl Ester		500	500
2587-90-8	Phosphorothioic Acid, O,O-Dimethyl-S-(2-Methylthio) Ethyl Ester	b, c	500	500
7723-14-0	Phosphorus	a, d	1	100
10025-87-3	Phosphorus Oxychloride		1,000	500
10026-13-8	Phosphorus Pentachloride	a	500	500
7719-12-2	Phosphorus Trichloride		1,000	1,000
57-47-6	Physostigmine		100	100/10,000
57-64-7	Physostigmine, Salicylate (1:1)		100	100/10,000

124-87-8	Picrotoxin		500	500/10,000
110-89-4	Piperidine		1,000	1,000
23505-41-1	Pirimifos-Ethyl		1,000	1,000
10124-50-2	Potassium Arsenite		1	500/10,000
151-50-8	Potassium Cyanide	a	10	100
506-61-6	Potassium Silver Cyanide	a	1	500
2631-37-0	Promecarb	d	1,000	500/10,000
106-96-7	Propargyl Bromide		10	10
57-57-8	Propiolactone, Beta-		10	500
107-12-0	Propionitrile		10	500
542-76-7	Propionitrile, 3-Chloro-		1,000	1,000
70-69-9	Propiophenone, 4-Amino-	c	100	100/10,000
109-61-5	Propyl Chloroformate		500	500
75-56-9	Propylene Oxide	f	100	10,000
75-55-8	Propyleneimine		1	10,000
2275-18-5	Prothoate		100	100/10,000
129-00-0	Pyrene	b	5,000	1,000/10,000
140-76-1	Pyridine, 2-Methyl-5-Vinyl-		500	500
504-24-5	Pyridine, 4-Amino-	d	1,000	500/10,000
1124-33-0	Pyridine, 4-Nitro-,l-Oxide		500	500/10,000
53558-25-1	Pyriminil	d	100	100/10,000

14167-18-1	Salcomine		500	500/10,000
107-44-8	Sarin	d	10	10
7783-00-8	Selenious Acid		10	1,000/10,000
7791-23-3	Selenium Oxychloride		500	500
563-41-7	Semicarbazide Hydrochloride		1,000	1,000/10,000
3037-72-7	Silane, (4-Aminobutyl)Diethoxymethyl-		1,000	1,000
7631-89-2	Sodium Arsenate		1	1,000/10,000
7784-46-5	Sodium Arsenite		1	500/10,000
26628-22-8	Sodium Azide (Na(N ₃))	a	1,000	500
124-65-2	Sodium Cacodylate		100	100/10,000
143-33-9	Sodium Cyanide (Na(CN))	a	10	100
62-74-8	Sodium Fluoroacetate		10	10/10,000
13410-01-0	Sodium Selenate		100	100/10,000
10102-18-8	Sodium Selenite	d	100	100/10,000
10102-20-2	Sodium Tellurite		500	500/10,000
900-95-8	Stannane, Acetoxytriphenyl-	c	500	500/10,000
57-24-9	Strychnine	b	10	100/10,000
60-41-3	Strychnine Sulfate		10	100/10,000
3689-24-5	Sulfotep		100	500
3569-57-1	Sulfoxide, 3-Chloropropyl Octyl		500	500
7446-09-5	Sulfur Dioxide	f	500	500

7783-60-0	Sulfur Tetrafluoride		100	100
7446-11-9	Sulfur Trioxide	a	100	100
7664-93-9	Sulfuric Acid		1,000	1,000
77-81-6	Tabun	b, d	10	10
7783-80-4	Tellurium Hexafluoride	e	100	100
107-49-3	TEPP		10	100
13071-79-9	Terbufos	d	100	100
78-00-2	Tetraethyllead	b	10	100
597-64-8	Tetraethyltin	b	100	100
75-74-1	Tetramethyllead	b, f	100	100
509-14-8	Tetranitromethane		10	500
10031-59-1	Thallium Sulfate	d	100	100/10,000
6533-73-9	Thallous Carbonate	b, d	100	100/10,000
7791-12-0	Thallous Chloride	b, d	100	100/10,000
2757-18-8	Thallous Malonate	b, d	100	100/10,000
7446-18-6	Thallous Sulfate		100	100/10,000
2231-57-4	Thiocarbazine		1,000	1,000/10,000
39196-18-4	Thiofanox		100	100/10,000
297-97-2	Thionazin		100	500
108-98-5	Thiophenol		100	500
79-19-6	Thiosemicarbazide		100	100/10,000

5344-82-1	Thiourea, (2-Chlorophenyl)-		100	100/10,000
614-78-8	Thiourea, (2-Methylphenyl)-		500	500/10,000
7550-45-0	Titanium Tetrachloride		1,000	100
584-84-9	Toluene 2,4-Diisocyanate		100	500
91-08-7	Toluene 2,6-Diisocyanate		100	100
110-57-6	Trans-1,4-Dichlorobutene		500	500
1031-47-6	Triamiphos		500	500/10,000
24017-47-8	Triazofos		500	500
76-02-8	Trichloroacetyl Chloride		500	500
115-21-9	Trichloroethylsilane	d	500	500
327-98-0	Trichloronate	e	500	500
98-13-5	Trichlorophenylsilane	d	500	500
1558-25-4	Trichloro(Chloromethyl)Silane		100	100
27137-85-5	Trichloro(Dichlorophenyl) Silane		500	500
998-30-1	Triethoxysilane		500	500
75-77-4	Trimethylchlorosilane		1,000	1,000
824-11-3	Trimethylolpropane Phosphite	d	100	100/10,000
1066-45-1	Trimethyltin Chloride		500	500/10,000
639-58-7	Triphenyltin Chloride		500	500/10,000
555-77-1	Tris(2-Chloroethyl)Amine	d	100	100
2001-95-8	Valinomycin	b	1,000	1,000/10,000

1314-62-1	Vanadium Pentoxide		1,000	100/10,000
108-05-4	Vinyl Acetate Monomer	f	5,000	1,000
81-81-2	Warfarin		100	500/10,000
129-06-6	Warfarin Sodium	d	100	100/10,000
28347-13-9	Xylylene Dichloride		100	100/10,000
58270-08-9	Zinc, Dichloro(4,4-Dimethyl-5((((Methylamino)Carbonyl)Oxy)Imino)Pentanenitrile)-, (T-4)-		100	100/10,000
1314-84-7	Zinc Phosphide	a	100	500
* Only the statutory or final RQ is shown. For more information, see 40 CFR 355.61 .				
Notes:				
a. This material is a reactive solid. The TPQ does not default to 10,000 pounds for non-powder, non-molten, non-solution form.				
b. The calculated TPQ changed after technical review as described in a technical support document for the final rule, April 22, 1987.				
c. Chemicals added by final rule, April 22, 1987.				
d. Revised TPQ based on new or re-evaluated toxicity data, April 22, 1987.				
e. The TPQ was revised due to calculation error, April 22, 1987.				
f. Chemicals on the original list that do not meet toxicity criteria but because of their acute lethality, high production volume and known risk are considered chemicals of concern (“Other chemicals”), November 17, 1986 and February 15, 1990.				
g. The TPQ was recalculated (September 8, 2003) since it was mistakenly calculated in the April 22, 1987 final rule under the wrong assumption that this chemical is a reactive solid, when in fact it is a liquid. RQ for this chemical was adjusted on September 11, 2006				

Appendix G: Risk Management of Substances Under EPA Clean Air Act

The Risk Management Program rule provides a List of Regulated Substances under section 112(r) of the Clean Air Act. This includes their synonyms and threshold quantities (in pounds) to help assess if a process is subject to the RMP rule. Where the Clean Air Act Section 112(r) program has been delegated to a state, that state may have additional requirements for the federally listed chemicals, and/or additional listed chemicals.

List of Regulated Substances and Thresholds for Accidental Release Prevention

Chemical Name	CAS No.	Threshold Quantity (lbs.)
1,1-Dichloroethylene	75-35-4	10,000
1,1-Dimethyl hydrazine	57-14-7	15,000
1,2-Ethanediamine	107-15-3	20,000
1,2-Propadiene	463-49-0	10,000
1,3-Butadiene	106-99-0	10,000
1,3-Butadiene, 2-methyl-	78-79-5	10,000
1,3-Pentadiene	504-60-9	10,000
1-Buten-3-yne	689-97-4	10,000
1-Butene	106-98-9	10,000
1-Butyne	107-00-6	10,000
1-Chloropropylene	590-21-6	10,000
1-Pentene	109-67-1	10,000
1-Propene	115-07-1	10,000
1-Propene, 1-chloro-	590-21-6	10,000
1-Propene, 2-chloro-	557-98-2	10,000
1-Propene, 2-methyl-	115-11-7	10,000
1-Propyne	74-99-7	10,000
2,2-Dimethylpropane	463-82-1	10,000
2-Butenal	4170-30-3	20,000
2-Butenal, (e)-	123-73-9	20,000
2-Butene	107-01-7	10,000
2-Butene, (E)	624-64-6	10,000
2-Butene-cis	590-18-1	10,000

2-Butene-trans	624-64-6	10,000
2-Chloropropylene	557-98-2	10,000
2-Methyl-1-butene	563-46-2	10,000
2-Methylpropene	115-11-7	10,000
2-Pentene, (E)-	646-04-8	10,000
2-Pentene, (Z)-	627-20-3	10,000
2-Propanamine	75-31-0	10,000
2-Propen-1-amine	107-11-9	10,000
2-Propen-1-ol	107-18-6	15,000
2-Propenal	107-02-8	5,000
2-Propenenitrile	107-13-1	20,000
2-Propenenitrile, 2-methyl-	126-98-7	10,000
2-Propenoyl chloride	814-68-6	5,000
3-Methyl-1-butene	563-45-1	10,000
Acetaldehyde	75-07-0	10,000
Acetic acid ethenyl ester	108-05-4	15,000
Acetylene	74-86-2	10,000
Acrolein	107-02-8	5,000
Acrylonitrile	107-13-1	20,000
Acrylyl chloride	814-68-6	5,000
Allyl alcohol	107-18-6	15,000
Allylamine	107-11-9	10,000
Ammonia (anhydrous)	7664-41-7	10,000
Ammonia (conc 20% or greater)	7664-41-7	20,000
Arsenous trichloride	7784-34-1	15,000
Arsine	7784-42-1	1,000
Aziridine	151-56-4	10,000
Aziridine, 2-methyl	75-55-8	10,000
Benzene, 1,3-diisocyanato-2-methyl-	91-08-7	10,000
Benzene, 1,3-diisocyanatomethyl-	26471-62-5	10,000
Benzene, 2,4-diisocyanato-1-methyl-	584-84-9	10,000
Bis(chloromethyl) ether	542-88-1	1,000
Borane, trichloro-	10294-34-5	5,000
Borane, trifluoro-	7637-07-2	5,000
Boron trichloride	10294-34-5	5,000
Boron trifluoride	7637-07-2	5,000
Boron trifluoride compound with methyl ether (1:1)	353-42-4	15,000
Boron, trifluoro[oxybis [methane]]-, (T-4)-	353-42-4	15,000

Bromine	7726-95-6	10,000
Bromotrifluoroethylene	598-73-2	10,000
Butane	106-97-8	10,000
Butane, 2-methyl-	78-78-4	10,000
Butene	25167-67-3	10,000
Carbon disulfide	75-15-0	20,000
Carbon oxide sulfide (COS)	463-58-1	10,000
Carbonic dichloride	75-44-5	500
Carbonochloridic acid, 1-methylethyl ester	108-23-6	15,000
Carbonochloridic acid, methylester	79-22-1	5,000
Carbonochloridic acid, propylester	109-61-5	15,000
Carbonyl sulfide	463-58-1	10,000
Chlorine	7782-50-5	2,500
Chlorine dioxide	10049-04-4	1,000
Chlorine monoxide	7791-21-1	10,000
Chlorine oxide	7791-21-1	10,000
Chlorine oxide (ClO ₂)	10049-04-4	1,000
Chloroethane	75-00-3	10,000
Chloroform	67-66-3	20,000
Chloromethane	74-87-3	10,000
Chloromethyl ether	542-88-1	1,000
Chloromethyl methyl ether	107-30-2	5,000
Crotonaldehyde	4170-30-3	20,000
Crotonaldehyde, (E)-	123-73-9	20,000
Cyanogen	460-19-5	10,000
Cyanogen chloride	506-77-4	10,000
Cyanogen chloride ((CN)Cl)	506-77-4	10,000
Cyclohexanamine	108-91-8	15,000
Cyclohexylamine	108-91-8	15,000
Cyclopropane	75-19-4	10,000
Diborane	19287-45-7	2,500
Diborane(6)	19287-45-7	2,500
Dichloromethyl ether	542-88-1	1,000
Dichlorosilane	4109-96-0	10,000
Difluoroethane	75-37-6	10,000
Dimethylamine	124-40-3	10,000
Dimethyldichlorosilane	75-78-5	5,000
Dimethylhydrazine	57-14-7	15,000
Epichlorohydrin	106-89-8	20,000
Ethanamine	75-04-7	10,000
Ethane	74-84-0	10,000

Ethane, 1,1'-oxybis-	60-29-7	10,000
Ethane, 1,1-difluoro-	75-37-6	10,000
Ethane, chloro-	75-00-3	10,000
Ethanedinitrile	460-19-5	10,000
Ethaneperoxoic acid	79-21-0	10,000
Ethanethiol	75-08-1	10,000
Ethene	74-85-1	10,000
Ethene, 1,1-dichloro-	75-35-4	10,000
Ethene, 1,1-difluoro-	75-38-7	10,000
Ethene, bromotrifluoro-	598-73-2	10,000
Ethene, chloro-	75-01-4	10,000
Ethene, chlorotrifluoro-	79-38-9	10,000
Ethene, ethoxy-	109-92-2	10,000
Ethene, fluoro-	75-02-5	10,000
Ethene, methoxy-	107-25-5	10,000
Ethene, tetrafluoro-	116-14-3	10,000
Ethyl acetylene	107-00-6	10,000
Ethyl chloride	75-00-3	10,000
Ethyl cyanide	107-12-0	10,000
Ethyl ether	60-29-7	10,000
Ethyl mercaptan	75-08-1	10,000
Ethyl nitrite	109-95-5	10,000
Ethylene	74-85-1	10,000
Ethylene oxide	75-21-8	10,000
Ethylenediamine	107-15-3	20,000
Ethyleneimine	151-56-4	10,000
Ethyne	74-86-2	10,000
Fluorine	7782-41-4	1,000
Formaldehyde	50-00-0	15,000
Formaldehyde (solution)	50-00-0	15,000
Formic acid, methyl ester	107-31-3	10,000
Furan	110-00-9	5,000
Hydrazine	302-01-2	15,000
Hydrazine, 1,1-dimethyl-	57-14-7	15,000
Hydrazine, methyl-	60-34-4	15,000
Hydrochloric acid (conc 37% or greater)	7647-01-0	15,000
Hydrocyanic acid	74-90-8	2,500
Hydrofluoric acid (conc. 50% or greater)	7664-39-3	1,000
Hydrogen	1333-74-0	10,000
Hydrogen chloride (anhydrous)	7647-01-0	5,000
Hydrogen chloride (gas only)	7647-01-0	5,000

Hydrogen cyanide	74-90-8	2,500
Hydrogen fluoride (anhydrous)	7664-39-3	1,000
Hydrogen selenide	7783-07-5	500
Hydrogen sulfide	7783-06-4	10,000
Iron carbonyl (Fe(CO) ₅), (TB-5-11)-	13463-40-6	2,500
Iron, pentacarbonyl-	13463-40-6	2,500
Isobutane	75-28-5	10,000
Isobutyronitrile	78-82-0	20,000
Isopentane	78-78-4	10,000
Isoprene	78-79-5	10,000
Isopropyl chloride	75-29-6	10,000
Isopropyl chloroformate	108-23-6	15,000
Isopropylamine	75-31-0	10,000
Methacrylonitrile	126-98-7	10,000
Methenamine	74-89-5	10,000
Methenamine, N,N-dimethyl-	75-50-3	10,000
Methenamine, N-methyl-	124-40-3	10,000
Methane	74-82-8	10,000
Methane, chloro-	74-87-3	10,000
Methane, chloromethoxy-	107-30-2	5,000
Methane, isocyanato-	624-83-9	10,000
Methane, oxybis-	115-10-6	10,000
Methane, oxybis[chloro-	542-88-1	1,000
Methane, tetranitro-	509-14-8	10,000
Methane, trichloro-	67-66-3	20,000
Methanesulfonyl chloride, trichloro-	594-42-3	10,000
Methanethiol	74-93-1	10,000
Methyl chloride	74-87-3	10,000
Methyl chlorocarbonate	79-22-1	5,000
Methyl chloroformate	79-22-1	5,000
Methyl ether	115-10-6	10,000
Methyl formate	107-31-3	10,000
Methyl hydrazine	60-34-4	15,000
Methyl isocyanate	624-83-9	10,000
Methyl mercaptan	74-93-1	10,000
Methyl thiocyanate	556-64-9	20,000
Methyltrichlorosilane	75-79-6	5,000
Monoethylamine	75-04-7	10,000
Monomethylamine	74-89-5	10,000
Nickel carbonyl	13463-39-3	1,000
Nitric acid (conc 80% or greater)	7697-37-2	15,000

Nitric oxide	10102-43-9	10,000
Nitrogen oxide (NO)	10102-43-9	10,000
Nitrous acid, ethyl ester	109-95-5	10,000
Oleum (fuming sulfuric acid)	8014-95-7	10,000
Oxirane	75-21-8	10,000
Oxirane, (chloromethyl)-	106-89-8	20,000
Oxirane, methyl-	75-56-9	10,000
Pentane	109-66-0	10,000
Peracetic acid	79-21-0	10,000
Perchloromethyl mercaptan	594-42-3	10,000
Phosgene	75-44-5	500
Phosphine	7803-51-2	5,000
Phosphorous trichloride	7719-12-2	15,000
Phosphorus oxychloride	10025-87-3	5,000
Phosphorus trichloride	7719-12-2	15,000
Phosphoryl chloride	10025-87-3	5,000
Piperidine	110-89-4	15,000
Plumbane, tetramethyl-	75-74-1	10,000
Propadiene	463-49-0	10,000
Propane	74-98-6	10,000
Propane, 2,2-dimethyl-	463-82-1	10,000
Propane, 2-chloro-	75-29-6	10,000
Propane, 2-methyl	75-28-5	10,000
Propanenitrile	107-12-0	10,000
Propanenitrile, 2-methyl-	78-82-0	20,000
Propene	115-07-1	10,000
Propionitrile	107-12-0	10,000
Propyl chloroformate	109-61-5	15,000
Propylene	115-07-1	10,000
Propylene oxide	75-56-9	10,000
Propyleneimine	75-55-8	10,000
Propyne	74-99-7	10,000
Silane	7803-62-5	10,000
Silane, chlorotrimethyl-	75-77-4	10,000
Silane, dichloro-	4109-96-0	10,000
Silane, dichlorodimethyl-	75-78-5	5,000
Silane, tetramethyl-	75-76-3	10,000
Silane, trichloro-	10025-78-2	10,000
Silane, trichloromethyl-	75-79-6	5,000
Sulfur dioxide (anhydrous)	7446-09-5	5,000
Sulfur fluoride (SF ₄), (T-4)-	7783-60-0	2,500

Sulfur tetrafluoride	7783-60-0	2,500
Sulfur trioxide	7446-11-9	10,000
Sulfuric acid (fuming)	8014-95-7	10,000
Sulfuric acid, mixture with sulfur trioxide	8014-95-7	10,000
Tetrafluoroethylene	116-14-3	10,000
Tetramethyllead	75-74-1	10,000
Tetramethylsilane	75-76-3	10,000
Tetranitromethane	509-14-8	10,000
Thiocyanic acid, methyl ester	556-64-9	20,000
Thiomethanol	74-93-1	10,000
Titanium chloride (TiCl ₄) (T-4)-	7550-45-0	2,500
Titanium tetrachloride	7550-45-0	2,500
Toluene diisocyanate (unspecified isomer)	26471-62-5	10,000
Toluene-2,4-diisocyanate	584-84-9	10,000
Toluene-2,6-diisocyanate	91-08-7	10,000
Toluene diisocyanate (mixed isomers)	26471-62-5	10,000
Trichloromethanesulfonyl chloride	594-42-3	10,000
Trichlorosilane	10025-78-2	10,000
Trifluorochloroethylene	79-38-9	10,000
Trimethylamine	75-50-3	10,000
Trimethylchlorosilane	75-77-4	10,000
Vinyl acetate	108-05-4	15,000
Vinyl acetate monomer	108-05-4	15,000
Vinyl acetylene	689-97-4	10,000
Vinyl chloride	75-01-4	10,000
Vinyl ethyl ether	109-92-2	10,000
Vinyl fluoride	75-02-5	10,000
Vinyl methyl ether	107-25-5	10,000
Vinylidene chloride	75-35-4	10,000
Vinylidene fluoride	75-38-7	10,000

Appendix H : Lists of P, U, K, and F Hazardous Wastes

EPA: Defining Hazardous Waste: Listed, Characteristic and Mixed Radiological Wastes

[Defining Hazardous Waste: Listed, Characteristic and Mixed Radiological Wastes](#)

Appendix I: Department of Justice List I and II of Regulated Chemicals

List I and II Regulated Chemicals - Alphabetical Order -

					DEA CHEMICAL		
CHEMICAL	NUMBER	NUMBER	CITATION	DATE	LIST	CODE	EFFECTIVE REGULATED
1-BOC-4-AP (tert-butyl 4-(phenylamino)piperidine-1-carboxylate) and its salts (Prior to 11/9/2022, 1-BOC-4-AP was a list I chemical as a carbamate of 4-AP with an effective date of 05/15/2020)				I	8336	87 FR 67550	11/9/2022
4-ANILINOPIPERIDINE (N-phenylpiperidin-4-amine; N phenyl-4piperidinamine; 4-AP) including its amides, its carbamates, its halides^, and its salts and any combination thereof, whenever the existence of such is possible. ^Halides designation specifically has an effective date of 11/30/2023 from a modification of the 4-anilinopiperidine listing. (See 88 FR 74352)				I	8335	85 FR 20822	5/15/2020
4-PIPERIDONE (piperidin-4-one) including its acetals, its amides, its carbamates, its salts, and salts of its acetals, its amides, and its carbamates, and any combination thereof, whenever the existence of such is possible				I	8330	88 FR 21902	5/12/2023
ACETIC ANHYDRIDE				II	8519	Pub. L. 100-690	3/18/1989
ACETONE				II	6532	Pub. L. 100-690	3/18/1989
N-ACETYLANTHRANILIC ACID, salts & esters				I	8522	Pub. L. 100-690	3/18/1989

ANTHRANILIC ACID, salts & esters	I	8530	Pub. L. 100- 3/18/1989 690
APAA (Alpha-phenylacetoacetamide) and its optical isomers (Effective 06/09/2021)	I	8515	86 FR 6/9/2021 24703
APAAN (Alpha-phenylacetoacetoneitrile), salts, optical isomers, salts of optical isomers	I	8512	82 FR 8/14/2017 32457
BENZALDEHYDE	I	8256	Pub. L. 103- 4/17/1994 200
BENZYL CHLORIDE	II	8570	Pub. L. 100- 3/18/1989 690
BENZYL CYANIDE	I	8735	Pub. L. 100- 3/18/1989 690
BENZYL FENTANYL (N-(1-benzylpiperidin-4-yl)-N-phenylpropionamide), including its salts.	I	8334	85 FR 5/15/2020 20822
gamma-BUTYROLACTONE	I	2011	Pub. L. 106- 2/18/2000 172
EPHEDRINE, salts, optical isomers, & salts of optical isomers	I	8113	Pub. L. 100-690 3/18/1989
EPHEDRINE - remove exemption for OTC single entity drug product	I	8113	Pub. L. 103- 4/17/1994 200
EPHEDRINE-remove exemption for OTC combination products and establish a 24 g retail threshold. Threshold remains zero for single entity products. Mail order report requirements imposed. For more info, see 21 CFR Parts 1309, 1310, 1313	I	8113	Pub. L. 104- 10/3/1996 237
ERGONOVINE or ERGOMETRINE & salts	I	8675	Pub. L. 100- 3/18/1989 690
ERGOCRISTINE	I	8612	76 FR 5/2/2011 17778
ERGOTAMINE & salts	I	8676	Pub. L. 100- 3/18/1989 690
ETHYLAMINE & salts	I	8678	Pub. L. 101- 2/27/1991 647
N-ETHYLEPHEDRINE - superseded by 1994 action	I		Pub. L. 101- 2/27/1991 647
N-ETHYLEPHEDRINE	REMOVED		Pub. L. 103- 4/17/1994 200
ETHYL ETHER	II	6584	Pub. L. 100- 3/18/1989 690
N-ETHYLPSEUDOEPHEDRINE - superseded by 1994 action	I		Pub. L. 101- 2/27/1991 647
DEA CHEMICAL CODE			
LIST NUMBER		EFFECTIVE DATE	
REGULATED CHEMICAL	NUMBER	CITATION	DATE

N-ETHYLPSEUDOEPHEDRINE	REMOVED		Pub. L. 103-200	4/17/1994
HYDROCHLORIC ACID (including anhydrous hydrogen chloride)	II	6545	57 FR 43614	10/22/1992
HYDROCHLORIC GAS (anhydrous hydrogen chloride)	II	6545	Pub. L. 104-237	10/3/1996
HYDRIODIC ACID - superseded by 1990 action	II	6695	Pub. L. 100-690	3/18/1989
HYDRIODIC ACID	I	6695	Pub. L. 101-647	2/27/1991
HYPOPHOSPHOROUS ACID, salts (Including ammonium hypophosphite, calcium hypophosphite, iron hypophosphite, potassium hypophosphite, manganese hypophosphite, magnesium hypophosphite, and sodium hypophosphite)	I	6797	66 FR 52670	11/16/2001
IODINE - superseded by 2007 action	II	6699	Pub. L. 104-237	10/3/1996
IODINE	I	6699	72 FR 35920	8/1/2007
ISOSAFROLE	I	8704	Pub. L. 101-647	2/27/1991
D-LYSERGIC ACID, salts, optical isomers, & salts of optical isomerssuperseded	I	7300	Pub. L. 101-647	2/27/1991
D-LYSERGIC ACID, salts, optical isomers, & salts of optical isomers*	REMOVED	7300	Pub. L. 103-200	4/17/1994
METHYLAMINE and salts	I	8520	Pub. L. 101-647	2/27/1991
METHYL ALPHA-PHENYLACETOACETATE (MAPA)	I	8795	86 FR 64362	12/20/2021
3,4-METHYLENEDIOXYPHENYL-2-PROPANONE	I	8502	Pub. L. 100-690	3/18/1989
N-METHYLEPHEDRINE, salts, optical isomers, & salts of optical isomers	I	8115	Pub. L. 101-647	2/27/1991
METHYL ETHYL KETONE (MEK) or 2-BUTANONE	II	6714	Pub. L. 100-690	3/18/1989
METHYL ISOBUTYL KETONE (MIBK)	II	6715	60 FR 19509	5/19/1995
N-METHYLPSEUDOEPHEDRINE, salts, optical isomers, salts of optical isomers	I	8119	Pub. L. 101-647	2/27/1991
NITROETHANE	I	6724	Pub. L. 103-200	4/17/1994
NORPSEUDOEPHEDRINE, salts, optical isomers, & salts of optical isomers	I	8317	Pub. L. 100-690	3/18/1989
N-PHENETHYL-4-PIPERIDONE (NPP)	I	8332	73 FR 43355	4/23/2007

PHENYLACETIC ACID, esters, and salts	I	8791	Pub. L. 100-690	3/18/1989
PHENYLPROPANOLAMINE, salts, optical isomers, & salts of optical isomers	I	1225	Pub. L. 100-690	3/18/1989
PHENYLPROPANOLAMINE-remove exemption for certain OTC transactions. Retail threshold of 24 g established for products not distributed in blister packs. Mail order report requirements imposed. For more info, see 21 CFR Parts 1309, 1310, and 1313.	I	1225	Pub. L. 104-237	10/3/1997
PIPERIDINE and salts	I	2704	Pub. L. 100-690	3/18/1989
PIPERONAL	I	8750	Pub. L. 101-647	2/27/1991
PMK GLYCIDATE (3,4-MDP-2-P METHYL GLYCIDATE) and its optical and geometric isomers (Effective 06/09/2021)	I	8535	86 FR 24703	6/9/2021
PMK GLYCIDIC ACID (3,4-MDP-2-P METHYL GLYCIDIC ACID) and its salts, optical and geometric isomers, and salts of isomers (Effective 06/09/2021)	I	8525	86 FR 24703	6/9/2021
POTASSIUM PERMANGANATE	II	6579	Pub. L. 100-690	3/18/1989
PROPIONIC ANHYDRIDE	I	8328	Pub. L. 101-647	2/27/1991
PSEUDOEPHEDRINE, salts, optical isomers, & salts of optical isomers	I	8112	Pub. L. 100-690	3/18/1989

REGULATED CHEMICAL	LIST NUMBER	DEA CHEMICAL CODE NUMBER	CITATION	EFFECTIVE DATE
PSEUDOEPHEDRINE -remove exemption for certain OTC transactions. Retail threshold of 24 g established for products not distributed in blister packs. Mail order report requirements imposed. For more info, see 21 CFR Parts 1309, 1310, and 1313.	I	8112	Pub. L. 104-237	10/3/1997
RED PHOSPHORUS	I	6795	66 FR 52670	11/16/2001
SAFROLE (includes sassafras oil)	I	8323	Pub. L. 101-647	2/27/1991
SODIUM PERMANGANATE	II	6588	71 FR 60823	12/18/2006
SULFURIC ACID	II	6552	57 FR 43614	10/22/1992

TOLUENE	II	6594	Pub. L. 100-690	3/18/1989
WHITE PHOSPHORUS (Other names: YELLOW I PHOSPHORUS)		6796	66 FR 52670	11/16/2001

Appendix J: Globally Harmonized System of Classification and Labeling Chemicals Hazard Classification codes

<https://pubchem.ncbi.nlm.nih.gov/ghs/>

Appendix K: Toxic and hazardous substances

[Title \(29\) 1910 subpart Z](#)

Appendix L: Checklists (SUNY Laboratory Safety)

[Mandatory elements in CHP](#)

Appendix M: OSHA 75 point checklist For Laboratory Safety

Here is a list of seventy-five questions that will assist as you review your laboratory safety programs, including laboratory security, access control, and purchasing. Not all items are directly required by regulation, and not all items are appropriate for each laboratory. The list does not address all regulation-required elements for managing laboratories. It is intended to provoke thought and discussion. It is separated into topics, because it probably can't be thoughtfully considered in a single attempt. Risk assessments must be conducted and appropriate actions implemented. Campuses manage these programs in various ways; the "you" may be a central coordinator or may be a person in a specific department or other unit.

PLANNING QUESTIONS			NOTES:
MANAGEMENT			
1	Have you considered the need for an Institutional or Department Safety and Security Committee or assigning a Chemical Safety and Security Officer? Have you implemented?		
2	Have you implemented a Security policy?		
3	Have you implemented a Chemical Hygiene Plan (CHP)?		

4	Has your CHP been reviewed over the past year? Has that review been documented and any necessary actions acted on?	
5	Have you identified a Chemical Hygiene Officer?	
6	Do you have an active and effective Chemical Hygiene or Lab Safety committee?	
7	Have you established a training program as required by your Chemical Hygiene Plan and the OSHA Lab Standard?	
8	Have you established general lab safety practices and expectations?	
9	Have you established general lab housekeeping expectations?	
10	Have you established expectations for Lab Principal Investigators?	
11	Have you established expectations for Lab Supervisors and Managers?	
12	Have you establish the need to document risk assessments before commencing work?	
ACCESS CONTROLS		
13	Are all lab doors lockable? Are building doors lockable?	
14	Have you established a policy for when lab doors or building doors must be locked, based on a sounded, documented risk assessment?	
15	Have you provided training on lab security for lab workers, including specific area policies?	
16	Have you established a policy on who should have access to labs and under what conditions the access is granted?	
17	Have all entities which authorize access established effective SOPs to distribute keys/permit card access and discontinue access upon separation? Do they maintain records?	
18	Have you established a policy to restrict minors (less than 18 years of age) in the lab (including temporary work, camps, etc)?	
19	Have you established a policy for unsupervised undergraduates working in the lab?	
20	Have you established a policy for working alone in the lab?	
21	Have you established rules and SOPs for experiments that operate unattended?	
22	Have you spot-tested access controls?	
23	Have you establish policies for working with carcinogenic materials and other materials of high hazard, including pre-approvals, restricted areas, and medical surveillance?	
PROCUREMENT		
24	Have you established rules for purchasing chemicals (who can purchase, methods for purchase, review of purchasing)?	
25	Have you established a review process for purchases of chemicals including confirmation of receipt and appropriateness of purchase in a timely manner?	
26	Have you established a policy for pre-approval for procurement of certain chemicals?	
27	Have you established a way to periodically review inventories for DHS CFATS chemicals of interest?	

28	Have you establish policies for working with carcinogenic materials and other materials of high hazard?	
EMERGENCIES AND SPILL RESPONSE		
29	Have you established SOPs for small spill response?	
30	Have you established SOPs for larger spill response?	
31	Do labs have appropriate spill response supplies?	
32	Do labs have emergency response plans?	
33	Do labs have continuity of operations plans?	
34	Have labs established emergency shutdown procedures?	
35	Is emergency contact info available at the scene and at a remote location?	
LAB FACILITIES		
36	Have you implemented a preventative maintenance schedule for lab hoods?	
37	Have you implemented a preventative maintenance schedule for biological safety cabinets?	
38	Have you implemented a preventative maintenance schedule for lab showers and eye washes?	
39	Have you implemented a preventative maintenance schedule for environmental control rooms or other specialty areas?	
PERSONAL PROTECTIVE EQUIPMENT (PPE)		
40	Have you established minimum PPE requirements for various types of labs?	
41	Have you established the expectation for PPE assessments be considered before work begins? Have lab personnel been training in the selection and use of PPE?	
42	Have you implemented an eye protection policy?	
43	Have you implemented a lab coat program which specifies conditions of work that require lab coats, appropriate materials for lab coats, and procurement, storage, and cleaning of lab coats?	
44	Is adequate appropriate PPE readily available? Is PPE storage, cleaning, maintenance and distribution addressed?	
45	Are all lab workers who use respirators included in the Respiratory Protection Program?	
DOOR SIGNAGE		
46	Have you implemented a program of door signage or other means to communicate primary hazards within the lab to emergency responders?	
47	Does the sign or other communication indicate the emergency contacts for the lab? Are they updated as necessary?	
48	Is this information available at a remote site?	
INSPECTIONS		
49	Have you established a system for routine internal lab inspections?	
50	Have you established a system for routine external lab inspections (e.g., by parties not working in the lab).	
51	Has a method of escalating unresolved findings been implemented?	
INVENTORIES AND SAFETY DATA SHEETS		

52	Have you established the requirements for lab inventories in your CHP?	
53	Have you established the required elements of an inventory?	
54	Have you established the frequency of updates for the inventories?	
55	Have you established the need for Safety Data Sheets for the labs? Are they readily accessible?	
56	Have you spot-tested inventories and availability of SDSs?	
INCIDENT REPORTING		
57	Have you established a system for reporting injuries?	
58	Have you established a system for reporting near-misses?	
59	Do you have a system for being advised of and reviewing all accident and near- miss reports?	
RADIOACTIVE MATERIALS/BIOLOGICAL MATERIALS		
60	Have you established a radiation safety [biological safety] program?	
61	Have you named a Radiation [Bio-] Safety Officer and Radiation Safety [Biosafety] Committee?	
62	Do you have clear processes in place for procurement, receipt, and shipping of radioactive [biological] materials?	
63	Do you keep an inventory of radioactive [biological] materials?	
64	Do you have a health program for persons working with radioactive [biological] materials?	
65	Have you adopted ALARA principles?	
66	Do you have a badge program if required?	
65	Do you have a process for recognition of, handling, and disposal of radioactive [biological] materials?	
67	Do you have an inventory of ionizing devices?	
68	Do you have the correct permits or licenses in place, and are you meeting all conditions?	
69	Is security adequate [Biological and Radiological]?	
70	Have you provided adequate training for radioactive [biological] materials or equipment users?	
71	Do you have a laser safety program and laser safety officer?	
72	Do you provided eye exams for Class IV users?	
73	Have you provided adequate training to comply with OSHA's Bloodborne Pathogens standard?	
74	Do you have procedures in place for autoclave use, including verification of function?	
75	Do you have Select Agents and adequate facilities, procedures, and training?	

Bibliography

Ref 1: OSHA laboratory standard (29) 1910.1450

<https://www.ecfr.gov/current/title-29/subtitle-B/chapter-XVII/part-1910/subpart-Z/section-1910.1450>

Ref 2: National research Council (2011) Prudent Practice in the Laboratory: Handling and Management of Chemical Hazards

<https://nap.nationalacademies.org/read/12654/chapter/1>

Ref3: SUNY Laboratory Safety

<https://system.suny.edu/ehsem/lab-safety/>

There will always be some chemicals that will not fit neatly in one category or another, but with careful consideration of the hazards involved, most of these cases can be handled in a reasonable fashion.