TEXAS STATE UNIVERSITY

The rising STAR *of Texas*

Campus Chemical Hygiene Plan

Environmental Health, Safety, and Risk Management Office

Approved 09/01/2017

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INTRODUCTION AND PURPOSE

Texas State University is committed to promoting a safe environment in all University laboratories, and to protecting employees from the health and physical hazards associated with hazardous materials. University facilities must be used in a safe and appropriate manner so as not to endanger the university community or the general public. All faculty, staff, students, and other members of the Texas State community share responsibility for the safety and security of the institution and must conduct university activities and operations in compliance with applicable federal and state regulations and university policies (UPPS 04.05.15).

The *Campus Chemical Hygiene Plan* (Campus CHP) was developed to assist campus labs in maintaining a safe workplace in compliance with the Occupational Safety and Health Administration (OSHA) rule 29 CFR 1910.1450, *Occupational Exposure to Hazardous Chemicals in Laboratories*, commonly referred to as the "OSHA Laboratory Standard." The Campus CHP is a key part of the overall Campus Laboratory Safety Manual.

This document, in and of itself, is not sufficient to maintain compliance with OSHA regulations. This document outlines roles and responsibilities for key personnel, contains policies and practices applicable to the entire campus, and provides an understanding of the applicability of various regulations to operations in a campus laboratory.

A Laboratory-Specific Chemical Hygiene Plan (Laboratory CHP) is required for all laboratories that use hazardous chemicals. Each Principal Investigator must prepare a laboratory-specific Chemical Hygiene Plan that contains hazard information, standard operating procedures (SOPs), personal protective equipment (PPE) requirements, engineering and administrative controls, and training requirements and documentation specific to their laboratory's operations. More information on the requirements of the Lab Specific CHP can be found in Chapter 3 of this document.

Background on Regulatory Compliance

All Texas State University laboratories are subject to a number regulatory requirements. The primary focus of the Campus CHP is to comply with the OSHA Laboratory Standard. The OSHA Lab Standard was developed to address workplaces where relatively small quantities of hazardous chemicals are used on a non-production basis, and it applies to all laboratories on campus.

The purpose of the standard is to protect laboratory employees from harm due to hazardous chemicals. This regulation became effective on May 1, 1990 and mandates implementation of health and safety practices and procedures in laboratories that use hazardous chemicals.

The key elements of the OSHA Laboratory Standard are:

- Protecting employees from physical and health hazards associated with hazardous chemicals in laboratories through the use of controls;
- Minimizing chemical exposures;
- Training and informing workers of the hazards posed by the chemicals used in the laboratory;
- Providing for medical consultations and exams, as necessary;
- Preparing and maintaining a Chemical Hygiene Plan specific to the identified hazards in the lab;
- Designating personnel to manage chemical safety.

Other agencies, including the U.S. Environmental Protection Agency, the U.S. Department of Transportation, the Texas Commission on Environmental Quality (TCEQ), the Texas Department of Health and Human Services, the City of San Marcos Water & Wastewater Department, and the City of San Marcos Fire Department, also impose obligations on users of hazardous chemicals, including:

- Specific storage and labeling requirements for hazardous chemicals;
- Limitations on the quantities of hazardous chemicals;
- Handling, storage, and disposal requirements for hazardous waste;
- Restrictions on the shipping and transportation of hazardous chemicals.

The requirements of these regulations are incorporated into the Campus Chemical Hygiene Plan and it will be noted as so within this document.

Scope and Applicability

The Campus Chemical Hygiene Plan describes the necessary protection from risks posed by the laboratory use of hazardous chemicals and is limited to laboratory settings (where small amounts of hazardous chemicals are used on a laboratory-scale on a non-production basis). All campus laboratories which use hazardous chemicals must comply with the requirements outlined in this document and must develop their own Lab-Specific Chemical Hygiene Plan. Those plans must, at a minimum, meet the elements outlined within this document and the laboratory-specific CHP template.

Hazardous chemicals are defined as any chemical which is classified as a physical hazard or a health hazard, a simple asphyxiant, combustible dust, pyrophoric gas, or hazard not otherwise classified.

This plan does not specifically address protection needed against radiological, biological or other hazards (electrical, laser, mechanical, etc.), though elements of these may be covered in lab-specific SOPs. Information on chemical, biological, and radiological safety – as well as other safety topics – can also be found in the Lab Safety Manual on the EHSRM website..

Implementation of the Plan

The OSHA Laboratory Standard requires the designation of personnel responsible for implementation of the Chemical Hygiene Plan. Specifically, it calls for the assignment of a Chemical Hygiene Officer (CHO). The Environmental Health, Safety and Risk Management (EHSRM) Office at Texas State University has primary responsibility for the University's hazardous materials and hazardous waste program. The EHSRM Director (or designee) is authorized to assure compliance with the OSHA Lab Standard and to assign the role of the Chemical Hygiene Officer. This individual has the responsibility for the development and implementation of the Campus CHP and for ensuring overall compliance with all chemical safety regulations.

In each lab, the Principal Investigator is responsible for developing and implementing the Laboratory CHP for any laboratories under their control. Ultimate responsibility for safety compliance within the lab resides with the Principal Investigator (or to an individual who has been assigned responsibility for a given laboratory).

Teaching and instructional laboratories containing hazardous materials must have their own safety officers, such as the departmental Lab Safety Coordinator, to help implement their chemical hygiene plans.

Availability of the Plan

All elements of the Chemical Hygiene Plan (including the Campus CHP and the Laboratory Specific CHP) must be made readily available to all lab personnel. Lab personnel includes all faculty, staff, and students who are assigned by their PI to work in a laboratory. Lab personnel also includes visiting scientists and industry partners who work in University lab space and have a signed agreement with the University.

Annual Review and Evaluation of Plan

The Texas State University Chemical Hygiene Officer shall review and evaluate the effectiveness of the Campus CHP at least annually and update it as necessary. The Texas State Lab Safety Committee will review and approve all changes to the plan. Updates to the CHP will be posted on the EHSRM website.

For a Laboratory CHP to be useful it must reflect the work that is currently performed within the laboratory. The Principal Investigator must formally review the Laboratory CHP at least annually to ensure that its contents are appropriate and adequate for current operations. If changes are necessary before the review date, the Laboratory CHP must be amended and the changes approved by the respective Principal Investigator.

ROLES AND RESPONSIBILITIES

In order to maintain an effective chemical safety program, it is important for all parties to clearly understand the responsibilities inherent in their roles. Below are assigned roles and responsibilities which are necessary to remain compliant with chemical safety regulations.

For the purpose of this document, a Principal Investigator is any individual who has primary responsibility for the operations of assigned laboratory space. In most instances this will be a Texas State University faculty member. In some instances, a facility director or department chair may assign the responsibilities outlined in this plan to a member of the academic staff (e.g., a supervisor of an instrumentation laboratory can be considered a Principal Investigator for the purposes of this plan).

University President

The President advocates for a strong safety culture on the University campus and is responsible for the approval of the Texas State University safety policies at all facilities under campus control.

Director, Environment, Health & Safety Department

The Director of EHSRM will appoint the CHO and provide the necessary staffing and resources for maintaining an effective Lab Safety Program.

University Chemical Hygiene Officer

The university Chemical Hygiene Officer (CHO) is housed in the EHSRM Office and has the primary responsibility for ensuring implementation of the Campus CHP and overall compliance with chemical safety regulations. The CHO will:

- Review and update the Campus CHP annually;
- Maintain and update the applicable sections of the *Laboratory Safety Manual* and other guidance documents;
- Facilitate the campus community's understanding of, and compliance with, required chemical health and safety regulations;
- Review Lab CHP's during lab inspections to ensure they meet the OSHA requirements.
- Maintain current knowledge concerning the requirements for storage and use of regulated substances in the laboratory;
- Conduct or oversee lab safety inspections and provide findings to the PI in accordance with the approved Lab Safety Inspection Procedure.
- Provide guidance for the safe handling, storage, and disposal of chemicals used on campus;
- Review and approve lab check-in and area registration information submitted by PI's.

Environmental Health, Safety, and Risk Management (EHSRM) Office

EHSRM has primary responsibility for developing policies and procedures to ensure that the university complies with federal, state and local requirements, as well as best-practices, related to environmental, safety, and health requirements. EHSRM personnel will:

- Develop and provide overall lab safety training to laboratory personnel;
- Inspect laboratories and identify hazards and issues of non-compliance;
- Inspect campus safety showers, eyewash stations, and fire extinguishers to ensure their proper operation;
- Review plans for new and renovated laboratory spaces to ensure compliance with campus specifications;
- Coordinate campus emergency spill response with the local Fire Department and Emergency Response (ER) Contractors;
- Maintain website and provide easily accessible information, guidance, and up-to-date information on lab safety and lab safety regulations.

Department Deans and Chairs

The Deans, Chairs, and Directors have primary responsibility for the health and safety of the individuals working in their department's laboratories. This responsibility is filled, in part, by ensuring that all departmental faculty members understand and take seriously their roles in implementing the Campus and Lab Specific Chemical Hygiene Plans. To facilitate this process, each Chair must appoint a Lab Safety Coordinator who will coordinate and monitor the implementation of the CHP within the department and work with the CHO when necessary.

Departments Chairs are also responsible for assigning required safety training indicators in accordance with training requirement descriptions on the EHSRM website. The required training indicators must be assigned to all position numbers which will perform duties described in the training requirements.

Lab Safety Coordinator

The Lab Safety Coordinator is the departmental liaison to the EHSRM and CHO for all lab safety issues in their respective departments. At a minimum, this position will:

- Be a part of the Texas State Lab Safety Committee
- Oversee safety and compliance with the lab specific or departmental CHP in all department instructional and academic labs.

Principal Investigator

The Principal Investigator (PI) is the faculty member or laboratory supervisor who has the primary responsibility for a laboratory space (as appointed by the department). The PI is responsible for providing a safe work environment and for ensuring compliance with all elements of the Campus and Laboratory CHPs within their own assigned laboratory space.

While the Principal Investigator can delegate health and safety responsibilities to a trained and knowledgeable individual (referred to as the Laboratory Manager or Safety Officer), the Principal Investigator must ultimately assure that the duties are performed.

The Principal Investigator must:

- Register their lab and staff in EHS Assistant.
- Develop and implement the Laboratory CHP;
- Develop and approve SOPs, ensuring that PPE, engineering controls, and administrative controls described within the SOPs provide adequate protection to lab personnel;
- Ensure that lab personnel understand the chemical hazards and follow the chemical safety policies, practices, and regulations related to their laboratory's operation;
- Maintain compliance with federal, state, and local regulations related to the use storage, and disposal of hazardous chemicals in their laboratory (as outlined in this document);
- Provide access to manufacturers' Safety Data Sheets (SDSs), the campus and laboratory CHPs, and other safety-related information for laboratory staff;
- Ensure that PPE and required safety equipment are available and in working order and that laboratory staff is trained in their use;
- Determine training requirements for laboratory workers based on their duties and tasks and ensure appropriate training specific to laboratory operations has been provided;
- Ensure that staff is knowledgeable on emergency plans, including fires, equipment failure, chemical exposures, and chemical spills;
- Complete and keep the Laboratory Area Registration up to date;
- Maintain up-to-date chemical inventories;
- Participate in EHSRM Lab Safety Inspections and correct unsafe conditions identified in the inspections in accordance with the Lab Safety Inspection Policy;
- Maintain documentation on training, exposure monitoring, prior approvals, and other safety related issues, as outlined in this document;
- Contact EHSRM on any lab-related injury or significant exposure and submit accident reports to the EHSRM Office within 24 hours of the incident.
- Attend required health and safety training.

Laboratory Personnel

Lab personnel includes all faculty, staff, and students who are assigned by their PI to work in a laboratory. Lab personnel also includes visiting scientists and industry partners who work in University lab space and have a signed agreement with the University. The individuals working under the supervision of the Principal Investigator must:

- Follow campus and laboratory practices, policies, and SOPs as outlined in the Campus and Laboratory CHPs;
- Attend all safety training as required by the University, Department, and Principle Investigator;
- Perform only procedures and operate only equipment that they have been authorized to use and trained to use safely;
- Check relevant information on the chemical reactivity and physical and toxicological properties of hazardous materials (such as Safety Data Sheets, or the Texas State Laboratory Safety Manual) prior to use of the chemical substance;
- Have knowledge of emergency procedures prior to working with hazardous chemicals;
- Incorporate safety in the planning of all experiments and procedures;
- Use the personal protective equipment and hazard control devices provided for his/her job;
- Report any unsafe condition immediately to the PI or other safety personnel;
- Keep work areas clean and orderly;
- Avoid behavior which could lead to injury;
- Dispose of hazardous waste according to university procedures;
- Report incidents involving chemical spills, exposures, work-related injuries, and illnesses or unsafe conditions to Principal Investigator;
- Consult with the Principal Investigator or with EHSRM staff on any safety concerns or questions.

Texas State Laboratory Safety Committee

The Laboratory (Lab) Safety Committee is comprised of university faculty and staff drawn from many organizations and departments. The Lab Safety Committee will:

- Collaborate with EHSRM on campus policies on issues related to the purchase, use, storage, and disposal of chemicals;
- Review compliance with campus policies and recommend methods to promote compliance;
- Periodically review chemical safety issues in EHSRM publications and on its web site, including reviews of the Campus Chemical Hygiene Plan;
- Collaborate with other institutional committees to assure that chemical safety concerns are properly addressed;
- Provide a forum for the campus community to raise concerns regarding the safe use, handling, and disposal of chemicals and assist in the resolution of disputes regarding chemical safety issues;
- Review and approve the Campus CHP.

LABORATORY SPECIFIC CHEMICAL HYGIENE PLAN

For each laboratory under their control which uses hazardous chemicals, the PI (or other lab authority as designated by the department) shall develop written documentation of the following:

- The identity and location of the laboratory
- Names of the Department Head and Departmental Lab Safety Coordinator, the Principal Investigator, and any other person responsible for implementation of the Lab CHP, such as a Lab Manager or Lab Safety Officer as appointed by the PI
- Contact information and emergency numbers for responsible parties
- Location of Safety Data Sheets (SDSs)
- Location of the lab's Chemical Inventory with the Particularly Hazardous Substances identified.
- Lab-specific strategies for controlling exposures and hazards
- List of Standard Operating Procedures that are relevant for the lab and their location within the Lab CHP
- Documentation of prior approval for all lab personnel using PHSs or High Risk Chemicals or Procedures
- Lab-specific information for chemical waste disposal
- Emergency Procedures
- Sign-off page to indicate that the CHP is accurate and has been reviewed (and updated as needed) on an annual basis
- Documentation of laboratory-specific chemical hygiene training for all lab personnel

PIs can meet the above requirements by completing the Laboratory-Specific Chemical Hygiene Plan template and by adding any additional required documentation. The template for the laboratory-specific CHP can be found on the EHSRM website or in Appendix A.

The template includes directions on how to complete each section and provides an organizational framework for ensuring that Principal Investigators are compliant with OSHA laboratory safety regulations.

CHEMICAL HAZARD INFORMATION AND TRAINING

The OSHA Lab Standard, the Texas Hazard Communication Act (THCA), and Texas State University policy require all laboratory personnel receive laboratory safety training and be informed of the potential health and safety risks that may be present in their workplace.

Required Hazard Awareness Training for Lab Personnel:

General Lab Safety Training:
All lab personnel shall be required to take a general laboratory safety course online before beginning work in the lab and annually thereafter.

Laboratory-Specific Training:
The Principal Investigator or Laboratory Safety Officer shall conduct laboratory-specific hazard awareness training for all laboratory personnel before they begin working in the lab. The training can be documented using the lab orientation checklist included in the Lab CHP template. The lab-specific training must cover:

- An overview of the OSHA Laboratory Standard
- An overview of the Texas State Lab Safety Manual and the Campus CHP
- The Lab-Specific Chemical Hygiene Plan, including:
    - The specific chemical and physical hazards in the lab.
    - Lab policies and Standard Operating Procedures, including the measures employees can take to protect themselves from the identified hazards, such as appropriate work practices, engineering controls, and personal protective equipment.
- The permissible exposure limits for OSHA regulated substances or recommended exposure limits for other hazardous chemicals where there is no applicable OSHA standard.
- Signs and symptoms associated with exposures to hazardous chemicals used in the laboratory.
- The location and availability of identified reference materials listing the hazards, safe handling, storage and disposal of hazardous chemicals found in the laboratory including, but not limited to SDS's received from the chemical supplier.

This hazard awareness training shall be reviewed as necessary and any time a new hazard is introduced. The PI or Laboratory Safety Officer shall review staff knowledge as often as necessary to verify that staff can perform their assigned tasks safely.

Laboratory Safety Officer Training: The PI and, if applicable, the designated Lab Safety Officer from each lab will be required to attend a one-time in-person Lab Safety Officer Training provided by EHSRM. This course will review resources available to help the LSO to develop lab-specific SOPs and deliver lab-specific training.

Documentation must be maintained by the PI and included in the Lab-Specific Chemical Hygiene Plan to demonstrate that such training was provided and received. Laboratory safety training must be obtained either through EHSRM classroom training, SAP (for paid employees) or TRACS (for unpaid volunteers or students).

Required Sources of Chemical Hazard Information

One of the key requirements in OSHA chemical safety regulations is the communication of the potential hazards to which a worker may be exposed. This section describes the Texas State University policies for meeting these requirements.

Labeling Chemical Containers

Proper labeling of chemicals is a way of warning laboratory students and staff of potential hazards that exist, preventing the generation of unknowns, and facilitating emergency responses such as cleaning up spills and obtaining the proper medical treatment.

- **Primary Containers** – are containers in which the chemical was received from the manufacturer or distributor. In 2015, OSHA became aligned with the Globally Harmonized System of Classification and Labeling of Chemicals (GHS) (Appendix B) which is an international approach to standardizing classification of hazards and labeling. Thus, federal and state regulations require that labels on primary containers must be maintained and not defaced and have at least the following components:

    - Product name
    - Signal word
    - Pictograms
    - Hazard statement(s)
    - Precautionary statements
    - Manufacturer name, address, and telephone number

    For chemicals purchased prior to 2015 the labels on primary containers must have at least the following components:

    - The name of the chemical as it appears on the Safety Data Sheet.
    - Warnings about any physical and health hazards.
    - The manufacturers name and address.

Aside from the Globally Harmonized System of labeling chemicals there are other labeling systems that laboratories may use such as NFPA fire diamonds (Appendix C), HMIS color bars (Appendix D), or USDOT shipping labels (Appendix E).

- **Secondary Containers / Workplace Containers** - are wash bottles, squirt bottles, temporary storage containers, beakers, flasks, bottles, or any container that a chemical from an original container is transferred. Federal and state regulations require that labels on secondary containers must be maintained and not defaced and have at least the following components:
    - The name of the chemical as it appears on the Safety Data Sheet.
    - Warnings about any physical and health hazards, which may be expressed through words, pictures, symbols, or a combination of these.

  Use of abbreviations such as structures, formulas, or acronyms should be avoided whenever possible. However, if abbreviations are used, an abbreviation key in a visible location (preferably close to the chemicals) should be provided. The key must contain the abbreviation and the name of the chemical. It is also useful to include the hazards of the chemical on the "key." The abbreviation key must be readily available upon request by EHSRM, visitors, and emergency responders.

    - **Small Containers** - For containers, which may be too small to write out a chemical name, structure, or formula, laboratories can:
        - Place containers in a Ziploc bag or other type of overpack container (beaker, plastic bottle, etc.) and label the overpack with the chemical name and its hazards.
        - For vials in a rack, label the rack with the chemical name and its hazards.

    - **Teaching Collections –** For preserved specimens in bottles, bags, or other containment units, the container must list the preservative and its hazards (ex: 70% Ethanol, Flammable and Toxic).

    - **Research Samples –** Should be stored on shelves, in boxes, or racks that are labeled with the preservative and its hazards. If individual samples taken out of storage areas for processing will be left unsupervised they must have a label listing the preservative and its hazards.

- **Dating of containers** – it is best practice to date all chemical containers on the date received and the date opened. It is <u>required</u> to date all time sensitive chemicals, such as peroxide formers, on the date received and the date opened. More information on peroxide forming chemicals can be found in Chapter 6 - Physical and Chemical Hazards. A list of common peroxide formers and the policy for their retention can be found in Appendix F.

All Peroxide Forming Chemicals must have a receive date and date opened written on the label.

Safety Data Sheets and Other Safety Information

Safety Data Sheets (SDSs), formally known as Material Safety Data Sheets (MSDSs) are an important part of any laboratory safety program in communicating information to chemical users. SDSs are prepared by the chemical manufacturer. The documents summarize the physical and chemical characteristics, health and safety information, handling, and emergency response recommendations related to their products.

- Any chemical shipment received should be accompanied by an SDS, if not check the chemical manufacturers website or call the manufacturer, or check EHSRM's website for links to SDSs.

- SDSs must be accessible at all times. Access to SDSs can mean maintaining paper copies or electronic access via the internet.

- If a laboratory chooses to use electronic access, then EHSRM recommends the SDS website link be posted on laboratory computers or in another conspicuous location.

It is the responsibility of Principal Investigators and laboratory supervisors to ensure that staff and students working in laboratories under their supervision have obtained required training and have access to SDSs (and other sources of information) for all hazardous chemicals used in laboratories under their supervision.

- The EHSRM "rule of thumb" is that a person working in a laboratory should be able to produce an SDS for any hazardous chemical found in the lab within five minutes.

- Any accidents involving a chemical will require an SDS being provided to emergency response personnel and to the attending physician so proper treatment can be administered

SDSs alone may not provide sufficient information on the hazards of a chemical. Laboratory personnel should review other sources of information on the chemical, such as the National Research Council's *Prudent Practices in the Laboratory*. These resources should be made available to laboratory staff.

If you have questions on how to read SDSs, or questions about the terminology or data used in SDSs, contact EHSRM at 512-245-3616 for more information.

Chemical Inventory

The university is subject to numerous regulations above and beyond the OSHA Laboratory Standard. In order to comply with these regulations, the University **requires** that all lab PI's maintain an up-to-date listing of all chemicals and compressed gases within their laboratory using the EHSRM web-based software, EHS Assistant. Instructions for the use of EHS Assistant and answers to Frequently Asked Questions regarding chemical inventories can be found on the EHSRM web page.

EHS Assistant will send automatic e-mails annually to all PI's to request a review and PI approval of the current lab inventory in their work area. EHSRM will run a report in EHS Assistant at the beginning of each year to develop and submit the reports required by the regulations defined above.

The location of chemical inventory (paper or electronic) for each lab must be made available to all lab personnel.

CHEMICAL INVENTORY REGULATIONS

Emergency Planning and Community Right-to Know Act (EPCRA): federal statute that requires all entities that store, use or process hazardous chemicals to report this information to their state agency responsible for emergency response planning (in Texas, the TCEQ) and to the Local Emergency Planning Committee (LEPC) in their area.

Department of Homeland Security (DHS) Chemicals of Interest - Requires facilities to determine if they have one of 300 specific chemicals above screening threshold quantities. While most of the thresholds are much higher than those quantities maintained at the University, a handful of the threshold amounts are significantly lower.

City of San Marcos Fire Codes Requires entities that use hazardous materials to maintain inventories and to provide them upon request.

Exposure Limits

Occupational Exposure Limits (OELs) are airborne concentrations that have been determined to be safe for employees for a set period of time. OSHA has published Permissible Exposure Limits (PELs) for a number of chemicals. These Permissible Exposure Limits (PELs) are listed in 29 CFR 1910.1000 TABLE Z-1. The American Conference of Governmental Industrial Hygienists (ACGIH), a professional organization, has published Threshold Limit Values (TLVs), which are recommended exposure limits for chemicals without PELs. Employees must be familiar with exposure limits for the chemicals in use in the lab.

It is the responsibility of the Principal Investigator to ensure that laboratory staff members have knowledge of the exposure limits applicable to the chemicals that are used within the lab.

While the published PELs are enforceable, they were not determined with a university laboratory setting in mind and many chemicals do not have any published exposure limits. Also in most cases, laboratory personnel perform operations over a short time span. It is Texas State University's policy, therefore, that all prudent steps will be taken to minimize chemical exposure by reasonable actions.

Lab Safety Manual

The Texas State Lab Safety Manual provides guidance and policy for safe operations in laboratories, including handling of compressed gases, cryogens, pressure and vacuum systems, and more. Much of the same information is also incorporated into Chapter 6, Physical and Chemical Hazards, in the Campus CHP. Laboratory personnel must be familiar with the various guidance and policies in the Texas State University Lab Safety Manual.

Chemical Information for Materials Produced in the Laboratory

Chemicals of known composition – when a chemical of known composition is produced and determined to be hazardous, the principal investigator or laboratory chemical hygiene officer must ensure that personnel who use this chemical are provided with appropriate training and controls.

Chemicals of unknown composition – when a chemical of unknown composition is produced in the laboratory, it must be considered a "Particularly Hazardous Substance" and handled accordingly. Each investigator or laboratory supervisor has the responsibility to identify and characterize these unknown chemicals as soon as possible so that it may be determined whether or not they are hazardous.

Recommended Chemical Safety Resources

Prudent Practices in the Laboratory
Published by the National Research Council, this book is an essential resource for chemical hygiene and safety. Particularly useful are the Laboratory Chemical Safety Summaries included for many common laboratory chemicals in Appendix B.

Safety in Academic Chemistry Laboratories
Published by The American Chemical Society, volume 1 (for students) and volume 2 (for faculty and administrators) provide a basic overview on preventing chemical-related accidents in the lab.

SAFE USE OF CHEMICALS

The main purpose of the OSHA Lab Standard is to protect laboratory personnel from hazards encountered in laboratory settings. In order to protect personnel, the hazards of the chemicals, processes, and equipment used in the lab must be properly assessed, and adequate controls must be used to reduce risks of exposure.

Hazard and Risk Assessment

Hazards and risks associated with use of hazardous chemicals should be evaluated during the planning stage of any new or modified process or project. The evaluation should review the chemical properties, reactions/byproducts, procedural hazards, equipment used, potential routes of exposure, as well as control measures to mitigate the hazards.

Once the hazard has been assessed, and the strategies for controlling the hazards have been determined, the PI will choose or develop a Standard Operating Procedure (SOP) for working with the hazard. More information about choosing and developing SOPs can be found below in the Administrative Controls section.

Resources which can be used to evaluate chemical hazards and risks include Safety Data Sheets, consulting published resources, and contacting EHSRM. Useful information about conducting hazard assessments can also be found on the American Chemical Society (ACS) website.

Particularly Hazardous Substances and High Risk Chemicals or Procedures

Particularly Hazardous Substances are defined by OSHA as chemicals which present extreme risk potential to laboratory workers if not handled appropriately; therefore, these substances require additional controls when used in the laboratory. More specifically, PHS chemicals are defined as acute toxins, reproductive toxins, and "select" carcinogens.

- **Acute Toxins -** 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."
- **Reproductive Toxins** - any chemical that may affect the reproductive capabilities, including chromosomal damage (mutations) and effects on fetuses (teratogenesis).
- **Select carcinogens** - chemical agents that cause cancer. Generally, they are chronically toxic substances. OSHA defines a "select carcinogen" as a substance that meets one of the following criteria:
  1. Is regulated by OSHA as a carcinogen;
  2. Is listed under the category "known to be a carcinogen" or "reasonably anticipated to be a carcinogen" in the Annual Report on Carcinogens published by the National Toxicology Program (NTP); or
  3. Is listed under Group 1 ("carcinogenic to humans") or under Group 2A ('probably carcinogenic to humans") or 2B ("possibly carcinogenic to humans") by the International Agency for Research on Cancer (IARC).

A list of Particularly Hazardous Substances (PHSs) can be found in Appendix G.

*Note that the EHSRM's list of PHSs is **not an all-inclusive list**. Laboratories are responsible for assessing the hazards of chemical materials that they may use or synthesize, and to take appropriate steps to implement safety controls.*

As noted above, use of a PHS requires the following additional considerations which must be included in the Standard Operating Procedure for the chemical or process using the chemical:

- Establishment of a designated work area;
- Defining the procedures for safe removal of contaminated waste;
- Describing the appropriate decontamination procedures.

The room or area where work with a PHS is performed must be posted with a ***Designated Area*** sign. The "designated area" may be the workbench or fume hood where work with the PHS is performed, or in some cases, it may be the entire room.

OSHA also defines certain "**High Risk"** chemical groups as Particularly Hazardous. Chemicals considered Particularly Hazardous include the following GHS/UN classifications:

- In contact with water emits flammable gas - Category 1
- In contact with water liberates toxic gas
- In contact with acids liberates toxic gas
- Pyrophoric liquid or solid - Category 1
- Self-heating - Category 1
- Self-Reactive or Organic peroxides

The use of PHS or a High Risk Chemical requires prior approval in the lab's Standard Operating Procedures for those chemicals, which are discussed in more detail in the Administrative Controls Section of this document.

Prior Approval

If a PI determines through the hazard assessment that the use of a chemical used in a procedure is a PHS or is a high risk, then the SOP must indicate that prior approval is required before using procedure or chemical. Typically, the need for prior approval will involve work with PHSs and high risk chemicals; however, other situations, such as changing the concentration or volume used in a procedure, or working during certain hours may also require prior approval.

The Principal Investigator will make the determination if a procedure needs prior approval and note it in the Standard Operating Procedure (SOP) template.

Strategies for Controlling Exposures and Hazards

The general strategy for keeping employees safe during work with chemicals (or other workplace hazards) is to use a hierarchy of controls that places emphasis on keeping hazards out of the workplace when possible. When use of hazardous chemicals is necessary, the preferred controls are those which remove the hazard from the workplace or place a barrier between the worker and the hazard (engineering controls) followed by work practices and personal protective equipment (PPE), which require more effort on the part of the individual employee.

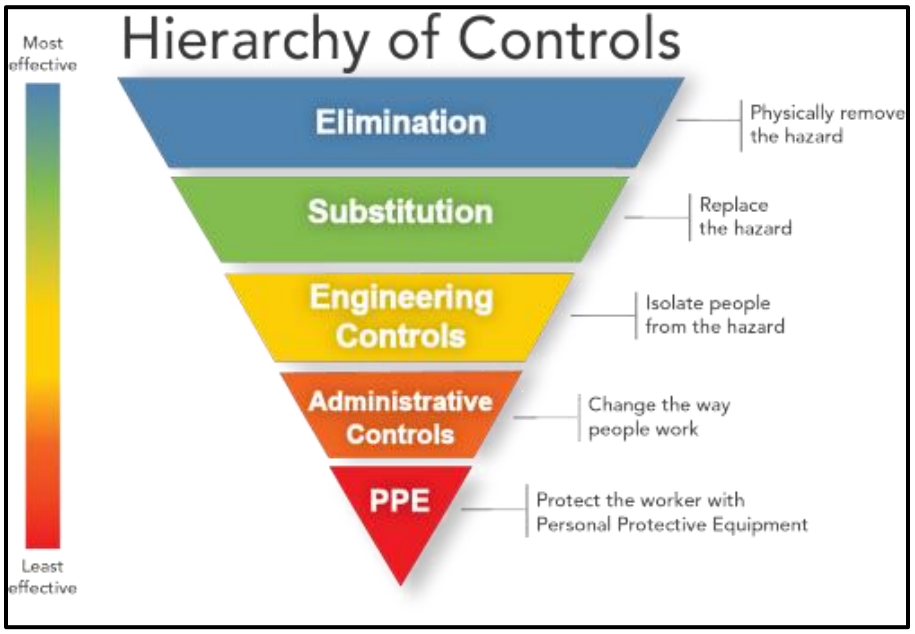

Figure 1

Source: http://www.cdc.gov/niosh/topics/hierarchy

Elimination or Substitution of Hazards

When planning research or clinical laboratory activities, consider the hazards of the chemicals that will be used. If possible, select an alternative procedure that uses less hazardous chemicals, or that substitutes a less hazardous form of the same chemical. Here are some examples:

- Phosphate assay: Some phosphate assay methods require heating perchloric acid, which can create explosive crystals in fume hood ductwork. Instead, use a method that does not call for perchloric acid, or purchase a phosphate assay kit.
- Acrylamide gels: Acrylamide is a Particularly Hazardous Substance (possible human carcinogen). Avoid potential exposure to acrylamide powder by purchasing precast polyacrylamide gels.
- Xylene: Consider using PARAclear or another environmentally-safe clearing agent instead of xylene to reduce exposure and disposal concerns.

Controlling Exposures and Hazards

Engineering Controls

Engineering controls are considered the first line of defense in the laboratory for the reduction or elimination of exposure to hazardous chemicals. Examples of engineering controls are chemical fume hoods, glove boxes, ventilated storage cabinets, as well as other containment enclosures. ***In all cases, lab personnel must be trained by the PI in the proper use of the equipment.***

- **Fume hoods -** are the primary containment devices used to protect personnel and the laboratory environment from hazardous or irritating chemicals that may become airborne through volatilization or aerosolization.
    - Use a chemical fume hood when working with:
        - Particularly Hazardous Substances
        - Volatile compounds
        - Chemicals with a strong odor
        - Other materials as indicated by the chemical Standard Operating Procedure.
    - Follow these work rules when working in a chemical fume hood:
        - Set the sash at the height indicated by the arrow on the inspection sticker. The only time the sash should be completely open is while setting up equipment
        - Place equipment and chemicals at least six inches behind the fume hood sash. This practice reduces the chance of exposure to hazardous vapors.
        - Do not allow paper or other debris to enter the exhaust duct of the hood.
        - Do not store excess chemicals or equipment in fume hoods, as it can disrupt air flow.
        - Do not block the baffle area of the fume hood.
        - Elevate any large equipment within the hood at least three inches to allow proper ventilation around the equipment.
        - Do not alter/modify the fume hood or associated duct work. Notify EHSRM and Facilities if you need to have your fume hood modified.

- ***A special note for working with perchloric acid*** - using perchloric acid in a standard fume hood can lead to buildup of potentially explosive perchlorate salt residues on surfaces and in duct work. To prevent this, a fume hoods with a water wash down system must be used/installed.
    - A fume hood designed for perchloric acid use should be used if any of the following is applicable:
        - Concentrated perchloric acid (60% or greater) is used;
        - Perchloric acid (at any concentration) is used at elevated temperatures;
        - Perchloric acid is used under conditions where it may become concentrated (such as with strong dehydrating agents).

- Fume hood velocity testing for all hoods on campus is conducted on a monthly basis by EHSRM. The face velocity of the hoods is measured in feet per minute (fpm) with the velocity recorded on the inspection sticker.

- If your fume hood is not functioning properly, stop working in the hood, close the sash, and place a sign on the hood to indicate that it is not working. If hood contents could create a hazardous situation in the room (even with the sash down), leave the room and contact EHSRM at 512-245-3616. Otherwise, complete a work order for Facilities Operations to repair the hood.

- Facilities Operations (Electric Shop) performs routine maintenance on the exhaust fans tied to the fume hoods. PIs are notified of maintenance in accordance with the Fume Hood Maintenance Procedure. For the safety of the maintenance personnel, all chemicals and experiments must be removed from fume hoods when maintenance is being performed. Failure to do so could result in chemical exposure.

- **Glove Boxes -** A glove box is a sealed container that is designed to allow material to be handled in a specific atmosphere (typically inert). Glove boxes can be used to protect sensitive items inside the glove box or the user on the outside of the glove box, or both.
    - The following recommendations should be followed by all personnel using a glove box:

        - All trained personnel must understand the design features and limitations of the glove box before use. The training must include detailed instruction on elements such as the ventilation and vacuum controls that maintain a pressure differential between the glove box and outside atmosphere, atmospheric controls (e.g., controlling oxygen concentrations and moisture), etc.
        - Prior to use, a visual glove inspection must be performed. Changing of a glove must be documented (date, manufacturer, model of glove, and person performing change). Gloves should not be used until they fail; they should be changed according to the glove box manufacturer's recommendations or whenever necessary.
        - Plugging ports that are never or infrequently used is recommended. A properly plugged port should have a stub glove and a glove port cap installed.
        - Chemical resistant gloves (e.g., disposable nitrile gloves) should be used under the glove box gloves to protect from contamination.
        - The glove box gloves should be cleaned on a routine basis (before each use is recommended) as a good hygiene practice.
        - The glove box pressure must be checked before use and immediately after gloves are changed. The pressure check should be documented.
        - Keep sharps in an approved container while in the glove box.

- Do not work in the glove box unless the lighting is working.
- Follow all safe work practices for using and handling compressed gas that may be associated with working in the glove box. Follow the manufacturer's recommendations.
- All equipment and chemicals in the glove box must be organized and all chemicals must be labeled. Do not allow items, particularly chemicals to accumulate in the glove box.

- **Biological Safety Cabinets** – These units provide filtered air inside the cabinet, and filter the air that leaves the cabinet. Though some biological safety cabinets are exhausted, their exhaust ducts may be under positive pressure. These cabinets are primarily intended to protect lab personnel from biological hazards and should not be used chemical hazards. More information on this control can be found in the Biosafety Manual.

- **Process modification** – This involves changing the temperature or pressure at which an experiment is conducted, or using an inert gas or other change in the experimental procedure to reduce the likelihood of exposure or other incident.

Administrative Controls

Administrative controls are practices and procedures developed to improve the safety of laboratories, examples include standard operating procedures, good housekeeping, and chemical purchasing. While EHSRM sets broad campus policy, as outlined in this document, it does not set specific administrative controls for the use of hazardous chemicals. Such controls must be set by individual PIs or Departments and kept up to date as conditions change. The following lists some essential controls:

- **Standard Operating Procedures (SOPs)** – are descriptions of how to safely perform a process or experiment using a hazardous chemical. Written SOPs are a required anytime there is work involving a hazardous chemical.

  SOPs are required for the use of hazardous chemicals and are part of the Lab-Specific CHP. A template for developing SOPs can be found in the Lab-Specific CHP template.

  General SOPs for various hazard classes and templates for some specific chemicals are being created by EHSRM and will be posted on the EHSRM website as they become available. Labs should check the website for the most current list of SOPs and templates.

  - Labs may produce customized SOPs for certain classes of Particularly Hazardous Substances, High Risk Chemicals, or High Risk Procedures as long as those chemicals grouped into a single SOP are handled in the same way AND as long as lab personnel can determine the hazards associated with each chemical covered (by referencing other readily available resources).

- Laboratory personnel are expected to be familiar with and to follow all SOPs relevant for their laboratory work.

- If the SOP requires prior approval for use of a certain chemical or procedure, then the PI must ensure that all lab personnel using it are properly trained on the SOP and that prior approval for its use is documented in the Lab-Specific CHP.

- **Housekeeping** – the appearance and condition of a laboratory is directly related to safety and must be given importance of equal value to other procedures. Lack of good housekeeping reduces work efficiency and may result in accidents. Laboratory personnel must adhere to the following:
    - Access to emergency equipment, showers, eyewashes, fire extinguishers, exits and circuit breakers shall never be blocked or obstructed.
    - All aisles, corridors, stairs, and stairwells shall be kept clear of chemicals, equipment, supplies, boxes, and debris.
    - Keep all areas of the lab free of clutter, trash, extraneous equipment, and unused chemical containers. Areas within the lab that should be addressed include benches, hoods, refrigerators, cabinets, chemical storage cabinets, sinks, trash cans, etc.
    - All chemicals should be placed in their proper storage areas at the end of each workday.
    - Collection containers for wastes must be clearly labeled including hazard identification (Contact EHSRM for empty containers and waste tags.).
    - In rooms with fire sprinklers, all storage, including both combustible and non-combustible materials, must be kept at least 18" below the level of the sprinkler head deflectors to ensure that fire sprinkler coverage is not impeded.

- **Personal Hygiene -** Good laboratory work practices include the use of personal protective equipment (PPE) and good personal hygiene habits. Although PPE offers a barrier of protection against chemicals and biological materials, good personal hygiene is also important to prevent chemical exposure.
    - Lab personnel should wear long pants and closed toed shoes when working in a laboratory.
    - Confine loose clothing, jewelry, and long hair.
    - Do not start a siphon or pipette by mouth. Always use a pipette aid or suction bulb to start a siphon.
    - No eating, chewing gum or tobacco, drinking or applying cosmetics in areas where chemicals are stored or used.
    - Food/drinks and associated products should also not be in the laboratories, if food/drinks are part of an experiment they should be labeled as "Not for Human Consumption"
    - Do not store food in the same refrigerator with chemicals, biohazards or

radioactive materials.
    - Refrigerators used for the storage of chemicals should be labeled "Chemicals Only, No Food".
    - Unless moving chemicals to another location, remove PPE before leaving laboratory.
    - Wash hands and arms with soap and water before leaving laboratory.

- **Working Alone -** Except with prior approval, laboratory personnel shall not work alone when conducting research using hazardous chemicals or processes which present physical or health hazards, such as use of toxic or explosive chemicals, use of compressed gases, or high-pressure cylinders.

  The Principle Investigator must approve, in advance, any work to be performed by individuals working alone. PI's must establish specific guidelines and standard operating procedures (SOPs) stating when working alone is not allowed and develop notification procedures when working alone takes place.

- **Leaving Experiments Unattended -** Experiments involving hazardous chemicals should not be left unattended, but if circumstances require that the experiment run when the lab is not occupied, seek the approval of the Principal Investigator or laboratory safety coordinator in advance.

  For unattended operations, light(s) should be left on and a warning sign should be placed on the laboratory door, or in a place that can be easily seen without putting someone in danger in the event of an emergency. The warning sign should list the following information:

    - The nature of the experiment.
    - The chemicals in use.
    - Hazards present (electrical, heat, etc.)
    - The name of the person conducting the experiment with a contact number. A second contact name with and their number.

  When setting up an experiment to be left unattended, take into account potential incidents that could happen:
    - Use secondary containment such as trays to contain any spills.
    - Use safety shields and keep the fume hood sash down to contain chemicals and glass in the event of an explosion.
    - Remove any chemicals or equipment that are not necessary
    - Whenever possible, use automatic shutoff devices to prevent accidents such as loss of cooling water shutoff, over-temperature shut off, etc.
    - Use emergency power outlets for equipment that could be negatively affected in the event there is a power outage or other utilities are interrupted.

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- **Visiting Scientists, Volunteers, Industry Partners**
    - The University requires the same compliance with rules and attention to responsibilities for visitors as it does for University employees.
    - The PI sponsoring the lab user is responsible for ensuring that the lab user receives all appropriate safety training and training specific to the operations of the laboratory in which the visitor will participate. The visitor must complete all training and documentation of the nature, scope, and date of training shall be made and retained by the faculty member.
    - If appropriate, the visitor shall be provided supervision at all times while participating in the laboratory activities.
    - The visitor shall agree to these guidelines and complete the appropriate release and indemnification agreement. The responsible faculty member shall retain these forms.

- **Visitors and Children in Laboratories -** Due to the potential hazards and liability issues, visitors, and in particular children under the age of 16, are not permitted in hazardous work areas, with the exception of University-sanctioned activity, e.g., tours, open houses, or other University related business as authorized by the Principal Investigator or laboratory supervisor. In these instances, all children under the age of 16 must be under careful and continuous supervision.

- **Animals in Laboratories –** In accordance with the Texas State Animal Policy, animals are not allowed in laboratories, except as allowed by the following exceptions:
    - Animals used in approved teaching, research and clinical activities (including livestock kept at university owned ranches and similar facilities).
    - Service animals that meet the criteria outlined in the Procedures for General Service and Psychiatric Service Animals and animals in training for persons with disabilities that meet §121.003(i) of the Texas Human Resources Code.
    - On-duty Emergency Service K-9s or rescue dog.

- **Laboratory Security** - Laboratories should take specific action in order to provide security against theft of hazardous materials and valuable equipment. EHSRM encourages each college, department, and research group to review and develop procedures to ensure the security of all hazardous materials in their area of responsibility.

  The following are guidelines designed to minimize opportunities for theft of any hazardous materials from your laboratory:

- Close and lock doors when no one is present in the laboratory.
- Develop and implement lab security procedures for your lab group and train lab on security procedures.
- Limit laboratory access to only those individuals who need to be in the lab and restrict off-hours access only to individuals authorized by the Principal Investigator.
- Be sure to lock freezers, refrigerators, storage cabinets, and other containers where stocks of biological agents, hazardous chemicals, or radioactive materials are stored not in direct view of workers (i.e: unattended storage areas).

- **Check-in (Area Registration) and Check-out of Laboratories** - Changes in laboratory occupancies can occur due to retiring faculty, new faculty hires, new lab staff are hired, students graduate, or when facility renovations take place.

  Faculty moving into a lab (either new or pre-existing lab) must fill out the online Area Registration Form.

  When a faculty member has made it known to their department that they are moving out of a lab the following must take place:
  - Department Chairs will notify EHSRM when a faculty member is leaving the University at least one month prior to his or her departure.
  - EHSRM will then contact faculty members with laboratories and arrange a meeting to discuss the lab closeout.
  - Faculty member must complete the Lab Check-Out Form and procedure.

- **Chemical Purchasing -** Prior to purchasing new chemicals, PI's and their lab personnel should review their chemical inventory and use those in stock whenever possible.
  - If it is necessary to purchase new chemicals, laboratory personnel should order the smallest quantity necessary to carry out the experiment. Avoid ordering extra quantities just because it "might be needed in the future."

  - All hazardous material purchases must be routed through EHSRM for approval by using the appropriate GL Code. If there is a questionable quantity or substance being purchased, EHSRM may contact the PI for further information after the purchase request is reviewed. Use of the P-Card for purchases of hazardous materials is prohibited in accordance with UPPS 04.05.15.

- **Inspections -** The purpose of inspections is to assist faculty and staff members in identifying and correcting potential regulatory compliance issues that could affect the ability to obtain grant funding as well as identify potential health and safety hazards that could pose a risk to laboratory personnel, students, and the campus community. Inspections fall under three types: EHSRM inspections, self-audits, and regulatory.
    - **EHSRM –** Inspections occur on a quarterly basis in accordance with the inspection checklist and procedure.
    - **Self-Audits –** labs should conduct their own self-audits routinely to address any potential issues. The EHSRM inspection checklist can serve as a useful guide.
    - **Regulatory -** Inspections by state and federal regulatory agencies can occur at any time and can result in citations and significant fines for the university. The best way to be prepared for these inspections is to understand what regulations apply to your area and what you need to do to comply with those regulations. If a state or federal inspector shows up in your work area unescorted, ask them to please wait and contact EHSRM immediately at 512-245-3616.

- **Ordering New Equipment** – When new equipment is planned to be purchased and installed in laboratories, especially equipment that is required to be hooked up to building utility services such as electric, water, or gas, laboratory personnel must first consult with Facilities Operations and EHSRM to ensure the building has the necessary resources to support the new piece of equipment. Lab personnel **should not** assume they can purchase equipment first and then expect the building to be able to handle the service requirements later.

  Additionally, as with installation of fume hoods, certain pieces of equipment require special installation due to their potential impact on the rest of the building ventilation system and utilities, and cannot be hooked up by laboratory personnel, building managers, or private contractors without first consulting with Facilities Operations and EHSRM. Laboratory personnel are strongly encouraged to be proactive and to consult with the appropriate departments ahead of time, before purchasing new pieces of large equipment.

- **Laboratory Construction and Remodeling -** To provide the best service during the construction/renovation process for laboratories, it is important to take health and safety considerations into account up front during the design process. Faculty or staff members that are planning new lab construction or lab renovation should, consult with the Facilities Operations Project Manager and contact the Chemical Hygiene Officer with the following information:
    - Contact name, phone number, email
    - Department, building and room(s) the project will occur in
    - Expected start date for project
    - A list of chemicals, including storage quantities
    - Equipment planning to be installed - fume hoods, biosafety cabinet, other capture devices, chemical cabinets, eyewash and emergency shower, monitoring devices, etc.

Personal Protective Equipment (PPE)

Engineering and administrative controls are the primary means of maintaining a safe laboratory. When these methods are used in conjunction with the proper selection of PPE, chemical exposure can be further minimized. Typical examples of PPE include safety goggles, safety glasses, lab coat, gloves, and respirators. Specific PPE requirements should be dictated by the in the Lab Specific CHP.

It is the responsibility of the Principal Investigator or laboratory safety officer to ensure laboratory staff have received the appropriate training on the selection and use of proper PPE, that proper PPE is available and in good condition, and laboratory personnel use proper PPE when working in laboratories under their supervision.

- **Eye protection** - Eye protection is one of the most important types of PPE to wear. Laboratory personnel should use eye protection for many of the chemical and physical hazards found in laboratories. All laboratory employees and visitors should wear protective eyewear while in laboratories where chemicals are being handled or stored, at all times, even when not working directly with chemicals. Additional information on protective eyewear can be found on the OSHA Eye and Face Protection eTool.

- **Hand Protection** - The proper use of hand protection can help protect from potential chemical and physical hazards. Gloves must be worn when using chemicals that are easily absorbed through the skin or are carcinogens, reproductive toxins, or substances with a high level of acute toxicity.
    - Chemically Resistant gloves - Remember there is no universal type of glove material which will protect you from all chemical exposure. Recommended gloves types may be listed in SDSs. If they are not, review glove manufactures' web sites to help you select the proper glove for the chemical you are handling.
    - The use of latex gloves, especially thin, disposable exam gloves, for chemical handling is discouraged because latex offers little protection from commonly used chemicals. To avoid issues with allergic reactions, use hypoallergenic, non-powdered gloves. The use of latex gloves is only appropriate for:
        - Most biological materials
        - Non-hazardous chemicals
        - Certain clean room requirements
        - Medical or veterinary applications
    - Cryogenic gloves – use when working with dry ice, liquid nitrogen and other cryogenic liquids.

- **Protective Clothing** – The use of protective clothing such as lab coats, Tyvek coveralls, aprons, boots, and shoe covers can provide protection from biological or chemical contamination or splashes. When choosing protective clothing consider:
    - the specific hazards encountered and the degree of protection needed;
    - the resistance to the specific hazards;
    - the comfort and ease of use; and
    - how quickly the clothing can be removed in an emergency

- **Respiratory Protection** – In situations where the laboratory fume hood or local exhaust does not adequately prevent inhalation exposure, respirators may be necessary. Use of respirators requires medical clearance, annual training, and an annual fit test. If you believe a respirator may be necessary, contact EHSRM at 512-245-3616. More information about the Respiratory Protection Program can be found in the Lab Safety Manual.

- **Hearing Protection** – If occupational noise exposures exceed permissible levels and cannot be reduced through engineering or other controls, then hearing protective devices such as earplugs, or earmuffs must be worn. For more information see EHSRM's Hearing Conservation Program.

PHYSICAL AND CHEMICAL HAZARDS

Information about general classes of chemical hazards can be found below. The information is meant to be a guide for PI's in assessing risks as well as proper handling and storage.

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. See Chapter 4, Chemical Hazard Information and Training, for more information on chemical labeling. In addition to specific chemical labels, hazard information for specific chemicals can be found by referencing the Safety Data Sheet (SDS) for that chemical.

It is essential that all laboratory personnel 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 produced in labs 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 protection equipment.

Flammability Hazards

Flammable and combustible liquids are one of the most common types of chemicals used at Texas State University and are an important component in a number of laboratory processes. While common, it is important to remember that these materials can constitute a significant immediate threat and should be treated with particular care.

Flammable liquids include those chemicals that have a flashpoint of less than 100 degrees Fahrenheit.

- Flammable liquids that are not in active use should be stored inside fire resistant flammable storage cabinets or safety cans.
- Minimize the amount of flammable liquids stored in the lab. As a general rule, do not store more than 10 gal/100sqft outside of flammable storage cabinets. For additional details, refer to Appendix H, Allowable Quantities of Flammable and Combustible Liquids.
- 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.).
- Always keep flammable liquids stored away from oxidizers and away from heat or ignition sources such as vacuum pumps, radiators, electric power panels, etc.
- When using flammable liquids, keep containers away from open flames; it is best to use heating sources such as steam baths, water baths, oil baths, and heating mantels. Never use a heat gun to heat a flammable liquid.
- Any areas using flammables should have a fire extinguisher present. If a fire extinguisher is not present, then contact EHSRM at 512-245-3616.

- When pouring flammable liquids, it is possible to generate enough static electricity to cause the flammable liquid to ignite. If possible, make sure both containers are electrically interconnected to each other by bonding the containers, and connecting to a ground.
- Always clean up any spills of flammable liquids promptly. Be aware that flammable vapors are usually heavier than air (vapor density > 1). For those chemicals with vapor densities heavier than air (applies to most chemicals), it is possible for the vapors to travel along floors and, if an ignition source is present, result in a flashback fire.

Oxidizer Hazards

The OSHA Laboratory Standard defines an oxidizer as "a chemical other than a blasting agent or explosive that initiates or promotes combustion in other materials, thereby causing fire either of itself or through the release of oxygen or other gases." Oxidizers are a concern for laboratory safety due to their ability to promote and enhance the potential for fires in labs. Common examples of oxidizers are bromine, hypochlorites, permanganates, nitric acid, and peroxides.

- As with any chemicals, but particularly with oxidizers, quantities stored on hand should be kept to a minimum.
- Whenever planning an experiment, be sure to read the SDS and other reference documents to understand the hazards and special handling precautions that may be required, including use of a safety shield.
- Be aware of the melting and auto-ignition temperatures for these compounds and ensure any device used to heat oxidizers has an over-temperature safety switch to prevent the compounds from overheating.
- Laboratory staff should be particularly careful when handling oxidizers (especially high surface area oxidizers such as finely divided powders) around organic materials.
- Store oxidizers away from flammables, organic compounds and combustible materials.
- Avoid using metal objects when stirring or removing oxidizers from chemical containers. Plastic or ceramic implements should be used instead.
- Laboratory personnel should avoid friction, grinding, and impact with solid oxidizers.
- Reaction vessels containing oxidizing material should be heated in a mantle or sand bath. Oil baths should not be used.
- Glass stoppers and screw cap lids should always be avoided and plastic or polyethylene lined bottles and caps should be used instead.

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.

- Water Reactive Materials –
  When water reactive materials come in contact with water, one or more of the following can occur: liberation of heat which may cause ignition of the chemical itself if it is flammable, or ignition of flammables that are stored nearby; release of a flammable, toxic, or strong oxidizing gas; release of metal oxide fumes; and formation of corrosive acids. Common examples include sodium metal and potassium metal.

  Water reactive chemicals can be particularly hazardous because water is the most commonly used fire extinguishing medium. Attempting to put out a fire involving water-reactive materials with water will only make the situation worse. Special "Class D" fire extinguishers are required for use with water-reactive compounds. To obtain a Class D fire extinguisher, contact the EHSRM office at 512-245-3616.

- Pyrophorics -
  Pyrophoric materials can ignite spontaneously in the presence of air. Examples of pyrophoric materials: Tert-butyllithium, White Phosphorus, Diethylzinc, Triethylaluminum, and several organometallic compounds

  In the event of an accident, such as a bottle being knocked off a shelf, the chemical can spontaneously ignite and a fire can occur. Extra care must be taken when handling spontaneously combustible chemicals. When transporting these chemicals, it is best to use a bottle carrier and carts. Flame-resistant laboratory coats must always be worn when working with pyrophoric chemicals.

- Peroxide-Forming Chemicals -
  Peroxides are very unstable and some chemicals that can form them are commonly used in laboratories. This makes peroxide-forming materials some of the most hazardous substances found in a lab. Peroxide-forming materials are chemicals that react with air, moisture, or impurities to form peroxides. The tendency to form peroxides by most of these materials is greatly increased by evaporation or distillation.

  Organic peroxides are extremely sensitive to shock, sparks, heat, friction, impact, and light. Many peroxides formed from materials used in laboratories are more shock sensitive than TNT. Just the friction from unscrewing the cap of a container of ether that has peroxides in it can provide enough energy to cause a severe explosion.

Below is a list of the most common examples of peroxide-forming materials (the italicized group is the more hazardous). A more complete list may be found in Apprendix F:

Diisopropyl Ether	Divinylacetylene
Sodium Amide	Potassium Amide
Dioxane	Diethyl Ether
Tetrahydrofuran	Vinyl Ethers
Butadiene	Vinylpyridine
Acrylonitrile	Styrene

- Peroxide-forming materials must be dated with the date received and date opened.
- Certain peroxide-forming chemicals such as diisopropyl ether, divinyl acetylene, sodium amide, and vinylidene chloride must be properly disposed of if they are older than three months. Contact EHSRM for further instruction if you need to dispose of these substances.
- Chemicals such as dioxane, diethyl ether, and tetrahydrofuran must be properly disposed of after one year if opened or expired. Contact EHSRM for further instruction if you need to dispose of these substances.
- Store all peroxide-forming materials away from heat, light, and sources of ignition. Light accelerates the formation of peroxides.
- Do not open the chemical container if peroxide formation is suspected. The act of opening the container could be sufficient to cause a severe explosion. Visually inspect liquid peroxide-forming materials for crystals or unusual viscosity before opening. Pay special attention to the area around the cap. Peroxides usually form upon evaporation, so they will most likely be formed on the threads under the cap.
- If you suspect that peroxides may be present contact EHSRM. If you notice crystal formation in the container or around the cap, do not attempt to open or move the container. Call EHSRM for proper disposal.
- Never distill ether unless it is known to be free of peroxides.

Health Hazards

OSHA defines "health hazards" as 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" 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.

Symptoms of exposure for inhalation include a burning sensation, coughing, wheezing, laryngitis, shortness of breath, nausea, and vomiting. For eyes, symptoms include pain, blood shot eyes, tearing, and blurring of vision. For skin, symptoms may include reddening, pain, inflammation, bleeding, blistering and burns. As a physical hazard, corrosive substances may corrode materials they come in contact with and may be highly reactive with other substances. It is important to review information regarding the materials they may corrode, and their reactivity with other substances, as well as information on health effects. In most cases, these materials should be segregated from other chemicals and require secondary containment when in storage.

Irritants
Irritants are defined as non-corrosive chemicals that cause reversible inflammatory effects on living tissue by chemical action at the site of contact. 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 (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 – i.e., substances that produce liver damage, such as nitrosamines and carbon tetrachloride

- Nephrotoxins – i.e., agents causing damage to the kidneys, such as certain halogenated hydrocarbons
- Neurotoxins – i.e., 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 – e.g., carbon monoxide and cyanides which decrease hemoglobin function and deprive the body tissues of oxygen.
- Agents which damage lung tissue – e.g., 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.

Particularly Hazardous Substances (PHSs)

OSHA regulations require that provisions for additional employee protection be made for work with particularly hazardous substances (PHSs). These include carcinogens, reproductive toxins, and substances that have a high degree of acute toxicity.

- **Acute Toxins -** 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.
- **Reproductive Toxins -** These include any chemical that may affect the reproductive capabilities, including chromosomal damage (mutations) and effects on fetuses (teratogenesis).
    - Reproductive toxins can affect the reproductive health of both men and women if proper procedures and controls are not used. For women, exposure to reproductive toxins during pregnancy can cause adverse effects on the fetus; these effects include embryolethality (death of the fertilized egg, embryo or fetus), malformations (teratogenic effects), and postnatal functional defects. For men, exposure can lead to sterility.
    - Examples of embryotoxins include thalidomide and certain antibiotics such as tetracycline. Women of childbearing potential should note that embryotoxins have the greatest impact during the first trimester of pregnancy. Because a woman often does not know that she is pregnant during this period of high susceptibility, special caution is advised when working with all chemicals, especially those rapidly absorbed through the skin (e.g., formamide). Pregnant women and women intending to become pregnant should consult with their laboratory supervisor and EHSRM before working with substances that are suspected to be reproductive toxins.

- **Select carcinogens** - The Occupational Safety and Health Administration (OSHA) defines a "select carcinogen" as a substance that meets one of the following criteria:
    - regulated by OSHA as a carcinogen;
    - Is listed under the category "known to be a carcinogen" or "reasonably anticipated to be a carcinogen" in the Annual Report on Carcinogens published by the National Toxicology Program (NTP); or
    - Is listed under Group 1 ("carcinogenic to humans") or under Group 2A ('probably carcinogenic to humans") or 2B ("possibly carcinogenic to humans") by the International Agency for Research on Cancer (IARC).

A list of Particularly Hazardous Substances (PHSs) which includes known Select Carcinogens, Reproductive Toxins, and Acute Toxins can be found in Appendix G.

Nanomaterials

The increasing use of nanomaterials in research labs warrants consideration of the hazards they may pose. As is the case with many new technologies, the health effects of nanomaterials have not been thoroughly investigated. Consequently, the uncertainty surrounding the toxicity of nanomaterials merits a cautious approach when working with them.

Nanomaterials include any materials or particles that have an external dimension in the nanoscale (~1 – 100 nm). Nanomaterials are both naturally occurring in the environment and intentionally produced. Intentionally produced nanomaterials are referred to as Engineered Nanomaterials (ENMs). Materials whose properties do not differ significantly between their nanoscale and larger forms are generally excluded from ENMs.

The most common types of ENMs are carbon based materials such as nanotubes, metals and metal oxides such as silver and zinc oxide, and quantum dots made of compounds such as zinc selenide.

Nanomaterials can be categorized by the potential risk of exposure they pose to personnel based on the physical state of the materials and the conditions in which they are used. In general, the risk of exposure is lowest when nanomaterials are bound in a solid matrix with little potential to create airborne dust or when in a non-volatile liquid suspension. The risk of exposure increases when nanomaterials are used as fine powders or are suspended in volatile solvents or gases. The parent compound of the nanomaterial should also be taken into consideration when evaluating the potential hazards associated with exposure (e.g., a highly toxic compound such as cadmium should be anticipated to be at least as toxic and possibly more toxic when used as a nanomaterial).

- Whenever possible, select less hazardous forms, such as engineering nanomaterials bound in a substrate or matrix or in a water-based liquid suspension gel.

- Always minimize airborne releases of nanomaterials by utilizing appropriate engineering controls such as glove boxes or other fully-enclosed systems.
- Whenever possible, nanomaterials should be worked with in solutions or attached to substrates so that dry material is not released.
- Line work area with absorbant pad. When working with powders, use antistatic paper and floor sticky mats. Wet wipe and/or HEPA-vacuum work surfaces potentially contaminated with nanoparticles at the end of each operation. Dispose of contaminated wipes and HEPA filters in a sealed container for hazardous waste disposal.

Compressed Gases

The presence of compressed gases creates physical and/or health hazards in the laboratory and therefore require safety control measures to ensure safe use. The large amount of pressure contained makes gas cylinders a potential rocket or bomb if the cylinder or valve fails. Users should refer to the appropriate Safety Data Sheet (SDS) for specific chemical hazard information of the gases in their lab and develop SOPs as appropriate. For more detailed information about compressed gases, refer to the Lab Safety Manual.

In general, the following safety measures should be taken when working with compressed gas cylinders:

- Secure all cylinders in racks, holders, or clamping devices. Fasten cylinders individually (not ganged) in a well-ventilated area.
- Do not rely on color to identify container contents. Check the label.
- Close valves, and release pressure on the regulators when cylinders are not in use.
- Minimize the number of hazardous gas cylinders in a laboratory.
- Store separately:
    - Full away from empty cylinders. (Label as full or empty.)
    - Oxidizing gases (such as oxygen) away from flammable gases.
- Keep heat, sparks, flames, and electrical circuits away from gas cylinders.
- Post storage area for flammable gases or oxygen with "No Smoking" and "No Open Flames" signs.
- Do not store gas cylinders in hallways or public areas.
- Never move a gas cylinder unless the cylinder cap is in place and the cylinder is chained or otherwise secured to a cart. Use a helper if possible.
- Only use regulators approved for the type of gas in the cylinder.
- Do not use adapters to interchange regulators.
- When opening a cylinder valve, direct the cylinder opening away from people, and open the valve slowly.
- For flammable gases, use a flashback arrestor between regulator and hose. (Prevents flame from entering cylinder.)
- Consider a ventilated gas cabinet or chemical fume hood for flammable or irritating gases, depending on quantities used.
- Return cylinders and unused gas to vendor. If vendor cannot be determined, contact EHSRM.

Drug Enforcement Agency (DEA) Scheduled Drugs

Due to their abuse potential, items identified by Drug Enforcement Administration (DEA) as controlled substances are subject to licensing, registration, storage, security, use, and disposal requirements.

Controlled substances are materials containing any quantity of a substance with a stimulant, depressant, or hallucinogenic effect on the higher functions of the central nervous system, and having the tendency to promote abuse or physiological or psychological dependence, as designated in state and federal controlled substance schedules. A list of DEA controlled substances is available on the EHSRM website.

Principal Investigators (PIs) using controlled substances in their laboratory research (including animal research) are subject to federal regulatory requirements. The University cannot, by law, maintain a campus-wide registration for controlled substances. It is therefore the responsibility of each PI to obtain appropriate licenses and registration and to adhere to applicable regulatory requirements when working with controlled substances. PI's must register their controlled substances with the DEA. Penalties for using such drugs in research without proper registration can be severe.

Copies of all registration and licensing related correspondence must be kept by the PI with additional copies sent to EHSRM.

To dispose of unwanted or expired controlled substances, contact EHSRM for further direction. Sewer disposal is not an acceptable method of disposal.

Thefts, suspected thefts, unauthorized uses, or other losses of any controlled substance must be reported to the University Police Department (UPD) and EHSRM upon discovery. Registrants must also document the incident to the federal DEA.

EMERGENCY AND SPILL RESPONSE PROCEDURES

Safety Showers, and Eyewashes

All laboratories using hazardous chemicals, particularly corrosive chemicals, must have access to an eyewash and/or an emergency shower as per the OSHA standard 29 CFR 1910.151 – Medical Services and First Aid. The ANSI Standard Z358.1-2009 - Emergency Eyewash and Shower Equipment provides additional guidance by stating that emergency eyewash and/or emergency showers be:

- Installed on same level as chemical hazards (i.e. access to units should not require going up or down stairs or ramps).
- Within 10 seconds walking time from chemical hazards (approximately 55ft).
- Path to the units should not be obstructed.

The ANSI Standard states that plumbed emergency eyewash and safety showers should be operated **weekly** for 3-5 minutes to verify proper operation and inspected semi-annually. Weekly flushing ensures the units are operating properly, helps to keep the units free of clutter, and helps prevent the growth of bacteria within the plumbing lines, which can cause eye infections. It is recommended to allow the water to run for at least 3 minutes. EHSRM strongly encourages laboratories to post an "**Eyewash Testing Sheet**" near the eyewash to document that weekly flushing is occurring. The testing sheet can be found in Appendix J

Laboratories are responsible for activating eyewashes in their spaces and ensuring that access to emergency eyewashes and showers are kept free of clutter and ensuring the eyewash nozzle dust covers are kept in place. If nozzle dust covers are not kept on the eyewash nozzles, dust or other particles can clog the nozzles and effect water flow. This could result in dust or other particles being forced into the eyes when the eyewash is used.

Contact your department administrator to submit a work order to Facilities Operations if your safety shower or eyewash has not been inspected or if you any questions concerning the requirements for eyewashes and safety showers.

Report any malfunctioning eyewashes and emergency showers to your building's Safety Coordinator to have the unit repaired. If either the emergency shower or eyewash is not working properly, post a "Do Not Use" sign on the unit to alert others.

EHSRM performs monthly inspections of eyewashes and annual inspections of emergency showers. EHSRM will inspect units for the following:

- The water flow for proper quantity, spray pattern, and water quality.
- Ensure the unit is the proper height from the floor.
- Ensure the unit is not obstructed.

- Ensure valves are working properly.
- Ensure signs are posted.
- Ensure the unit is free of corrosion.

Those working in laboratories must be instructed in the location and proper use of eyewashes and safety showers. Other equipment such as a drench hoses may support but not replace approved eyewashes and showers.

In the event of a chemical spill or splash in the eyes or on the body, follow these procedures:

Use of Eyewashes

- If you get a chemical in your eyes, call for help from other workers in the lab.
- Immediately go to the nearest eyewash and push the activation handle all the way on.
- Put your eyes or other exposed area in the stream of water and begin flushing.
- Hold open your eyelids with your fingers and roll your eyeballs around to get maximum irrigation of the eyes.
- Keep flushing for at least 15 minutes or until help arrives.
- Seek medical attention / call 911.
- Complete a "Supervisor's Report of Incident, Injury, or Illness" and submit to EHSRM within 24 hours of the incident.

If a coworker gets a chemical in their eyes, assist them to the eyewash and activate the eyewash. Help them get started flushing their eyes using the procedures listed above and seek medical help / call 911. After calling for medical help, go back to assist the person using the eyewash and continue flushing for 15 minutes.

Use of Emergency Showers

- If you splash a chemical on your body, call for help from other workers in the lab.
- Immediately go to the nearest emergency shower and pull the activation handle.
- Once under the stream of water, begin removing your clothing to wash off all chemicals.
- Keep flushing for at least 15 minutes or until help arrives.

- Seek medical attention / call 911.

- Complete a "Supervisor's Report of Incident, Injury, or Illness" and submit to EHSRM within 24 hours of the incident

If a coworker in the lab needs to use an emergency shower (and it is safe for you to do so), assist them to the emergency shower, activate the shower for them, and help them get started flushing using the procedures listed above and then call **911**. After calling 911, go back to assist the person and continue flushing for 15 minutes or until help arrives.

NOTE: Although an emergency is no time for modesty, if a person is too modest and reluctant to use the emergency shower, you can assist them by using a lab coat or other piece of clothing or barrier while they undress under the shower. If you are assisting someone else, you should wear gloves to avoid contaminating yourself. When using an emergency shower or eyewash, do not be concerned about the damage from flooding. The important thing to remember is to keep flushing for 15 minutes. If there is a large quantity of chemical spilled or washed off, please contact EHSRM at 512-245-3616 (after hours 512-738-6650) to see if the rinsate needs to be collected as hazardous waste.

Fire Hazards

Laboratory personnel shall not attempt to extinguish large fires (larger than a small trash can). The following steps should be taken:

- Confine the fire by closing the vent hood sash or laboratory doors and fire doors as appropriate.
- Immediately evacuate the fire area, pull building alarms, and dial 911 once outside the building.

Beginning stage fires may be extinguished by designated laboratory personnel trained in the use of portable fire extinguishers. Contact EHSRM at 245-3616 to request fire extinguisher training. Ideally, at least two people should be available when the fire is extinguished. The following steps should be taken:

- Alert other personnel and have them dial 911.
- Extinguish the fire by using the P.A.S.S. system.
    - **P**: **Pull the pin** that is located on the top of the fire extinguisher. Pulling the pin releases the fire extinguisher's locking mechanism.
    - **A**: **Aim** the fire extinguisher at the base of the fire.
    - **S**: **Squeeze the lever** to release the extinguishing agent in a controlled manner. To stop the discharge, let go of the lever. Remember that the extinguisher only holds a limited amount of extinguishing agent.
    - **S**: **Sweep** the fire extinguisher back and forth across the base of the fire until it has been completely extinguished., and as the fire begins to recede, more forward
- If the fire cannot be controlled, evacuate the area.

Chemical Spills

With proper training and preparation laboratory personnel can safely and effectively handle the majority of chemical spills that occur in the laboratory. Due to the hazardous properties of certain chemicals, the size of the spill or the likelihood that a spill might become an emergency, assistance from EHSRM or UPD (university police) may be necessary. Proper training and planning includes:

- Be sure that EHSRM's emergency contact sign (Appendix K) is posted in the lab. Post numbers of laboratory PI and laboratory workers.
- Make sure lab personnel are trained and understand the chemical spill response procedures.
- Review the spill kit provided by EHSRM and tailor it to clean up small spills of chemicals commonly used in your lab.
- Keep spill kit fully stocked and easily accessible.
- Train personnel how to use the spill kit and when it is safe to clean up a spill.
- Make sure everyone working in the lab knows:
    - Locations of fire alarm pull stations, eye washes, showers, and telephones.
    - Locations of fire extinguishers and how to operate a fire extinguisher and when it is appropriate to do so.

When a chemical spill occurs, it is necessary to take prompt and appropriate action. The first action to take is to determine if the spill is a minor or major spill:

- **Minor Spill** – small quantity spill (<5 gallons/≈20L) which does not spread rapidly; it has low health and safety risk to people; it does not endanger property or the environment.

- **Major Spill –** Large quantity spill (>5 gallons/≈20L) which spreads rapidly, and/or poses safety and health hazards for people, property or environment (such as fire, explosion, or is toxic, corrosive, oxidizer) or is an unidentified chemical**.**

When considering cleaning up a **minor spill**:

- Alert people in the lab that a spill has occurred.
- Evaluate the spill and decide if it can be handled by lab personnel.
- Put on the Proper Personal Protective Equipment (PPE) such as goggles, gloves, etc. before beginning cleanup.
- Confine the spill to a small area. Use absorbent material from your spill kit to absorb spilled materials.
- Place the saturated absorbent in a chemical waste bag.
- Place all cleaning materials into the chemical waste bag in the spill kit and seal it.
- Label the bag with a hazardous waste label and include it in the next hazardous waste collection by EHSRM staff.
- Clean the spill area with water.
- Replenish your spill kit supplies, if kit is maintained by EHSRM call 245-3616 to have kit resupplied.
- Report the spill to the laboratory PI.

When a **major spill** has occurred:

- Alert people in the area and evacuate, closing all doors. If the building needs to be evacuated, pull the fire alarm.
- Identify the spilled material if you can do so safely.
- If the spill involves a flammable liquid, turn off all ignition sources if you can do so safely.
- Once evacuated isolate any contaminated persons and protect yourself and others from chemical exposure.
- Call UPD (university police) at 911 and EHSRM at 245-3616 (512-738-6650 after hours) provide the following information:
    - Where the spill occurred (building and room number).
    - If there are there any injuries and if medical attention is needed.
    - The identity of the spilled material(s) - be prepared to spell out the chemical names.
    - The approximate amount of material spilled.
    - How the spill occurred (if you know).
    - Any immediate actions taken.
    - Who first observed the spill and the approximate time it occurred.
    - Where you will meet emergency responders, or provide a call back number (if available).
- Keep people away from the spill area until qualified spill responders arrive.
- Have someone available who is knowledgeable about the spilled material to provide information to the spill responders.

Following notification to 911, all major spills, or spills involving chemical exposure should be reported to the EHSRM by telephone at 245-3616 (or 512-738-6650 after hours). This is important to ensure that you have not been exposed or injured and that the spill is reported to the appropriate regulatory agencies. The spill reports are also used to develop practices to reduce the likelihood of future spills.

Minor spills which are handled quickly are considered near miss accidents and may be an indication of potential for more significant incidents. You are encouraged to report these minor spills to EHSRM. Doing so will provide information regarding trends in the laboratory and where remedial actions should be taken. Such actions include modification of work practices, additional training on chemical handling and storage, and spill response.

CHEMICAL STORAGE, TRANSPORT, AND DISPOSAL

There are established regulations as well as recommended practices for proper storage of chemicals. Proper storage of chemicals results in safer and healthier working conditions, extends the usefulness of chemicals, and can help prevent contamination. Chemical storage areas include, but are not limited to, central stockrooms, laboratory work areas, storage cabinets, refrigerators, and freezers.

Chemical Compatibility and Safe Storage

Laboratories should adhere to the following storage guidelines for the proper and safe storage of chemicals. By implementing these guidelines, laboratories can ensure safer storage of chemicals and enhance the general housekeeping and organization of the lab. Proper storage of chemicals also helps utilize limited laboratory space in a more efficient manner.

- Always segregate and store chemicals according to compatibility and hazard classes. See Appendix I for recommendations.

- Flammable liquids in excess of quantities for specific flammability classes must be stored in approved flammable liquid storage cabinets. See Appendix H, Allowable Quantities of Flammable and Combustible Liquids for further information.

- Do not store acids in flammable liquid storage cabinets. The exceptions are: organic acids, such as Acetic acid, Lactic acid, and Formic acid, which are considered flammable/combustible and corrosive and can be stored in flammable or corrosive storage cabinets.

- Do not store flammable liquids in standard refrigerators or freezers. Due to the potential explosion hazard, only store flammables in units approved by the manufacturer for storage of flammables.

- All chemical containers must be labeled. Labels should include the name of the chemical and the hazards the chemical presents to the user.

- Be sure to check chemical containers regularly and replace any labels that are deteriorating or falling off and/or relabel with another label before the chemical becomes an unknown.

- Keep all containers of chemicals closed when not in use.

- Every chemical should have an identifiable storage place and should be returned to that location after use.

- The storage of chemicals on bench tops should be kept to a minimum to prevent clutter and possible spills

- Chemical storage in fume hoods should be kept to a minimum. Excess storage in hoods can interfere with airflow, reduce working space, and increase the risk of a spill, fire, or explosion.

- Chemicals should not be stored on the floor due to the potential for spills. If it is necessary to store bottles on the floor, then the bottles should be placed in secondary containment away from aisle spaces.

- For multiples bottles of the same chemical, older containers should be stored in front of newer containers and containers with the least amount of chemical should be stored in front of full containers. This allows for older chemicals to get used up first and helps to minimize the number of chemical containers in the storage area.

- Do not store chemicals in direct sunlight or next to heat sources.

- Laboratories should keep only the minimum quantity of chemicals necessary..

- Liquid chemical containers should be stored in secondary containment, such as trays, to minimize the potential for bottle breakage and minimize the potential for spills.

- Chemical containers should be dated when they arrive and should be checked regularly and disposed of when they get past their expiration date. **Please Note:** Due to the potential explosion hazard, peroxide forming chemicals are required to have a received and opened date (see Section 3.2 for detailed information).

- No chemicals should be stored above eye level.

Chemical Retention

Prudent chemical retention and storage practices are vital to maintain a safe laboratory working environment and to minimize the financial costs and environmental impact associated with the handling and disposal of unwanted chemicals. Because chemical purity can be affected by factors such as temperature, light, exposure to air, and other substances, lab personnel and PIs should follow the general guidelines set by chemical suppliers.

Chemicals with an expiration date that has been exceeded should be properly disposed through the EHSRM Hazardous Waste Program. Some chemicals retained past the expiration date can become unstable or may form explosive compounds (peroxides) over time. **EHSRM requires that certain chemicals which are known to degrade or form peroxides must be used or properly disposed of by their expiration date**. See Physical and Chemical Hazards, and Appendix F for more detailed information on handling and disposing of peroxide forming materials. Contact EHSRM if you have peroxide-forming chemicals which have exceeded the expiration date or designated shelf-life. Do not attempt to handle or open suspect containers.

Although not recommended, should you decide to retain chemicals with an "indefinite shelf life", you should ask yourself:

- Do I trust the purity of the chemical(s) to not skew my research results?
- Do I really need that chemical(s)?
- How much space am I giving up to store that chemical(s).

Transporting Chemicals

When moving chemicals from room to room in your building:

- Take precautions to avoid dropping or spilling chemicals.
- Make sure that chemical containers are sealed during transport and that incompatible chemicals are placed in secondary containment away from one another.
- Carry breakable containers in specially-designed bottle carriers or leak-resistant, unbreakable secondary containers.
- When transporting chemicals on a cart, use a cart that is suitable for the load and one that has high edges to contain leaks or spills. The cart should be capable of negotiating uneven surfaces without tipping the chemical container or the cart.
- Transport chemicals by traveling least-trafficked routes. When possible, use freight elevators.
- Gas cylinders must be strapped to a hand truck specifically designed for that purpose. Cylinder cover caps must be in place.

If transporting large amounts of chemicals for a laboratory move, (or any amount of chemicals on a public road), contact the EHSRM Office at 512-245-3616 for consultation on safe packaging and compliance with federal, state, and local laws.

Shipping of chemicals must be done in compliance with all applicable federal, state, and local laws. Contact the EHSRM Office at 512-245-3616 for consultation on safe packaging and compliance with these laws.

Hazardous Waste Disposal

Hazardous waste can pose a threat to students, employees, visitors and the environment if managed improperly. To minimize the possibility of such threats, appropriate practices and procedures are required. EHSRM has primary responsibility for the overall management of the university's hazardous waste program; however, each PI or Lab Manager is responsible for proper management of hazardous waste within their labs. All lab personnel must comply with the campus Hazardous Waste Management Program requirements found in UPPS 04.05.15 and all applicable state and federal regulations.

Texas State University is registered with the TCEQ and the EPA as a Large Quantity Generator of hazardous waste and therefore, strict regulations apply. Compliance with these regulations requires partnership and cooperation from all departments involved in the generation and storage of waste on campus.

The Resource Conservation and Recovery Act (RCRA) requires "cradle-to-grave" tracking and management of hazardous waste, meaning waste must be properly tracked and managed from the point of generation, through transportation, storage, treatment, and final disposal.

Anyone or any facility that generates, treats, stores or disposes of hazardous waste must comply with RCRA and the corresponding state regulations [30 TAC Chapter 335] .

Waste Determination

Laboratories that generate chemical waste or chemically contaminated lab debris must accurately identify the contents of the waste container on the hazardous waste label. This information is crucial and is required for EHSRM to properly classify the waste stream for proper disposal.

Additional information on identifying hazardous waste and proper disposal of chemical wastes in the lab can be found in the Hazardous Waste Management Program Manual.

Storing Hazardous Waste

All chemical wastes that are generated as a result of lab processes or unwanted chemicals are considered hazardous wastes by the University and must be stored in the Satellite Accumulation Area (SAA) within the laboratory.

PIs or their designee must ensure that the SAA is properly managed in accordance with federal and state regulations. All lab personnel who work in labs where hazardous wastes are generated must take the Hazardous Waste training.

All SAA's must be audited by the PI or Lab Manager weekly to ensure the following requirements are met:

- All **containers must be closed** except when waste is actively being added. Caps must be screwed on. If you are concerned about vapor build-up in your container, please contact EHSRM to discuss options.

- Waste **containers must be compatible** with the contents. EHSRM provides 5-gallon carboys and 30-gallon bung top drums for liquid wastes and DOT approved 5-gallon buckets and open-top drums for solid wastes. Chemical-contaminated sharps boxes are also available.
- All **wastes must be labeled** with the Texas State Hazardous Waste label. The contents of the container must be filled out as soon as a waste is added to the container.
- **Do not accumulate more than 55-gallons** of waste in your SAA. Contact EHSRM for pick up well before this volume is reached.
- Liquid wastes must be **stored in secondary containment** and incompatible wastes should be stored in separate secondary containment devices.
- Always ensure that you leave at least 3 – 4 inches of head space in the waste container.

PI's are responsible for requesting a waste pick up when their waste containers are approaching the fill line. Please contact EHSRM at 512-245-3616 to request a pick up or fill out the on-line request form.

Drain Disposal

Texas State University 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 EHSRM. This applies to weak acid and base solutions with no other contaminates. Contact EHSRM for specific questions about drain disposal variances.

Waste Minimization Principles

The Waste Reduction Policy Act (WRPA) requires large quantity generators to prepare and submit a Pollution Prevention Plan (P2 Plan) every 5 years. The purpose of the P2 Plan is to develop goals and projects to reduce the amount of hazardous waste generated each year.

At Texas State, one major component of our P2 Plan is abiding by waste minimization principles by stopping waste before it can be generated. For laboratories, this can be accomplished by purchasing only the chemicals you need. The same practice should be also applied to solutions that are created in the lab. Refrain from accepting chemicals from other laboratories simply because they are offered.

All TSU laboratories should follow the American Chemical Society's guidance document Less is Better, which outlines strategies for waste reduction and the benefits of a waste minimization program.

EXPOSURE MONITORING AND MEDICAL CONSULTATIONS

Lab personnel are eligible for medical surveillance and consultation if they perform work-related tasks that might be reasonably anticipated to cause occupational exposure to a potential hazard. The program does not include pre- employment medical examinations.

Medical examinations and consultation shall be performed by or under the direct supervision of a licensed physician, at a reasonable time and place without cost or loss of pay to the employee. It is the responsibility of the affected Department or PI to contact the EHSRM Office to arrange for such care.

An opportunity to receive medical attention, including any follow-up examinations which the examining physician determines to be necessary, shall be provided to employees under the following circumstances:

- When an employee develops signs or symptoms associated with occupational exposure to a hazardous chemical;
- When air sampling reveals exposure levels routinely above the action level, or in its absence the PEL for an OSHA regulated substance. Medical surveillance shall comply with the requirements of that particular standard;
- Medical consultation shall be provided whenever an abnormal event such as a spill, leak or explosion takes place in the laboratory. Its purpose shall be to determine whether subsequent medical examination is necessary.

Incident/Accident Notification Investigation

Supervisors should ensure that a Supervisors Report of Incident/Injury/Illness is completed within 24 hours for all work-related injuries or illnesses involving activities for which campus persons are paid. These reports should be completed and e-mailed or delivered to the EHSRM Workers Compensation Specialist regardless of where or whether the person received medical follow-up.

As a state employee Texas State University employees are covered through the State Office of Risk Management's Workers' Compensation Program who serves as the state's insurance carrier. The Workers' Compensation Act covers on-the-job injuries that occur in the course and scope of employment and that result in damage or harm to the body. It also covers occupational diseases directly caused by exposure in the workplace. The Worker's Compensation Program pays for medical treatment and lost wages for employees who are injured or become ill as a result of their work. If you have an injury on the job, notify your supervisor and claims coordinator immediately. Supervisors are responsible of completing a Supervisor's Report of Incident, Injury, or Illness Form within 24 hours of date of injury. The report must be signed by the supervisor and sent to the EHSRM Worker's Compensation Specialist who is responsible of submittal of claim (within 3 days) for university compliance. The injured employee must obtain clearance through the EHSRM Worker's Compensation Specialist to return to work.

Laboratory Chemical Hygiene Plan

For

[*Insert name of research group for which the plan is applicable*]

Certification and Annual Review and Updates

By signing and dating here, the Principal Investigator certifies that this Laboratory-Specific Chemical Hygiene Plan is accurate and that it effectively provides for the chemical safety of employees and students in this laboratory.

Principal Investigator:

Signature Printed Name Date

Laboratory Safety Officer (if other than PI):

Signature Printed Name Date

By signing and dating here, the Laboratory Principal Investigator certifies that the required annual review (and update, if needed) of the Laboratory-Specific Chemical Hygiene Documentation has been completed, and that this document continues to be accurate and to effectively provide for the chemical safety of employees in this laboratory.

Reviewed by:		Review Date:	
Reviewed by:		Review Date:	
Reviewed by:		Review Date:	

Table of Contents

Section 1: Personnel

Safety Personnel

List the names of key safety personnel. In addition to indicating the individual in charge of the laboratory (i.e. the P.I. or lab manager) and the Laboratory Safety Officer, the names of key staff such as building manager or other important individuals should be included.

Name	Position	Phone
	Principal Investigator	
	University Chemical Hygiene Officer	512-245-3616
UPD Dispatch	Emergency	911
UPD Dispatch	Non-Emergency	512-245-2805
EHSRM	After-Hours Spill Reporting	512-738-6650

Laboratory Staff/Students

List all individuals who work with hazardous chemicals in the labs and are therefore subject to this plan.

Name	Name	Name

Section 2: Laboratory Room Locations

List all rooms in which use of hazardous chemicals will occur:

Building	Rooms	Room Assigned to the PI (Y/N)	Shared Facility (Y/N)

Section 3: Laboratory-Specific Policies

Include below all laboratory-specific policies instituted by the Principal Investigator (e.g., lab coats must be worn in the lab at all time, no working alone, etc.). This space provides the opportunity to place in one location and document the lab's safety policies related to the use of hazardous chemicals.

Standard Operating Procedure

for work(*ing*) with *enter chemical name (with CAS#) or process.*

PI:	**Building(s):**
PI Signature:	**Room Number(s):**
Revision Date:	

Work involves a PHS?

☐ Carcinogen ☐ Reproductive Toxin ☐ High Acute Toxicity

☐ Air Reactive/Pyrophoric ☐ Water Reactive ☐ Explosive/Unstable

Prior Approval: This procedure is considered hazardous enough that prior approval is needed from the Principal Investigator: ☐ Y ☐ N

Designated Work Area:

1. Hazard Identification

a. Preparation and Use:

Note: If identified as a **process**, provide additional detailed procedural steps for the use of **each** hazardous chemical in **Section 5**, below.

b. Potential Hazards and Risk:

2. Hazard Control

a. **Selection and Purchasing:**

b. **Engineering Controls:**

☐ Fume hood ☐ Biosafety cabinet ☐ Glove box ☐ Vented gas cabinet
☐ Other (*include controls as pressure relief valves, intrinsically safe hot plates, auto shut-offs*):

c. **Administrative and Work Practice Controls** *List any specific work practices needed to perform this procedure (e.g., cannot be performed alone, must notify other staff members before beginning, etc.).***:**

d. **Personal Protective Equipment (PPE):**

☐ Safety Glasses ☐ Face shield ☐ Chemical Splash Goggles
☐ Chemical apron ☐ Gloves (type):
☐ Lab coat ☐ Respirator (type):
☐ Other:

e. **Storage and Transportation:**

3. **Emergencies, Spill Procedures, and Exposures/Unintended Contact**

4. **Waste**

5. **Details of Process**

Section 4: Laboratory SOPs – Task Table

Prepared By: | **Revision Date:**

*For many procedures a simple description of the tasks, the associated hazards, and the PPE required to mitigate risks is acceptable. This table is **not appropriate** for work involving Particularly Hazardous Substances or for use of chemicals that pose a high risk due to reactivity or other properties. This table is appropriate for describing safety requirements for miscellaneous tasks performed in a laboratory.*

Task	Hazard Description	Required PPE and Engineering Controls

Section 5: Orientation Checklist:

A checklist for all laboratory personnel listed in Section 1 must be filled out.

As part of my orientation with the laboratory operation I have read and am familiar with the contents (and location) of:

☐ The OSHA Laboratory Standard
☐ The Texas State *Laboratory Safety Manual*
☐ SDSs for lab chemicals
☐ The Texas State Campus CHP
☐ The Laboratory CHP

I have been instructed on:

☐ The chemical hazards in the lab
☐ Laboratory-specific policies
☐ The relevant exposure limits [PELs (OSHA), TLVs (ACGIH), etc.]
☐ The signs and symptoms associated with exposures to hazardous chemicals used in the lab
☐ The physical hazards of the laboratory (heat, electrical, mechanical, etc.)

I have reviewed the laboratories emergency procedures, including:

☐ Emergency phone numbers
☐ Evacuation routes
☐ Location and use of chemical spill kits
☐ Laboratory exhaust failure procedure
☐ Procedures for uncontrolled releases
☐ Safety equipment failure procedures

I have been shown the location of emergency equipment:

☐ Fire extinguishers
☐ Safety showers
☐ Eye wash stations
☐ First-aid supplies

I have been made familiar with routine operations of the laboratory, including:

☐ Lab cleaning and maintenance rules
☐ Proper use of PPE
☐ Chemical storage policies for the lab
☐ Waste handling procedures
☐ Chemical procurement practices
☐ The proper use of chemical fume hoods

In addition, I have been made familiar with the following lab-specific health and safety features and safety resources:

☐ _____ ☐ _____
☐ _____ ☐ _____
☐ _____ ☐ _____
☐ _____ ☐ _____

I have completed orientation of all the above items

Name: _____ Date: _____

Signature: _____

PI Signature: _____

Section 6: Laboratory Safety Training
Master List of Required Training

List the training required in order to work with hazardous chemicals in your laboratory. This list should include training provided by the university, outside sources, and hands-on training of tasks and procedures provided in-lab. It is understood that the training below does not apply to all students or staff but will be based on each individual's work assignments.

Training Title	Description/Purpose

Section 6: Laboratory Safety Training
Documentation of Training

Track required training using the table below. A separate sheet should be used for each training course and/or training session.

Title of Training:

Training Performed by:

Description of Training:

Name (print)	Signature	Date

Name (print)	Signature	Date

Section 7: Prior Approvals

This section of the lab-specific CHP allows the PI to document approval for individuals to perform specific Standard Operating Procedures (as indicated in the SOP description).

Standard Operating Procedure Title:

Name of Approved Individual	PI Authorization Signature	Date of Authorization

Section 8: SDSs and Inventory of Hazardous Chemicals

A number of regulations require that Safety Data Sheets (SDSs) be maintained and readily accessible for all hazardous chemicals. The Campus Chemical Hygiene Plan also requires that inventories be maintained for a certain categories of hazardous chemicals above specified amounts. Provide a description of where the SDSs are stored and how inventory records are maintained.

Safety Data Sheets

Location of SDSs:

Format of SDS (electronic, hard copy, etc):

Chemical Inventory

Method of Maintaining Inventory:

Location of Inventory Records:

Section 9: Exposure Monitoring Records

In rare instances it may be necessary to perform personnel exposure monitoring when working with a hazardous chemical. This can occur when chemical exposure levels approach or exceed the Permissible Exposure Limit (PEL) of OSHA and the Threshold Limit Value(TLV) of ACGIH (see Section 12 and Appendix A of the Campus CHP for details). Initial monitoring is required if there is reason to believe that the action level (or PEL if there is no applicable action level) for a substance is routinely exceeded. If the initial monitoring discloses employee exposure over the action level or PEL an exposure monitoring program may be initiated. Employees must be notified of the results within 15 working day after the receipt of the results by posting in an accessible location.

Describe any exposure monitoring requirements for laboratory operations:

Location of Exposure Monitoring Records:

Section 10: References

This section can be used to include chemical or laboratory safety information relevant to the operations of the laboratory. The references can either be appended to the end of this section or references can be cited below.

References:

Appendix B: Globally Harmonized System for Chemical Labeling and Hazard Classification (GHS)

The **Globally Harmonized System for Chemical Labeling** adopted by OSHA is a revision to the Hazard Communication Standard (HCS) which provides a consistent and understandable approach to classifying chemicals and communicating chemical hazard information on labels and Safety Data Sheets (SDSs). GHS safety labels have six elements:

1. **Product Identifier (chemical name)** – Should match the name on the Safety Data Sheet (SDS).

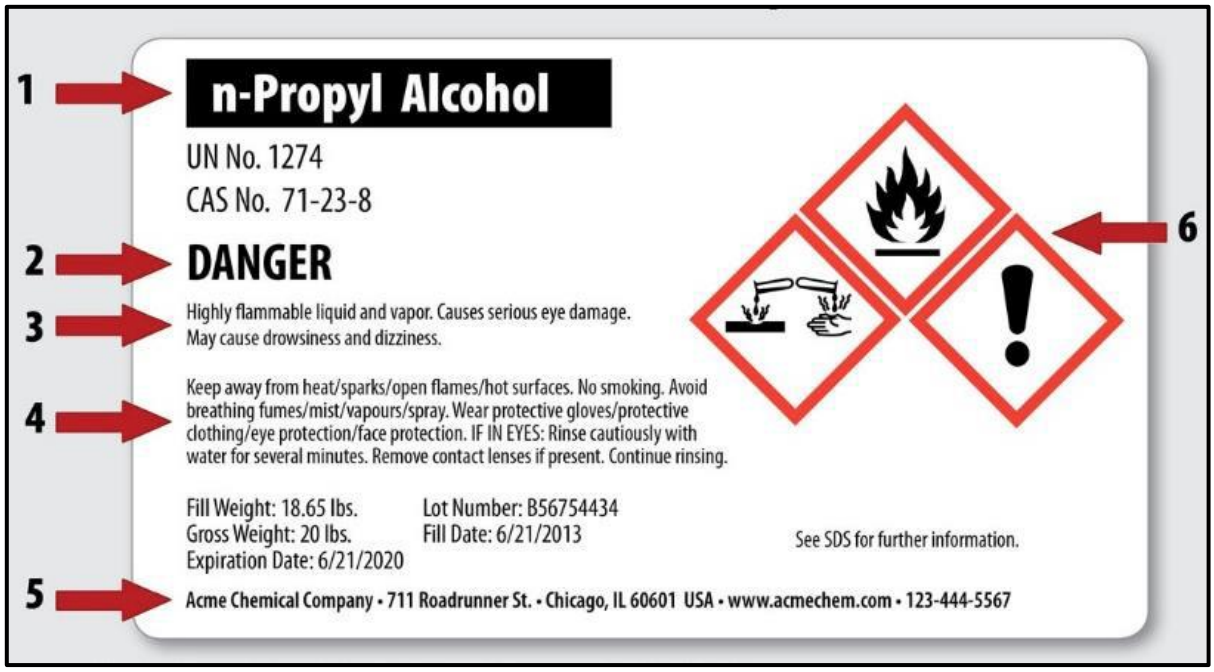
2. Signal Word – Can be either "Danger" (severe) or "Warning" (less severe).

3. Hazard Statements – A phrase(s) assigned to a hazard class that describes the products hazards.

4. Precautionary Statements – Describes recommended measures to minimize or prevent adverse effects resulting from exposure.

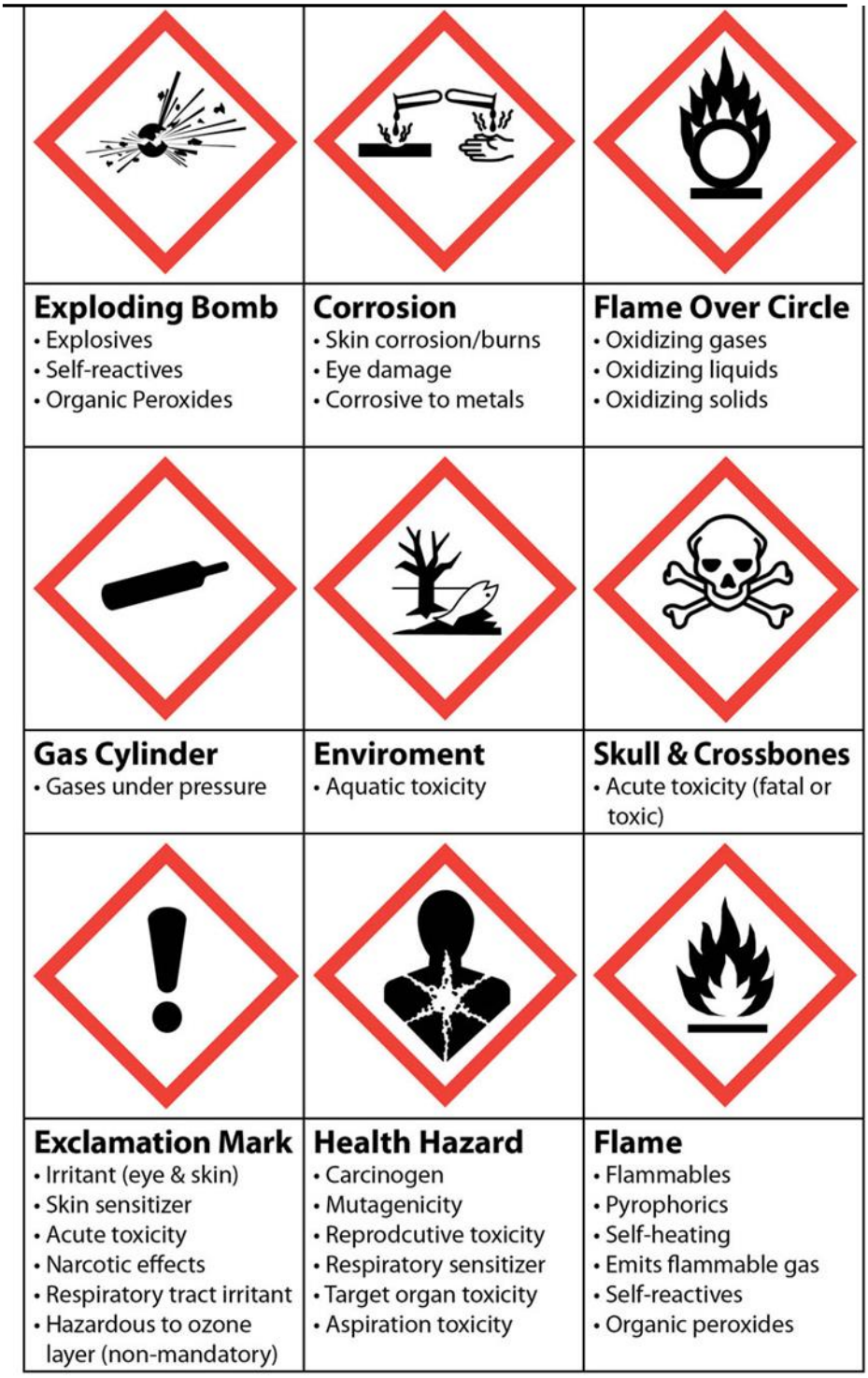
5. Supplier Information – the name, address, and telephone number of the manufacturer or supplier.

6. Pictograms – Symbols to convey specific hazard information.



To convey health, physical, and environmental hazard information, GHS uses nine pictograms which are composed of a red diamond border, a symbol in black, and a white background.

GHS Pictograms



Exploding Bomb	Corrosion	Flame Over Circle
• Explosives • Self-reactives • Organic Peroxides	• Skin corrosion/burns • Eye damage • Corrosive to metals	• Oxidizing gases • Oxidizing liquids • Oxidizing solids
Gas Cylinder	**Enviroment**	**Skull & Crossbones**
• Gases under pressure	• Aquatic toxicity	• Acute toxicity (fatal or toxic)
Exclamation Mark	**Health Hazard**	**Flame**
• Irritant (eye & skin) • Skin sensitizer • Acute toxicity • Narcotic effects • Respiratory tract irritant • Hazardous to ozone layer (non-mandatory)	• Carcinogen • Mutagenicity • Reprodcutive toxicity • Respiratory sensitizer • Target organ toxicity • Aspiration toxicity	• Flammables • Pyrophorics • Self-heating • Emits flammable gas • Self-reactives • Organic peroxides

GHS is similar to the National Fire Protection Association (NFPA) Fire Diamond fire diamond and the Hazardous Material Information System (HMIS) color bar in that numbers are used to categorize the severity of the hazard. **However**, unlike NFPA or HMIS, with GHS the lower the number the greater the severity of the hazard. In addition, the GHS numbers only appear on the

Safety Data Sheets (SDSs) whereas NFPA and HMIS numbers will be seen on the label of the container.

GHS Hazard Ranking	NFPA/HMIS Hazard Ranking
Category 1 = Extreme Hazard	0 = Minimal hazard
Category 2 = Serious Hazard	1 = Slight Hazard
Category 3 = Moderate Hazard	2 = Moderate Hazard
Category 4 = Slight Hazard	3 = Serious Hazard
Category 5 = Minimal Hazard	4 = Extreme Hazard

GHS has dropped the word "Material" from Material Safety Data Sheets (MSDS). They are now called Safety Data Sheets (SDS). MSDS may contain from 8 to 16 sections depending on the format in which it was written. SDSs will contain 16 sections. OSHA will not enforce sections 12-15 that require information outside OSHA's jurisdiction. The 16 sections are:

1. Identification
2. Hazard(s) identification
3. Composition/information on ingredients
4. First-aid measures
5. Fire-fighting measures
6. Accidental release measures
7. Handling and storage
8. Exposure control/personal protection
9. Physical and chemical properties
10. Stability and reactivity
11. Toxicological information
12. Ecological information
13. Disposal considerations
14. Transport information

15. Regulatory information
16. Other information

Appendix C: National Fire Protection Association (NFPA) Fire Diamond

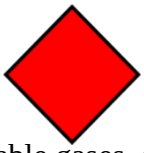
The **National Fire Protection Association (NFPA) Fire Diamond** is a hazard rating system that incorporates the use numbers, colors, and symbols as a compliance aid for OSHA's Hazard Communication Standard.

The is NFPA fire diamond is similar to the Hazardous Material Information System (HMIS) color bar. The NFPA fire diamond is designed for emergencies to quickly and easily identify the risks posed by hazardous materials. This helps determine what, if any, special equipment should be used, procedures followed, or precautions taken during the initial stages of an emergency response. The HMIS color bar is not for emergencies, but is used to convey broader health warning information.

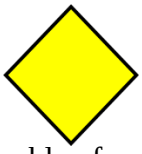
The four diamonds are color-coded: blue for health hazards, red for flammability, yellow for reactivity / instability, and white for special hazards. The number ratings range from 0-4. (0 = low hazard to 4 = extreme hazard)

Health 

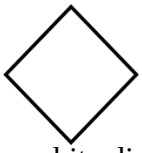
- **4.** Life-threatening, major or permanent damage may result from single or repeated overexposures.
- **3.** Major injury likely.
- **2.** Temporary or minor injury may occur.
- **1.** Irritation or minor reversible injury.
- **0.** No significant risk to health.

Flammability 

- **4.** Flammable gases, or very volatile flammable liquids with flash points below 73° F (23° C), and boiling points below 100° F (38° C). Materials may ignite spontaneously with air.
- **3.** Materials capable of ignition under almost all normal temperature conditions. Includes flammable liquids with flash points below 73° F (23° C) and boiling points above 100° F (38° C), as well as liquids with flash points between 73° F and 100° F.
- **2.** Materials which must be moderately heated or exposed to high ambient temperatures before ignition will occur. Includes liquids having a flash point at or above 100° F (38° C) but below 200° F (93° C).
- **1.** Materials that must be preheated before ignition will occur. Includes liquids, solids and semi solids having a flash point above 200° F (93° C).
- **0.** Materials that will not burn.

Reactivity / Instability Hazard 

- **4.** Materials that are readily capable of explosive water reaction, detonation or explosive decomposition, polymerization, or self-reaction at normal temperature and pressure.
- **3.** Capable of detonation or explosive decomposition but requires a strong initiating source, must be heated under confinement before initiation, reacts explosively with water, or will detonate if severely shocked.
- **2.** Undergoes violent chemical change at elevated temperatures and pressures, reacts violently with water, or may form explosive mixtures with water.
- **1.** Normally stable, but can become unstable at elevated temperatures and pressures.
- **0.** Normally stable, even under fire exposure conditions, and is not reactive with water.

Special Hazards 

Any symbol within the white diamond indicates any special hazards associated with a material. The following hazard codes are defined by the NFPA 704 standard:

- **OX** - Oxidizer, allows chemicals to burn without an air supply.
- **~~W~~** - Reacts with water in an unusual or dangerous manner.
- **SA** - Simple asphyxiant gas. Specifically limited to the following gases: nitrogen, helium, neon, argon, krypton and xenon.

The following five hazard codes are not part of the NFPA 704 standard, but may be encountered:

- **COR** Corrosive (can burn through things). Example: sulfuric acid.
- **BIO** or  - Biological hazard

- **POI** - Poisonous.
- **RA, RAD** or  - Radioactive.
- **CRY or CRYO** – Cryogenic.

Appendix D: Hazardous Materials Identification System (HMIS)

The **Hazardous Materials Identification System** (**HMIS**) is a hazard rating system that incorporates the use of labels, numbers, colors, and letter codes as a compliance aid for OSHA's Hazard Communication Standard.

The HMIS color bar is similar to the fire diamond created by the National Fire Protection Association (NFPA). The NFPA fire diamond is designed for emergencies when information about the effects of acute, exposure is needed. The HMIS color bar is not for emergencies but is used to convey broader health warning information.

The four bars are color-coded, using the modern color bar symbols with blue indicating the level of health hazard, red for flammability, orange for physical hazards, and white for Personal Protection. The number ratings range from 0-4. (0 = low hazard to 4 = high hazard)

Health 

The Health section conveys the health hazards of the material. The Health bar has two spaces, one for an asterisk and one for a numeric hazard rating. If present, the asterisk signifies a chronic health hazard (i.e. long-term exposure may cause a health problem).

- **4.** Life-threatening, major or permanent damage may result from single or repeated overexposures.
- **3.** Major injury likely.
- **2.** Temporary or minor injury may occur.
- **1.** Irritation or minor reversible injury possible.
- **0.** No significant risk to health.

Flammability 

Before 2002 the criteria used to assign numeric values to flammability were identical to those used by NFPA. After 2002 the flammability criteria are defined according to OSHA standards.

- **4.** Flammable gases, or very volatile flammable liquids with flash points below 73° F (23° C), and boiling points below 100° F (38° C). Materials may ignite spontaneously with air.
- **3.** Materials capable of ignition under almost all normal temperature conditions. Includes flammable liquids with flash points below 73° F (23° C) and boiling points above 100° F (38° C), as well as liquids with flash points between 73° F and 100° F.
- **2.** Materials which must be moderately heated or exposed to high ambient temperatures before ignition will occur. Includes liquids having a flash point at or above 100° F (38° C) but below 200° F (93° C).
- **1.** Materials that must be preheated before ignition will occur. Includes liquids, solids and semi solids having a flash point above 200° F (93° C).
- **0.** Materials that will not burn.

Physical Hazard 

After 2002, the yellow color bar (which represented chemical reactivity) was replaced by an orange bar, which represents physical hazards. Seven hazard classes are recognized: Water Reactives, Organic Peroxides, Explosives, Compressed gases, Pyrophoric materials, Oxidizers, and Unstable Reactives.

- **4.** Materials that are readily capable of explosive water reaction, detonation or explosive decomposition, polymerization, or self-reaction at normal temperature and pressure.
- **3.** Materials that may form explosive mixtures with water and are capable of detonation or explosive reaction in the presence of a strong initiating source. Materials may polymerize, decompose, self-react, or undergo other chemical change at normal temperature and pressure with moderate risk of explosion.
- **2.** Materials that are unstable and may undergo violent chemical changes at normal temperature and pressure with low risk for explosion. Materials may react violently with water or form peroxides upon exposure to air.
- **1.** Materials that are normally stable but can become unstable (self-react) at high temperatures and pressures. Materials may react non-violently with water or undergo hazardous polymerization in the absence of inhibitors.
- **0.** Materials that are normally stable, even under fire conditions, and will not react with water, polymerize, decompose, condense, or self-react. Non-explosives.

Personal Protection 

HMIS uses the white section and a letter code to indicate what personal protective equipment (PPE) should be used when working with a chemical. The codes for personal protective equipment are listed below, this list is not all inclusive.

Letter Code	Protective Equipment	Protective Equipment Symbol
A	Safety Glasses	
B	Safety Glasses, Gloves	
C	Safety Glasses, Gloves, Apron	
D	Face Shield, Gloves, Apron	
E	Safety Glasses, Gloves, Dust Respirator	
F	Safety Glasses, Gloves, Apron, Dust Respirator	
G	Safety Glasses, Gloves, Vapor Respirator	
H	Splash Goggles, Gloves, Apron, Vapor Respirator	
I	Safety Glasses, Gloves, Dust and Vapor Respirator	
J	Splash Goggles, Gloves, Apron, Dust & Vapor Respirator	

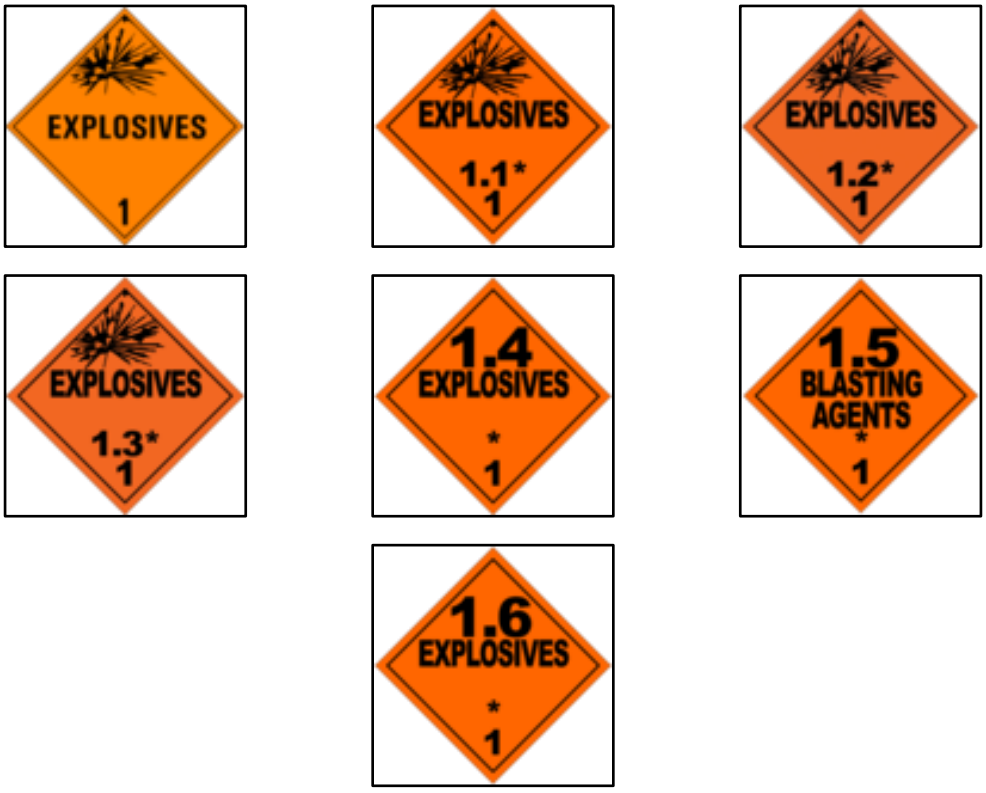
Appendix E: United States Department of Transportation (DOT) Placards

Title 49 of the United States Code of Federal Regulations (49CFR) requires the use of US DOT (US Department of Transportation) hazardous materials placards when shipping hazardous materials cargo and dangerous goods in the United States. These placards will not only be found on shipping vehicles, but also on containers, and entrances to areas with hazardous materials.

Hazardous materials are divided into nine classes (in addition to subcategories) based on the specific chemical characteristics producing the hazard.

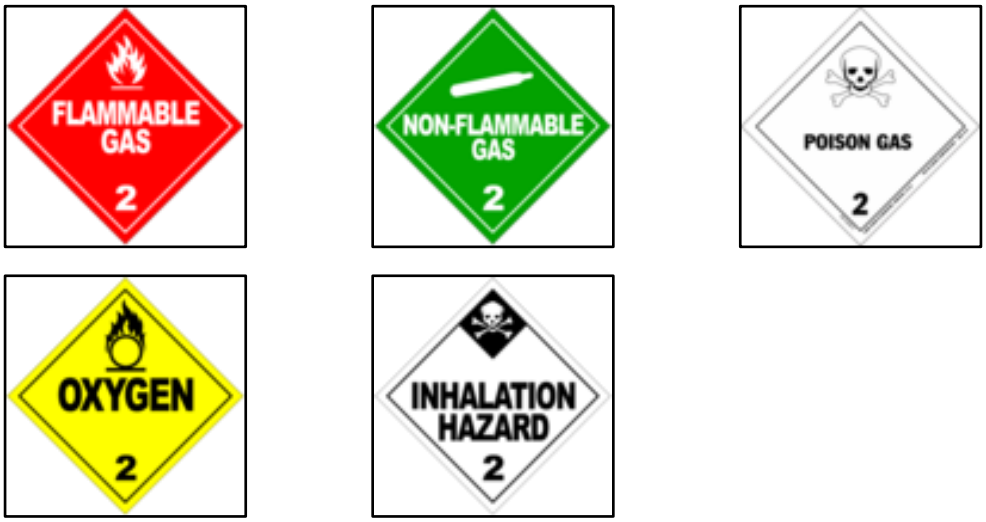
Class 1: Explosives

1.1 — Explosives with a mass explosion hazard. (nitroglycerin/dynamite)
1.2 — Explosives with a blast/projection hazard.
1.3 — Explosives with a minor blast hazard. (rocket propellant, display fireworks)
1.4 — Explosives with a major fire hazard. (consumer fireworks, ammunition)
1.5 — Blasting agents.
1.6 — Extremely insensitive explosives.

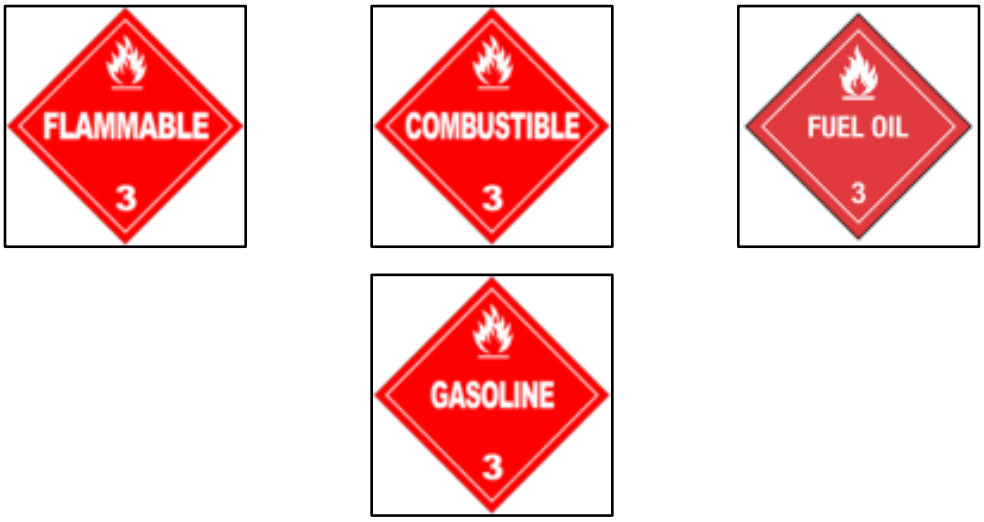


Class 2: Gases

2.1 Flammable Gas: Gases which ignite on contact with an ignition source, such as acetylene, hydrogen, and propane.
2.2 Non-Flammable Gases: Gases which are neither flammable nor poisonous. Includes the cryogenic gases/liquids used for cryopreservation and rocket fuels, such as nitrogen, neon, and carbon dioxide.
2.3 Poisonous Gases: Gases liable to cause death or serious injury to human health if inhaled; examples are fluorine, chlorine, and hydrogen cyanide.



Class 3: Flammable and Combustible Liquids



Class 4: Flammable Solids

4.1 Flammable Solids: Solid substances that are easily ignited and readily combustible (nitrocellulose, magnesium, safety or strike-anywhere matches).

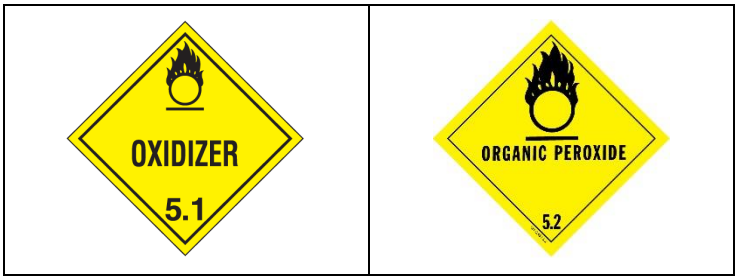
4.2 Spontaneously Combustible: Solid substances that ignite spontaneously (aluminum alkyls, white phosphorus).

4.3 Dangerous when Wet: Solid substances that emit a flammable gas when wet or react violently with water (sodium, calcium, potassium, calcium carbide).

Class 5: Oxidizing Agents and Organic Peroxides

5.1 Oxidizing agents other than organic peroxides (calcium hypochlorite, ammonium nitrate, hydrogen peroxide, potassium permanganate)

5.2 Organic peroxides, either in liquid or solid form (benzoyl peroxides, cumene hydroperoxide).



Class 6: Toxic and Infectious Substances

6.1a Toxic substances which are liable to cause death or serious injury to human health if inhaled, swallowed or by skin absorption (potassium cyanide, mercuric chloride).

6.1b Toxic substances (Now PGIII) which are harmful to human health (pesticides, methylene chloride).

6.2 Biohazardous substances.

Class 7: Radioactive Substances

Radioactive substances comprise substances or a combination of substances which emit ionizing radiation (uranium, plutonium).

Class 8: Corrosive Substances

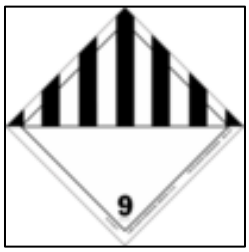
Corrosive substances are substances that can dissolve organic tissue or severely corrode certain metals:

8.1 Acids: such as sulfuric acid, hydrochloric acid.

8.2 Alkalis / Bases: such as potassium hydroxide, sodium hydroxide.

Class 9: Miscellaneous

Hazardous substances that do not fall into the other categories (asbestos, air-bag inflators, dry ice).



Appendix F: Common Peroxide Forming Chemicals

(NOTE: The lists below cover many commonly known peroxide formers, but is not all-inclusive)

List A: Chemicals known to form explosive levels of peroxides without concentration

Suggested safe storage period: If unopened from manufacturer, up to 18 months or stamped expiration date, whichever comes first. After opening, materials should be discarded or evaluated for peroxides within 3 months. Store under nitrogen if possible.

Divinyl acetylene	Potassium amide
Divinyl ether	Sodium amide (sodamide)
Isopropyl ether	Butadiene[a]
Vinylidene chloride	Chloroprene[a]
Potassium metal	Tetrafluoroethylene[a]

[a] When stored as a liquid monomer

List B: Chemicals that may auto-polymerize as a result of peroxide accumulation

Suggested safe storage period: If unopened from manufacturer, up to 18 months or stamped expiration date, whichever comes first.

- **After opening, materials without inhibitors should not be stored for longer than 24 hours.**
- After opening, materials with inhibitors should be discarded or

Acrylic acid[a]	Tetrafluoroethylene[b]
Acrylonitrile[a]	Vinyl acetate
Butadiene[b]	Vinylacetylene
Chloroprene[b]	Vinyl chloride
Chlorotrifluoroethylene	Vinylpyridine
Methyl methacrylate[a]	
Styrene	

[a] Although these chemicals form peroxides, no explosions involving these monomers have been reported.

[b] When stored in liquid form, these chemicals form explosive levels of peroxides without concentration. They may also be stored as a gas in gas cylinders. When stored as a gas, these chemicals may auto-polymerize as a result of peroxide accumulation.

List C: Chemicals known to present peroxide hazards upon concentration (distillation/ evaporation)

Suggested safe storage period: If unopened from manufacturer, up to 18 months or stamped expiration date, whichever comes first. After opening, materials should be discarded or evaluated for peroxides within 12 months.	
Acetal (1,1-diethoxyethane)	2-Hexanol
Acetaldehyde	Methylacetylene
Benzyl alcohol	3-Methyl-1-butanol
2-Butanol	Methylcyclopentane
Cumene	Methyl isobutyl ketone
Cyclohexanol	4-Methyl-2-pentanol
2-Cyclohexen-1-ol	2-Pentanol
Cyclohexene	4-Penten-1-ol
Decahydronaphthalene	1-Phenylethanol
Diacetylene	2-Phenylethanol
Dicyclopentadiene	2-Propanol
Diethyl ether	Tetrahydrofuran
Diethylene glycol dimethyl ether (diglyme)	Tetrahydronaphthalene
Dioxanes	Vinyl ethers
Ethylene glycol dimethyl ether (glyme)	Other secondary alcohols
4-Heptanol	

Appendix G:
OSHA Particularly Hazardous Substances

1910.1450(e)(3) Chemical Hygiene plan … shall include: (viii) Provisions for additional employee protection for work with **particularly hazardous substances**. These include "select carcinogens," reproductive toxins and substances which have a high degree of acute toxicity. **CAS#** - Chemical Abstracts Service Number. **Select Carcin** - Select carcinogen as defined by OSHA in 1910.1450. **Repro Toxin** - Reproductive toxins means chemicals which affect the reproductive chemicals which affect the reproductive capabilities including mutations and effects on fetuses (teratogenesis). **Acute Toxic** - Acutely toxic chemicals are capable of causing serious harm upon a single, brief exposure. **Skin Haz.** - Skin hazards are chemicals capable of causing harm through direct skin (contact) absorption.

CHEMICAL NAME	CAS #	Select Carcin	Repro Toxin	Acute Toxic	Skin Haz.
2,4,5-T	000093-76-5		X		
ACETALDEHYDE	000075-07-0	X			
ACETAMIDE	000060-35-5	X			
ACETYLAMINOFLUORENE,2-	000053-96-3	X			
ACROLEIN	000107-02-8			X	
ACRYLAMIDE	000079-06-1	X			X
ACRYLONITRILE	000107-13-1	X		X	X
ADIPONITRILE	000111-69-3			X	
ADRIAMYCIN	023214-92-8	X			
AFLATOXIN M1	006795-23-9	X			
AFLATOXINS	001402-68-2	X			
AF-2[2-(2-FURYL)-3-(5-NITRO-2- FURYL)ACRYLAMIDE]	003688-53-7	X			
AMINOANTHRAQUINONE, 2-	000117-79-3	X			
AMINOAZOBENZENE,para-	000060-09-3	X			
AMINOAZOTOULENE,ortho-	000097-56-3	X			
AMINODIPHENYL,4-, "s"	000092-67-1	X			X
AMINOPTERIDINE	000054-62-6		X		
AMINO-2-METHYLANTHRAQUINONE, 1-	000082-28-0	X			
AMINO-3,4-DIMETHYL-3h-IMIDAZO(4,5f)QUINOLINE,2-	077094-11-2	X			
AMINO-3,8-DIMETHYL-3H-IMIDAZO(4,5-f) QUINOXALINE, 2-	077500-04-0	X			
AMINO-5-(5-NITRO-2-FURYL)-1,3,4-THIADIAZOLE, 2-	000712-68-5	X			
AMITROLE	000061-82-5	X			
AMMONIA (GAS)	007664-41-7			X	
AMMONIUM DICHROMATE (VI)	007789-09-5	X			
ANDROGENIC (ANABOLIC) STEROIDS	000000-00-0	X	X		
ANILINE AND COMPOUNDS	000062-53-3			X	X
ANISIDINE, ORTHO-	000090-04-0	X			X
ANISIDINE HYDROCHLORIDE, o-	000134-29-2	X			
ANTHRACENEDIONE,9,10-, 1,4,5,8-TETRAAMINO	002475-45-8	X			
ANTHRAQUINONE, 1,8-DIHYDROXY	000117-10-2	X			
ANTIMONY OXIDE	001309-64-4	X			
ANTINEOPLASTIC AGENTS	000000-00-0		X		
ANTITHYROID DRUGS	000000-00-0		X		
ARAMITE	000140-57-8	X			
ARSENEOUS ACID, CALCIUM SALT (2:1)	015194-98-6	X			
ARSENEOUS ACID, POTASSIUM SALT	013464-35-2	X			
ARSENIC ACID	007778-39-4	X	X	X	
CHEMICAL NAME	CAS #	Select Carcin	Repro Toxin	Acute Toxic	Skin Haz.

ARSENIC ACID, CALCIUM SALT	010103-62-5	X			
ARSENIC ACID, CALCIUM SALT (2:3)	007778-44-1	X			
ARSENIC ACID, DISODIUM SALT, HEPTAHYDRATE	010048-95-0	X			
ARSENIC ACID, LEAD(2+) SALT (1:1)	007784-40-9	X			
ARSENIC ACID, MONOPOTASSIUM SALT	007784-41-0	X			
ARSENIC ACID, SODIUM SALT	007631-89-2	X			
ARSENIC AND COMPOUNDS	007440-38-2	X	X		
ARSENIC COMPOUNDS	000000-00-0	X	X		
ARSENIC PENTAFLUORIDE	007784-36-3	X	X	X	
ARSENIC PENTOXIDE	001303-28-2	X			
ARSENIC TRIOXIDE	001327-53-3	X	X	X	
ARSENIUOS ACID, CALCIUM SALT	027152-57-4	X			
ARSENIUOS ACID, MONOSODIUM SALT	007784-46-5	X			
ARSINE	007784-42-1			X	
ARSONIC ACID, CALCIUM SALT (1:1)	052740-16-6	X			
ASBESTOS	001332-21-4	X			
ASBESTOS, ACTINOLITE	077536-66-4	X			
ASBESTOS, AMOSITE	012172-73-5	X			
ASBESTOS, ANTHOPHYLLITE	077536-67-5	X			
ASBESTOS, CHRYSOTILE	012001-29-5	X			
ASBESTOS, CROCIDOLITE	012001-28-4	X			
ASBESTOS, TREMOLITE	077536-68-6	X			
ATRAZINE	001912-24-9	X			
AURAMINE, TECHNICAL-GRADE	000492-80-8	X			
AZACITIDINE	000320-67-2	X			
AZASERINE	000115-02-6	X			
AZATHIOPRINE	000446-86-6	X			
AZBLLEN ASBESTOS	017068-78-9	X			
A-a-C(2-AMINO-9H-PYRIDO[2,3-b]INDOLE)	000000-00-0	X			
BARIUM CHROMATE(VI)	010294-40-3	X			
BENZENE	000071-43-2	X	X		
BENZIDINE	000092-87-5	X			
BENZIDINE, 2,3'-DIMETHOXY-,DIHYDROCHLORIDE	020325-40-0	X			
BENZIDINE, 3,3'-DICHLORO-, DIHYDROCHLORIDE	000612-83-9	X			
BENZIDINE-BASED DYES	000000-00-0	X			
BENZOFURAN	000271-89-6	X			
BENZOTRICHLORIDE	000098-07-7	X			
BENZO[a]PYRENE	000050-32-8	X			
BENZO[b]FLUORANTHENE	000205-99-2	X			
BENZO[f]FLUORANTHENE	000205-82-3	X			
BENZO[k]FLUORANTHENE	000207-08-9	X			
BENZYL VIOLET 4B	001694-09-3	X			
BENZ[a]ANTHRACENE	000056-55-3	X			
BERYLLIUM ALUMINUM ALLOY	012770-50-2	X			
BERYLLIUM ALUMINUM SILICATE	001302-52-9	X			
BERYLLIUM AMD COMPOUNDS	007440-41-7	X			
BERYLLIUM CHLORIDE	007787-47-5	X			
BERYLLIUM COMPOUNDS	000000-00-0	X			
BERYLLIUM FLUORIDE	007787-49-7	X			
BERYLLIUM HYDROGEN PHOSPHATE (1:1)	013598-15-7	X			
BERYLLIUM HYDROXIDE	013327-32-7	X			
CHEMICAL NAME	**CAS #**	**Select Carcin**	**Repro Toxin**	**Acute Toxic**	**Skin Haz.**
BERYLLIUM OXIDE	001304-56-9	X			
BERYLLIUM OXIDE CARBONATE	066104-24-3	X			

BERYLLIUM SULFATE, TETRAHYDRATE (1:1:4)	007787-56-6	X			
BERYLLIUM SULFATE (1:1)	013510-49-1	X			
BERYLLIUM ZINC SILICATE	039413-47-1	X			
BETEL QUID WITH TOBACCO	000000-00-0	X			
BISCHLOROETHYL NITROSOUREA (BCNU)	000154-93-8	X			
BITUMENS,EXTRACTS OF STEAM-&AIR- REFINED	008052-42-4	X			
BLEOMYCIN, HYDROCHLORIDE	067763-87-5	X			
BLEOMYCIN SULFATE	009041-93-4	X			
BLEOMYCINS	000000-00-0	X			
BLEOMYCINS	011056-06-7	X			
BORON TRIBROMIDE	010294-33-4			X	
BORON TRIFLUORIDE	007637-07-2			X	
BRACKEN FERN	000000-00-0	X			
BROMINE	007726-95-6			X	
BROMINE PENTAFLUORIDE	007789-30-2			X	
BROMOACETONE	000598-31-2			X	
BROMODICHLOROMETHANE	000075-27-4	X		X	
BUSULFAN	000055-98-1		X		
BUTADIENE,1,3-	000106-99-0	X			
BUTANE, (+-)-1,2:3,4-DIEPOXY-	000298-18-0	X			
BUTANEDIOL DIMETHANESULPHONATE,1,4- (MYLERAN)	000055-98-1	X			
BUTYLATED HYDROXYANISOLE (BHA)	025013-16-5	X			
BUTYLATED HYDROXYANISOLE (BHA)	030031-64-2	X			
BUTYRIC ACID, 4-(N-BUTYL-N-NITROSAMINO)-	038252-74-3	X			
BUTYROLACTONE,BETA-	003068-88-0	X			
CADMIUM AND COMPOUNDS	007440-43-9	X	X		
CADMIUM CARBONATE	000513-78-0	X			
CADMIUM CHLORIDE	010108-64-2	X			
CADMIUM COMPOUNDS	000000-00-0	X			
CADMIUM FLUOBORATE	014486-19-2	X			
CADMIUM NITRATE	010325-94-7	X			
CADMIUM OXIDE	001306-19-0	X			
CADMIUM SULFATE (1:1)	010124-36-4	X			
CADMIUM SULFIDE	001306-23-6	X			
CAFFEIC ACID	000331-39-5	X			
CALCIUM CHROMATE (VI)	013765-19-0	X			
CAPTAFOL	002425-06-1	X			
CARBAMIC ACID, N-METHYL-N-NITROSO,ETHYL_ESTER	000615-53-2	X			
CARBON DISULFIDE	000075-15-0		X		X
CARBON MONOXIDE	000630-08-0		X		
CARBON TETRACHLORIDE	000056-23-5	X			X
CARBON-BLACK EXTRACTS	000000-00-0	X			
CARRAGEENAN, DEGRADED	009000-07-1	X			
CERAMIC FIBERS (RESPIRABLE SIZE)	000000-00-0	X			
CHLORAMBUCIL	000305-03-3	X	X		
CHLORAMPHENICOL	000056-75-7	X			
CHLORDANE	000057-74-9	X			
CHLORDANE	012789-03-6	X			
CHLORDANE, ALPHA	005103-71-9	X			
CHEMICAL NAME	**CAS #**	**Select Carcin**	**Repro Toxin**	**Acute Toxic**	**Skin Haz.**
CHLORDANE, BETA	005103-74-2	X			
CHLORDANE, GAMMA	005566-34-7	X			
CHLORENDIC ACID	000115-28-6	X			
CHLORINATED PARAFFINS (CARBON-12, 60% CHLORINE)	108171-26-2	X			

CHEMICAL NAME	CAS #	Select Carcin	Repro Toxin	Acute Toxic	Skin Haz.
CHLORINATED PARAFFINS (CARBON-23, 43%CHLORINE)	108171-27-3	X			
CHLORINATED TOULENES, ALPHA-	000000-00-0	X			
CHLORINE TRIFLUORIDE	007790-91-2			X	
CHLOROETHYL(2)-3-CYCLOHEXYL-1-NITROSOUREA,1-	013010-47-4	X			
CHLOROETHYL(2)-3-(4-METHYLCYCLOHEXYL)-1-NITROSOUREA,1-	013909-09-6	X			
CHLOROFORM	000067-66-3	X			
CHLOROMETHYL ETHER,BIS-	000542-88-1	X			
CHLOROMETHYL METHYL ETHER	000107-30-2	X			
CHLOROPHENOL, meta-	000108-43-0	X			
CHLOROPHENOLS	000000-00-0	X			
CHLOROPHENOXY HERBICIDES	000000-00-0	X			
CHLOROPICRIN	000076-06-2			X	
CHLOROPRENE	000126-99-8		X		X
CHLOROZOTOCIN	054749-90-5	X			
CHLORO-2-METHYLPROPENE, 3-	000563-47-3	X			
CHLORO-ortho-PHENYLENEDIAMINE,4-	000095-83-0	X			
CHLORO-ortho-TOLUIDINE, para-	000095-69-2	X			
CHLORO-O-TOLUIDINE HYDROCHLORIDE, 4-	003165-93-3	X			
CHROMATE(1-),HYDROXYOCTAOXODIZINCATEDI-POTASSIUM	011103-86-9	X			
CHROMIC ACID, DISODIUM SALT	007775-11-3	X			
CHROMIC ACID, LEAD(2+) SALT (1:1)	007758-97-6	X			
CHROMITE (MINERAL)	001308-31-2	X			
CHROMIUM, DICHLORODIOXO-	014977-61-8	X			
CHROMIUM, HEXAVALENT AND COMPOUNDS	007440-47-3	X			
CHROMIUM CARBONATE	029689-14-3	X			
CHROMIUM COUMPOUNDS,HEXAVALENT	000000-00-0	X			
CHROMIUM PHOSPHATE	007789-04-0	X			
CHROMIUM TRIACETATE	001066-30-4	X			
CHROMIUM (III) OXIDE (2:3)	001308-38-9	X			
CHROMIUM (VI) OXIDE (1:3)	001333-82-0	X			
CHROMIUM (VI)CHLORIDE,	014986-48-2	X			
CI ACID RED 114	006485-34-3	X			
CI DIRECT BLUE 15	002429-74-5	X			
CISPLATIN	015663-27-1	X			
CITRUS RED NO. 2	006358-53-8	X			
COAL TAR	065996-89-6	X			
COAL TAR DISTILLATE	065996-92-1	X			
COAL TAR DYE	000000-00-0	X			
COAL-TAR	008007-45-2	X			
COAL-TAR PITCHES	065996-93-2	X			
COBALT	007440-48-4	X			
COBALT, BIS(CARBONATA(2-))HEXAHYDROXYPENTA-MONOHYDRATE	051839-24-8	X			
COBALT, TRI-MU-CARBONYLNONACARBONYLTETRA-,TETRAHYDRO	010210-68-1	X			
COBALT, (MU(CARBONATO(2-)-O:O'))DIHYDROXYDI	012069-68-0	X			
COBALT ACETATE	000071-48-7	X			
COBALT ALLOY, CO, CR	011114-92-4	X			
COBALT CARBONATE	000513-79-1	X			
COBALT CARBONATE, COBALT DIHYDROXIDE (2:3)	012602-23-2	X			
COBALT CARBONYL	017786-31-1	X			

COBALT DINITRATE HEXAHYDRATE	010026-22-9	X			
COBALT HYDROXIDE	001307-64-4	X			
COBALT HYDROXIDE OXIDE	012016-80-7	X			
COBALT NAPHTHATE	061789-51-3	X			
COBALT OXIDE	001308-05-1	X			
COBALT TRIACETATE	000917-69-1	X			
COBALT (2+) SULFIDE	001317-42-6	X			
COBALT (III) OXIDE	001308-04-9	X			
COBALT (II) ACETATE	006147-53-1	X			
COBALT(2+) OXIDE	001307-96-6	X			
COBALT(II) CHLORIDE	007646-79-9	X			
COBALT(II) CHLORIDE, HEXAHYDRATE	007791-13-1	X			
COBALT(II) HYDROXIDE	021041-93-0	X			
COBALT(II) NITRATE (1:2)	010141-05-6	X			
COBALT(II) SULFATE (1:1)	010124-43-3	X			
COBALT-CHROMIUM-MOLYBDENUM ALLOY	012629-02-6	X			
COBALT-CHROMIUM-NICKEL-TUNGSTEN ALLOY	012638-07-2	X			
COBLAT MOLYBDATE(VI)	013762-14-6	X			
CONESTORAL	000438-67-5	X			
COUMARIN ANTICOAGULANTS	000000-00-0		X		
CREOSOTES	008001-58-9	X			
CRESIDINE, para-	000120-71-8	X			
CRESOATE, WOOD	008021-39-4	X			
CUPFERRON	000135-20-6	X			
CYANAMIDE	000420-04-2			X	
CYANIDES	000057-12-5			X	X
CYANOGEN	000460-19-5			X	
CYCASIN	014901-08-7	X			
CYCLOPENTA(C)FURO(3',3':4,5)FOURO(2,3-H)(1)BENZOPYRAN	001162-65-8	X			
CYCLOPHOSPHAMIDE	000050-18-0	X	X		
CYCLOPHOSPHAMIDE	006055-19-2	X			
CYCLOSPORIN	079217-60-0	X			
CYCLOSPORIN A	059865-13-3	X			
C.I. BASIC RED 9 MONOHYDROCHLORIDE	000569-61-9	X			
DACARBAZINE	004342-03-4	X			
DAUNOMYCIN	020830-81-3	X			
DDT	000050-29-3	X	X		X
DECABORANE	017702-41-9			X	X
DIACETYLBENZIDINE,N,N'-	000613-35-4	X			
DIAMINOANISOLE, 2,4-	000615-05-4	X			
DIAMINOANISOLE SULPHATE, 2,4-	039156-41-7	X			
DIAMINODIPHENYL ETHER, 4,4'-	000101-80-4	X			
DIAMINOTOLUENE, 2,4-	000095-80-7	X			
DIAZEPAM	000439-14-5		X		
CHEMICAL NAME	**CAS #**	**Select Carcin**	**Repro Toxin**	**Acute Toxic**	**Skin Haz.**
DIBENZO[a, e]PYRENE	000192-65-4	X			
DIBENZO[a, h]PYRENE	000189-64-0	X			
DIBENZO[a, i]PYRENE	000189-55-9	X			
DIBENZO[a, l]PYRENE	000191-30-0	X			
DIBENZO[c, g]CARBAZOLE, 7H-	000194-59-2	X			
DIBENZ[a, h]ACRIDINE	000226-36-8	X			
DIBENZ[a, h]ANTHRACENE	000053-70-3	X			
DIBENZ[a, j]ACRIDINE	000224-42-0	X			

DIBORANE	019287-45-7			X	
DIBROMOPROPYL(2,3)PHOSPHATE, TRIS	000126-72-7	X			
DIBROMO-3-CHLOROPROPANE,1,2-	000096-12-8	X	X		
DICHLOROACETYLENE	007572-29-4			X	
DICHLOROBENZENE, para-	000106-46-7	X			
DICHLOROBENZIDINE,3,3'-	000091-94-1	X			X
DICHLOROETHANE, 1,2-	000107-06-2	X			
DICHLOROETHANE,1,1-,2-(O-CHLOROPHENYL)-2(P-CHLOROPHENYL)	000053-19-0	X			
DICHLOROMETHANE	000075-09-2	X			
DICHLOROPROPENE, 1,3- (TECHNICAL-GRADE)	000542-75-6	X			X
DICHLORO-2,2-BIS(P-CHLOROPHENYL)ETHANE, 1,1- (DDD)	000072-54-8	X			
DICHLORO-2,2-BIS)P-CHLOROPHENYL)ETHYLENE, 1,1-(DDE)	000072-55-9	X			
DICHLORO-4,4'-DIAMINODIPHENYL ETHER, 3,3'-	028434-86-8	X			
DICHLORVOS	000062-73-7	X			
DIEPOXYBUTANE	001464-53-5	X			
DIESEL ENGINE EXHAUST	000000-00-0	X			
DIESEL FUEL MARINE	000000-00-0	X			
DIETHYL SULPHATE	000064-67-5	X			
DIETHYLHYDRAZINE, 1,2-	001615-80-1	X			
DIETHYLSTILBOESTROL	000056-53-1	X	X		
DIGLYCIDYL RESORCINOL ETHER	000101-90-6	X			
DIHYDROSAFROLE	000094-58-6	X			
DIISOPROPYL SULFATE	002973-10-6	X			
DIMETHOXYBENZIDINE, 3,3'- (o-DIANISIDINE)	000119-90-4	X			
DIMETHYL SULFATE	000077-78-1	X		X	X
DIMETHYL SULFOXIDE	000067-68-5		X		X
DIMETHYLAMINOAZOBENZENE, para-	000060-11-7	X			
DIMETHYLBENZIDINE, 3,3'- (o-TOLIDINE)	000119-93-7	X			
DIMETHYLCARBAMOYL CHLORIDE	000079-44-7	X			
DIMETHYLFORMAMIDE,N,N-	000068-12-2	X			
DIMETHYLHYDRAZINE, 1,1-	000057-14-7	X			X
DIMETHYLHYDRAZINE, 1,2-	000540-73-8	X			
DIMETHYLVINYL CHLORIDE	000513-37-1	X			
DINITROPYRENE, 1,6-	042397-64-8	X			
DINITROPYRENE, 1,8-	042397-65-9	X			
DIOXANE, 1,4-	000123-91-1	X			X
DIRECT BLACK 38	001937-37-7	X			
DIRECT BLUE 6	002602-46-2	X			
DISPERSE BLUE 1	002475-45-8	X			
DI(2-ETHYLHEXYL)PHTHALATE	000117-81-7	X			
ENDOSULFAN	000115-29-7			X	X
CHEMICAL NAME	**CAS #**	**Select Carcin**	**Repro Toxin**	**Acute Toxic**	**Skin Haz.**
ENDRIN	000072-20-8			X	X
EPICHLOROHYDRIN	000106-89-8	X			X
ERIONITE	012510-42-8	X			
ERIONITE	066733-21-9	X			
ESTRADIOL-17	000050-28-2	X			
ESTRA-1,2,5(10),7-TETRAEN-17-ONE,3-(SULFOOXY)-, SODIUM SALT	016680-47-0	X			
ESTRONE	000053-16-7	X			
ETHINYLESTRADIOL	000057-63-6	X			
ETHYL ACRYLATE	000140-88-5	X			X

ETHYL ALCOHOL CONSUMPTION	000064-17-5		X		
ETHYL METHANESULPHONATE	000062-45-7	X			
ETHYLENE CHLOROHYDRIN	000107-07-3			X	X
ETHYLENE DIBROMIDE	000106-93-4	X	X		X
ETHYLENE GLYCOL ETHERS	000000-00-0		X		
ETHYLENE OXIDE	000075-21-8	X	X		
ETHYLENE THIOUREA	000096-45-7	X			
ETHYLENEIMINE	000151-56-4	X			
ETHYL-N-NITROSOUREA,N-	000759-73-9	X			
FLUORINE	007782-41-4			X	
FORMALDEHYDE	000050-00-0	X			
FOWLER'S SOLUTION	001332-10-1	X			
FUEL OIL, RESIDUAL	068476-33-5	X			
FURAN	000110-00-9	X			
GASOLINE	008006-61-9	X			
GASOLINE, ENGINE EXHAUST FUMES	000000-00-0	X			
GERMANE	007782-65-2			X	
GLASSWOOL (RESPIRABLE SIZE)	000000-00-0	X			
GLU-P-1 (2-AMINO-6-METHYLDIPYRIDO[1,2-a:3',2'-d] IMIDAZOLE)	067730-11-4	X			
GLU-P-2(2-AMINODIPYRIDO[1,2-A:3',2' D]IMIDAZOLE)	067730-10-3	X			
GLYCIDALDEHYDE	000765-34-4	X			
GLYCIDOL	000556-52-5	X			
GOSSYPOL	000303-45-7		X		
GRISEOFULVIN	000126-07-8	X			
HALOTHANE	000151-67-7		X		
HC BLUE 1	002784-94-3	X			
HEPTACHLOR	000076-44-8	X			
HEPTACHLOR EPOXIDE	001024-57-3	X			
HEXACHLOROBENZENE	000118-74-1	X	X		
HEXACHLOROETHANE	000067-72-1	X			
HEXACHLOROHEXANES	000608-73-1	X			
HEXAMETHYLPHOSPHORAMIDE	000680-31-9	X			
HYDRAZINE	000302-01-2	X			X
HYDRAZINE, SULFATE (1:1)	010034-93-2	X			
HYDRAZOBENZENE	000122-66-7	X			
HYDROGEN CYANIDE	000074-90-8			X	X
HYDROGEN FLUORIDE (HYDROFLURIC ACID)	007664-39-3			X	X
HYDROGEN SELENIDE	007783-07-5			X	
HYDROGEN SULFIDE	007783-06-4			X	
INDENO[1,2,3-cd]PYRENE	000193-39-5	X			
CHEMICAL NAME	**CAS #**	**Select Carcin**	**Repro Toxin**	**Acute Toxic**	**Skin Haz.**
IQ(2-AMINO-3-METHYLIMIDAZO[4,5-f]QUINOLINE)	076180-96-6	X			
IRON-DEXTRAN COMPLEX	009004-66-4	X			
ISOPRENE	000078-79-5	X			
KEPONE (CHLORDECONE)	000143-50-0	X			
LASIOCARPINE	000303-34-4	X			
LEAD ACETATE	000301-04-2	X			
LEAD ACETATE (II) TRIHYDRATE	006085-56-4	X			
LEAD AND COMPOUNDS	007439-92-1	X	X		
LEAD CHROMATE (VI) OXIDE	018454-12-1		X		
LEAD COMPOUNDS, INORGANIC	000000-00-0	X	X		
LEAD (II) PHOSPHATE (3:2)	007446-27-7	X			
LINDANE, ALPHA	000319-84-6	X			

LINDANE, BETA	000319-85-7	X			
LINDANE AND OTHER HEXACHLOROCYCLOHEXANE ISOMERS	000058-89-9	X			X
LITHIUM	007439-93-2		X		
LITHIUM CARBONATE	000554-13-2		X		
LITHIUM CITRATE	000846-59-1		X		
MAGENTA (CONTAINING CI BASIC RED 9)	000632-99-5	X			
MeA-ALPHA-C(2-AMINO-3-METHYL-9H-PYRIDO[2,3- b] INDOLE)	068006-83-7	X			
MECOPROP	000093-65-2	X			
MEDROXYPROGESTERONE	000071-58-9	X			
MELPHALAN	000148-82-3	X			
MERCHALAN	000531-76-0	X			
MERCURY	007439-97-6		X		X
MERCURY, INORGANIC COMPOUNDS	000000-00-0		X		X
MESTRANOL	000072-33-3	X			
METHANE,TERANITRO-	000509-14-8	X			
METHIMAZOLE	000060-56-0		X		
METHOXSALEN AND UV RADIATION	000298-81-7	X			
METHOXYPSORALEN,5-	000484-20-8	X			
METHYL BROMIDE	000074-83-9			X	X
METHYL CYCLOPENTADIENYL MANGANESE TRICARBONYL	012108-13-3			X	X
METHYL HYDRAZINE	000060-34-4			X	
METHYL ISOCYANATE	000624-83-9			X	X
METHYL MERCURY	022967-92-6		X		
METHYL METHANESULPHONATE	000066-27-3	X			
METHYLAMINOPTERIN	000059-05-2		X		
METHYLANILINE, 2,6-	000087-62-7	X			
METHYLAZIRIDINE, 2- (PROPYLENEIMINE)	000075-55-8	X			
METHYLAZOXYMETHANOL	000590-96-5	X			
METHYLAZOXYMETHANOL ACETATE	000592-62-1	X			
METHYLCHRYSENE, 5-	003697-24-3	X			
METHYLDICHLOROARSINE	000593-89-5			X	
METHYLENE BIS(2-CHLOROANILINE), 4,4- (MBOAC)	000101-14-4	X			X
METHYLENE BIS(2-METHYLANILINE), 4,4'-	000838-88-0	X			
METHYLENEBIS(N,N-DIMETHYL)BENZENAMINE, 4,4'	000101-61-1	X			
METHYLENEDIANILINE, 4,4'- AND ITS DIHYDORCHLORIDE	000101-77-9	X			
METHYLENEDIANILINE,4,4'-DIHYDROCHLORIDE	013552-44-8	X			
CHEMICAL NAME	**CAS #**	**Select Carcin**	**Repro Toxin**	**Acute Toxic**	**Skin Haz.**
METHYLTHIOURACIL	000056-04-2	X			
METHYL-1-NITROANTHRAQUINONE, 2- (UNCERTAIN PURITY)	000129-15-7	X			
METHYL-N-NITROSOURETHANE, N-	000000-00-0	X			
METHYL-N-NITRO-N'-NITROSOGUANIDINE,N-(MNNG)	000070-25-7	X			
METRONIDAZOLE	000443-48-1	X			
MICHLER'S KETONE	000090-94-8	X			
MINERAL OILS,UNTREATED AND MILDLY TREATED	000000-00-0	X			
MIREX	002385-85-5	X	X		
MITOMYCIN C	000050-07-7	X			
MOLYBDATE ORANGE	012656-85-8	X			
MONOCROTALINE	000315-22-0	X			
MORPHOLINOMETHYL-3-[(5- NITROFURFURYLIDENE) AMINO], 5-	003031-51-4	X			

MUSTARD GAS (SULPHUR MUSTARD)	000505-60-2	X			
NAFENOPIN	003771-19-5	X			
NAPHTHYL METHYLCARBAMATE	000063-25-2		X		
NAPHTHYLAMINE, 2-	000091-59-8	X			X
NAPHTHYLAMINE, ALPHA-	000134-32-7	X			X
NAPHTHYLAMINE,N,N-BIS(2CHLOROETHYL)-2-	000494-03-1	X			
NICKEL, METALLIC	007440-02-0	X			
NICKEL ALLOY AISI 687	011068-91-0	X			
NICKEL BISCYCLOPENDADIENE	001271-28-9	X			
NICKEL CARBONYL	013463-39-3	X		X	
NICKEL CARBONYL	013464-39-3	X			
NICKEL COMPOUNDS	000000-00-0	X			
NICKEL SULFIDE (3:20	012035-72-2	X			
NICKEL (III) HYDROXIDE	012125-56-3	X			
NICKEL (II) ACETATE (1:2)	000373-02-4	X			
NICKEL (II) CARBONATE (1:1)	003333-67-3	X			
NICKEL (II) HYDROXIDE	012054-48-7	X			
NICKEL (II) OXIDE (1:1)	001313-99-1	X			
NICOTINE	000054-11-5		X	X	X
NIRIDAZOLE	000061-57-4	X			
NITRIC ACID (FUMING)	007697-37-2			X	X
NITRIC OXIDE	010102-43-9			X	
NITRILOTRIACETIC ACID	005064-31-3	X			
NITRILOTRIACETIC ACID, DISODIUM SALT	015467-20-6	X			
NITRILOTRIACETIC ACID, DISODIUM SALT, MONOHYDRATE	023255-03-0	X			
NITRILOTRIACETIC ACID, MONOSODIUM SALT	018994-66-6	X			
NITRILOTRIACETIC ACID, SODIUM SALT	010042-84-9	X			
NITRILOTRIACETIC ACID, TRISODIUM SALT,MONOHYDRATE	018662-53-8	X			
NITRILOTRIACETIC ACID AND SALTS	000139-13-9	X			
NITROACENAPHTHENE, 5-	000602-87-9	X			
NITROBIPHENYL,4-	000092-93-3	X			
NITROCHRYSENE, 6-	007496-02-8	X			
NITROFEN (TECHNICAL-GRADE)	001836-75-5	X			
NITROFLUORENE	000607-57-8	X			
CHEMICAL NAME	**CAS #**	**Select Carcin**	**Repro Toxin**	**Acute Toxic**	**Skin Haz.**
NITROFURFURYLIDIENE(5)-AMINO-2- IMIDAZOLIDINONE, 1-	000555-84-0	X			
NITROGEN DIOXIDE	010102-44-0			X	
NITROGEN MUSTARD	000051-75-2	X			
NITROGEN MUSTARD HYDROCHLORIDE	000055-86-7	X			
NITROGEN MUSTARD N-OXIDE	000126-85-2	X			
NITROGEN MUSTARD N-OXIDE HYDROCHLORIDE	000302-70-5	X			
NITROGEN TETROXIDE	010544-72-6			X	
NITROPROPANE, 2-	000079-46-9	X			
NITROPYRENE, 1-	005522-43-0	X			
NITROPYRENE, 4-	055738-54-0	X			
NITROPYRENE, 4-	057835-92-4	X			
NITROSOBUTYLBUTANOLAMINE, N-	003817-11-6	X			
NITROSODIETHANOLAMINE, N-	001116-54-7	X			
NITROSODIETHYLAMINE,N-	000055-18-5	X			
NITROSODIMETHYLAMINE,N-	000062-75-9	X			

NITROSODI-n-BUTYLAMINE, N-	000924-16-3	X			
NITROSODI-n-PROPYLAMINE, N-	000621-64-7	X			
NITROSOMETHYLETHYLAMINE, N-	010595-95-6	X			
NITROSOMETHYLVINYLAMINE, N-	004549-40-0	X			
NITROSOMORPHOLINE, N-	000059-89-2	X			
NITROSONORNICOTINE, N'-	016543-55-8	X			
NITROSONORNICOTINE, N-	084237-38-7	X			
NITROSOPIPERIDINE, N-	000100-75-4	X			
NITROSOPYRROLIDINE, N-	000930-55-2	X			
NITROSOSACOSINE, N-	013256-22-9	X			
NITROSO-N-METHYLUREA,N-	000684-93-5	X			
NORETHISTERONE	000068-22-4	X			
N-NITROSOMETHYLAMINO-1-(30PYRIDYL)-1-BUTANONE, 4-(NNK)	064091-91-4	X			
N-NITROSOMETHYLAMINO-PROPIONITRILE, 3-	060153-49-3	X			
N-[4-(5-NITR-2-FURYL)-2-THIAZOYL]ACETAMIDE	000531-82-8	x			
OCHRATOXIN A	000303-47-9	X			
OIL ORANGE SS	002646-17-5	X			
OXAZOLIDININE,2,5-(MORPHOLINOMETHYL)-3-[(5-NITROFURYLIDENE)	003795-88-8	X			
OXYMETHOLONE	000434-07-1	X			
PANFURAN S (CONTAININGDIHYDROXMETHYLFURATRIZINE)	000794-93-4	X			
PARAMETHADIONE	000115-76-3		X		
PARATHION	000056-38-2			X	X
PCB (AROCLOR 1254)	011097-69-1	X			
PCB (AROCLOR 1260)	011096-82-5	X			
PENICILLAMINE	002219-30-9		X		
PENTABORANE	019624-22-7			X	
PENTACHLOROBIPHENYL	025429-29-2	X			
PENTACHLOROPHENOL	000087-86-5	X			
PENTACHLOROPHENOL	000087-86-5			X	X
PHENACETIN	000062-44-2	X			
PHENAZOPYRIDINE HYDROCHLORIDE	000136-40-3	X			
PHENOBARBITAL	000050-06-6	X			
CHEMICAL NAME	**CAS #**	**Select Carcin**	**Repro Toxin**	**Acute Toxic**	**Skin Haz.**
PHENOXYBENZAMINE HYDROCHLORIDE	000062-92-3	X			
PHENYL GLYCIDYL ETHER	000122-60-1	X			
PHENYTOIN	000057-41-0	X	X		
PHLP(2-AMINO-1-METHYL-6-PHENYLIMIDAZO[4,5-B] PYRIDINE)	105650-23-5	X			
PHOSGENE	000075-44-5			X	
PHOSPHINE	007803-51-2			X	
PHOSPHORUS (YELLOW)	007723-14-0			X	
POLYBROMINATED BIPHENYL (FF-1)	067774-32-7	X			
POLYBROMINATED BIPHENYLS	000000-00-0	X	X		
POLYCHLORINATED BIPHENYLS	000000-00-0	X	X		
POLYCHLORINATED BIPHENYLS	001336-36-3	X			
PONCEAU 3R	003564-09-8	X			
PONCEAU MX	003761-53-3	X			
POTASSIUM BROMATE	007758-01-2	X			
POTASSIUM CHROMATE (VI)	007789-00-6	X			
POTASSIUM DICHROMATE (VI)	007778-50-9	X			
PROCARBAZINE HYDROCHLORIDE	000366-70-1	X			

PROGESTERONE	000057-83-0	X			
PROGESTINS	000057-83-0	X			
PROPANE SULTONE, 1,3-	001120-71-4	X			
PROPARGYL BROMIDE	000106-96-7			X	
PROPIOLACATONE, BETA	000057-57-8	X			
PROPIONIC NITRILE	000107-12-0			X	
PROPRIONIC ACID,2-(2,4-DICHLOROPHENOXY)	000120-36-5	X			
PROPYLENE OXIDE	000075-56-9	X		X	
PROPYLTHIOURACIL	000051-52-5	X			
RADON AND ITS DECAY PRODUCTS	010043-92-9	X			
RESERPINE	000050-55-5	X			
RETINOIC ACID, 1,3-CIS-	004759-48-2		X		
SACCHARIN	000081-07-2	X			
SACCHARIN, CALCIUM SALT	006485-34-3	X			
SACCHARIN, SODIUM SALT	000128-44-9	X			
SAFROLE	000094-59-7	X			
SELENIUM HEXAFLUORIDE	007783-79-1			X	
SELENIUM SULFIDE	007446-34-6	X			
SENARMONITE	012412-52-1	x			
SHALE-OILS	068308-34-9	X			
SILICA, CRYSTALLINE CRISTOBALITE	014464-46-1	X			
SILICA, CRYSTALLINE TRIDYMITE	015468-32-3	X			
SILICA, CRYSTALLINE TRIPOLI	001317-95-9	X			
SILICIC ACID BERYLLIUM SALT	015191-85-2	X			
SODIUM DICHROMATE (VI)	010588-01-9	X			
SODIUM FLUOROACETATE	000062-74-8			X	X
SODIUM ortho-PHENYLPHENATE	000132-27-4	X			
SOOTS	000000-00-0	X			
STERIGMATOCYSTIN	010048-13-2	X			
STIBINE	007803-52-3			X	
STREPTOZOTOCIN	018883-66-4	X			
STRONTIUM CHROMATE (VI)	007789-06-2	X			
STRYCHNINE	000057-24-9			X	
CHEMICAL NAME	**CAS #**	**Select Carcin**	**Repro Toxin**	**Acute Toxic**	**Skin Haz.**
STYRENE	000100-42-5	X			
STYRENE-7,8-OXIDE	000096-09-3	X			
SULFALLATE	000095-06-7	X			
SULFUR TRIOXIDE	007446-11-9	X			
SULFURIC ACID	007664-93-9	X			
SULFURIC ACID, FUMING	008014-95-7	X			
TALC CONTAINING ASBESTIFORM FIBRES	014807-96-6	X			
TETRACHLORODIBENZO-para-DIOXIN, 2,3,7,8- (TCCD)	001746-01-6	X	X		
TETRACHLOROETHYLENE	000127-18-4	X	X		X
TETRACYCLINES	000060-54-8		X		
TETRAETHYL LEAD	000078-00-2		X	X	X
TETRAETHYL PYROPHOSPHATE	000107-49-3			X	
TETRAMETHYL SUCCINONITRILE	003333-52-6			X	X
THALIDOMIDE	000050-35-1		X		
THIAZOLE,2(2-FORMYLHYDROZINE)-4-(5-NITRO-2- FURYL)	003570-75-0	X			
THIOACETAMIDE	000062-55-5	X			
THIODIANILINE, 4,4'-	000139-65-1	X			
THIOPHENOL	000108-98-5			X	
THIOTEPA	000052-24-4	X			
THIOUREA	000062-56-6	X			

CHEMICAL NAME	CAS #	Select Carcin	Repro Toxin	Acute Toxic	Skin Haz.
THORIUM DIOXIDE	001314-20-1	X			
TOBACCO PRODUCTS, SMOKELESS	000000-00-0	X			
TOBACCO SMOKE	000000-00-0	X	X		
TOLUENE	000108-88-3		X		X
TOLUENE DIISOCYANATE, 2,6-	000091-08-7	X			
TOLUENE DIISOCYANATES	000584-84-9	X			
TOLUENE DIISOCYANTE	026471-62-5	X			
TOLUENESULFONAMIDE, O-	000088-19-7	X			
TOLUIDINE, ORTHO-	000095-53-4	X		X	X
TOLUIDINE, ORTHO-	000108-49-0			X	X
TOLUIDINE HYDROCHLORIDE, O-	000630-21-5	X			
TOXAPHENE (POLYCHLORINATED CAMPHENES)	008001-35-2	X			
TREOSULPHAN	000299-75-2	X			
TRICHLOROETHANE,1,1,1-,2-(O-CHLOROPHENYL)- 2-(P-CHLOROPHENYL	000789-02-6	X			
TRICHLOROETHYLENE	000079-01-6	X			
TRICHLOROMETHINE	000817-09-4	X			
TRICHLOROPHENOL, 2,4,6-	000088-06-2	X			
TRICHLOROPROPANE, 1,2,3-	000096-18-4	X			
TRIMETHADIONE	000127-48-0		X		
TRP-P-1(3-AMINO-1,4-DIMETHYL-5H-PYRIDO[4,3-b] INDOLE)	062450-07-1	X			
TRP-P-2(3-AMINO-1-METHYL-5H-PYRIDO[4,3- b]INDOLE)	062450-06-0	X			
TRYPAN BLUE	000072-57-1	X			
URACIL MUSTARD	000066-75-1	X			
URETHANE	000051-79-6	X			
VALENTINITE	001317-98-2	X			
VALPROIC ACID	000099-66-1		X		
VANADIUM PENTOXIDE	001314-62-1			X	
VENOM, SNAKE- CROTALUS ADAMANTEUS	000000-00-0			X	
VENOM, SNAKE- CROTALUS ATROX	000000-00-0			X	
VINYL ACETATE	000108-05-4	X			
VINYL BROMIDE	000593-60-2	X			
VINYL CHLORIDE	000075-01-4	X	X		
VINYL FLUORIDE	000075-02-5	X			
VINYLCYCLOHEXENE, 4-	000100-40-3	X			
VINYLCYCLOHEXENE DIEPOXIDE	000107-87-6	X			
VINYL-1-CYCLOHEXENE DIEPOXIDE, 4-	000106-87-6	X			
VITAMIN A CONSUMPTION	000068-26-8		X		
WARAFIN	000081-81-2		X		
WELDING FUMES	000000-00-0	X			
XYLIDINE	001330-73-8			X	X
ZINC CHROMATE HYDROXIDE	013530-65-9	X			
ZINC CHROMATE (VI) HYDROXIDE HYDRATE	015930-94-6	X			

Appendix H: Allowable Quantities of Flammable and Combustible Liquids

(NFPA 30 / 29 CFR 1910.106)

Classifications

Flammable liquids are categorized into three groups as follows:

- Class IA – Liquids having flashpoints below 73° F (22.8° C) and having boiling points below 100°F (37.8°C). Examples: Acetaldehyde, ethyl ether and cyclohexane.

- Class IB – Liquids having flashpoints below 73° F (22.8° C) and having boiling points at or above 100° F (37.8°C). Examples: Acetone, benzene and toluene.

- Class IC – Liquids having flashpoints at or above 73° F (22.8° C) and having boiling points below 100° F (37.8°C). Examples: Hydrazine, styrene and turpentine.

A combustible liquid is any liquid having a flashpoint at or above 100° F (37.8° C). Combustible liquids are divided into two classes:

- Class II – Liquids having flashpoints at or above 100° F (37.8° C) and below 140° F (60° C), except any mixture having components with flashpoints of 200°F (93.3°C) or higher, the volume of which make up 99 percent or more of the total volume of the mixture. Examples: Acetic acid, and Stoddard solvent.

- Class III – Liquids having flashpoints at or above 140°F (60°C). Class III liquids are subdivided into two subclasses:
    - Class IIIA – Liquids having flashpoints at or above 140°F (60°C) and below 200°F, except any mixture having components with flashpoints of 200°F (93.3°C) or higher, the total volume of which make up 99 percent or more of the total volume of the mixture. Examples: Cyclohexanol, formic acid and nitrobenzene.

    - Class IIIB – Liquids having flashpoints at or above 200°F (93.3°C). Examples: Formalin and picric acid.

Per 1910.106(a)(18)(ii)(b) "Class IIIB liquids" shall include those with flashpoints at or above 200°F (93.3°C). This section does not cover Class IIIB liquids. Where the term "Class III liquids" is used in the section, it shall mean only Class IIIA liquids. (Class IIIB is used in this document for reference purposes only.)

*Note: When a combustible liquid is heated for use to within 30°F (16.7°C) of its flashpoint, it shall be handled in accordance with the requirements for the next lower class of liquids (1910.106(a)(18)(iii)).

Storage Container Requirements

One technique to reduce the hazards associated with flammable and combustible liquids is the use of safety cans. OSHA defines a safety can as " An approved container, of not more than 5 gallons capacity, having a spring-closing lid and spout cover and so designed that it will safely relieve

internal pressure when subjected to fire exposure" (1910.106(a)(29)).

In addition to the storage of flammable and combustible liquids in safety containers, 29 CFR 1910.106 limits the amount of liquid in a single container. The following chart shows what the allowable amounts of liquid are for each class of liquid.

MAXIMUM ALLOWABLE SIZE OF CONTAINERS AND METAL PORTABLE					
Container Type	***Flammable Liquids***			***Combustible Liquids***	
	Class IA	Class IB	Class IC	Class II	Class III
Glass or approved plastic	1 pt.	1 qt.	1 gal.	1 gal.	1 gal.
Metal (other than DOT drums)	1 gal.	5 gal.	5 gal.	5 gal.	5 gal.
Safety Cans	2 gal.	5 gal.	5 gal.	5 gal.	5 gal.
Metal Drum (DOT spec.)	60 gal.	60 gal.	60 gal.	60 gal.	60 gal.
Approved Metal Portable Tanks	660 gal.	660 gal.	660 gal.	660 gal.	660.gal

Storage Quantities

29 CFR 1910.106 also limits the total amount of a liquid kept outside of a cabinet or storage room. The quantity of liquid that may be stored outside of an inside storage room or a cabinet in any one fire area/laboratory of a building cannot exceed:

		Quantity		**Special Notes**
	Liquid Class(es)	**gal**	**L**	
Flammable liquids	IA	30	115	1 , 2
	IB and IC	120	460	1, 2
	IA, IB, IC combined	120	460	1, 2, 3
Combustible liquids	II	120	460	1, 2
	IIIA	330	1,265	1, 2
	IIIB	13,200	50,600	1, 4

Special Notes:

(1) Quantities are permitted to be increased 100 percent where stored in approved flammable liquids storage cabinets or in safety cans in accordance with the fire code. Where Note 2 also applies, the

increase for both notes is permitted to be applied accumulatively.

(2) Quantities are permitted to be increased 100 percent in buildings equipped throughout with an automatic sprinkler system installed in accordance with NFPA 13, *Standard for the Installation of Sprinkler Systems*. Where Note 1 also applies, the increase for both notes is permitted to be applied accumulatively.

(3) Containing not more than the maximum allowable quantity per control area of Class IA, Class IB, or Class IC flammable liquids, individually.

(4) Quantities are not limited in a building equipped throughout with an automatic sprinkler system installed in accordance with NFPA 13,

Storage Cabinets

The volume of Class I, Class II, and Class IIIA liquids stored in an individual storage cabinet shall not exceed 120 gals (460 L).

The total aggregate volume of Class I, Class II, and Class IIIA liquids in a group of storage cabinets shall not exceed the maximum allowable quantity of flammable and combustible liquids per control area based on the occupancy where the cabinets are located.

Appendix I: General Chemical Segregation

When certain hazardous chemicals are stored or mixed together, violent reactions may occur because the chemicals are unsuitable for mixing, or are incompatible. Classes of incompatible chemicals should be segregated from each other when in storage. Use the following general guidelines.

HAZARD CLASS	RECOMMENDED STORAGE METHOD	EXAMPLES	INCOMPATIBILITIES CHECK SDS/MSDS
Oxidizers	Store inside a noncombustible cabinet, separate from flammable and combustible materials. Store inorganic oxidizers, organic peroxides, separate from each other via secondary containment.	Inorganic oxidizers - Sodium hypochlorite, ammonium nitrate Organic peroxides – methyl ethyl ketone peroxide, allyl compounds, haloalkenes, dienes, monomeric vinyl compounds,	Separate from reducing agents, flammables and combustibles
Flammable Liquids	Store in grounded flammable storage cabinet.	Acetone, benzene, methanol, ethanol, toluene	Separate from acids, bases, oxidizers, and poisons.
Flammable Solids	Store in grounded flammable storage cabinet. Flammable solids must be segregated from flammable liquids using secondary containment.	Phosphorus, lithium, sodium, potassium	Separate from acids and oxidizers.
Corrosives Acids	Store in separate acid storage cabinet. Within the acid cabinet store each of the following groups separately via secondary containment: oxidizing acids, flammable (organic) acids, and mineral acids.	Oxidizing acids - nitric acid, perchloric acid, chromic acid, picric acid Flammable and organic acids – glacial acetic acid, trifloroacetic acid, trichloroacetic acid Mineral acids - Hydrochloric acid, sulfuric acid, phosphoric acid	Separate from flammable liquids, flammable solids, bases, oxidizers.

CLASS OF CHEMICALS	RECOMMENDED STORAGE METHOD	EXAMPLES	INCOMPATIBILITIES CHECK SDS/MSDS
Corrosives - Bases	Store in separate storage cabinet. Store inorganic bases separate from reducing agents via secondary containment.	Inorganic bases – sodium hydroxide, potassium hydroxide, ammonium hydroxide Reducing agents – Lithium aluminum hydride, sodium borohydride, lithium borohydride	Separate from oxidizers and acids.
General Chemicals Non-reactive	Store on general laboratory benches or shelving preferably below eye level.	Agar, sodium chloride, sodium bicarbonate, and most non-reactive salts	See SDS/MSDS
Water Reactive Chemicals	Store in dry, cool, location, protect from water fire sprinkler. Note: Many water reactive chemicals are flammable solids. If flammable solid, store as such. If not, store separately from all other chemicals.	Sodium metal, potassium metal, lithium metal, lithium aluminum hydride	Separate from all aqueous solutions, and oxidizers.
Poisons (Toxicological Hazard)	If poisons can be categorized as oxidizer, acid, or flammable, store as such. If non-reactive but highly toxic store separately from all other chemicals.	Cyanides, heavy metals compounds (e.g., cadmium, mercury, osmium) methyl iodide, dimethyl sulfate, mercury	Flammable liquids, acids, bases, and oxidizers.

EYEWASH TESTING LOG

Per ANSI Z358.1-2009
"Eyewashes shall be activated weekly for a period long enough to verify operation and ensure that flushing fluid is available."

If eyewash is not working properly contact your department administrator to submit a work order.

Date Tested	Initials of Tester		Date Tested	Initials of Tester

TO BE POSTED NEAR EYEWASH STATION

TEXAS STATE

EMERGENCY

Police * Fire * Medical

DIAL 911

NON - EMERGENCY

University Police http://www.police.txstate.edu/	**512-245-2805**
Student Health Center http://www.healthcenter.txstate.edu/	**512-245-2161**
Poison Control Center http://www.poisoncontrol.org/	**1-800-222-1222**
Parking Services http://www.parking.txstate.edu/	**512-245-2887**

Environmental Health, Safety & Risk Management

http://www.fss.txstate.edu/ehsrm/

8 – 5 pm: 512-245-3616

After Hours: 512-738-6650