Alfred University

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CHEMICAL HYGIENE PLAN

Version 02.06.16

ALFRED UNIVERSITY CHEMICAL HYGIENE PLAN

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PART I Scope, Application and Compliance

1.1 SCOPE

The OSHA Lab Standard☑, 29 CFR 1910.1450, "Occupational Exposure to Hazardous Chemicals in Laboratories" mandates a Chemical Hygiene Plan (CHP) be developed to protect employees engaged in the laboratory use of hazardous chemicals. OSHA describes "a CHP as a written program developed and implemented by the employer which sets forth procedures, equipment, personal protective equipment and work practices that are capable of protecting employees from health hazards presented by hazardous chemicals used in that particular workplace and assuring exposures to OSHA regulated substances do not exceed the permissible exposure limits specified in 29 CFR part 1910, subpart Z☑".

Alfred University (AU) has written this document, consisting of **Part I** Scope, Application and Compliance, **Part II** General Standard Operating Procedures (SOPs) and **Appendices**, to serve as the AU institutional CHP. Applicable to all AU laboratories, it provides information, policies, practices, and procedures to ensure the safety of laboratory employees engaged in the laboratory use of hazardous chemicals. This AU institutional CHP must be supplemented with laboratory specific SOPs laboratory specific training to meet the requirements of the OSHA Lab Standard. This supplemented document then constitutes the CHP for a laboratory, department or division within the College of Liberal Arts and Sciences, the School of Engineering and the New York State College of Ceramics.

All laboratory faculty and staff are responsible for complying with the standards put forth in this document with the common goal of promoting a healthy and safe working environment for both employees and students. Prior to the commencement of laboratory duties, all employees must read the CHP and follow all policies and procedures as specified. Employees sign the Employees Annual Site-Specific CHP Review Form, Appendix E☑. The form is inserted into the lab/division CHP; employees review CHP and sign form annually. Failure to review and sign the form does not absolve the employee from the legal responsibilities or requirements of the OSHA Lab Standard or Alfred University CHP. Students who get paid for working in a lab are AU employees and are, therefore, subject to the requirements of the OSHA Lab Standard and the CHP. Other employees (such as office, custodial, maintenance and repair personnel) who regularly spend a significant amount of their time within a laboratory environment as part of their duties also may fall under the requirements of the OSHA Lab Standard.

The CHP must be readily available to employees, employee representatives and, upon request, to the Assistant Secretary of Labor for Occupational Safety and Health, U.S. Division of Labor, or their designee. The institutional CHP is located online at the EH&S Website☑. Hardcopies of the CHP containing lab specific SOPs must be located within each Division/Department or laboratory. Electronic versions of lab specific SOPs are preferred to allow for laboratory specific SOPs to be posted on the EH&S webpage. A list of EH&S acronyms used in this document is also available on the EH&S Website.

The CHP contains external document links and internal document links and bookmarks. External links connect to resources or information outside the CHP document through your default web browser. Internal links and bookmarks connect to sections within the CHP document. Move around the document by utilizing and customizing the Navigation Panels and Toolbar selections

available in the View option of the Adobe Acrobat Reader menu bar. If you discover a broken web link, please email EH&S☑; indicate the section, page number and the name of the link. Contact EH&S with questions or suggestions to improve this document.

EH&S is responsible for maintaining the AU institutional CHP. The EH&S Coordinator is the Chemical Hygiene Officer (CHO) and has the overall responsibility for implementation and interpretation of the CHP. The CHP is considered a living document; the Chemical Hygiene Committee (CHC) shall annually review and evaluate the effectiveness of the CHP and update it as necessary. Laboratory Supervisors, Faculty and Principle Investigators (LSF/PI) will develop laboratory specific SOPs for the lab/department CHP; update as required.

In addition to the CHC, other committees have authority to regulate certain aspects of work in laboratories. This document does not preempt any of the regulations issued by other committees (e.g. Radiation Safety, Institutional Biosafety, Animal Care and Use, Human Subjects). In cases where the jurisdictions of two committees overlap, the more stringent regulation will apply.

1.2 APPLICATION

The AU CHP applies only to laboratories; it is applicable to all laboratories that utilize hazardous chemicals, regardless of the area of research or laboratory activity. Science and engineering laboratories are examples of workplaces where the CHP is applicable.

OSHA defines 'laboratory' as a "facility where the 'laboratory use of hazardous chemicals' occurs. It is a workplace where relatively small quantities of hazardous chemicals are used on a non-production basis".

OSHA defines 'laboratory use of hazardous chemicals as "handling or use of such chemicals in which all of the following conditions are met:

- Chemical manipulations are carried out on a 'laboratory scale' (excludes those workplaces whose function is to produce commercial quantities of materials);
- Multiple chemical procedures or chemicals are used;
- The procedures involved are not part of a production process, nor in any way simulate a production process; and
- Protective laboratory practices and equipment are available and in the common use to minimize the potential for employee exposure to hazardous chemicals."

OSHA defines a 'hazardous chemical', as a "chemical for which there is statistically significant evidence based on at least one study conducted in accordance with established scientific principles that acute or chronic health effects may occur in exposed employees. The term 'health hazard' includes chemicals that are carcinogens, toxic or highly toxic agents, reproductive toxins, irritants, corrosives, sensitizers, hepatotoxins, nephrotoxins, neurotoxin,
agents that act on the hematopoietic systems, and agents which damage the lungs, skin, eyes, or mucous membranes".

Non-laboratory workplaces, such as painting studios, printing shops, work or maintenance shops, that use or store hazardous chemicals shall comply with 29 CFR part 1910.1200, (Hazardous Communication Standard). AU HazCom Plan is located on the EH&S Website.

1.3 COMPLIANCE

1.3.1 REQUIREMENTS

The Lab Standard requires that a CHP shall include each of the following elements and shall indicate specific measures that the employer will take to ensure laboratory employee protection:

1. Standard operating procedures relevant to safety and health considerations to be followed when laboratory work involves the use of hazardous chemicals;
2. Criteria that the employer will use to determine and implement control measures to reduce employee exposure to hazardous chemicals including engineering controls, the use of personal protective equipment and hygiene practices; particular attention shall be given to the selection of control measures for chemicals that are known to be extremely hazardous; the requirement that fume hoods and other protective equipment are functioning properly and specific measures that shall be taken to ensure proper and adequate performance of such equipment;
3. Provisions for employee information and training;
4. Circumstances under which a particular laboratory operation, procedure or activity shall require prior approval before implementation;
5. Provisions for medical consultation and medical exams;
6. Designation of responsibility for the implementation for the CHP, assignment of a CHO, and establishment of a CHC.
7. Provisions for additional employee protection for work with particularly hazardous substances. These include “select carcinogens,” reproductive toxins and substances that have a high degree of acute toxicity. Specific consideration shall be given to the following provisions which shall be included where appropriate: establishment of a designated area, use of containment devices such as fume hoods or glove boxes, procedures for safe removal of contaminated waste, and decontamination procedures.

The Lab Standard also requires the University to set forth procedures for the following:

- Exposure monitoring,
- Hazard identification with respect to labels and safety data sheets,
- Provisions that shall apply to chemical substances developed in the laboratory,
- Use of respirators,
- Recordkeeping,
- Emergency response.

1.3.2 AU COMPLIANCE POLICIES

1.3.2.1 STANDARD OPERATING PROCEDURES

The OSHA Lab Standard mandates: “Standard Operating Procedures (SOPs) relevant to safety and health considerations be followed when laboratory work involves the use of hazardous chemicals (29 CFR 1910.1459(e)(3) (i)) and site-specific SOPs must be developed if lab operations include the routine use of ‘select carcinogens,' reproductive toxins [or] substances which have a high degree of acute toxicity (29 CFR 1910.1459(e)(3) (viii))”.

The AU CHP includes a “General SOP” that specifies general health and safety policies and procedures for using hazardous chemicals to which all laboratories must adhere.

It is the responsibility of each division or program chair or LSF/PI to establish "site-specific SOPs" relevant to the hazardous operations and use of hazardous chemicals in their laboratory including equipment/process emergency shutdown and laboratory evacuation procedures. Each site-specific SOP must be written as presented in Part II Standard Operating Procedures☑ using Appendix W☑ and added to this document.

1.3.2.2 CONTROLS TO REDUCE EMPLOYEE EXPOSURE TO HAZARDOUS CHEMICALS

Alfred University will ensure that engineering control systems and other protective equipment and practices are in place and functional and meet the requirements for procedures performed.
Follow procedures in Part II Control Measures☑.

Repair and maintenance of engineering control systems in both private and public buildings, is the responsibility of the respective Physical Plant and NYSCC Maintenance Facilities. Any observed malfunction should be reported immediately. Post "DO NOT USE" signs on the malfunctioning unit. See Appendix B☒ for building list and phone numbers.

1.3.2.3 EMPLOYEE INFORMATION AND TRAINING

All individuals who work in laboratories must be apprised of the hazards of the chemicals present in their work area. The information and training as outlined below must be provided at the time of an employee's initial assignment and prior to assignments involving new exposure situations. All training records must be retained; labs/departments/divisions should maintain a notebook or file for site-specific training records and manage forms as instructed in this CHP.
The training program for laboratory workers consists of three parts:

1. OSHA Lab Standard training - conducted or coordinated by EH&S on an annual basis;

2. Site-specific training – provided by the LSF/PI;

3. Other types of training - conducted or coordinated by the LSF/PI or EH&S.

1.3.2.3.1 OSHA Lab Standard Training

Provides a brief overview of the necessary mechanisms used to reduce employee exposure to harmful chemicals in the laboratory.

Training must be renewed annually by the LSF/PI and include:

- The applicable details of the employer's written Chemical Hygiene Plan;
- Methods and observations that may be used to detect the presence or release of a hazardous chemical (such as monitoring conducted by the employer, continuous monitoring devices, visual appearance or odor of hazardous chemicals when being released, etc.);
- The physical and health hazards☑ of chemicals in the work area;
- The measures employees can take to protect themselves from these hazards, including specific procedures implemented to protect employees from exposure to hazardous chemicals, especially 'particularly hazardous substances☑' (PHS), such as appropriate work practices, emergency procedures and personal protective equipment☑ to be used;
- Informing employees of:
  - The contents of The OSHA Lab Standard☑ and it's Appendix A☑ and Appendix B☑ ;
  - The location and availability of the Chemical Hygiene Plan;
  - The Permissible Exposure Limits☒ (PEL) - 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; and
- The location and availability of known reference material on the hazards, safe handling, storage and disposal of hazardous chemicals found in the laboratory including, but not limited to, Safety Data Sheets. Reference list offered by OSHA☑ .

1.3.2.3.2 Site-Specific Training

While 'general' laboratory safety procedures are presented in Part II of this document, any lab specific information and procedures must be clearly presented to the employees during site-specific training. The LSF/PI must ensure that all workers are trained to deal with the hazards found in his/her lab.

- Training requirements can be met with the use of demonstrations, videos, single or group training sessions, handouts, etc., along with the opportunity for question/answer dialogue. Site-specific training must include:
  - Instruction in lab-specific Engineering Controls☑.
  - Instruction in lab-specific Administrative Controls. ☑
  - Instruction in lab-specific:
    - Emergencies - chemical spill, fire, shutdown, evacuation, etc.
    - SOPs for hazardous chemicals and operations.
    - Location and operation/use of PPE, showers, eyewashes, etc.
    - Location and use of CHP, SOPs, SDS's and other reference materials.
      - See Part I, Hazard Identification With Respect to Safety Data Sheets☑.
      - See Part II, Safety Data Sheets☑.
- All training should be presented in a manner that the employee can understand. Each affected employee shall demonstrate an understanding of the training specified and the ability to perform the task properly, before being allowed to do the work. Authorization to perform the task is given by the LSF/PI by completing Appendix G LSF/PI Site Specific Authorization Form for Laboratory Employees☑ and attaching copy of the form to the SOP.
- When the LSF/PI has reason to believe that any affected employee who has already been trained does not have the understanding and skill required, the LSF/PI shall retrain that employee until understanding has been achieved. Other circumstances where retraining is required include, but are not limited to, situations where changes in the workplace render previous training obsolete; changes in the materials to be used render previous training obsolete.
- Testing and Documentation Requirements
  - The LSF/PI shall verify that each affected employee has received and understood the required training through a written certification (test) that contains the name of the employee trained, the date(s) of training, and the subject of the certification.
  - Site-specific training must be documented with the training date, description of the information covered during the training session, the LSF/PI name and the name and signature of the employees attending the training session. See the Site-specific Training Form Appendix F☑. The employees shall sign the form at the end of the training session as they will be signing the statement ***"I, the undersigned, have participated in this safety training session and fully understand the information provided."***
- Recordkeeping requirements:
  - Retain training documentation records in the lab/department/Division training file;
  - Send copies of the completed Site-specific Training Form to EH&S;
  - Attach a copy of the signed Appendix G LSF/PI Site Specific Authorization Form for Laboratory Employees☑ to the SOP.

1.3.2.3.3 Other Types of Training

Other types of training provide instruction and information related to other health and physical hazards that may be encountered in the employees work area.

- Examples of training that may be necessary include, but are not limited to:
  - **Hazardous waste training** is mandatory for anyone who will be generating hazardous waste.
  - **Radiation safety training** is required for people working with radioactive materials.
  - **Laser safety training** is required for people working with lasers.
  - **Biosafety and/or Bloodborne Pathogens training** is required for people working with Biohazardous materials.
  - **SDS Online Administrative training** is required for SDS SDS Managers.

1.3.2.4 OPERATIONS, PROCEDURES, ACTIVITIES REQUIRING PRIOR APPROVAL

In order to protect the health and safety of laboratory employees and ensure compliance of regulatory requirements and sponsored research requirements prior approval from EH&S, a specific campus committee, Administrator or support facility is required **before** certain operations, procedures or activities can take place or be implemented. The circumstances under which prior approval is required and the procedure for obtaining such approval are found in Part II, Prior Approval☑ section 2.3.3.1.

1.3.2.5 PROVISIONS FOR MEDICAL CONSULTATION AND EXAMS

Employees have the right to obtain medical consultation under the circumstances listed below; it is, therefore, essential that each employee inform his/her LSF/PI in every case involving a suspected chemical over-exposure. The LSF/PI will initiate the investigation procedure with EH&S.

- Alfred University shall provide all employees who work with hazardous chemicals an opportunity to receive medical attention, including any follow-up examinations that the examining physician determines to be necessary, under the following circumstances:
  - Whenever an employee develops signs or symptoms, Appendix H☑, associated with a hazardous chemical to which the employee may have been exposed in the laboratory, the employee shall be provided an opportunity to receive an appropriate medical examination.
  - Where exposure monitoring reveals an exposure level routinely above the action level (or in the absence of an action level, the PEL) for an OSHA regulated substance for which there are exposure monitoring and medical surveillance requirements. Medical surveillance shall be established for the affected employee as prescribed by the particular standard.
  - Whenever an event takes place in the work area such as a spill, leak, explosion, or other occurrence resulting in the likelihood of a hazardous exposure, the affected employee shall be provided an opportunity for medical consultation. Such consultation shall be for the purpose of determining the need for a medical examination.
- All medical examinations and consultations shall be performed by or under the direct supervision of a licensed physician and shall be provided without cost to the employee, without loss of pay and at a reasonable time and place during normal working hours.
- AU will provide the following information to the physician:
  - The identity of the hazardous chemical(s) to which the employee may have been exposed, which may include the safety data sheet(s) for the hazardous chemical(s); A description of the conditions under which the exposure occurred including date and an approximate exposure time/duration, if available;
  - A description of the signs and symptoms of the exposure that the employee is experiencing, if any.

- AU will obtain a written opinion, for required examinations or consultations, from the examining physician that shall include the following:
  - Any recommendation for further medical follow-up;
  - The results of the medical examination and any associated tests;
  - Any medical condition that may be revealed in the course of the examination that may place the employee at increased risk as a result of exposure to a hazardous workplace;
  - A statement that the physician has informed the employee of the results of the consultation or medical examination and any medical condition that may require further examination or treatment.
- The written opinion shall not reveal specific findings of diagnoses unrelated to occupational exposure.

1.3.2.6 CHEMICAL HYGIENE RESPONSIBILITIES

This section designates authority and responsibility for Chemical Hygiene on the campus of Alfred University.

1.3.2.6.1 President of Alfred University

The President of Alfred University has the ultimate responsibility for chemical hygiene within the institution and, along with other officers and administrators, provides continuing support for efforts to improve laboratory safety and health.

1.3.2.6.2 Vice President for Business and Finance

The VP for Business and Finance supervises the CHO and authorizes her/him to take the necessary steps to carry out the objectives of the CHP.

1.3.2.6.3 Provost, Deans, Directors, and Chairpersons

The Provost, Deans, Directors, and Chairpersons are responsible for laboratory safety within the college, program or division.

The Provost, Deans, Directors, and Chairpersons responsibilities are:

- Be familiar with and promote the objectives and requirements of the AU CHP to faculty, staff (part-time or temporary), student employees, visiting professors or volunteers working in laboratories.
- Assist the CHO with implementation of the CHP.
  - Direct laboratory personnel, including but not limited to LSF/PIs, faculty, lab technicians, regular and temporary employees, visiting professors, and student employees to obtain the training required by the CHP before working with hazardous chemicals or performing hazardous operations.
  - Ensure laboratory personnel adhere to the policies and procedures specified in the CHP.
    - Site-specific SOPs are written and added to the AU institutional CHP.
    - SDS “SDS Managers” are appointed.
- Review, approve and submit Prior Approval Notification Form as necessary (See appendix A).
- Ascertain safety needs are met and ensure that proper safety equipment is available (e.g., engineering controls, personnel protective equipment).
- Ensure compliance with applicable federal, state and local regulations.
- Ensure noncompliance issues identified in safety audits are promptly corrected.
- Encourage the employee participation in safety committees.

- Ensure laboratory emergency shutdown and evacuation procedures are established and conveyed to employees.
- Establish priorities, objectives, and targets for laboratory safety and health performance. Obtain assistance and guidance from EH&S when necessary.
- Promote EH&S consultations and inspections to regularly check laboratory performance against regulatory requirements and identify opportunities for improvement.
- Notify EH&S before a faculty member leaves AU to ensure proper laboratory clean out and management of chemicals. See policy for vacating laboratories☑ (See section 2.3.3.8 and appendix 4).
- Inform EH&S of plans for laboratory renovations or new laboratory construction projects.

1.3.2.6.4 Office of Environmental Health and Safety (EH&S)

The Environmental Health and Safety Coordinator is the **Chemical Hygiene Officer**. The Chemical Hygiene Officer (CHO) will exercise her/his authority in order to minimize the short and long-term dangers to laboratory employees, other workers, the community, and the environment.

- The Environmental Health and Safety Coordinator/CHO:
  - Reports to the Director of Capital;
  - Assists with employee chemical health and safety trainings and associated activities;
  - Has the authority to shut down or suspend operations that do not conform to health and safety practices required by this CHP;
  - Provide assistance in hazard assessment and standard operating procedure design.
  - Investigates cases of suspected over exposure or exposure due to accident;
  - Acts as Chairperson of the CHC;
  - Works with other members of the CHC to develop and implement appropriate chemical hygiene policies and practices;
  - Ensures that Division Chair and/or LSF/PI is appropriately trained and follows the CHP (See Appendix E – Employee annual site-specific).

1.3.2.6.5 Chemical Hygiene Committee

The CHC is composed of the EHS Coordinator and a technician from a Department/Division in which laboratory work involves the use of hazardous chemicals. See Appendix A☑ for a contact list of members.

- Duties of the CHC:
  - Bi-annual review and revision of the CHP, EH&S will provide updates as needed;
  - Ensure that the CHP is published on the Alfred University web site which is readily accessible to all employees;
  - Communicate to the Division or Division Deans when a CHP review has been completed, who will inform the LSF/PI of any relevant safety information or concerns pertaining to his/her Division.

1.3.2.6.6 Laboratory Supervisors, Faculty and Principal Investigators

Laboratory Supervisors, Faculty, and Principal Investigators (LSF/PI) have the front-line responsibility for ensuring that all work taking place in their teaching or research laboratories is done in a safe and healthy manner and in full compliance with this CHP.
The duties of the LSF/PI include the following:

- Read CHP and applicable SOPs and SDSs, review annually;
  - Sign the Employees Annual Site-Specific CHP Review Form☑, update annually, place signed form in Lab/Division/Department CHP.
- Define

- all hazardous operations, alert employees to the hazards, and establish safe procedures for these operations by selecting suitable engineering controls and personal protective equipment; complete the Hazard Assessment Form Appendix I☑;
- the location of "designated work areas" where "particularly hazardous substances☑" (PHS) will be used.

- Develop
  - site-specific standard operating procedures (SOPs) Appendix W☑ for hazardous chemicals used and operations performed in each laboratory, review and update as needed;
    - laboratory security policies/procedures and emergency procedures for shutdown of operations and evacuation of personnel must be included in site-specific SOPs;
  - the laboratory or department CHP by adding the site-specific SOPs to the AU institutional CHP.
- Obtain 'Prior Approval☑'s as required.
- Ensure:
  - the laboratory/department CHP and any other relevant safety information is available to and read by all laboratory workers;
  - all laboratory employees and students who work with hazardous chemicals and/or perform hazardous operations are provided with laboratory information and training☑, initial and annual refresher, including training on site-specific SOPs and training when employee's duties change;
    - Site-specific Training Form Appendix H☑ is completed and a copy is sent to EH&S;
    - Appendix G LSF/PI Site-Specific Authorization Form for Laboratory Employees ☑is completed and attached to SOP.
    - Completed, read, and sign the appropriate lab safety agreement.
  - all notifications, forms, reports and records are managed as specified in this CHP;
  - File work orders with respective physical plant for any laboratory repairs or maintenance issues.
  - all employees utilize protective equipment necessary for the safe performance of their jobs;
  - proper management of chemical inventory;
    - develop an SOP for procurement of chemicals to include:
      - circumstances requiring prior approval;
      - chemical hazard reduction, quantity/volume reduction;
      - eliminate or minimize use of EPA 31 Priority Chemicals, see EPA link https://www.epa.gov/environmental-topics/land-waste-and-cleanup-topics☒;
      - review of AU campus SDSonline database prior to purchasing chemicals in order to locate desired chemical already available on campus, request use of said available chemical and always obtain permission from owner before using/taking any chemicals;
    - submit annual updated chemical inventory to EH&S by June 15;
      - manage peroxide forming chemicals according to safe storage time limits☑;
  - maintenance of SDS electronic file with ongoing SDS updates for chemicals used in the lab;
    - appoint a 'SDS Manager' for the SDSOnline database.
- Supervise
  - proper accumulation, satellite accumulation area inspection, storage and disposal of unwanted and/or hazardous chemicals and waste from his/her laboratory;
  - monitoring of fume hoods, Appendix P☑ .

- Investigate all accidents that occur in his/her laboratory and take corrective measures to prevent reoccurrence.
  - Report all accidents immediately to EH&S@ 2190.
  - Complete the AU Accident Report☒ and send it to EH&S, within 48 hours. Retain a copy.
  - Report a work related life threatening accident or death **immediately** to 911. As soon as possible, report the even to Public Safety @2108 and EH&S @2190

1.3.2.6.7 Laboratory Employees

Laboratory employees are those who, in the course of their work, are present in the laboratory and are at risk of possible chemical exposure on a regular or periodic basis. These personnel include faculty, laboratory technicians, instructors, researchers, visiting researchers, teaching assistants, graduate assistants, student aides, and part-time and temporary employees.

Responsibilities of laboratory employees:

- Read CHP and applicable SOPs and SDSs, review annually;
  - Sign the Employees Annual Site-Specific CHP Review Form☑and Safety Agreement form, and update annually;
  - SDSs are accessible to all AU employees at the EH&S web site https://chemmanagement.ehs.com/9/b8407485-a573-43bc-a8f4-8acdb302393c/ebinder ☑;
  - SDS hard copies must be available in areas without computer access;
- Follow all rules, health and safety standards and perform work in accordance with the CHP and applicable SOP's for the laboratory in which he or she works;
- Report all hazardous conditions or problems related to their laboratory to the LSF/PI, or the CHO if the LSF/PI is unavailable;
- Report any suspected job-related injuries or illnesses to the LSF/PI and seek treatment immediately;
- Obtain the proper training and authorization required for the work you will be performing. Do not perform any hazardous duties nor operate any equipment or instrumentation without proper instruction and authorization from LSF/PI (Site-Specific Authorization Form for Laboratory Employees)
- Inform the LSF/PI of any substantive changes in protocol, or the introduction of new chemicals to a procedure.

1.3.2.7 PROCEDURES AND PRECAUTIONS FOR WORKING WITH PARTICULARLY HAZARDOUS SUBSTANCES (P-Listed)

The Lab Standard requires that special consideration be given to provisions for additional protection for employees who work with particularly hazardous substances (PHS). These substances include "select carcinogens", reproductive toxins and substances which have a high degree of acute toxicity. Definitions and procedures for use of these substances are detailed in Part II Particularly Hazardous Substances☑. (?)

1.3.2.8 EXPOSURE MONITORING

Employee exposure determination shall be done in accordance with paragraph (d) of the 29 CFR 1910.1450 of the OSHA Lab Standard☑.

- Initial monitoring will be performed if there is reason to believe that exposure levels for a substance routinely exceed the action level or in the absence of an action level, the permissible exposure limit (PEL).

- If the initial monitoring performed discloses the employee was over-exposed, AU shall immediately comply with the exposure monitoring provisions of the relevant standard.
- Within 15 working days after the receipt of any monitoring results, the employee will be notified of these results in either writing individually or by posting results in an appropriate location that is accessible to employees.
- Monitoring may be terminated when exposure levels have been mitigated.
- Anyone with reason to believe that exposure levels for a substance routinely exceeds the PEL may request an investigation by your LSF/PI with additional support from EH&S☑.

1.3.2.9 HAZARD IDENTIFICATION WITH RESPECT TO LABELS AND SAFETY DATA SHEETS

- Labels
  - Ensure that labels on incoming containers of hazardous chemicals are not removed or defaced.
  - See Labeling procedures☑.
- Safety Data Sheets
  - SDSs are centrally maintained and managed on the World Wide Web by AU EH&S along with a network of campus 'SDS Managers' using the private vendor software of SDS Online, Inc, 350 North Orleans, Ste. 950, Chicago, IL 60654. This vendor updates our SDS's to the most current available from the chemical manufacturer.
  - SDSs of new hazardous chemicals are immediately added to the AU SDS Online Program database by 'SDS Managers'. 'SDS Managers' are appointed by LSF/PI or Chairperson.
    - Training for 'SDS Managers' is available through EH&S☑.
  - SDSs are accessible to all AU employees via the EH&S page on the Our Alfred web site. The direct link is: http://people.alfred.edu/~envhealthsafety/SDS/SDS.htm☑.
    - SDS hard copies must be available in areas without computer access.
  - See Part II SDS procedures☑.

1.3.2.10 PROVISIONS THAT SHALL APPLY TO CHEMICAL SUBSTANCES DEVELOPED IN THE LABORATORY

Chemical substances developed in the laboratory are properly labeled and stored with SDSs developed and managed as detailed in the **Part II** Hazard Identification Labeling☑, Chemical Substances Developed in the Laboratory☑, Safety Data Sheets☑ sections of this CHP.

1.3.2.11 RECORDKEEPING

Alfred University shall establish and maintain for each employee an accurate record of any measurements taken to monitor employee exposures and any medical consultation and examinations including tests or written opinions. AU shall assure that such records are kept, transferred, and made available to the employee. Appropriate confidentiality will be maintained.

All training records, including Training Form Appendix H☑, must be retained; labs/departments/divisions should maintain a notebook or file for site-specific training records. Ensurea copy of all completed site-specific training forms are available upon request.

1.3.2.12 EMERGENCY RESPONSE

To call for emergency assistance:

Using a campus phone dial 911 then 2108 AU Public Safety or 2190 EH&S
Using a cell phone dial 911 then 607-871-2108 Public Safety or 607-871-2190 EH&S

- For campus emergencies, follow the emergency procedures printed on the outside of the AU Emergency Response Information Folder. Each AU employee has received this orange folder. An Emergency Response Activation Flowchart and list of Evacuation Assembly Areas are found inside the Folder. This list indicates the closest exit to use for evacuation and the specific outside area for assembly for a given location within each building. The list is also found on the EH&S website☑ under Programs, Policies, Manuals.
  - The Building Contact and Safety Monitor (BC/SM), appointed for each campus building by EH&S, assists with administering emergency drills and is in charge during the drill. List of BC/SMs found on the EH&S website☑ under Programs, Policies, Manuals.
  - All building occupants must exit the building IMMEDIATELY upon the sounding of the fire alarm or as instructed to do so by the BC/SM. Disciplinary action will result for noncompliance of evacuation.
    - The LSF/PI must be the last to leave the lab or area, ensuring all occupants have evacuated, closing the door behind him/her.
  - All building occupants must report to the designated assemble area and remain there until accounted for by the BC/SM. They may then leave when discharged by the BC/SM or official emergency personnel.
  - During an actual emergency evacuation the BCP/SM
    - transfers pertinent information to official emergency personnel (authority on scene);
    - ensures no one re-enters the evacuated area;
    - takes attendance of evacuees in assembly area;
    - releases evacuees from the assembly area, if or when appropriate.
- For laboratory emergency situations including but not limited to explosion, fire or chemical spills requiring assistance **also** see Part II of this CHP for Emergency procedures☑ .
  - The LSF/PI must ensure that lab employees know the location and/or proper use of:
    - emergency notification systems, telephones,
    - first-aid kits, HF first aid kits
    - chemical spill-kits, HF spill kits
    - fire extinguishers, blankets
    - emergency safety shower/eyewashes,
    - emergency shutdown procedures, exits and evacuation routes,
    - CHP w/ site-specific SOPs,
    - SDSs.
- Emergency Numbers and Exit Route Appendix Z☒ is offered as a convenience for posting in labs and next to emergency phones.

1.3.2.13 WASTE MANAGEMENT

All waste generated by Alfred University must be managed in accordance with federal, state and local regulations. In general, only waste substances listed on the Allegany County Landfill Disposal List and AU Wastewater Discharges to Village of Alfred Sanitary Sewer System Disposal List are allowed to be disposed of in the trash or into the sanitary sewer drain.
Refer to the (AU Hazardous Waste Guide), AU Used Electronics Policy, AU Universal Waste Policy, Regulated Medical Waste Policy and Procedures, Allegany County Landfill Disposal List and AU Wastewater Discharges to Village of Alfred Sanitary Sewer System Disposal List available at EH&S room 117 Myers Hall. Access posted policies at https://my.alfred.edu/environmental-health-safety/☑.

ALFRED UNIVERSITY CHEMICAL HYGIENE PLAN

PART II General Standard Operating Procedures

Procedures for using hazardous chemicals that are not specifically regulated or do not require a site-specific Standard Operating Procedure (SOP).

2.0 INTRODUCTION

It is the policy of Alfred University to provide a safe and healthy work place, free from the hazards associated with exposure to hazardous chemicals. The purpose of Part II is to provide general information and the basic set of practices and procedures that all employees or other persons working in AU laboratories follow.

Division Chairs/Program Chairs/Laboratory Supervisors or Faculty/Principal Investigators are responsible for developing detailed laboratory site-specific SOPs for the chemical and operational hazards in their laboratory. See Developing Site-Specific SOPs Appendix W☑. These site-specific SOPs must be written and added to the institutional CHP to complete the CHP for divisions/laboratories.

2.1 SAFE WORK PRACTICES - EMPLOYEE RESPONSIBILITIES

Safety is the collective responsibility of everyone and requires full cooperation. The focus of the CHP is to minimize contact with potentially harmful substances. This requires knowledge of the hazards posed by a specific substance, the likely or possible routes of contamination, and the equipment and work practices known to be effective in minimizing contamination.

- Every employee who works in a laboratory is required to:
  - Know the location of the CHP and be able to produce the CHP for any state or federal regulatory inspectors upon request.
  - Read the CHP and perform work in accordance with the CHP and applicable SOP's for the laboratory in which he or she works.
  - Sign the Employees Annual Site-Specific CHP Review Form, Appendix E☑; as required.
  - Know the potential hazards and appropriate safety precautions before work begins.
    - Know how to access computer SDSs or know location of hard copies.
    - Read applicable SDS. Be able to answer – What are the hazards? What are the worst things that could happen? What do I need to do to be prepared? What work practices, facilities or PPE are needed to minimize the risk?
  - Become familiar with the location and use of emergency equipment and facilities:
    - Eyewash and drench showers,
    - First aid kits, HF first aid kits
    - Fire extinguishers, blankets, alarms,
    - Emergency shutdown procedures, exits and evacuation routes,
    - Chemical spill kits, HF spill kits
    - Emergency notification systems, telephones.
  - Report to the LSF/PI any major variations involving the frequency, amount, or physical conditions likely to affect exposure to any hazardous chemicals.
  - Report to the LSF/PI any introduction of a new chemical to the work site.
  - Maintain an appropriate level of hygiene at the work site.
  - Be alert to unsafe work conditions and actions and bring them immediately to the attention of the LSF/PI so corrections can be made as soon as possible.

- Never eat, drink, smoke or apply cosmetics in the laboratory, (smoking is not permitted anywhere in academic or facility buildings).
- Needles and syringes must be stored in a locked drawer or cabinet and must never be thrown in the trash, left out on a bench or in washing areas. Use "Sharps" containers and manage as Regulated Medical Waste. Call EH&S @2190 for proper disposal.
- Glassware must never be disposed of in the trash. Use labeled "Glass Disposal" boxes or "Sharps" containers and manage appropriately.
- Never leave open containers of chemicals unattended.
- Clearly label all containers of any substance that will remain at the work site in your absence. See labeling requirements☑.
- Remove barrier protection such as gloves, lab coats, or aprons, before leaving the laboratory.
- Keep potentially contaminated equipment where it will pose no threat to others.
- Decontaminate, clean or sanitize personal protective equipment on a regular basis.
- Properly discard used chemicals, equipment, and any other hazardous waste according to AU policies and local, state and federal regulations.
- In all situations, individual faculty or staff will be responsible for enforcing adequate safety and hygiene measures in laboratories they supervise.

2.2 EMERGENCY PROCEDURES

For emergency assistance, dial 911 using a campus phone or 911 using a cell phone. If assisting chemically contaminated victims, PPE will be necessary.

2.2.1 EMERGENCY NUMBERS

	using a campus phone	or a cell phone
Emergency – Fire/Police/Ambulance	911	911
Alfred University Public Safety	2108	607-871-2108
Environmental Health and Safety	2190	607-871-2190
Radiation Safety	2438	607-871-2438
NYSCC Maintenance, statutory	2460	607-871-2460
Physical Plant non-statutory	2154	607-871-2154
Crandall Health Center (non-emergency)	2400	607-871-2400
Poison Control Hotline	9-1-800-888-7655	800-888-7655

Post emergency numbers in each lab and next to emergency phones.
Appendix Z Emergency Numbers and Exit Route☒ is offered for your convenience.

2.2.2 EMERGENCY EXIT ROUTES

In an emergency it is imperative to exit the building using the closest exit, then meet in the designated Evacuation Assembly Area☑. Remain in the assembly area until you are accounted for and/or discharged by the (BC/SM).

- All hallways and corridors must remain clear of equipment, furniture, and other obstructions that could hinder the means of egress.
- All exit doorways must remain clear and unobstructed.

2.2.3 FIRE EMERGENCY

The Alfred Fire Department will take command as soon as they are on the scene. The (BC/SM) is in charge until the emergency personnel arrives.

- **Evacuation**
  - Evacuation is the highest priority in a fire emergency. Upon the discovery of smoke and/or fire:
    - Close the doors in the fire area;
    - Activate the nearest alarm-pull box; the alarm rings **ONLY** in the building;
    - Evacuate the building immediately using the closest exit and report to the designated Evacuation Assembly Area;
    - Once outside, call for emergency assistance;
    - Report any victims within the building;
    - The LSF/PI must be the last to leave the lab or area, ensuring all occupants have evacuated, closing the door behind him/her;
    - Do not use elevators to evacuate.
  - Personnel may consider use of a fire extinguisher provided he/she has been properly trained. **When in doubt, get out**.
- **Fire extinguishers**
  - The use of fire extinguishers is regulated by OSHA standard (29 CFR 1910.157) ☑.
    - Only properly trained personnel may use a fire extinguisher.
    - Portable fire extinguishers suitable to the existing conditions and hazards shall be provided and maintained in an effective operating condition.
    - Portable fire extinguishers shall be conspicuously located and properly wall mounted where they will be readily accessible.
    - Extinguishers shall not be obstructed or obscured from view.
    - All fire extinguishers are to be visually inspected monthly for broken seals, hose damage, and low gauge pressure, depending on type of extinguisher by the AU personnel designated as Building Inspector. A tag affixed to the extinguisher is initialed by the AU inspector after each inspection.
    - An outside contractor performs annual static pressure testing of all fire extinguishers.
  - The use of a fire extinguisher is not a substitute for calling 911, AU Public Safety and EH&S in the event of a fire.
    - Extinguished fires must be reported to AU Public Safety and EH&S. (NYS regulation)
    - If a fire extinguisher is used, even partially, e-mail a Work Order to the Physical Plant for a replacement extinguisher.
    - All incidences that could have resulted in an injury must be reported to the LSF/PI.
      - Notify EH&S of fire related incidents envhealthsafety@alfred.edu☑.
      - File a completed Accident report☒ with EH&S within 24 hours
- **Drench Showers** - can be used to extinguish clothing fires.
- **Fire Blankets** - can be used to smother fire if clothing catches fire by placing the blanket over the victim and patting out the fire. Do not roll the standing victim into the blanket as this will cause a chimney effect and result in face burns.

2.2.4 ACCIDENTS

- Accidents involving injuries
  - If an employee is injured on University owned or operated space:
    - Call for emergency assistance, if necessary.
    - Immediately report the accident to the LSF/PI.
    - The LSF/PI immediately completes the AU Accident Report form☒ and sends report to HR humanresources@alfred.edu☑.
- Incident and Near Miss = Accident without injury
  - All laboratory incidents must be reported to the LSF/PI immediately.
  - The LSF/PI immediately reports details to EH&S at envhealthsafety@alfred.edu☑.

2.2.5 CHEMICAL SPILLS

- Ensure proper spill cleanup material is available for chemicals used or stored.
  - For spills involving Hydrofluoric acid, refer to Appendix N Hydrofluoric acid☑.
    Hydrofluoric acid spills require specific clean up materials.
- Minor chemical spill A minor chemical spill is one that laboratory personnel can safely handle with the resources/spill materials locally available.

  - If the spilled material is flammable, turn off all ignition and heat sources;
  - Alert people in the immediate area of the spill;
  - Confine the spill to a small area;
  - Stop the source
  - Ensure that the proper personal protective equipment is worn during the clean up (consult the SDS);
  - Neutralize or absorb the spilled chemical with appropriate material (refer to SDS) and store/dispose of according to proper hazardous waste procedures;
  - Wipe area clean.
  - Notify LSF/PI as soon as possible;
- Major chemical spill A major chemical spill is a spill that is beyond your ability to safely or properly clean up.
  - If the spilled material is flammable and only if it is safe to do so – turn off all ignition and heat sources;
  - Evacuate spill area;
  - Close doors to the affected area;
  - Evacuate building if necessary;
  - Call for emergency assistance or EH&S 2190 and notify LSF/PI.

2.2.6 USING EMERGENCY EYEWASHES

If chemical contamination to eyes occurs:

- Yell for help;
- Immediately go to the nearest eyewash, activate the unit and begin flushing;
- Hold eyelids open with fingers and roll eyeballs around to get maximum irrigation;
- Keep flushing for at least 15 minutes, this is most important;
  - If you are alone, call for emergency assistance after flushing at least 15 minutes;
- If wearing contact lenses, remove as soon as possible but do not stop flushing;
- Call for emergency assistance, seek medical attention;
- Complete an Accident Report form☑.
- If someone else in the lab needs to use an eyewash, lead them to the eyewash and activate the unit, help start the flushing as outlined above then call for emergency assistance and go back to assist the person until help arrives.
- For contamination involving Hydrofluoric acid; refer to Appendix N Hydrofluoric acid☑.

2.2.7 USING EMERGENCY SHOWERS

If chemical contamination to skin occurs:

- Yell for help;
- Immediately go to the nearest emergency shower and activate the unit;
- Once under the stream of water, remove contaminated clothing;
- Keep flushing for at least 15 minutes; this is most important;

- If you are alone, call for emergency assistance, after flushing at least 15 minutes;
- Call for emergency assistance, seek medical attention;
- Complete an Accident Report form☒.
- If someone else in the lab needs to use an emergency shower, lead them to the emergency shower, activate the unit, help start the flushing as outlined above then call for emergency assistance, and go back to assist the person until help arrives. If necessary, assist in removing the contaminated clothing, wear gloves, eye protection and avoid contamination. If the victim is reluctant to remove contaminated clothing, use a lab coat, fire blanket, etc. as screen. If there is a large quantity of chemical spilled, contact EH&S 2190 prior to cleaning up the water; there should be no floor drain for an emergency shower.
- For contamination involving Hydrofluoric acid, refer to Appendix N Hydrofluoric acid☑.

2.2.8 EMERGENCY SHUTDOWN AND EVACUATION PROCEDURES

Emergency shutdown and evacuation procedures for labs will be found in the site-specific SOPs located within the laboratory/department/division.

2.3 CONTROL MEASURES

As required by the OSHA Lab Standard AU has established control measures to reduce employee exposure to hazardous chemicals. The engineering and administrative controls, use of personal protective equipment and hygiene practices and establishment of control measures for chemicals that are known to be extremely hazardous, provided in this CHP comply with the requirements and intent of the OSHA Lab Standard to promote a healthy and safe working environment.
The OSHA Lab Standard☑ requires that "fume hoods and other protective equipment function properly and that specific measures are taken to ensure proper and adequate performance of such equipment." The proper functioning and maintenance of fume hoods, local exhaust and general ventilation systems and other protective equipment, (eyewashes, showers, fire extinguishers) used in laboratories, is the responsibility of the AU Physical Plant and NYSCC Maintenance Facilities.

2.3.1 ENGINEERING CONTROLS

General laboratory room ventilation is not adequate to provide proper protection against bench top use of hazardous chemicals. Engineering controls are considered the first line of defense in the laboratory for the reduction or elimination of overexposure to hazardous chemicals.
Examples of engineering controls include dilution ventilation, local exhaust ventilation (fume hoods), glove boxes, safety shields, and proper storage units. See Chemical Fume Hoods and Other Local Ventilation Devices Appendix P☑ for the limitations of and safe work practices for using fume hoods and other local ventilation devices.

- **Chemical Fume Hoods**
  The chemical fume hood is the major engineering control unit in AU laboratories and is intended to provide protection from toxic gasses, vapors, and particulates by maintaining a steady flow of air away from the user.
  - EH&S performs the following on an annual basis.
    - Tests fume hoods for average face velocity and places dated sash height markers on the hood indicating the area where the sash must be placed to achieve a particular face velocity. Face velocities of:
      - **Above 150** (fpm): Unacceptable for laboratory use;

        - **95-125** fpm: Provides adequate control of inhalation exposure to most hazardous substances, including radioactive materials and particularly hazardous substances☑;
        - **80-95** and **125-150** fpm: Adequate for manipulation of laboratory quantities of hazardous materials except radioactive materials and particularly hazardous substances;
        - **Below 80** fpm: Use approved by EHS on case by case basis based on activities, placement of hood, smoke tests, etc.
    - Tests fume hoods for air flow patterns and leakage,
    - Attaches an airflow indicator ribbon to the hood sash or verifies its presence. The indicator shows the direction of airflow, and is the only way to know for certain that air is flowing **into** the hood. Sometimes the air flow is reversed by accident during maintenance.
    - Inspection of fume hood for spills, airflow blockage, and disabled sash stops.
- Laboratory personnel are expected to use fume hoods and other available engineering controls properly to protect themselves while working with hazardous chemicals.
    - Wear proper PPE.
    - Read and follow Chemical Fume Hoods and Other Local Ventilation Devices Appendix P☑
    - **DO NOT USE A HOOD FOR ANY FUNCTION FOR WHICH IT IS NOT INTENDED.** Experiments involving high pressure reactions, heating or volatilizing of Perchloric Acid Appendix O☑ require specially constructed hoods. Specialty hoods are labeled by the manufacturer with the uses for which they are designed and it is dangerous to use a hood not designed for these purposes.
    - Before using a hood:
        - verify airflow **into** the hood by making sure the airflow indicator ribbon is blowing **into** the hood. Also check any air monitoring device if the hood is equipped with one;
        - determine placement of sash to achieve the recommended face velocity and maximum protection for your upper body with sash height always below 14 inches;
        - immediately report any observed malfunction to the LSF/PI or send a work order requesting repair to the proper facility;
        - post a dated “DO NOT USE” sign on the malfunctioning hood.
    - **DO NOT USE A HOOD THAT IS NOT WORKING PROPERLY.**

2.3.2 EYEWASHES AND SAFETY SHOWERS

Laboratories using or storing hazardous chemicals, particularly corrosive chemicals, must have a properly working eyewash and shower readily accessible to lab employees as per OSHA 29CFR 1910-151 (c) ☑ and ANSI Z358.1. The American National Standard Institute (ANSI) sets the construction, water pressure and flow rate standards as well the location, operation, testing, and maintenance requirements for emergency face/eyewash and shower equipment. ANSI standards are not available online. A hardcopy of the ANSI Z358.1-2014 standard is located in EH&S.

- All eyewashes and safety showers must be ANSI approved and installed by AU Physical Plant or NYSCC Maintenance in consultation with EH&S.
    - Hand held eyewash bottles do not qualify as approved eyewashes.
- Emergency eyewash stations and drenching showers must be readily available for employees who work in areas where corrosives are used or stored.
    - There is no threshold quantity of corrosive material that triggers this requirement.
    - Eyewash stations and showers must be located:
        - on the same level as the hazard;

- in an area requiring not more than 10 seconds to reach;
- in a prominent and easily accessible area with unobstructed access.

- LSF/PI ensures/provides lab-specific training of employees addressing the:
  - locations of emergency eyewashes and showers, these locations must be identified with a highly visible sign;
  - proper use of the lab specific emergency eyewash and shower.
- Laboratory personnel or Building Inspectors test and inspect eyewashes weekly, inspect the unit as outlined on the AU Eyewash/Safety Shower Inspection Form☑ which is then sent monthly to EH&S.
- Lab specific unit manuals should be consulted for specific manufacturer's guidelines.

2.3.3 ADMINISTRATIVE CONTROLS

Administrative controls set the standard for behavior and/or practice in AU laboratories and serve to protect the health and safety of all employees. These policies and procedures must be implemented and adhered to by all personnel working in the laboratory.

- It is the responsibility of the LSF/PI to ensure that personnel working in laboratories under their supervision are informed and follow laboratory specific, divisional, and University policies and procedures related to laboratory safety.
  - While the minimum requirements and recommendations to meet the intent of the OSHA Lab Standard☑ are provided here, colleges, divisions, LSF/PIs have the authority to implement more stringent policies, via SOPs, within laboratories under their supervision and are encouraged to do so.

2.3.3.1 PRIOR APPROVAL

In order to protect the health and safety of laboratory employees and ensure compliance with regulatory requirements and sponsored research requirements certain laboratory operations, procedures, purchases or activities require prior approval before they can take place or be implemented.

The LSF/PI and laboratory employees must obtain prior approval as follows:

- The LSF/PI must obtain prior approval from EH&S, a specific campus committee and/or VP of Business and Finance, Academic Dean, AU Physical Plant☑ or NYSCC Maintenance☑ **before** performing research, academic instruction or other AU activity that will require/necessitate any of the following:
  - Purchase or current possession/use of: approval required upon initial purchase, also complete Appendix D☑
    - Particularly hazardous substances☑ (PHS), EPA P-List.
    - Explosive materials (as defined by the US Division of Alcohol, Tobacco & Firearms). A comprehensive list of explosive materials may be accessed from this Department of the Treasury list☑.
    - Extremely toxic gases (some are PHS). These gases include:

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

    - Etiologic agents (microorganism and microbial toxins that cause disease in humans). All work must comply with the Centers for Disease Control 4th Edition of "Biosafety in Microbiological and Biomedical Laboratories (BMBL) ☑"
    - Radioactive materials or radiation-producing devices. As of January 2008, AU has voluntarily suspended its NYSDOH Radioactive Materials Permit.

- Chemical treatment with discharge to storm or sanitary drain.
- Use of animals.
- Use of human subjects. Policy at Human Subjects Research Committee Policies☑
- Additional personnel or space that will require support beyond that provided in the research proposal.
- Additional costs for waste removal and clean up related to research.
- Working with recombinant DNA molecules or genetically modified organisms. Must also comply with NIH Guidelines for Research involving Recombinant DNA Molecules☑.
- Any modification to a chemical fume hood or other laboratory local exhaust system.
- Any fixed installation of equipment requiring discharge to sanitary or storm sewer or increased use or new installation of utility services such as electric, water, or gas.
- Any renovation, construction or rental of space

For any of the above circumstances, the LSF/PI completes the Prior Approval Form☑, obtains the indicated signature(s) (see Appendix A☑ for approval contact list) and the form is then sent to EH&S for review. EH&S will respond within five business days. Approval signatures verify compliance with all regulations applicable to request. Also submit any additional form as instructed.

- Laboratory employees are responsible for obtaining authorization from the LSF/PI to use certain chemicals or perform certain tasks. The LSF/PI is required to evaluate lab operations and specify in the site-specific SOP's any instances, additional to those listed below, that would require lab employees to obtain the LSF/PI's prior approval. LSF/PI Site-Specific Authorization Form for Laboratory Employees☑.
  Circumstances requiring prior approval of LSF/PI are:
  - Working alone (after normal working hours). See Section 2.3.3.2☑;
  - Laboratory operations that will be left unattended. See Section 2.3.3.3☑;
  - Use of Particularly Hazardous Substances☑;
  - The use of equipment, performance of a process or experiment for which a site-specific SOP is written. Copy of the LSF/PI Authorization Form is attached to the SOP.
  - Modifications to any established laboratory procedure (SOP);
  - Modifications to laboratory chemical inventory;
  - Continuation of any laboratory procedure if unexpected results occur;
  - Any operation for which employees are not aware of the hazards nor are not confident that they are adequately protected or trained.
- Use of a respirator must be reviewed and approved by the AU EH&S Coordinator
- Other circumstances requiring prior notification and/or approval may be found throughout Part II and the appendices of this CHP along with the procedures and/or forms required for said notifications.

2.3.3.2 Working Alone

Whenever possible, laboratory personnel should avoid working alone especially when experiments involve hazardous substances and procedures.

- The LSF/PI must establish lab specific SOP's specifying when working alone is not allowed and develop a notification policy and procedures (monitoring system) for when working alone occurs. Procedures for operation shutdown and evacuating laboratory of personnel must be included in site- specific SOP.
- The LSF/PI must approve, in advance, all work to be performed by someone working alone and the monitoring system that is established for this work.
  - Monitoring Guidelines

- If working alone is deemed necessary, utilize the “lab buddy system”. Arrange with someone else in the lab area or building to be the “buddy”. The “buddy” must have comparable lab skills.
- Establish/verify lab access for the “buddy”.
- Establish a time schedule at 15 – 30 minutes intervals for the “buddy” to check on the person working alone, either physically or verbally, to ensure no accident has occurred.
- If the person working alone is doing highly hazardous work and there is a suspicion of an incident, the “buddy” should consider not entering the lab/danger zone. “Check, Call, Care” should be the protocol.
  - Establish a visual check system to indicate “all OK” or “help needed”.
  - If an emergency arises requiring the “buddy” to leave prior to the completion of an experiment involving highly hazardous chemicals, the “buddy” should notify the person working alone and the LSF/PI. Provide the name of the person working alone, the location, and the end time of the experiment involved.
  - The person working alone should make an effort to complete the experiment in a safe manner and notify LSF/PI upon completion of the experiment.

- Examples of activities where working alone would be permissible include:
  - Office work such as writing papers, calculations, computer work, and reading.
  - Housekeeping activities such as general cleaning, reorganization of supplies or equipment, etc., as long activity does not involve moving large quantities of chemicals.
  - Assembly or modification of laboratory apparatus when no chemical, electrical, or other physical hazards are present.
  - Routine lab functions that are part of SOP’s that have been demonstrated to be safe and not involve highly hazardous operations.
- Examples of activities where working using a “buddy system” should be considered include:
  - Experiments involving toxic or otherwise hazardous chemicals especially poison inhalation hazards.
  - Experiments involving high-pressure equipment.
  - Experiments involving large quantities of cryogenic materials.
  - Experiments involving work with unstable (explosives) materials.
  - Experiments involving Class 3b or 4 Lasers.
  - Transfer of large quantities of flammable materials, acids, bases, and other hazardous materials.
  - Changing out compressed gas cylinders containing hazardous materials.

2.3.3.3 Unattended Operations

It is the responsibility of the LSF/PI to ensure that site specific SOP’s for unattended operations are developed and followed by personnel working in laboratories under their supervision. It is important that safeguards are in place in the event of an emergency. Procedures for operation shutdown and evacuating laboratory of personnel must be included in site-specific SOP.

- Laboratory personnel shall adhere to the following guidelines when it is necessary to carry out unattended operations involving hazardous chemicals (chemicals for which there are statistically significant evidence based on at least one study conducted in accordance with established scientific principles that acute or chronic health effects may occur in exposed employees).
  - Leave a light on in the room or area.
  - Complete Appendix T Unattended Operations☑ warning sign/notification form with the following information, post on the laboratory door or other conspicuous place out of the danger zone and email copy to EH&S. LSF/PI signs and retains a copy.

- Nature of the experiment in progress.
- Chemicals in use.
- Hazards present (electrical, heat, etc.).
- Name of the person conducting the experiment and a contact number. A secondary name and contact number is also recommended.

- Ensure all hose connections are secure and that electrical and other connections pose minimal risk of accident.
- Ensure proper and continuous drainage.
- Use secondary containment such as trays to contain any spills that may occur.
- Use safety shields and keep the hood sash down low to contain chemicals and glass in case an explosion occurs.
- Remove any chemicals or equipment that are not necessary for the experiment or items that could potentially react with the chemicals or other materials being used in the experiment.
- 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 those pieces of equipment that could be negatively affected in the event electric service is interrupted.

2.3.3.4 Laboratory Housekeeping

Laboratory housekeeping refers to the general condition and appearance of a laboratory. Good housekeeping has obvious health and safety benefits and a clean work environment can have a positive mental effect on laboratory personnel. **Note that the general condition of a laboratory observed in the first few minutes of an OSHA, EPA or DEC inspection can have a significant impact (positive or negative) on the rest of the inspection process.**

- It is the responsibility of the LSF/PI to ensure laboratories under their supervision are maintained in a clean and orderly manner and personnel working in the lab practice good housekeeping.
  - EH&S will perform lab inspections regularly or as requested by LSF/PI, and when lab is vacated by LSF/PI.
  - Lab personnel will maintain good housekeeping within labs on a daily basis.
  - Lab personnel will perform lab self-inspections at least twice per semester.

- **Good Housekeeping checklist**

  Areas within the lab that should be addressed include benches, hoods, refrigerators, shelves, chemical storage cabinets, aisles, sinks, overflowing trash cans, etc.

  ☐ all areas of the lab are free of extraneous equipment, glassware, chemical containers not currently in use, and general clutter. All chemicals and equipment will be properly stored and managed.

  ☐ all areas are wiped clean and chemical spills are cleaned up immediately, regardless if the chemical is hazardous or not. When cleaning up a chemical spill, look for any splashes that may have resulted on nearby equipment, cabinets, doors, counter tops and floors. For more information on cleaning up spills, see the Chemical Spill☑ section.

  ☐ areas around emergency equipment such as eyewash/emergency showers, electric power panels, fire extinguishers, and spill cleanup supplies are unobstructed, clean and free of clutter. Eyewash bowls must be clean.

- ☐ a minimum of three feet of clearance is maintained (as required by fire codes) between benches and equipment.

- ☐ aisles and exits must be clear of obstacles and tripping hazards such as bottles, boxes, equipment, electric cords, backpacks, etc.

- ☐ combustible material (such as paper, boxes, plastics, etc.) must not be stored within two feet of the ceiling in rooms without fire sprinklers and within 18" of the crown of a sprinkler head in rooms with sprinklers. (NYS Building Code regulation)

2.3.3.5 Personal Dress, Hygiene and Lab Behavior, Eating, Drinking, Etc.

- **Dress and Hygiene**
  Proper dress and personal hygiene habits are essential to working safely in a lab and preventing chemical exposure and contamination, even when using PPE.
  - Confine long hair, loose clothing, and jewelry.
  - Wear required lab attire:
    - closed toed shoes covering the foot,
    - long pants,
    - shirts that limit skin exposure,
    - wear natural fiber clothing when working with high heat sources.
  - Wear a lab coat when working with hazardous materials.
  - Remove lab coats, scrubs, gloves, and other Personal Protective Equipment before leaving the lab; do not wear PPE in areas outside the lab, particularly not in areas where food and drink are served, or other public areas.
  - Wash hands with soap and water (never solvents) before leaving the lab or using items such as the phone, turning doorknobs, or using an elevator.
  - Remove laboratory coats, gloves, and other PPE immediately when chemical contamination occurs. Failure to do so could result in chemical exposure.
  - After removing contaminated PPE, be sure to wash any affected **skin** areas with water for at least 15 minutes.
- Wash lab coats separately from personal clothing. If lab equipment has been contaminated with a particularly hazardous substance, place in a separate plastic bag clearly labeled with name of chemical and proceed to contact EH&S for disposal.
- **Behavior**
  Professional standards of personal behavior are required in all AU laboratories.
  - Avoid distracting or startling other workers - no practical jokes or horseplay.
  - Use laboratory equipment only for its designated purpose.
  - Use a pipette bulb or a mechanical device to pipette chemicals.
  - Keep work areas clean and free from obstruction.
  - Clean up spills immediately.
  - Do not block access to exits, emergency equipment, controls, electrical panels etc.
  - Avoid working alone.

- **Eating, Drinking, Chewing Gum and Applying Cosmetics in the Laboratory**
  Chemical exposure can occur through ingestion of food and beverages contaminated with chemicals or chemical vapors or the use of cosmetics, chewing gum and tobacco products in the laboratory.
  - Eating or drinking in areas exposed to toxic materials is prohibited by the OSHA 29 CFR 1910.141(g).
  - Do not eat, drink, chew gum, or apply cosmetics in areas where hazardous chemicals are used or stored.
  - Do not bring food, gum or beverage into a lab where hazardous chemicals are used or stored.
  - Do not store food, gum or beverage, even temporarily, in laboratory refrigerators, freezers, or cabinets where hazardous chemicals are or have been stored.
    - Refrigerators for the storage of food must not be located in a laboratory.
    - Refrigerators used for the storage of chemicals must be labeled "Chemicals Only, No Food".
  - Wash your hands thoroughly after using any chemical or other laboratory materials, even if you were wearing gloves, especially before eating and drinking.

2.3.3.6 Access To Laboratories

Admittance to and use of University laboratories, store rooms and other areas housing potentially dangerous chemicals, conditions, machinery or processes, is limited to authorized University faculty, staff, students or other persons on official University business. Measures should be taken to ensure that persons entering these areas be appropriately trained and adequately protected from hazards and informed about the safety and emergency procedures relevant to their activities

- **Visitors and Children in Laboratories**
  Due to potential hazards and liability issues, visitors or other persons, in particular children under the age of 16 are not permitted in hazardous work areas.
  - The exception is a University-sanctioned program, event or activity, e.g., summer science institutes, 48 hour challenge, science demonstrations, tours, open houses, or other University related business as authorized by the LSF/PI.
    - In these instances, all children under the age of 16 must be under direct supervision at all times.
    - Policies on PPE must be strictly adhered to.
    - All AU policies and procedures shall apply.
  - It is the responsibility of the Division Chairperson and/or LSF/PI to restrict access of visitors and children to areas under their supervision when potential health and physical hazards exist.
- **Volunteers in Laboratories**
  AU policy states that volunteers act as agents of the University. While not required to sign an agreement, volunteers are under the supervision of authorized University personnel and all AU policies and procedures apply.
  - Activities involving volunteers in laboratories must be authorized by the Division Chairperson and/or LSF/PI.
  - Volunteers in laboratories must be directly supervised by authorized personnel.
- **Visiting Scientists and Other Similar Laboratory Users**
  There are potential risks associated with allowing access to labs and equipment by visiting scientists. These risks include: theft, bodily injury, and property damage.
  - The Division Chair/ LSF/PI authorize laboratory and equipment use by visiting scientists and other similar users.

- The LSF/PI should verify that all users of the lab have the required safety and health training prior to allowing access to the lab and/or use of specialized equipment.
  - It is the user's responsibility to have or obtain the appropriate training.
  - It is the user's obligation to follow all AU policies and procedures.

2.3.3.7 Laboratory Security

Adequate security measures must be established to prevent the theft of hazardous materials, valuable equipment and ensure compliance with federal and state regulations.

- Division Chairs, LSF/PI must establish a security policy with procedures to include the criteria listed below for all laboratories, workshops, store rooms and other work areas housing potentially dangerous materials, conditions, machinery or processes under his/her supervision. Lab personnel must be trained to this policy.
  - Laboratories, workshops, store rooms and other work areas housing potentially dangerous materials, conditions, machinery or processes:
    - must be locked at all times when authorized personnel are not present.
    - must be verified as locked at the end of the work day.
    - must have access limited to authorized personnel only.
  - All chemical use must be under the direct supervision of the LSF/PI or their authorized personnel at all times or otherwise must be locked within a laboratory or cabinet.
    - Maintain a chemical inventory.
      - Additional attention should be paid to the security of hazardous chemicals such as cyanides and highly reactive materials.
      - Immediately report missing chemicals to AU Public Safety 2108 and EH&S 2190 and file an EH&S Accident/Incident/Near-Miss Report within 24 hours. Send report to EH&S☑, AU Public Safety☑ office and the Division chair.
  - All DEA regulated compounds and controlled substances must be stored under double lock and strictly monitored. Refer to the University Biosafety Manual. (pending)
  - All needles and syringes must be stored under double lock and not left out in view.
  - Report thefts, unauthorized entry, suspicious packages or threatening phone calls to AU Public Safety 2108.

2.3.3.8 Policy For Vacating Laboratories

The purpose of this policy is to ensure all chemicals, especially hazardous materials, are properly managed and a safe, clean laboratory space is transferred to the next occupant.

- This policy applies to faculty, staff, post-doctoral and visiting scientists, and graduate students. The LSF/PI assumes responsibility for their undergraduate researchers.
- Prior to departure from Alfred University or a move from one laboratory space to another, lab personnel, as well as undergraduate researchers, must
  - follow procedures for lab cleanout and complete the Checklist for Vacating Labs☑.
    - submit completed checklist to EH&S☑and the Division Chair.
  - schedule an inspection with EH&S to obtain clearance.
- Employees departing from AU must also submit a completed and signed "Employee Seperation Checklist☑" to HR.

2.3.3.9 Pets In Laboratories

The AU Control of Animals policy, specifically states that "no animals of any kind, with the exception of registered service or assistance dogs (and aquarium fish, as per Residence Life policies) are allowed in campus buildings. Animals may be permitted elsewhere on campus as long as they are leashed, attended by the owner at all times, and not interfering with normal use of University facilities. Stray animals found on campus will be removed."

2.3.3.10 Laboratories Used As Classrooms

When laboratories are used as classrooms (Lecutre only), all hazardous chemicals must be removed from the lab and properly stored in an area outside of the lab or stored in closed cabinets within the lab. Bench/counter tops must be wiped clean and disinfected if necessary.

- The storage or consumption of food and/or beverage is prohibited in any room or area where chemicals are used or stored.
- With chemicals properly stored away, the use of eye protection is not required.
- All lab classrooms must be locked when not in use or occupied by authorized personnel.

2.3.3.11 Energy Conservation In Laboratories

Laboratories are energy intensive facilities consuming many times the energy use of the average academic non-lab classroom. Excessive energy use has a negative impact on the University budget as well as the environment.

- Lab personnel can reduce excessive energy use by participating in the following conservation efforts.
  - Turn off lights when leaving rooms.
  - Close windows when leaving rooms.
  - Use shades and blinds.
  - Whenever possible turn off all electrical equipment, including computers, when not in use, especially at the end of the day.
  - Use timers to turn equipment on and off automatically.
  - Purchase energy saving equipment.
  - Keep all standard fume hoods shut off and sashes CLOSED when not in use. Keep sashes CLOSED on Variable Air Volume fume hoods when not in use.
  - Send a work order to the Physical Plant to report rooms that are too hot or too cold.
  - Send a work order to the Physical Plant to report leaking faucets, etc.

2.3.4 USE OF PERSONNEL PROTECTIVE EQUIPMENT (PPE)

OSHA states "Protective equipment, including personal protective equipment for eyes, face, head, and extremities, protective clothing, respiratory devices, and protective shields and barriers, shall be provided, used, and maintained in a sanitary and reliable condition wherever it is necessary by reason of the hazards of the processes or environment, chemical hazards, radiological hazards, or mechanical irritants encountered in a manner capable of causing injury or impairment in the function of any part of the body through absorption, inhalation or physical contact."

- The purpose of PPE is to protect employees from the risk of injury by creating a barrier against workplace hazards.
  - PPE is not a substitute for good engineering or administrative controls or good work practices, but should be used in conjunction with these controls to ensure the safety and health of employees.
  - PPE is a last resort protection system that does not reduce or eliminate the hazard and protects only the wearer. The need for PPE is dependent upon the type of operations and the nature and quantity of the materials in use. Workers who rely on PPE must understand the functioning, proper use, and limitations of the PPE used.
- The OSHA Personal Protective Equipment standard, 29 CFR 1910 Subpart I☑ requires the following:
  - hazard assessment and equipment selection,
  - employee training,
  - record keeping requirements,

- guidelines for selecting PPE,
- hazard assessment certification.

It is the responsibility of the LSF/PI to ensure that proper PPE is available and in good condition and that the laboratory personnel under their supervision have received the appropriate training on the selection and proper use of PPE☑.

2.3.4.1 HAZARD ASSESSMENT AND EQUIPMENT SELECTION

LSF/PI must conduct hazard assessments of the specific operations or procedures occurring in their laboratories to determine appropriate PPE.

- Identify all types of hazards present in the work area or laboratory and complete the Hazard Assessment Form Appendix I☑.
  - Email a copy to EH&S☑, or deliver to room 117, Myers Hall.
  - Notify EH&S of procedural changes that alter PPE assessments.
- A number of factors must be considered when deciding on the appropriate PPE to wear while performing operations or experiments presenting a chemical hazard:
  - chemicals being used, including concentration and quantity;
  - hazards the chemicals pose;
  - routes of exposure for the chemicals;
  - the material the PPE is constructed of;
  - the permeation and degradation rates specific chemicals will have on the material;
  - the length of time the PPE will be in contact with the chemicals;
- Give careful consideration to the comfort and fit of PPE to ensure that it will be used by laboratory personnel.
- Purchase and/or use only those items that meet NIOSH☑ (National Institute of Occupational Safety and Health) and/or ANSI☑ (American National Standards Institute) standards.
- The specific PPE required for procedures or operations within the laboratory, and its proper use, must be included in the site-specific SOPs.

2.3.4.2 TRAINING AND TESTING REQUIREMENTS FOR PERSONAL PROTECTIVE EQUIPMENT

While EH&S provides some PPE training and offers information and training on conducting hazard assessments, and assistance with the selection and proper use of PPE, the responsibility for lab specific training lies with the LSF/PI.

Training Requirements

Training requirements can be met with use of videos, group training sessions, and handouts.

- Examples of topics to be covered during the training include:
  - when PPE must be worn;
  - what PPE is necessary to carry out a procedure or experiment;
  - how to properly put on, take off, adjust, and wear PPE;
  - the proper cleaning, care, maintenance, useful life, limitations, and disposal of the PPE.
- All training should be presented in a manner that the employee can understand. Each affected employee shall demonstrate an understanding of the training specified and the ability to use PPE properly, before being allowed to perform work requiring the use of PPE.
- When the LSF/PI has reason to believe that any affected employee who has already been trained does not have the understanding and skill required, the LSF/PI shall retrain that employee.
  - Other circumstances where retraining is required include, but are not limited to, situations where:
    - changes in the workplace render previous training obsolete;

- changes in the types of PPE to be used render previous training obsolete.

Testing and Documentation Requirements

The LSF/PI shall verify that each affected employee has received and understood the required training through a written certification (test) that contains the name of the employee trained, the date of training, and the subject of the certification.

- Recordkeeping requirements for PPE:
  - As with any training session, PPE training must be documented with the training date, description of the information covered during the training session, the trainer's name and the name and signature of the employees attending the training session. See Site-specific Training Form Appendix F☑.
  - Written certification must be kept and must contain the name of the person trained, the type of training provided, and the dates when training occurred.
  - Retain training records for the lab/department; send copies of the completed Site-specific Training Form and written certification to EH&S.

2.3.4.3 GUIDELINES FOR SELECTION AND USE OF PPE

2.3.4.3.1 Eye and Face Protection

See OSHA Eye and Face Protection Standard☑

Eye protection is one of the most important and easiest forms of PPE to wear. Laboratory personnel must use eye protection to prevent injury from chemical and physical hazards found in laboratories including flying particles, molten metal, acids or caustic liquids, chemical liquids, chemical gases or vapors, or potentially injurious light radiation.

- It is an AU EH&S policy that all laboratory employees and visitors must, at all times, wear protective eyewear while in laboratories where chemicals are being handled or not put away in storage.
- These OSHA eye and face protection requirements☑ must be met.
  - Eye and face protection must comply with the American National Standards Institute, ANSI/ISEA Z87.1-2015 standard.
  - Eye and face PPE shall be distinctly marked to facilitate identification of the manufacturer.
  - The following minimum requirements must be met by all protective devices. Protectors shall:
    - Provide adequate protection against the particular hazards for which they are designed
    - Be of safe design and construction for the work to be performed
    - Be reasonably comfortable when worn under the designated conditions
    - Fit snugly and not unduly interfere with the movements of the wearer
    - Be durable
    - Be capable of being disinfected
    - Be easily cleanable
    - Be distinctly marked to facilitate identification only of the manufacturer
  - Handling Emergencies
    - If an eye injury occurs, quick action can prevent a permanent disability. For this reason:
      - Emergency eyewashes should be placed in all hazardous areas
      - First-aid instructions should be posted close to potential danger spots
      - Employees must know where the closest eyewash station is and how to get there with restricted vision
  - Consideration should be given to comfort and fit. Poorly fitting eye and face protection will not offer the necessary protection.

- Fitting of goggles and safety spectacles should be done by someone skilled in the procedure.
    - Prescription safety spectacles should be fitted only by qualified optical personnel.
- Devices with adjustable features should be fitted on an individual basis to provide a comfortable fit that maintains the device in the proper position.
- Eye protection from dust and chemical splash should form a protective seal when fitted properly.
- Welding helmets and face shields must be properly fitted to ensure that they will not fall off during work operations.

- Employees must be trained in the proper care, maintenance, useful life, and disposal of PPE. Employees must properly maintain their PPE.

  Maintenance:
  - PPE must be used and maintained in a sanitary and reliable condition.
  - The use of PPE with structural or optical defects is prohibited.
  - Pitted lenses, like dirty lenses, can be a source of reduced vision. They should be replaced. Deeply scratched or excessively potted lenses are apt to break.
  - Slack, worn-out, sweat-soaked, or twisted headbands do not hold the eye protector in proper position. Visual inspection can determine when the headband elasticity is reduced to a point below proper function.

  Cleaning:
  - Atmospheric conditions and the restricted ventilation of the protector can cause lenses to fog. Frequent cleansing may be necessary.
  - Eye and face protection equipment that has been previously used must be disinfected before being issued to another employee.
  - When employees are assigned protective equipment for extended periods, the equipment must be cleaned and disinfected regularly.
  - Several methods for disinfecting eye-protective equipment are acceptable. The most effective method is to disassemble the goggles or spectacles and thoroughly clean all parts with soap and warm water.
    - Carefully rinse all traces of soap and replace defective parts with new ones. Swab thoroughly or completely and immerse all parts for 10 minutes in a solution of germicidal deodorant fungicide.
    - Remove parts from solution and suspend in a clean place for air drying at room temperature or with heated air.
    - Do not rinse after removing parts from the solution because this will remove the germicidal residue that retains its effectiveness after drying.

  Storage:
  - Goggles should be kept in a case when not in use. Spectacles, in particular, should be given the same care as one's own glasses, since the frame, nose pads, and temples can be damaged by rough usage.
  - Items should be placed in a clean, dust-proof container, such as a box, bag, or plastic envelope, to protect them until next use.

- When selecting proper eye and face protection, be aware there are a number of different styles of eyewear that serve different functions.
  - Prescription Safety Eyewear OSHA regulations require that employees who wears prescription lenses while engaged in operations that involve eye hazards shall wear eye protection that incorporates the prescription in its design, or must wear eye protection that can be worn over the prescription lenses (goggles, face shields, etc.) without disturbing the proper position of the prescription lenses or the protective lenses. Any prescription eyewear purchase must comply with ANSI/ISEA Z87.1-2015.
  - Note: Contact lenses, by themselves, are not considered protective eyewear.

- Safety Glasses - provide eye protection from moderate impact and particles associated with grinding, sawing, scaling, broken glass, and minor chemical splashes, etc. Side protectors are required when there is a hazard from flying objects. Safety glasses are available in prescription form for those persons needing corrective lenses. Safety glasses do not provide adequate protection for processes that involve heavy chemical use such as stirring, pouring, or mixing. In these instances, splash goggles should be used.
- Splash Goggles - provide adequate eye protection from many hazards, including potential chemical splash hazards, use of corrosive material, and bulk chemical transfer. Goggles are available with clear or tinted lenses, fog proofing, and vented or non-vented frames. Be aware that goggles designed for woodworking are not appropriate for working with chemicals. These types of goggles can be identified by the numerous small holes throughout the face piece. In the event of a splash, chemicals could enter into the small holes, and result in a chemical exposure to the face. Ensure the goggles you choose are rated for use with chemicals.
- Welder's/Chippers' Goggles - provide protection from sparking, scaling, or splashing metals and harmful light rays. Lenses are impact resistant and are available in graduated lens shades. Chippers'/Grinders' goggles provide protection from flying particles. A dual protective eyecup houses impact resistant clear lenses with individual cover plates.
- Face Shields - provide additional protection to the eyes and face when used in combination with safety glasses or splash goggles. Face shields consist of an adjustable headgear and face shield of tinted or clear lenses or a mesh wire screen. They should be used in operations when the entire face needs protection and should be worn to protect eyes and face from flying particles, metal sparks, and chemical/biological splashes. Face shields with a mesh wire screen are not appropriate for use with chemicals. Face shields must not be used alone and are not a substitute for appropriate eyewear. Face shields should always be worn in conjunction with a primary form of eye protection such as safety glasses or goggles.
- Welding Shields - are similar in design to face shields but offer additional protection from infrared or radiant light burns, flying sparks, metal splatter, and slag chips encountered during welding, brazing, soldering, resistance welding, bare or shielded electric arc welding, and oxyacetylene welding and cutting operations.
- Filter lenses - equipment fitted with appropriate filter lenses must be used to protect against light radiation. Tinted and shaded lenses are not filter lenses unless they are marked or identified as such.
- LASER Eye Protection - a single pair of safety glasses is not available for protection from all LASER outputs. The type of eye protection required is dependent on the spectral frequency or specific wavelength of the laser source. See OSHA Laser Hazard Standards☑ for more information.

2.3.4.3.2 Hand Protection

Most accidents involving hands and arms can be classified under four main hazard categories: chemicals, abrasions, cuts, and heat/cold.

- Gloves must be worn whenever there are significant potential hazards from chemicals, cuts, lacerations, abrasions, or punctures.
- Gloves must be worn whenever it is necessary to handle corrosive or toxic chemicals, broken or damaged glassware, or whenever protection is needed against unintentional exposure to chemicals.
- Gloves are to be selected based on an evaluation of the performance characteristics of the hand protection relative to the task(s) to be performed, conditions present, duration of use, and the hazards and potential hazards identified.

- All gloves provide some protection but will be penetrated by most chemicals at varying rates. No glove is 100% impermeable to everything, and therefore no one glove will form a satisfactory barrier against all substances. Thus, one must evaluate the performance of a glove against various chemicals on a substance-by-substance basis. Refer to Glove Selection Chart Appendix C☑ for chemical/glove chart.
  - Disposable gloves choices: (referenced from VWR and Best Glove catalogs)
    - Rubber (Latex) - Latex resists many bases, acids alcohols, and dilute water solutions of many types of chemicals. It offers fair protection against undiluted ketones and aldehydes. It offers good resistance to cuts. Allergic reactions to the proteins in natural rubber latex gloves have been reported. If latex sensitivity is known or suspected, switching to nitrile or neoprene is recommended.
    - Synthetic Rubber (nitrile and neoprene) – Nitrile offers good protection against bases, oils and many solvents and esters, grease and animal fats. It is **NOT** recommended for ketones and some organic solvents. Nitrile offers excellent resistance to snags, punctures, abrasion, and cuts. Neoprene is resistant to a very broad range of oils, acids, caustics and solvents but is less resistant to snags, cuts, punctures and abrasion than nitrile or natural rubber.
    - Polyvinyl Chloride (PVC) – PVC offers good protection against many acids, caustics, alkalies, bases and alcohols. It is NOT recommended for ketones and many other types of solvents. PVC offers good abrasion and cut resistance, but some styles are susceptible to cuts.
    - Vitron Material - Recommended when working with carcinogenic or highly toxic chemicals, organic solvents such as benzene, toluene, xylene, methylene chloride, and carbon disulfide, especially if PVA (Polyvinyl alcohol) gloves are ruled out by the risk of contact with water or light alcohols. Vitron gloves should not be used with ketones, ester, and amines.
    - Butyl Polymer – Provides excellent chemical resistance to gases and ketones but is severely affected by exposure to fuels and aliphatic and aromatic hydrocarbon solvents.
    - Double gloving with butyl rubber and a 4 mil Laminate (Silver Shields or Safety 4H) is effective when handling certain special carcinogens and other highly toxic agents.
    - Silver Shields used alone provides resistance to a wide range of solvents and caustics.
- Gloves must be inspected, before each use, for punctures, tears, or discoloration. Any gloves, which show physical degradation, including pitting, cracking, swelling or discoloration, should be immediately discarded.
- On removal of gloves, always wash your hands. The use of barrier or other protective skin creams is highly recommended.
- For proper glove selection consult chemical SDS and/or the glove selection guide in Glove Selection Chart Appendix C☑ or Web site for: Best Gloves Selection Guide☑ (Chemical name, view sheet) and Labsafety EZ Glove Guide☑. These web sites are provided as additional reference. Alfred University has not investigated the accuracy of these sites and claims no responsibility for their contents
- The best gloving strategy is: **AVOID CONTACT WITH HAZARDOUS SUBSTANCES - IF CONTACT OCCURS, REMOVE GLOVES IMMEDIATELY AND WASH YOUR HANDS.**

2.3.4.3.3 Protective Clothing

Protective clothing includes lab coats or other protective garments such as aprons, boots, shoe covers, plastic arm covers, Tyvek coveralls, and other items, that can be used to protect street clothing from biological or chemical contamination and splashes as well as providing additional body protection from some physical hazards. Protective clothing must be readily available and used.

- When working with toxic, corrosive, or flammable agents, you must wear protective clothing appropriate to the potential hazard.
- The following considerations should be taken into account when choosing protective clothing:
  - The specific hazard(s) and the degree of protection required, including the potential exposure to chemicals, radiation, biological materials, and physical hazards such as heat.
  - The type of material the clothing is made of and its resistance to the specific hazard(s) that will be encountered.
  - The comfort of the protective clothing, which impacts the acceptance and ease of use by laboratory personnel.
  - Whether the clothing is disposable or reusable - which impacts cost, maintenance, and cleaning requirements
  - How quickly the clothing can be removed during an emergency. It is recommended that lab coats use snaps or other easy to remove fasteners instead of buttons.

2.3.4.3.4 Respiratory Protection

The primary objective in the control of those occupational diseases caused by breathing air contaminated with harmful dusts, fogs, fumes, mists, gasses, smokes, sprays, or vapors, shall be to prevent atmospheric contamination. This shall be accomplished by accepted engineering control measures, as far as feasible, (e.g., enclosure or confinement of the operation, general ventilation and fume hoods), and substitution of less toxic materials.

Respirators may only be used when engineering controls, are not feasible or do not reduce the exposure of a chemical to acceptable levels. The use of a respirator is regulated by the

- OSHA Respiratory Protection Standard☑ and is subject to prior review and approval by EH&S, according to university policy. Personal respiratory protection is only effective if it is selected specifically for the wearer and the contaminant of interest, within a known concentration range.
- Any employee who works with materials, chemicals or in environments which require respirator use must be trained in the AU respirator program.
  - This program involves procedures for respirator selection, medical assessment of employee health, employee training, proper fitting, respirator inspection and maintenance, and recordkeeping.
  - When medical surveillance is required, AU shall provide these services at no cost to the employee.
  - Respiratory Protection intended for comfort (mild irritants, odors) is allowed under the auspices of the AU Respiratory Protection Program.

2.4 HAZARD IDENTIFICATION WITH RESPECT TO LABELS

Proper labeling of chemicals informs people who work in laboratories of potential hazards that exist, prevents the generation of unknowns, and facilitates emergency responses such as cleaning up spills and obtaining proper medical treatment. To maintain a basic level of safety, AU requires that **all** containers be appropriately labeled.

- The OSHA Hazardous Communication Standard (29CFR 1910.1200(f)(5))requires each container of hazardous chemical in the workplace to be labeled, tagged or marked with the identity of the chemical and appropriate physical and health hazards and warnings. The OSHA Lab Standard requires that labels on all incoming containers must be maintained and not defaced. Since 1986, chemical manufacturers, importers, and distributors have been required to ensure that every container of hazardous chemicals shipped is appropriately labeled with the name and address of the producer, the identity of the material and appropriate hazard warnings.
  - The manufacturer's label must be kept intact. Do not intentionally deface or obscure the label or the hazard warnings until the container has been **completely** emptied.
    - As part of laboratory self-inspections, if any manufacturers label appears to be falling off, tape the label back on the container or if the label is damaged re-label with a permanent label containing the information listed above.
    - Inadequate labels on hazardous chemicals purchased prior to 1986 should be updated to meet current standards.
- If a commercial chemical is repackaged into a new container for storage, this secondary container should be labeled with all the essential information on the original container.
- Each container of hazardous chemicals in the workplace, including secondary containers (transferred chemicals) must be labeled, tagged or marked with the following information:
  - Identity of the hazardous chemical(s) / product(s) contained therein; legible and written out in English (another language may be added).
  - Signal Word
  - Pictograms
  - Maufacturer name, address, and phone number
  - Appropriate hazard statements , in wordswhich provides at least general information regarding the hazards of the chemicals.
- Each container of non-hazardous chemicals must be labeled with, at a minimum, the chemical name and manufacturer's name, address, and phone number, legible and written out in English.
- All personnel working in the laboratory must be fully trained on how to label chemicals and to understand the labeling system.
  - Training must occur:
    - when a new person begins working in the laboratory,
    - when new chemicals are introduced,
    - on a regular basis – annually at a minimum.
  - See Site-specific Training Form Appendix H☑.

2.4.1 GHS STANDARD HAZARDOUS LABELING SYSTEM

OSHA has standardized the labeling requirement by GHS. The following standards have been adopted worldwide.

- The objectives of the GHS system are to:

2.4.2 LABELING PROCEDURES FOR PURCHASED CHEMICALS AND CHEMICALS SYNTHESIZED OR DEVELOPED IN THE LABORATORY WITH KNOWN COMPOSITION

- Ensure that original labels on incoming containers of hazardous chemicals are not removed or defaced.
- Secondary containers of **known** hazardous chemicals, whether purchased, synthesized or newly developed, must be clearly labeled according to GHS system:

2.4.3 LABELING PROCEDURES FOR CHEMICAL SUBSTANCES WITH UNKNOWN COMPOSITION

- Containers of newly developed or synthesized materials, must be clearly labeled as follows:
  - List the chemical names of starting materials.
  - List all suspected or potential hazards.
  - Provide a reference to the lab book entry for the experiment in which the substance was prepared.
  - Provide the name, not just initials, location, and phone number of the person who prepared the substance.
  - Date that the material was placed in the container and labeled.
- Containers of materials of unknown origin:
  - Perform any available tests to identify or classify materials.
  - Label according to GHS requirements; list the possible identities of the material based on tests or general knowledge, origin or area where unknown was found.
  - Label and store for hazardous waste removal.

2.4.4 LABELING PEROXIDE FORMING CHEMICALS

- Peroxidizable chemicals Appendix J☑ must be labeled with:
  - date received,
  - date opened,
  - date tested for peroxides, initials of person performing testing,
  - test results,
  - disposal date.

2.4.5 METHODS FOR LABELING MULTIPLE SMALL CONTAINERS

- Legend Method
  - Label containers using a color, letter, number or abbreviated chemical name system.
    - Provide the identity “key” to the labeling system, with complete chemical name and hazard warning, on a sign or in a log book in a visible location where containers are stored. Document that employees are trained on the labeling system.
    -
    - Please keep in mind that some laboratory employees may be color-blind, red-green and blue-yellow. This fact needs to be taken into consideration, BEFORE a color-coding system is used.
- Overpack Method
  - Put containers in a compatible bottle with a screw lid, box, tray or Ziploc bag, etc.
  - Label overpack container with chemical name and hazard warning.
  - If containers are removed from the box/tray/bag they must be properly labeled or returned to the box/tray/bag immediately after use.
  - Document that employees are trained on the labeling system
- Tag Method

- Label containers using “price tag” GHS style labels and attach to container with string or a rubber band.

2.4.6 LABELING CONSUMER PRODUCTS

- Consumable products (caffeine containing products, analgesics, etc.) used in laboratory experiments **must be** noticeably labeled –“For Experimental Purposes Only”.
- Products available over the counter (spray paint, adhesives, rubbing alcohol, 3% Hydrogen Peroxide, etc) to the general public are exempt from AU labeling requirements if it has already been labeled by the manufacturer.

2.4.7 LABELING STATIONARY CONTAINERS

- Stationary process containers such as tanks may be identified with signs, placards, process sheets, batch tickets or other written materials instead of actually affixing labels to process containers.
  - The sign or placard must convey the same information that a label would and be visible to employees.

2.4.8 LABELING PORTABLE CONTAINERS – BEAKERS, TUBES, ETC.

- A portable container into which a hazardous chemical is temporarily transferred from a labeled container is exempt from labeling if the portable container is in control of the person who transferred it and the chemical is used immediately.
  - However, EH&S recommends that a temporary label identifying the chemical and its primary hazard be affixed to the container.
- Laboratory personnel are encouraged to use commercially available pre-labeled containers (such as squirt bottles) for chemicals that get used frequently.

2.5 SAFETY DATA SHEETS

A Safety Data Sheet (SDS) is a document containing chemical hazard and safe handling information. It is prepared by the chemical manufacturer in accordance with the OSHA Hazard Communication Standard☑. SDS’s are shipped with hazardous chemicals, found on manufacturer or distributor websites and are managed on the AU SDS Online Program database and/or in files. The SDS Online headquarters address and phone numbers are; SDS Online, 350 North Orleans, Suite 950, Chicago, IL 60654; Main Telephone: 312.881.2000, Fax: 312.881.2001, Toll Free: 1.888.362.2007.

- All employees must read the SDS prior to using a chemical for the first time.
  - Anyone on campus can access the SDS Online database, as a read only file, for any area on campus by accessing https://my.alfred.edu/environmental-health-safety/☑. Scroll down and click on MSDSOnline (Safety Data Sheets).
- LSF/PI must prepare SDSs for chemicals developed in the laboratory, as outlined in Provisions That Shall Apply to New Chemicals Substances Developed in the Laboratory☑.
- The LSF/PI receives from the manufacturer a copy of the Safety Data Sheet for managing the SDS online database.
- The LSF/PI ensures the assemblage and maintenance of the SDS electronic file with ongoing SDS updates for chemicals used or stored in his/her Division or lab.
  - The LSF/PI assigns a SDS Manager for each area or lab that uses chemicals.
    - SDS Managers contact EH&S☑for instruction on how to manage the SDS electronic file binder using the SDS Online Website.

- Only SDS Managers can make changes to the files.
    - Messages for additions are delivered by e-mail to EH&S for final approval if required.
    - SDSs of chemicals newly purchased or developed in the laboratory are immediately added to the SDS Online database by the SDS Manager.

- Areas where employees are working without a network computer available to access the AU SDS electronic file are required to maintain and manage a hardcopy SDS file as well as an online file.
    - The department of EH&S will plan for this SDS Manager to have use of a computer to assemble and update the SDS file.
- Satellite access and campus emergency responders will allow access to the SDS online database in case of a large-scale emergency.
    - Emergency responders, such as the fire department, have access to view our SDS Online database during an emergency by contacting EH&S.
- Contact EH&S at 2190 or envhealthsafety@alfred.edu☑ for questions and assistance.

Safety Data Sheet Headings:

Identification of the substance or mixture and of the supplier:

- GHS product identifier.
- Other means of identification.
- Recommended use of the chemical and restrictions on use.
- Supplier's details (including name, address, phone number, etc.).
- Emergency phone number.

Hazards identification:

- GHS classification of the substance/mixture and any national or regional information.
- GHS label elements, including precautionary statements.
- (Hazard symbols may be provided as a graphical reproduction of the symbols in black and white or the name of the symbol, e.g., flame, skull and crossbones.)
- Other hazards which do not result in classification (e.g., dust, explosion hazard) or are not covered by the GHS.

Composition/information on ingredients:

Substance

- Chemical identity.
- Common name, synonyms, etc.
- CAS number, EC number, etc.
- Impurities and stabilizing additives which are themselves classified and which contribute to the classification of the substance.

Mixture

- The chemical identity and concentration or concentration ranges of all ingredients which are hazardous within the meaning of the GHS and are present above their cutoff levels.

First aid measures

- Description of necessary measures, subdivided according to the different routes of exposure, i.e., inhalation, skin and eye contact and ingestion.
- Most important symptoms/effects, acute and delayed.
- Indication of immediate medical attention and special treatment needed, if necessary.

Firefighting measures

- Suitable (and unsuitable) extinguishing media.
- Specific hazards arising from the chemical (e.g., nature of any hazardous combustion products).
- Special protective equipment and precautions for firefighters.

Accidental release measures

- Personal precautions, protective equipment and emergency
- Globally Harmonized System of Classification and Labeling of Chemicals – GHS http://www.osha.gov/dsg/hazcom/ghs.html
- Procedures.
- Environmental precautions.
- Methods and materials for containment and cleaning up.

Handling and storage:

- Precautions for safe handling.
- Conditions for safe storage, including any incompatibilities

Exposure controls/personal protection.

- Control parameters, e.g., occupational exposure limit values or biological limit values.
- Appropriate engineering controls.
- Individual protection measures, such as personal protective equipment.

Physical and chemical properties:

- Appearance (physical state, color, etc.).
- Odor. Odor threshold. pH. Melting point/freezing point.
- Initial boiling point and boiling range.
- Flash point. Evaporation rate.
- Flammability (solid, gas). Upper/lower flammability or explosive limits.
- Vapor pressure. Vapor density. Relative density.
- Solubility (is). Partition coefficient: n-octane/water.
- Auto ignition temperature. Decomposition temperature.

Stability and reactivity:

- Chemical stability.
- Possibility of hazardous reactions.
- Conditions to avoid (e.g., static discharge, shock or vibration).
- Incompatible materials.
- Hazardous decomposition products.

Toxicological information

- Concise but complete and comprehensible description of the various toxicological (health) effects and the available data used to identify those effects, including:
- information on the likely routes of exposure (inhalation, ingestion, skin and eye contact);

- Symptoms related to the physical, chemical and toxicological characteristics;
- Delayed and immediate effects and also chronic effects from short- and long-term exposure;
- Numerical measures of toxicity (such as acute toxicity estimates).

Ecological information

- Ecotoxicity (aquatic and terrestrial, where available).
- Persistence and degradability.
- Bio accumulative potential.
- Mobility in soil.
- Other adverse effects.

Disposal considerations:

- Description of waste residues and information on their safe handling and methods of disposal, including the disposal of any contaminated packaging.

Transport information UN Number.

- UN Proper shipping name.
- Transport Hazard class(es).
- Packing group, if applicable.
- Marine pollutant (Yes/No).
- Special precautions which a user needs to be aware of or needs to comply with in connection with transport or conveyance either within or outside their premises.

Regulatory information:

- Safety, health and environmental regulations: specific for the product in question.

Other information including information on preparation and revision of the SDS 4.9

2.6 PROVISIONS THAT APPLY TO NEW CHEMICAL SUBSTANCES DEVELOPED IN THE LABORATORY

The following requirements apply to new chemical substances developed in the laboratory:

- The LSF/PI is responsible for ensuring that newly synthesized chemicals are properly managed within their laboratories.
- If the newly synthesized chemical is determined to be hazardous, the LSF/PI must comply with the requirements of this CHP for Employee Information and Training☑, Hazard Identification in regards to Labeling☑ and Storage and Handling of Chemicals☑.
  - If the hazards of the new chemical are **unknown**, then the chemical must be assumed hazardous and the label should indicate that the potential hazards of the chemical have not been determined.
  - If the composition of the new chemical substance is **known**, the LSF/PI must determine if it is a hazardous chemical as defined by the OSHA Lab Standard☑. This can be done by referencing SDSs, doing a literature search for similar substances or a comprehensive review of the constituents.
- The LSF/PI must prepare a SDS for newly synthesized chemicals if the chemical is hazardous by OSHA definition or assumed hazardous (see above) and if the newly created chemical or intermediate compound is going to be transferred to a different lab, researcher or testing lab on or off of the University campus. Log or retain copy of shipping information.
  - See OSHA newly synthesized chemical SDS☑ information.
  - A blank SDS form (OSHA Form 174☒) can be found on the OSHA website.

2.7 STORAGE AND HANDLING OF CHEMICALS

Chemical storage areas in the academic laboratory setting include central stockrooms, storerooms, laboratory work areas, storage cabinets, refrigerators, and freezers.

- The typical risks within a storage area are dependent in large part on the chemical inventory; chemical hazards, chemical volume, and storage conditions.
  - The primary goals of proper chemical storage are to promote safe and healthy working conditions, extend the usefulness of chemicals and assure regulatory compliance.
  - Improper storage of chemicals can result in:
    - Degradation of containers that can release hazardous vapors.
    - Degradation of containers that can allow chemicals to become contaminated.
    - Degradation of labels that can result in the generation of unknowns.
    - Chemicals becoming unstable and/or potentially explosive.
    - Citations and/or fines from state and federal regulatory agencies.
- Of important and increasing concern is the physical security of chemical storage areas.
  - Chemical storage areas must be locked when authorized personnel are not present.
  - **Provide adequate security so that unauthorized personnel do not have access to chemicals**

2.7.1 CHEMICAL STORAGE - GENERAL PROCEDURES

These procedures are based on compliance regulations as well as recommended practices for proper storage of chemicals.

Always keep spill control materials and PPE on hand in areas where chemicals are stored and used. Ensure all personnel working in the lab have been properly trained on the location and use of the spill kit and PPE.

- Be aware of any special antidotes or medical treatment that may be required for chemicals such as cyanides and Hydrofluoric acid☑.
- Choose chemicals that minimize hazards such as toxicity, flammability, and reactivity. When possible, use the least hazardous chemical. (See Chemical Substitution List – Appendix ?)
- Order only the volume of chemical needed. When only a small amount of a chemical is needed it can often be obtained from another laboratory on campus.
  - Label chemical containers with the date of receipt and the date opened. This is especially important for peroxide forming chemicals☑ and other chemicals with specific safe storage shelf life.
- Be sure appropriate storage conditions such as physical space and storage units (flammable, corrosive cabinets, etc.) are available prior to purchasing a chemical. Some chemicals may have security restrictions or special storage requirements regarding temperature, or time. Generally, chemicals should be stored in cabinets or on shelves.
  - Limit storage of chemicals in laboratory hoods to the experiment being conducted in order to maximize the hood ventilation performance.
  - Avoid storage of chemicals on the floor unless secondary containment is used. Do not store in aisle spaces.
  - Avoid storing materials and equipment on top of cabinets. If you must place things there, however, you must maintain a clearance of *at least 18 inches from the sprinkler heads* or (if no sprinkler heads are present) *24 inches from the ceiling.*
  - The storage of chemicals on bench tops should be kept to a minimum to help prevent clutter and spills, and to allow for adequate working space.
  - Do not store chemicals in direct sunlight or next to heat sources.
  - Store higher risk chemicals (highly toxic, flammable, or reactive) in secondary containment to reduce the likelihood of release.

    - For liquid chemicals, plastic tubs and trays can be used as secondary containment for larger containers or multiple containers, while sealed cans and plastic bags can be used for smaller, individual containers.
    - For solid chemicals, sealed containers or plastic bags can provide secondary containment.
- Chemical storage shelving units or cabinets must be sturdy. Secure to a wall or other structure to avoid tipping over.
  - Shelving should be secure and able to support the materials placed on them.
  - Shelves should have a barrier or lip to prevent chemical containers from falling off. This can also be accomplished by using heavy gauge twine or wire to create a barrier on the shelf.
  - Arrange larger chemical bottles towards the back; smaller bottles should be stored up front where they are visible with labels facing forward.
  - For multiples of the same chemical, older containers should be stored in front of newer chemicals 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.
  - Every chemical should have an identified storage place and should be returned to that location after use.
- All chemical containers MUST be properly labeled. See labeling procedures☑.
  - Label incoming chemical containers with the date of receipt and the date opened. This is especially important for peroxide forming chemicals☑ and other chemicals with specific safe storage shelf life.
  - Check chemical containers regularly and replace any deteriorating labels before the chemical becomes an unknown.
  - Turn chemical bottles with the labels facing out so they can be easily read.
- A chemical inventory must be maintained for all chemicals stored within a division or laboratory. Keep inventories current by adding and deleting chemicals as they are received or disposed of. Use the AU chemical inventory formatted EXCEL worksheet☑, which will then be uploaded into Quartzy. Contact EHS for instructions.
  - Chemical Inventories must be updated at least annually by June 15th.
  - Each laboratory should perform periodic, at least annually, visual inspections of the chemicals in the inventory.
  - Chemicals that are no longer needed, or which meet any of the following conditions, must be disposed of through EH&S:
    - shelf life has been exceeded,
    - evidence of chemical reaction,
    - container and/or cap corroded, leaking, or otherwise in poor condition.
- Always segregate and store☑ chemicals according to compatibility and hazard classes **NOT** alphabetically.
- Flammable liquids☑ in excess of quantities for specific flammability classes must be stored in approved flammable liquid storage cabinets.
  - Do not store flammable liquids in standard (non-explosion proof) refrigerators or freezers. Due to the potential explosion hazard, only store flammables in refrigerators or freezers approved by the manufacturer for storage of flammables.
- Corrosive chemicals should be stored in corrosion resistant cabinets.
  - The exceptions to this rule 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 corrosives above a height of 5 feet.

- Be aware of special medical treatment for contact with Hydrofluoric acid☑.

- Highly toxic chemicals such as inorganic cyanides must be stored in locked storage cabinets. Always keep the quantities of highly toxic chemicals to an absolute minimum. See Particularly Hazardous Substances☑ .

2.7.2 CHEMICAL STORAGE AND HANDLING BASED ON PHYSICAL AND HEALTH HAZARDS

Materials which present a physical hazard can be safely used if the specific hazard(s) are understood. If appropriate precautions are not taken, personal injury or property damage may occur. Additionally, certain chemicals cannot be safely mixed or stored with other chemicals because of the danger of a violent reaction or a reaction that generates toxic gas. See a table of Incompatible Chemicals☑. The Chemical Reactivity Worksheet☒ is an excellent resource. It is a database that includes information about the intrinsic hazards of each chemical and about whether a chemical reacts with air, water, or other materials. It also includes case histories on specific chemical incidents, with references. Employees must follow special procedures for handling and storage of certain hazardous chemicals. The LSF/PI must create site-specific SOP's☒ for these chemicals as specified.

2.7.2.1 FLAMMABLE/COMBUSTIBLE LIQUIDS

Flammable and combustible liquids are one of the most common types of chemicals used. However, in addition to the flammable hazard, some flammable liquids also may possess other hazards such as being toxic and/or corrosive. Under the Division of Transportation (DOT) hazard class system, flammable liquids are listed as hazard class 3.

OSHA Flammable and Combustible☑ Liquids Standard

- A **flammable liquid** is any liquid having a flashpoint below 100 degrees F (37.8 degrees C), except any mixture having components with flashpoints of 100 degrees F (37.8 degrees C) or higher, the total of which make up 99% or more of the total volume of the mixture.
  - Flashpoint is defined as the minimum temperature at which a liquid gives off enough vapor to ignite in the presence of an ignition source. An important point to keep in mind is the risk of a fire requires that the temperature be above the flashpoint and the airborne concentration be in the flammable range above the Lower Explosive Limit (LEL) and below the Upper Explosive Limit (UEL).

- A **combustible liquid** as any liquid having a flashpoint at or above 100 degrees F (37.8 degrees C), but below 200 degrees F (93.3 degrees C), except any mixture having components with flashpoints of 200 degrees F (93.3 degrees C), or higher, the total volume of which make up 99% or more of the total volume of the mixture.

- OSHA and NFPA (National Fire Protection Association) further breaks down flammables into Class I liquids, and combustibles into Class II and Class III liquids. *Please note this classification is different than the criteria used for DOT classification. This distinction is important because allowable container sizes and storage amounts are based on the particular OSHA Class of the flammable liquid.*

  - These classes give a measure of the fire risk.

	Flash Point	Boiling Point
Flammable		
Class IA	< 73 °F (22.8 °C)	< 100 °F (37.8 °C)
Class IB	< 73 °F (22.8 °C)	≥ 100 °F (37.8 °C)
Class IC	≥ 73 °F (22.8 °C) & < 100 °F (37.8˚C)	
Combustible		
Class II	≥ 100 °F (37.8 °C) & < 140 °F (60 °C)	
Class IIA	≥ 140 °F (60 °C) & < 200 °F (93 °C)	
Class IIIB	≥ 200 °F (93 °C)	

- **Maximum Flammable and Combustible Liquid Container Size**

The maximum allowable (OSHA, NFPA) sizes for flammable and combustible liquid storage containers are as follows:

Container Type	**Flammable Liquids**			**Combustible Liquids**	
	Class IA	Class IB	Class IC	Class II	Class IIIA
Glass or approved plastic	1 pint	1 quart	1 gallon	1 gallon	1 gallon
Metal (other than DOT drums)	1 gallon	5 gallon	5 gallon	5 gallon	5 gallon
Safety cans	2 gallon	5 gallon	5 gallon	5 gallon	5 gallon
Metal drums (DOT spec)	60 gallon	60 gallon	60 gallon	60 gallon	60 gallon
Approved portable tanks	660 gallon	660 gallon	660 gallon	660 gallon	660 gallon
Polyethylene (DOT Spec. 34 or as authorized by DOT Exemption	1 gallon	5 gallon	5 gallon	60 gallon	60 gallon

Exceptions: Glass or plastic containers up to one gallon capacity can be used for Class IA or IB flammable liquid if the stored liquid would be rendered unfit for its intended use by contact with metal, or would excessively corrode a metal container so as to create a leak hazard.

- **Maximum Allowable Quantities in Laboratory Buildings**

Contemporary laboratory safety practice dictates that the volume of flammable and combustible liquids stored and used in the laboratory be minimized. Flammable liquids, and to a lesser extent combustible liquids, should always be stored in flammable liquid storage cabinets and safety cans to minimize the risk of fire.

The NYS Division of Code Administration and Enforcement, through incorporation of the International Fire Code (IFC), regulates maximum storage quantities for flammable and combustible liquids per fire control area. The IFC also limits the number of control areas per building and per floor. The maximum allowable quantities of flammable and combustible liquid, including chemical waste, per control area[1] (control areas shall be separated from each other by not less than a 1hour fire barrier constructed in accordance with the Building Code of NYS) are:

Class	Quantity - Storage	Quantity – In Use, Closed System	Quantity – In Use, Open System
1A	30 gallons	30 gallons	10 gallons

1A, 1B, and 1C combined*	120 gallons	120 gallons	30 gallons
II	120 gallons	120 gallons	30 gallons
IIA	330 gallons	330 gallons	80 gallons

* Quantity limits for Class 1A may not be exceeded.

Note 1: A single control area may be composed of multiple laboratory rooms; thus, the maximum allowable quantity of flammable and combustible liquids in an individual laboratory room will usually be less than the above control area values.
Note 2: The maximum allowable limits for flammable and combustible liquids can be doubled if stored in an approved flammable liquid storage cabinet (maximum of 3 cabinets) or approved safety cans, and can be doubled again if the rooms comprising the control area are equipped with automatic fire suppression sprinklers.

- **Quantities of flammable liquids stored outside of flammable storage cabinets or safety cans** should be limited as follows:
  - The maximum quantity of Class I flammable liquids and Class II combustible liquids, combined, that can be stored outside of a flammable storage cabinet is 10 gallons; however, this total can be increased to 25 gallons if the flammable and combustible liquids are stored in safety cans.
  - The quantity of flammable liquid stored in refrigerators is included in the maximum amount that can be stored outside of an approved flammable liquid cabinet.
- **Storage in Flammable Liquid Cabinets**
  - Cabinets must be regulation approved.
  - Storage cabinets must be labeled “Flammable-Keep Fire Away.
  - Maximum Storage Quantities
    - Maximum number of flammable storage cabinets is limited to 3 per control area.
    - Maximum storage quantities per individual flammable liquid storage cabinet are:
      - first dependent on approved capacity of cabinet.
      - 60 gallons of flammable or combustible liquid.
      - 120 gallons of flammable and combustible liquid combined.
- **Ventilation of Flammable Liquid Cabinets**
  - Do not vent flammable storage cabinets.
  - Do not remove vent bungs from flammable storage cabinets.
- **Selection and use of refrigerators for flammable material storage**
  - Do **NOT** use ordinary refrigerators - they drain interior condensation as well as any spilled chemical and the motors are potential ignition sources.
  - Flammable Materials Refrigerators are designed with magnetic door seals (to avoid pressure buildup) and produce no sparks or hot surfaces inside storage box **but** motor produces sparks outside storage box. Use in ordinary laboratory but do not inside a flammable storage room.
  - Explosion-Proof Refrigerators contain no hot surfaces and provide a safe spark free interior and exterior. Use in a hazardous environment (Class I, Division I & II Group C and D applications).
  - Control odiferous vapors within a refrigerator by placing a tray of activated charcoal in the refrigerator. The charcoal should be handled in the hood because of the dust but it effectively controls many vapors.
- **While handling Flammable/Combustible liquids, observe the following guidelines**:
  - Assure appropriate fire extinguishers and/or sprinkler systems are in the area.

- Eliminate ignition sources such as open flames, hot surfaces, sparks from welding or cutting, operation of electrical equipment, and static electricity.
- Store in NFPA approved flammable liquid containers or storage cabinets, in an area isolated from ignition sources or in a special storage room designed for flammable materials.
- All 5 gallon flammable liquid containers should be stored in a flammable liquid storage cabinet.
- Ensure there is proper bonding and grounding when it is required, such as when transferring or dispensing a flammable liquid from a large container or drum. Assure bonding and grounding is checked periodically.

2.7.2.2 CORROSIVES

OSHA defines a corrosive as "a chemical that causes visible destruction of, or irreversible alterations in living tissue by chemical action at the site of contact."
Under the DOT hazard class system, corrosives are listed as hazard class 8.

- **Corrosive liquids** (e.g. mineral acids, alkali solutions and some oxidizers) represent a very significant hazard to eyes, skin, respiratory tract, and gastrointestinal tract.
  - Splashes can easily occur and their effect on human tissue generally takes place very rapidly.
  - Bromine, sodium hydroxide, sulfuric acid, hydrogen peroxide, perchloric acid, and hydrofluoric acid are examples of highly corrosive liquids.
    - See hydrofluoric acid☑ Appendix N, for information on special emergency procedures and the use of Calcium gluconate gel if exposure occurs.
    - See specific procedures for using perchloric acid☑.
- **Corrosive solids** and their dusts can react with moisture on the skin or in the respiratory tract causing irritation or burns. Sodium hydroxide pellets and phenol are examples of corrosive solids.
- **Corrosive gases and vapors** are hazardous to all parts of the body; eyes and respiratory tract are particularly sensitive.
  - The magnitude of the effect is related to the solubility of the material in the body fluids.
    - Highly soluble gases (ammonia, hydrogen chloride) cause severe nose and throat irritation while substances of lower solubility (nitrogen dioxide, phosgene, sulfur dioxide) can penetrate deep into the lungs.
- **Corrosive chemicals handling procedures**
  - Read the SDSs and follow handling procedures.
  - Appropriate PPE and a fume hood must be available where corrosives are used.
  - Calcium gluconate gel is required on site where hydrofluoric acid is stored or used.
  - Ensure spill cleanup material is available for neutralization, such as Calcium carbonate for acids and Citric acid for bases. **An HF spill kit, provided by EH&S, must be available in labs using HF. The kit must contain PPE specific HF spill pillows or calcium compounds such as calcium carbonate, calcium sulfate or calcium hydroxide**. ***Sodium bicarbonate should never be used*** *since it does not bind the fluoride ion and can generate toxic aerosols.*
  - An eyewash and emergency shower must be available wherever acids and bases are stored or used. See emergency response section☑., and HF Exposure☑
  - Containers and equipment used for storage and processing of corrosive materials should be corrosion resistant.
  - Segregate and store☑ corrosive chemicals properly, never store above 5 feet.
  - Always use a protective bottle carrier when transporting corrosive chemicals.

- Wear splash goggles instead of safety glasses when working with corrosive materials. Splash goggles used in conjunction with a face shield provides better protection. A face shield alone does not provide adequate protection.
- Wear rubber gloves (glove selection chart☑) and other appropriate protective clothing to protect all exposed skin surfaces from contact with gases and vapors.
- Handle corrosive chemicals in a fume hood to avoid breathing corrosive vapors and gases.
- Wear a respirator if required by SDS. Some chemicals react with acids and liberate toxic and/or flammable vapors.
- When corrosive gases are to be discharged into a liquid, a trap, check valve, or vacuum break device should be employed to prevent dangerous reverse flow.
- Regulators and valves should be closed when a corrosive gas cylinder is not in use and flushed with dry air or nitrogen after use.
- When mixing concentrated acids with water, always add acid slowly to the water (specifically, add the more concentrated acid to the dilute acid). Never add water to acid, this can result in a boiling effect and cause acid to splatter. Do not pour the acid directly into the water; it should be poured in a manner that allows it to run down the sides of the container.

2.7.2.3 PARTICULARLY HAZARDOUS SUBSTANCES (PHS)

The OSHA Lab Standard☑ requires that provisions for additional employee protection for work involving 'particularly hazardous substances' (PHS) be included in the CHP. The LSF/PI is responsible for determining if PHS are used or stored in his/her laboratory and if so determined the LSF/PI must complete the PHS Use Form☑, the Prior Approval Form☑ and follow the specified PHS handling procedures☑.

The OSHA Lab Standard defines PHS as **"select carcinogens", reproductive toxins and substances which have a high degree of acute toxicity.** Also, certain PHS☑ may be subject to additional occupational safety and health 29 CFR 1910 standards; these specific standards are not replaced by the 1910.1450, OSHA Lab Standard. A list of PHS is found in Appendix Q☑. This list not exhaustive, refer to SDS and other references. Consult SDSs and links listed below for more information to determine whether a particular chemical may be a PHS.

- **Select Carcinogens**
  A carcinogen is any substance or agent that is capable of causing cancer – the abnormal or uncontrolled growth of new cells in any part of the body in humans or animals. Most carcinogens are chronic toxins with long latency periods that can cause damage after repeated or long duration exposures and often do not have immediate apparent harmful effects.
  - The OSHA Lab Standard defines a "select carcinogen" as any substance which meets one of the following criteria:
    - It is regulated by OSHA as a carcinogen☑; or
    - It is listed under the category, "known to be carcinogens," in the Annual Report on Carcinogens published by the National Toxicology Program NTP☑ (Public Health, Report on Carcinogens)(latest edition); or
    - It is listed under Group 1 ("carcinogenic to humans") by the International Agency for Research on Cancer Monographs IARC☑ (type 'classification') in the search box (latest editions); or
    - It is listed in either Group 2A or 2B by IARC or under the category, "reasonably anticipated to be carcinogens" by NTP☑, and causes statistically significant tumor incidence in experimental animals in accordance with any of the following criteria:

    - After inhalation exposure of 6-7 hours per day, 5 days per week, for a significant portion of a lifetime to dosages of less than 10 mg/m(3);
    - After repeated skin application of less than 300 (mg/kg of body weight) per week; or
    - After oral dosages of less than 50 mg/kg of body weight per day.
  - With regard to mixtures, OSHA requires that a mixture "shall be assumed to present a carcinogenic hazard if it contains a component in concentrations of 0.1% or greater, which is considered to be carcinogenic.
- **Reproductive Toxins**
  Reproductive Toxins☑ are substances that have adverse effects on various aspects of reproduction, including fertility, gestation, lactation, and general reproductive performance. When a pregnant woman is exposed to a chemical, the fetus may be exposed as well because the placenta is an extremely poor barrier to chemicals. Reproductive toxins can affect both men and women. Male reproductive toxins can in some cases lead to sterility.
- **Substances with a High Acute Toxicity**
  - High acute toxicity includes any chemical /toxic gas☑/ that falls within any of the following OSHA-defined categories: (Hydrofluoric Acid is a substance with high acute toxicity)
    - A chemical with a median lethal dose☑ (LD_{50}) of 50 mg or less per kg of body weight when administered orally to certain test populations.
    - A chemical with an LD_{50} of 200 mg or less per kg of body weight when administered by continuous contact for 24 hours to certain test populations.
    - A chemical with a median lethal concentration (LC_{50}) in air of 200 parts per million (ppm) by volume or less of gas or vapor, or 2 mg per liter or less of mist, fume, or dust, when administered to certain test populations by continuous inhalation for one hour, provided such concentration and/or condition are likely to be encountered by humans when the chemical is used in any reasonably foreseeable manner.
  - Estimating the hazard posed by the use of a chemical is controversial and complex. It involves much more than determining its toxicity. The severity of a chemical hazard depends not only on the toxicity but on its chemical and physical properties and the manner and quantity in which it is used. By learning about the potential hazards of the substances you use, and by practicing appropriate procedures for those substances, you can work safely in an informed and intelligent manner.
    - The exposure limits for any chemical is found in the SDS.
      The Limits will either be:
      - "regulatory" limits, which are mandated by OSHA, are called Permissible Exposure Limits (PEL). When a PEL exists, it will be used to determine the proper safety precautions, control measures, and personal protective equipment to be used. If no limit is provided, contact EH&S for guidance.

        -or-
      - "recommended limits" such as the American Conference of Governmental Industrial Hygienists (ACGIH) Threshold Limit Values (TLVs). The TLV will be used if the TLV is lower than the PEL, or in the absence of a PEL.
    - Toxicity information is also found on product labels and in the Registry of Toxic☑ Effects of Chemical Substances☑ (RTECS-requires membership)
- **Certain PHS Subject to Specific OSHA 29 CFR 1910 Standards**
  - Users of the materials listed below are expected to adhere to the provisions of all applicable substance-specific standards when and if employee exposure routinely exceeds the OSHA mandated permissible exposure limit (or Action Level, if specified).
  - These standards are found at this link of specific OSHA standards☑. Once the link is opened, scroll down on the list of standards to Subpart Z – Toxic and Hazardous

Standards; find the specific 1910.1000 or 1926.1101 series code listed below for the specific chemical.

Asbestos, tremolite, anthophyllite and actinolite 29 CFR 1910.1001
4-Nitrobiphenyl .1003
alpha-Naphthylamine .1004
4,4'-Methylene bis(2-chloroaniline) .1005
Methyl chloromethyl ether .1006
3,3'-Dichlorobenzidine (and salts) .1007
bis-Chloromethyl ether .1008
beta-Naphthylamine .1009
Benzidine .1010
4-Aminodiphenyl .1011
Ethyleneimine .1012
beta-Propiolactone .1013
2-Acetylaminofluorene .1014
4-Dimethylaminoazobenzene .1015
N-Nitrosodimethylamine .1016
Vinyl Chloride .1017
Arsenic (inorganic) .1018
Lead .1025
Cadmium .1027
Benzene .1028
Cotton dust .1043
1,2-Dibromo-3-chloropropane .1044
Acrylonitrile .1045
Ethylene oxide .1047
Formaldehyde .1048
4,4'-Methylenedianiline .1050
Methylene Chloride .1052
Non-Asbestiform tremolite, anthophyllite and actinolite 1926.1101☑

- **PHS Handling Procedures**
  - The LSF/PI must develop laboratory (site) specific SOPs☑ for PHS used in his/her lab and provide site-specific training☑ to all laboratory workers using PHS.
    - Training is documented on the Site-Specific Training Form Appendix F☑; a copy is sent to EH&S.
    - The LSF/PI will authorize those employees who are adequately trained to work with a PHS. Complete Appendix G☑ Employee Authorization Form and attach to SOP.
  - Prior to purchase or use (if currently in inventory) of a PHS, complete the Prior Approval Form Appendix V☑ and PHS Use Form Appendix D☑ and send to EH&S for approval; EH&S will reply within 2 workdays.
  - The LSF/PI must designate a lab or area, typically a fume hood, glove box, etc. where the PHS will be used. The area is posted with a noticeable sign stating:

Danger – Designated Work Area

For select carcinogens, reproductive toxins, substances with high acute toxicity

all use must take place in this designated work area

ONLY AUTHORIZED INDIVIDUALS USING PROPER PPE MAY WORK WITH THESE CHEMICALS

For additional information contact AU EH&S 2190

- All work is conducted within the Designated Area.

- The increased hazard risk associated with PHS calls for more stringent operating procedures in the laboratory; consider the following when preparing site-specific SOP:
  - **Work Habits**
    - No eating, drinking, smoking, chewing of gum or tobacco, application of cosmetics or storage of utensils, food or food containers in laboratory areas where PHS (or any chemicals) are used or stored.
    - Wash hands and arms immediately after the completion of any procedure in which a PHS has been used and prior to leaving the laboratory.
    - Conducted each procedure with the minimum amount of the substance, consistent with the requirements of the work.
    - Keep records of the amounts of each highly hazardous material used, the dates of use and the names of the users.
    - Work on trays or absorbent plastic-backed paper (Bench Kote) or pads to help contain spilled materials and to simplify subsequent cleanup and disposal.
  - **Personal Protective Equipment**
    - PHS may require more stringent use of personal protective equipment☑. Check the SDS for information on proper gloves, lab clothing and respiratory protection.
    - Proper PPE must be worn at all times when handling PHS.
    - Wear lab clothing that protects street clothing, such as a fully fastened lab coat or a disposable jumpsuit when PHS is being used. Laboratory clothing used while manipulating PHS must not be worn outside the laboratory area.
    - When methods for decontaminating clothing are unknown or not applicable, wear disposable protective clothing. Disposable gloves must be discarded after each use and immediately after overt contact with a PHS.
    - For using Hydrofluoric Acid see Appendix N☑.
  - **Ventilation/Isolation**
    - Most PHS work should be performed in a fume hood☑, glove box, or with other form of ventilation. If the chemical may produce vapors, mists or fumes, or if the procedure may cause generation of aerosols, use of a fume hood is required.
    - A fume hood used for PHS must have an average face velocity of between 95 and 125 feet per minute. This measurement is noted on the hood survey sticker. If the hood has not been inspected within the past 3 months, contact EH&S 2190 for re-inspection before using the hood.
    - Use a glove box if protection from atmospheric moisture or oxygen is needed or when a fume hood may not provide adequate protection from exposure to the substance; e.g., a protection factor of 10,000 or more is needed.
    - Highly toxic gases must be used and stored in a vented gas cabinet connected to a laboratory exhaust system. Gas feed lines operating above atmospheric pressure must use coaxial tubing.

- **Storage and Transportation**
  - PHS must be stored in a designated storage area or cabinet with limited access. Additional storage precautions (i.e., a refrigerator, a hood, a flammable liquid storage cabinet) may be required for certain compounds based upon other properties.
  - Containers must be clearly labeled.
  - Double containment should also be considered. Double containment means that the container will be placed inside another container that is capable of holding the contents in the event of a leak and provides a protective outer covering in the event of contamination of the primary container.
  - Store containers on trays or pans made of polyethylene or other chemically resistant material.
  - Persons transporting PHS from one location to another must wear proper PPE and use double containment to protect against spills and breakage.
- **Vacuum Lines and Services**
  - Protect each vacuum service, including water aspirators, with an absorbent or liquid trap to prevent entry of any PHS into the system.
  - Use a separate vacuum pump when using volatile PHS. The procedure should be performed inside a fume hood.
- **Decontamination and Disposal**
  - Plans for the handling and ultimate disposal of contaminated wastes and surplus amounts of the PHS must be completed prior to the start of any laboratory activity involving a PHS. EH&S can assist in selecting the best methods available for disposal.
  - Contaminated materials should either be decontaminated by procedures that decompose the PHS to produce a safe product and/or be properly removed and stored for subsequent hazardous waste disposal.
  - All work surfaces must be decontaminated at the end of the procedure or work day, whichever is sooner.

2.7.2.4 OXIDIZERS AND ORGANIC PEROXIDES

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." See Appendix R☑ for a list of common oxidizers. The OSHA Laboratory Standard defines organic peroxide as "an organic compound that contains the bivalent –O-O- structure and which may be considered to be a structural derivative of hydrogen peroxide where one or both of the hydrogen atoms have been replaced by an organic radical."

- **Safety Concerns:**
  - Oxidizers and organic peroxides promote and enhance the potential for fires. Fire requires a fuel source, an oxygen source, an ignition source, and a chemical reaction.
    - Oxidizers can supply the oxygen.
    - Organic peroxides supply both the oxygen and the fuel source.
  - Both oxidizers and organic peroxides may become shock sensitive and explode when they
    - dry out;
    - are stored in sunlight;
    - become contaminated with other materials, particularly when contaminated with heavy metals.
  - Most organic peroxides are also temperature sensitive.
- **Storage and Handling:**
  - Refer to Appendix K Segregation and Storage☑.

- Keep quantities on hand to a minimum.
- Read the SDS and other reference documents prior to use.
  - Understand the hazards and special handling precautions.
  - Be aware of the melting and auto ignition temperatures.
  - Ensure any device used to heat oxidizers has an over temperature safety switch to prevent the compounds from overheating.
- Use particular care when handling high surface area oxidizers such as finely divided powders in the presence of organic materials.
- Avoid using metal objects when stirring or removing oxidizers or organic peroxides from chemical containers. Plastic or ceramic implements should be used instead.
- Avoid friction, grinding, and impact with solid oxidizers and organic peroxides.
- Avoid glass stoppers and screw cap lids. Use plastic/polyethylene bottles and caps.
- If the oxidizer or organic peroxide may have been contaminated, evident by discoloration of the chemical, dispose of the chemical as hazardous waste. Indicate on the hazardous waste label that you suspect contamination. If crystals are observed either in the liquid or around the cap, do not move the bottle and immediately call EH&S 2190.

2.7.2.5 PEROXIDE FORMING COMPOUNDS

Many commonly used chemicals; organic solvents in particular, can form shock, heat, or friction sensitive peroxides upon exposure to oxygen and light. These carbon-based chemicals are capable of forming potentially explosive peroxide "O-O" bonds, thus making them among the most dangerous substances handled in the laboratory. Therefore, the LSF/PI must ensure that all peroxide forming chemicals in his/her laboratory are identified, tracked and tested for peroxides in order to protect the health and safety of laboratory workers.

- **Common Peroxide Forming Chemicals**
  Appendix J☑ contains Tables A, B, C, and D listing common peroxide forming chemicals and their disposal times. The chemicals listed here are considered potentially explosive in their pure form. When they are mixed with other compounds, their hazards can change. When mixed with other compatible chemicals, especially water, their explosive hazard is sometimes decreased through dilution, but not always. **Appendix J is not all inclusive**; keep in mind there are no "complete lists" of peroxide forming chemicals. A wide range of organic chemicals can be oxidized by reaction with molecular oxygen to form explosive peroxides and there are many uncertainties about their hazards. Therefore, laboratory workers should consult container labels, SDSs, books such as "Hawley's Chemical Dictionary," or a list of common peroxide moieties (also found in Appendix J) if the hazards of a chemical are not well known or the chemical is suspected to form organic peroxides.

  1. **Table A** contains chemicals that form explosive levels of peroxides without a concentration step, e.g., evaporation, distillation, etc. These chemicals can be a particular hazard since peroxides can form even without opening the containers. Therefore, only small amounts should be ordered and used as soon as possible. After opening, they should not be kept for over **three months.** When possible, store these chemicals under nitrogen.

  2. **Table B** contains chemicals that form explosive levels of peroxides upon concentration. These chemicals typically accumulate hazardous levels of peroxides when evaporated, distilled, contaminated, or have their peroxide inhibiting compounds compromised. After opening, they should not be kept for over **12 months.**

  3. **Table C** contains chemicals that may autopolymerize as a result of peroxide accumulation. These chemicals can undergo hazardous polymerization reactions that are initiated by

peroxides that have accumulated in solution. They are typically stored with polymerization inhibitors to prevent these dangerous reactions. Inhibitors do become compromised over time however, and thus after opening, these chemicals should not be kept for over **12 months.**

Uninhibited chemicals of this subcategory should not be stored over **24 hours**. Uninhibited chemicals should be inhibited with the appropriate compounds before the 24-hour mark is exceeded. Do not store inhibited chemicals in this category under an inert atmosphere because some of the inhibitors require a small amount of oxygen to work.

4. **Table D** contains chemicals that cannot be placed into the above categories but still have the potential for forming hazardous levels of organic peroxides. After opening, they should not be kept for over **12 months.**

- **Peroxide Forming Chemicals Disclaimer**
  Currently, no specific OSHA regulations apply for the identification and handling of peroxide forming chemicals. Also, there is no definitive data about what concentration level of peroxides poses a hazard. However, AU must adhere to a requirement set forth by the TSDF (transport, storage and disposal facility) accepting our chemical waste. The TSDF allows a maximum peroxide concentration level of 10 ppm to ensure safe handling, transport and disposal of waste from peroxide forming chemicals. Follow the procedures below.
- **Managing Peroxide Forming Compounds**
  LSF/PI must ensure proper management and tracking of peroxide forming chemicals.
  - Purchase only the absolute minimum amount.
    - Peroxide-forming chemicals and reagents should be purchased with inhibitors added by the manufacturer, whenever possible.
    - Avoid evaporation or distillation – distillation separates these inhibitors from the peroxide-forming chemical.
    - An inert gas such as nitrogen or argon can be introduced into the container as an inert blanket to minimize available oxygen **(inhibited vinyl monomers and Table C chemicals, are the exception to this recommendation).**
  - Label container as "Peroxide Forming Chemical" with the date received, date opened, disposal date, each peroxide test date, test results and initials of tester.
    - Read the container label and SDS. Know the reactivity and stability characteristic. Note the appearance of the chemical as stated on the SDS. This is important for visual inspections of peroxide formers.
    - Only essentially anhydrous alcohols are subject to peroxidation. Solutions of alcohols with water (70% 2-propanol + 30% water) do not need to be labeled, tracked or tested.
  - Inspect containers of peroxide-forming chemicals often, looking for signs of precipitation, stratification of liquid, crystal formation, color changes or other irregularities.
    - The presence of any of these signs indicates a potential shock sensitive container – **NEVER** open a container of a peroxide-forming chemical that has obvious crystal formation. The friction caused by opening a crystallized lid can cause an explosion. Do not move the container - contact EH&S as soon as possible.
  - Test chemical for peroxides when bottle is first opened, at subsequent uses and/or every 6 months thereafter.
    - **Always evaluate chemicals as outlined below before testing for peroxides**.
  - Clean up all spills immediately. Use vermiculite or other absorbing material and dispose of properly.

- Dispose of peroxide formers as indicated in the tables in Appendix J Peroxide Forming Chemicals☑ or when a peroxide level of 10 ppm or greater is detected. It is the responsibility of the LSF/PI to reduce the level of peroxides to 10ppm prior to waste removal.
  - Chemicals that reach their disposal date can still be used if testing for peroxides reveals a concentration below 10 ppm.

- **Storage of Peroxide Forming Chemicals**
  - Store only the amount of chemical needed within that chemical's safe shelf-life; see Appendix J☑.
  - Store material in the original manufacturer's container.
    - Diethyl ether should be packaged in steel containers; the iron in the steel containers acts as an inhibitor.
  - Never return unused quantities back to the original container.
  - Never store in open, partially empty or transparent containers as these conditions promote peroxide formation.
  - Store in a well ventilated area away from incompatible material such as oxidizers. For specific incompatibilities, refer to SDS.
  - Protect from flame, static electricity, sparks, sources of heat and sunlight.
  - Protect from physical damage, shock and/or friction.
  - Formation of peroxides may be slowed but not prevented by refrigeration and stabilizers will only retard formation.
    - Peroxide forming chemicals should not be refrigerated at or below the temperature at which the peroxide forming compound freezes or precipitates as these forms of peroxides are especially sensitive to shock and heat.

- **Handling Peroxide Forming Chemicals**
  - Once peroxides have formed, an explosion can result during routine handling.
    - Since these chemicals are sometimes packaged in an atmosphere of air, peroxides can form even though the containers have not been opened.
  - Extreme care should be taken when opening and pouring organic peroxide formers.
    - After pouring, wipe any chemical off the threads of the container with a dry towel to prevent source of peroxide formation under the cap.
  - Wear chemical goggles and other appropriate PPE, consult SDS.
  - Work in a fume hood and use secondary containment if practical.
  - Never attempt to force open a stuck cap on a container.
  - Verify that an operable safety shower/eyewash and fire extinguisher is readily accessible.
  - At least one other person not directly involved in handling of the chemicals should be present.
  - Always test peroxide-forming chemicals prior to distillation or other concentration procedures as this is when explosions commonly occur. **DO NOT** distill or concentrate if they contain **any** measurable amount of peroxide. 20% residual volume should be left during distillation. Test residual volume for peroxides prior to disposal. A non-volatile organic liquid, such as mineral oil, can be added to minimize concentration of any peroxides. Note this on hazard waste label.

- **Evaluate Chemicals Prior To Testing For Peroxides**
  - **Never** test containers of unknown age or origin or try to force open a rusted or stuck on cap. Do not handle these containers, contact EH&S.
  - Visually inspect peroxide-forming chemicals.
    - A flashlight or other light source can be used to increase the visibility of the interior of amber bottles.

- Diethyl ether is commonly sold in steel containers which prevents visual inspection of the liquid. Therefore, diethyl ether containers whose age and use history are unknown should be assumed to contain dangerous levels of peroxides, and should not be disturbed. Contact EH&S.
- Containers that exhibit any unusual visual characteristics, such as the examples listed below, should be assumed to contain dangerous levels of peroxides and should not be disturbed. Contact EH&S.
  - Liquid Chemicals
    - Crystallization (around the cap or in the liquid)
    - Visible discoloration
    - Liquid stratification
  - Solid Chemicals (potassium metal, potassium and sodium amide)
    - Discoloration and/or formation of a surface crust (for example, potassium metal forms a yellow or orange superoxide at the surface)
    - Evaluation of alkali metals and their amides is based on visual criteria only. **These substances react strongly with water and oxygen, and standard peroxide tests should not be performed.**

- Only chemicals which pass visual inspection should be evaluated further.
- Only chemicals that meet this criteria should be opened and tested for peroxides:
  - The identity of the chemical is known.
  - The age of the chemical (since manufacture) is known.
  - Evaporation of the chemical is thought to be less than 10% - if this is in question, assume evaporation has occurred and that high peroxide levels may be present.
  - The chemical is within the expiration or disposal date as specified in Appendix J☑.
  - The chemical was tested for peroxides within the past 6 months.
- Chemicals that do **not** meet the above criteria should be considered high risk and not be disturbed. Notify EH&S.
- If after opening the container, visual irregularities such as those listed above are apparent, assume that dangerous levels of peroxides are present. Gently cover the container to minimize evaporation, do not move container, notify other lab personnel of the potential hazard and notify EH&S immediately.

- **Peroxide Testing Procedure**
  - Laboratory personnel are responsible for performing peroxide testing of chemicals present in their laboratories or storage areas.
  - For chemicals that have been determined to be safe to open, measure the peroxide concentration by test strips or other wet methods.
    - Commercial peroxide test strips are fast and easy. The types of test strips that provide quantitative results are the suggested test method. These test strips can be purchased from a variety of safety supply vendors, such as VWR, Fisher Scientific and Laboratory Safety Supply.
    - Procedures for other wet methods can be found in Prudent Practices in the Laboratory ☑and the American Chemical Society booklet Safety in Academic Chemistry Laboratories☒.
    - Follow testing procedures as specified by the chosen testing method.
    - Chemicals that contain peroxide levels that exceed test detection range may be diluted with a miscible, peroxide-free solvent, Hexane, for example, to bring levels to within testing levels.
    - Run a control test for efficacy with a dilute solution of hydrogen peroxide.
    - Chemicals with <10ppm peroxide levels may be safely used depending upon the application; **do not distill or evaporate these chemicals**.

- **Disposal of Peroxide Forming Chemicals**
  - Chemicals with a peroxide concentration of 10 or less ppm can be disposed of as hazardous waste following AU Hazardous Waste policies and procedures.
  - Chemicals with a peroxide concentration of greater than 10 but less than 100 ppm must have the peroxide concentration reduced to less than 10 ppm before disposal.
    - Laboratory personnel are responsible for reducing peroxide levels. Record date and final test result on container. Appendix J☑ provides procedures for reducing peroxide levels.
  - Chemicals with a peroxide concentration greater than 100 ppm are considered high risk, and may require special handling and stabilization by a "bomb squad" prior to disposal. Do not move. Post warning signs and immediately notify EH&S.
  - Chemicals that are suspected of having very high peroxide levels because of age, unusual viscosity, discoloration, or crystal formation should be considered extremely dangerous. Do not open or move. Post warning signs and immediately notify EH&S.

2.7.2.6 WATER REACTIVE MATERIALS

These materials react with water to produce a flammable or toxic gas or other hazardous conditions often resulting in a fire or explosion. Safe handling of water reactive materials will depend on the specific material and the conditions of use and storage. Read the SDS. Examples of water reactive chemicals include alkali metals such as lithium, sodium, and potassium; acid anhydrides, and acid chlorides.

2.7.2.7 PYROPHORIC MATERIALS

These materials ignite spontaneously upon contact with air. Often the flame is invisible. Examples of pyrophoric materials are commercial Grignard reagents, organic lithiums, silane, silicon tetrachloride, and white or yellow phosphorous. **Pyrophoric chemicals should be used and stored with precautions to remove water and air.**

2.7.2.8 LIGHT-SENSITIVE MATERIALS

These materials degrade in the presence of light, forming new compounds and/or conditions such as pressure build-up inside a container which may be hazardous. Examples of light sensitive materials include peroxide forming compounds☑, chloroform, tetrahydrofuran, ketones and anhydrides.

- Store light-sensitive materials in a cool, dark place in amber colored bottles or other containers that reduce or eliminate penetration of light.

2.7.2.9 UNSTABLE MATERIALS – SHOCK SENSITIVE, EXPLOSIVES

These compounds spontaneously release large amounts of energy under normal conditions, or when struck, vibrated, or otherwise agitated. Some chemicals become increasingly shock-sensitive with age. Picric acid, azides and the inadvertent formation of explosive or shock-sensitive materials such as peroxides and perchlorates (from perchloric acid) are of great concern. Picric acid is distributed by the manufacturer wet with greater than 30% water and tends to form dangerously sensitive and unstable picrate salts over time or if improper storage allows the liquid to evaporate. A list of some common shock sensitive and explosive materials is provided in Appendix S☑. This list is not all-inclusive; consult SDSs.

- Follow these guidelines:
  - Write the date received and date opened on all containers of shock sensitive chemicals. Some chemicals become increasingly shock sensitive with age.
  - Dispose of shock sensitive materials in accordance with manufacture's expiration date or for peroxide forming compounds see Appendix J☑.

- Unless an inhibitor was added by the manufacturer, closed containers of shock sensitive materials should be properly disposed of after 1 year.
- Wear appropriate personal protective equipment when handling shock sensitive chemicals.
- If there is a chance of explosion, use barriers or other methods for isolating the materials and call EH&S.
- If there is a suspicion that the formation of shock sensitive materials has occurred in ductwork or piping, contact EH&S.

2.7.2.10 CRYOGENIC LIQUIDS

These materials have a boiling point of less than -73° C (-100 °F). Common examples include liquid nitrogen, helium, argon, and dry ice/alcohol slurries. Cryogenic liquids undergo large volume expansion upon transition to the gas phase; for example, one volume of liquid nitrogen vaporizes to 694 volumes of nitrogen gas. Consequently, the warming of a cryogenic liquid in a sealed container produces high pressure, which can rupture the container.

- **Hazards of cryogenic liquids include:**
  - fire (in the case of flammable or oxidizing materials),
  - pressure buildup, explosion,
  - severe frostbite (on contact with skin)
  - asphyxiation (due to depletion of available oxygen).
  - cryogenic liquids such as liquid nitrogen are capable of condensing atmospheric oxygen, resulting in a localized, oxygen-enriched environment. An oxygen-enriched environment in combination with flammable/combustible materials and an ignition source can result in a violent reaction.

- **Safe Handling Practices:**
  - Equipment should be kept clean, especially when working with liquid or gaseous oxygen.
  - Mixtures of gases or fluids should be strictly controlled to prevent formation of flammable or explosive mixtures.
  - Always wear chemical splash goggles when handling. If there is a chance of a splash or spray, a full face protection shield, an impervious apron or coat, cuff-less trousers, and high topped shoes should be worn. Watches, rings, and other jewelry should not be worn. Gloves should be impervious and sufficiently large to be easily thrown off should a cryogen spill on them. Pot holders could also be used. Clothes or shoes and socks should be immediately removed should a cryogen spill on them.
  - Handle objects that are in contact with cryogenic liquids with tongs or proper gloves.
  - Keep liquid oxygen away from organic materials and ignition sources.
  - Only work with cryogenic liquids in well-ventilated areas to avoid localized oxygen depletion or build up of flammable or toxic gas.
  - Refrigerated rooms generally recycle room air and dangerous atmospheres can result from use of cryogenic liquids or dry ice in these rooms.
  - Transfers or pouring of cryogenic liquids should be done slowly to avoid splashing.
  - Cryogenic liquid/dry ice baths should be open to the atmosphere to avoid pressure build up.
  - Transfer of liquid hydrogen in an air atmosphere can condense oxygen in the liquid hydrogen, creating an explosion risk.
  - Containers and systems containing cryogenic liquids should have pressure relief mechanisms which will vent container resulting in a hissing sound. Label tank affixed with pressure relief valve so valve is not inadvertently closed.

- Containers and systems should be capable of withstanding extreme cold without becoming brittle.
- Since glass ampoules can explode when removed from cryogenic storage if not sealed properly, storage of radioactive, toxic or infectious agents should be placed in plastic cryogenic storage ampoules. Reheat cold sample containers slowly.
- Cryogenic liquid cylinders and other containers (such as Dewar flasks) should be filled no more than 80% of capacity to protect against thermal expansion.
- Shield or wrap fiber tape around glass Dewars to minimize flying glass and fragments should an implosion occur. Plastic mesh will not stop small glass fragments.

2.7.2.11 Compressed Gases

Compressed-gas cylinders are designed to Department of Transportation (DOT) specifications. A standard 2-ksi+ (ksi=1000 psi) cylinder has 1.5 cu.ft. of water volume and holds about 200 standard cu.ft. of gas. Compressed gases can be toxic, flammable, oxidizing, corrosive, inert or a combination of hazards. In addition to the chemical hazards, compressed gases may be under a great deal of pressure. The amount of energy in a compressed gas cylinder makes it a potential rocket with sufficient thrust to drive it through a masonry wall.

Proper employee training☑ and appropriate care in the handling and storage of compressed gas cylinders is essential.

- **Hazards of Handling and Storing Compressed Gases:**
  - Asphyxiation is the primary hazard associated with inert gases. Because inert gases are colorless and odorless, they can escape into the atmosphere undetected and quickly reduce the concentration of oxygen below the level necessary to support life. The use of oxygen monitoring equipment is strongly recommended for enclosed areas where inert gases are being used.
  - Fire and explosion are the primary hazards associated with flammable gases, oxygen and other oxidizing gases. Flammable gases can be ignited by static electricity or by a heat source, such as a flame or a hot object. Oxygen and other oxidizing gases do not burn, but will support combustion of organic materials.
  - Chemical burns can be caused by corrosive gases; the gas can chemically attack various materials, including fire-resistant clothing. Some gases are not corrosive in their pure form, but can become extremely destructive if a small amount of moisture is added. Corrosive gases can cause rapid destruction of skin and eye tissue.
  - Chemical poisoning is the primary hazard of toxic gases. Even in very small concentrations, brief exposure to these gases can result in serious poisoning injuries. Symptoms of exposure may be delayed.
  - High Pressure stored inside the cylinder make all compressed gases potentially hazardous. A sudden release of pressure can cause injuries by propelling the cylinder or whipping a gas line.
  - Back or muscle injury may result from manually moving a cylinder. A standard cylinder has an outside diameter of 9 inches, but can vary in height-most being 50 inches tall and may weigh over 130 pounds. Dropping or dragging a cylinder could cause serious injury.
- **Procurement of Compressed Gases:**
  - Compressed gas cylinders are not to be purchased but rented or leased from local vendors except for lecture bottles and commercial grade propane cylinders.

    - Lecture bottles should be purchased ONLY from distributors or manufacturers who will accept the empty bottle as a return. (SEE EMPTY CYLINDERS SECTION).
    - Propane cylinders must be brought to your Central Accumulation Area for recycling or proper disposal.
  - Order cylinders through the Procurement Office.
- **Safe Handling Procedures**:
  - Always wear proper PPE, always read the SDS.
  - Always secure cylinders whether in storage, transit or use.
  - Always transport cylinders, upright, using a cylinder hand truck or cart equipped with a chain or belt, even for short distances. Never drag, roll or slide cylinders.
  - NEVER ride in an elevator with compressed gas cylinders. Have one person send the elevator and another person receives the elevator.
  - Cylinder caps protect the valve and must be kept on until the cylinder has been secured with a chain or strap to a wall, bench or placed in a cylinder stand, and is ready for installation of the regulator.
  - Under no circumstances should any attempt be made to repair a cylinder or valve.
  - Never force a gas cylinder valve; if the valve cannot be opened by the wheel handle, return the cylinder to the vender.
    - Keep the cylinder valve closed except when in use.
    - Do not use the cylinder valve itself to control flow by adjusting the pressure.
  - Use compressed gases only in a well-ventilated area.
    - Toxic, flammable and corrosive gases should be carefully handled in a hood or gas cabinet.
    - Proper containment systems should be used and minimum quantities of these products should be kept on-site.
  - When discharging gas into a liquid, a trap or suitable check valve should be used to prevent liquid from getting back into the cylinder or regulator.
  - Never tamper with pressure relief devices in valves or cylinders. Label cylinder using pressure relief valve so valve is not inadvertently closed.
  - Where more than one type of gas is in use, label the gas lines. This is particularly important when the gas supply is not in the same room or area as the operation using the gases.
  - Do not use Oxygen as a substitute for compressed air.
  - Never discharge contents for any gas cylinder towards any person.
- **Storage of Compressed Gas Cylinders**
  - Store compressed gas cylinders in a safe and secure area.
    - Inspect cylinders on receipt, ensure that the cylinder is properly and prominently labeled as to its contents.
    - Return damaged or improperly labeled cylinders to vender.
    - Inspect storage area regularly.
    - If storage is outdoors, protect cylinders from weather extremes and damp ground to prevent corrosion.
    - Store cylinders away from heavily traveled areas or emergency exits.
    - Limit access to storage areas.
  - All cylinders must be stored upright and secured to a fixed support using a chain or strap placed 2/3 of the way up. NEVER place acetylene cylinders on their side.

        - Cylinder stands are an alternative to chains or straps.
        - Cylinders should be chained or strapped individually.
        - Do not permit cylinders to strike each other violently.
    - Do not store full and empty cylinders together.
    - Oxidizers and flammable gases should be stored in areas separated by at least 20 feet or by a noncombustible wall.
    - Greasy and oily materials shall never be stored around oxygen; nor should oil or grease be applied to fittings.
    - Cylinders should not be stored near radiators or other heat sources.
        - No part of a cylinder should be subjected to a temperature higher than 125° F.
        - A flame should never come in contact with any part of a compressed gas cylinder.
    - Do not place cylinders where they may become part of an electric circuit.
    - Keep the number of cylinders to a minimum to reduce the fire and toxicity hazards.
- **Using Compressed Gas Cylinders**
    - Before using cylinders, read all label information, SOP and SDSs associated with the gas being used.
        - The cylinder label or decal is the only positive way to identify the contents of a cylinder.
    - Use a pressure-reducing regulator or separate control valve to safely discharge gas from a cylinder. Do not use the cylinder valve itself to control flow by adjusting pressure.
        - The cylinder valve outlet connections are designed by the Compressed Gas Association (CGA) to prevent mixing of incompatible gases. The outlet threads vary in diameter; some are internal and some are external; some are right-handed, and some are left-handed. Generally, right-handed threads are used for non-fuel and water-pumped gases, and left-handed threads are used for fuel and oil-pump gases.
    - Some valves may require washers; if so, check compatibility before the regulator is fitted.
    - Use check valves to prevent reverse flow into the cylinder.
    - Use Teflon tape or thread lubricant for assembly, if necessary. Teflon tape should only be used for tapered pipe thread, not straight lines or metal-to-metal contacts. Teflon® tape is compatible for use in oxygen or oxidizer service.
    - Do not force threads that do not fit exactly.
    - Discontinue use and contact the supplier if a cylinder valve is difficult to operate. Wrenches should not be used on valves equipped with hand wheels. If the valve is faulty, tag the cylinder, identifying the problem, and notify the supplier.
    - **To attach a regulator**, follow these steps:
        - Wear proper PPE. (safety glasses, face shield)
        - Properly transport and secure cylinder for use.
        - Select the proper regulator specific to the gas involved. Check the CGA number on the back of the regulator to insure proper use.
            - Mark each new gas regulator with its intended gas service.
            - Regulators that have been used in oxygen or oxidizing gas service must not be used in another service.
            - To ensure safety and to avoid contamination, it is strongly recommended that regulators be dedicated to one gas service.
        - Attach the closed regulator to the cylinder.
            - The regulator should easily attach to a cylinder without forcing the threads.

        - If the regulator inlet does not fit the cylinder outlet, do not force the fitting.
        - A poor fit may indicate that the regulator is not intended for use on the gas chosen.
    - Never open the cylinder valve unless the regulator is completely closed.
    - Turn the delivery pressure adjusting screw counter-clockwise until it turns freely. This prevents unintended gas flow into the regulator.
    - Open the cylinder slowly until the inlet gauge on the regulator registers the cylinder pressure. If the cylinder pressure reading is lower than expected, the cylinder valve may be leaking.
    - With the flow control valve at the regulator outlet closed, turn the delivery pressure adjusting screw clockwise until the required delivery pressure is reached.
    - Check for leaks using Snoop or soap solution. At or below freezing temperatures, use a glycerin and water solution, such as Snoop, rather than soap. Never use an open flame to detect leaks.
    - When finished with the gas, close the cylinder valve and release the regulator pressure.
- **Assembly of Equipment and Piping**
    - Inspect tubing frequently and replace when necessary.
        - Avoid sharp bends of copper tubing.
        - Copper tubing hardens and cracks with repeated bending.
    - Tygon and plastic piping should not be used for any portion of a high-pressure system.
        - These materials can fail under pressure or thermal stress.
    - Do not conceal distribution lines where a high concentration of a leaking hazardous gas could build up.
    - Distribution lines and their outlets should be clearly labeled as to the type of gas they contain.
    - To minimize undesirable connections, only CGA standard combinations of valves and fittings should be used in compressed gas installations; the assembly of miscellaneous parts should be avoided.
    - Do not use oil or lubricants on equipment used with oxygen.
    - Do not use copper piping for acetylene.
    - Do not use cast iron piping for chlorine.
    - When work involving a compressed gas is completed, the cylinder must be turned off, and if feasible, the lines bled.
- **Leaking Cylinders**
    - Most leaks occur at the valve in the top of the cylinder and may involve the valve threads valve stem, valve outlet, or pressure relief devices.
        - Lab personnel should never attempt to repair leaking cylinders.
    - **Where action can be taken without serious exposure to lab personnel**:
        - Move the cylinder to an isolated, well-ventilated area (away from combustible materials if the cylinder contains a flammable or oxidizing gas).
        - Contact EH&S 2190 or AU Public Safety 2108.
    - **Whenever a large or uncontrollable leak occurs**, evacuate the area, follow emergency procedures, and immediately call for emergency assistance.
- **Empty Cylinders**

- When the cylinder is empty, all valves shall be closed, the system bled, and the regulator removed. The valve cap shall be replaced, the cylinder returned to the storage area and clearly mark as "empty," for pickup by the supplier.
- Do not store full and empty cylinders together.
- Do not have full and empty cylinders connected to the same manifold. Reverse flow can occur when an empty cylinder is attached to a pressurized system.
- Do not refill empty cylinders; only the cylinder supplier should refill gases.
- Do not empty cylinders to a pressure below 25 psi (172 Kpa). The residual contents may become contaminated with air.
- Lecture bottles should always be returned to the distributor or manufacturer promptly when no longer needed. Do not purchase lecture bottles that cannot be returned.
- All propane cylinders when empty should be brought to your Central Accumulation Area for recycling.

- **Lecture Bottle Disposal**

MANAGEMENT OPTIONS FOR PARTIALLY FULL LECTURE BOTTLE
If you no longer have a use for a partially full lecture bottle, you should attempt to contact someone within the University who can use it. If the gas is Freon, it may be possible to recycle it with the manufacturer or with our Physical Plant Department, which can be reached at x2154 non-statutory or x2460 statutory. If the lecture bottle cannot be reused within the University, then return the lecture bottle to the manufacturer. If the gas is non-hazardous (air, argon, carbon dioxide, helium, neon, nitrogen, or xenon), then you may vent the gas to fume hood. After the lecture bottle is empty, you must then remove the valve, and the remaining metal carcass can then be recycled or disposed in the regular trash. If the lecture bottle contains a poison or other hazardous gas and none of the other options are workable, then it may require disposal as a hazardous waste.

REMOVING VALVES FROM NON-HAZARDOUS ONLY LECTURE BOTTLES
Removal of valves from lecture bottles can present a significant hazard if the cylinder is not fully discharged or if there are hazardous chemical residues present. Lecture bottles that held flammable gases may still present a fire or explosion hazard, while those that held corrosive, poisonous, or reactive gases may still have sufficient residues to present a hazard to the person working with the cylinder. Remaining residues may require it to be managed as a hazardous waste. In general, all pyrophorics should be excluded from this procedure. Eye protection and gloves should be minimum protection whenever removing valves from lecture bottles.
Ensure that the lecture bottle is empty

Visually inspect the valve to see if there are obvious physical defects or corrosion that may have affected the valve. If there is a defect or corrosion problem, do not attempt to manipulate the valve. Rather, cap or plug the outlet and dispose of as hazardous waste.
If the valve appears to be safely operable, check the gas pressure within the lecture bottle by attaching the correct Compressed Gas Association pressure regulator. Once the pressure, if any, has been determined, remove the regulator and then place the lecture bottle in the fume hood

and carefully open the valve. Allow the lecture bottle to set for a few minutes to assure that the pressure inside is at the ambient level.
All lecture bottle labels should be defaced prior to disposal.

Remove the valve.

If hazardous, dispose of as hazardous waste if supplier will not accept bottle back. Only as last resort.

HAZARDOUS WASTE DISPOSAL

Any lecture bottle that is not returnable or cannot be managed on site will require management as a hazardous waste. EH&S will arrange for most cost effective and environmentally sound disposal for you. Lecture bottles will not be accepted and picked up until EH&S receives an appropriate budget number in which to bill back the disposal cost.

- **NFPA Guidelines for Maximum Number of Gas Cylinders:**
  - According to NFPA 45, Standard on Fire Protection for Laboratories Using Chemicals, the maximum quantity and size limitations for compressed gas or liquefied gas cylinders in laboratory work areas[1] is:

	Flammable gases and/or Oxygen		Liquified Flammable gases		Gases with Health Hazard rating of 3 or 4
	sprinklered space	non-sprinklered space	sprinklered space	non-sprinklered space	
Max. # of cylinders per 500 sq.ft. or less	6	3	3	2	2
Max. cylinder size in inches	10 x 50	10 x 50	9 x 30	9 x 30	4 x 15

[1]In instructional laboratory work areas the total number of cylinders shall be reduced to three maximum size cylinders or ten 2"x 13"cylinders or equivalent volume. In all other cases twenty-five 2"x 13" cylinders or equivalent volume shall be permitted.

- **Flammable Gases**
  - Keep sources of ignition away from the cylinders.
  - Oxidizers and flammable gases should be stored in areas separated by at least 20 feet or by a non-combustible wall.
  - Bond and ground all cylinders, lines and equipment used with flammable compressed gases.
  - Compliance with Hydrogen monitoring according to OSHA 29 CFR 1910.103☑ is required when a hydrogen system (tank, regulators, filters, piping, etc) in a lab contains 400 cu. ft. or more of hydrogen (applies only to the hydrogen portion of mixed gases).
- **Gases Requiring Special Handling**
  - Highly toxic gases, such as arsine, diborane, fluorine, hydrogen cyanide, phosgene, and silane, oxygen and acetylene, present special hazards, either due to their toxicity or physical properties, requiring additional precautions. Consult SDS and contact EH&S for additional guidance. Some of these gases are Particularly Hazardous Substances☑, PHS Appendix Q☑, and their use requires prior approval☑ by EH&S.

- **Additional information** on the safe handling and use of compressed gases is available from the Compressed Gas Association☑ and Matheson Tri-Gas Products☒ .

3.0 TRANSPORTING CHEMICALS ON CAMPUS

When transporting chemicals between laboratories or other buildings on campus, the following procedures must be adhered to. If you plan on transporting or shipping any hazardous chemicals off the contiguous campus (you are off the contiguous campus once you are on Main Street), be aware there are specific procedures, training and other legal requirements that must be followed. For further information, refer below to the Section 4.0.

- Always wear proper PPE.
- Know where the nearest spill kit is located.
- Chemicals must be in a closed container.
- For liquids, use a secondary container such as a rubber acid carrying bucket, plastic bucket, or a 5-gallon pail.
- Use compatible packing material (shipping peanuts, vermiculite, or cardboard inserts), to prevent bottles from tipping over or breaking during transport;
- Carts with lipped surfaces (such as Rubbermaid carts) should be used whenever feasible.
- Whenever possible, do not use elevators when transporting chemicals, especially cryogenic liquids or compressed gas cylinders.
  - If it is necessary to use an elevator, all passengers are prohibited.
    - Use the buddy system in which one person sends the properly secured chemicals, dewars or cylinders on the elevator, while the other person waits at the floor by the elevator doors to receive the material.
- When transporting compressed gas cylinders, always use a proper gas cylinder hand truck with the cylinder strapped to the cart and keep the cap in place.
- Do **not** transport hazardous chemicals in personal vehicles. Contact EH&S 2190 for assistance in arranging proper transport.

4.0 HAZARDOUS MATERIALS SHIPPING or TRANSPORT OFF CAMPUS

The U.S. Division of Transportation (DOT)☒ and the International Civil Aviation Organization regulates the shipping/transport of hazardous materials. Additional regulations are enforced by the airlines through the International Air Transport Association (IATA) ☑.

- All AU package preparation for shipping and/or transportation of hazardous materials off University property is subject to DOT regulations and enforcement.
  - Packing must be leak tight for liquids and gases, shift proof for solids and be securely closed and secured against shifting and damage.
  - Each material must be packaged in the manufacturer's original packaging or a packaging of equal or greater strength and integrity.
  - Contact EH&S to arrange for off campus shipping or transport of hazardous materials.
- The following are DOT regulated as hazardous materials for shipping or transport:
  - Alcohol solutions
  - Compressed gases
  - Corrosives
  - Dry Ice (air shipments only)
  - Explosives
  - Flammable liquids and solids

- Formaldehyde - solutions between 0.1% and 25% (air shipments only)
- Infectious substances (animals and humans only)
- Oxidizers
- Poisons
- Radioactive materials

5.0 REFRIGERATORS AND HOT/COLD ROOMS

Refrigerators and Hot or Cold Rooms are not ventilated, and pose a special hazard for the accumulation of high air concentrations of volatile chemicals.

- Special care is necessary to ensure protection from explosion, fire or exposure from vapors when storing chemicals in a refrigerator. Ensure that flammable chemicals are stored in refrigerators that are "explosion-proof." Sparking that may occur in household units can ignite and explode vapors.
- Refrigerators and Hot/Cold rooms must not be used to store foods for consumption. Post appropriate sign.

6.0 WASTE MANAGEMENT AND DISPOSAL

Waste management and disposal, including disposal cost (call EH&S with disposal cost questions), must be considered prior to purchase of any chemical. "Less is better" and "Green Chemistry" applies.

- Laboratory employees must properly manage and dispose of all chemicals in accordance with Federal, State and Local regulations.
  - There are restrictions on sink and land-fill disposal set forth by the Village of Alfred Sewer Ordinance, Allegany County Division of Public Works, New York Division of Environmental Conservation (NYSDEC) and the U.S. Environmental Protection Agency (EPA).
    - Only substances listed on the approved disposal lists from the Allegany County Landfill and Village of Alfred POTW are allowed to be disposed of in the trash or down the drain.
    - Treatment (e.g., elemental neutralization, submit Neutralization report form), trash or drain disposal of any hazardous waste must be reviewed and approved by EH&S☑.
  - Refer to the AU Hazardous Waste Guide, Used Electronics Policy, Universal Waste Policy, Regulated Medical Waste Policy and Procedures, Allegany County Landfill Disposal List and Wastewater Discharges to Village of Alfred Sanitary Sewer System Disposal List available at EH&S for waste management information and procedures. Access policies and manuals at https://my.alfred.edu/environmental-health-safety/ ☑.
  - REFER TO P-LIST SUBSTANCES /WASTES IN SECTION 2.7.2.3

7.0 STANDARD OPERATING PROCEDURES

The OSHA Lab Standard☑ requires that a CHP include standard operating procedures (SOPs) that provide detailed descriptions for the safe and proper use of hazardous chemicals. SOPs must also be developed for equipment, processes or operations that use a hazardous chemical or pose physical hazards. SOPs should be clear and precise so that an individual responsible for a particular procedure or piece of equipment can easily understand them.

The AU CHP Parts I, II (General SOP) and Appendices along with laboratory site-specific SOPs constitute the CHP for that laboratory or for a Division/Department with laboratories using the same chemicals. Employees are required to read and receive training on the SOPs relevant to their particular job.

- AU General SOP

Part II of the CHP is the AU General SOP. It specifies University policies, provides information and general operating procedures for handling of hazardous chemicals, including hazardous chemical classes such as corrosive, flammable, etc., to which all AU laboratories must adhere.

- Site-specific SOPs (Laboratory specific)
  It is the responsibility of the LSF/PI within each laboratory, Division or Department to write site-specific SOPs and add them to the lab CHP.
  - Site-specific SOPs are required:
    - when certain classes of hazardous chemicals are routinely used in a laboratory, OSHA Lab Standard☑ (29CFR 1910.1450(e)(3)(i), (viii).
      - These classes are select carcinogens, reproductive toxins or substances that have a high degree of acute toxicity. See PHS☑.
    - for highly flammable chemicals (NFPA/HMIS Flammability Rating of 4) and very reactive chemicals such as strong corrosives, oxidizers and reducing agents, (NFPA/HMIS Reactivity Rating of 3 or 4).
    - for hazardous processes or operations.
  - Review and update SOPs on an annual basis. Updates should be made when there is any significant change in the procedure, new chemical products or equipment are used, new hazards are identified, or stated safety precautions are determined to be inadequate.
  - Use the site-specific SOP forms provided in Appendix W. Electronic versions are encouraged. When completing the electronic SOP form, use an ink color that will stand out from the form's black type.
    - Select the proper SOP form and complete as instructed in Appendix W☑.
      Process/Experiment/Equipment: (distillation, synthesis, chromatography, etc.)
      OR
      Chemical/Hazard Class: benzene, hydrochloric acid, etc. or flammable, oxidizer, carcinogen, etc.
- Site-specific SOP's are not needed when the AU CHP (Parts I and II) covers the scope of the work performed in the laboratory.
  - If your laboratory does not meet the criteria requiring site-specific SOPs as detailed in this section **7.0** or as specified elsewhere in the AU CHP, insert a statement, signed by the LSF/PI, into your copy of the CHP stating that all chemicals stored and used and all procedures/duties performed in the lab are covered by the AU CHP, Parts I, II and Appendices.

Appendix A - Contact Personnel for Prior Approval, Chemical Hygiene

Prior Approval Contact Person

Name	Contact person for:	Phone Number	Email Address
Dean Perry, Coordinator	Environmental Health & Safety	2196	envhealthsafety@alfred.edu
Jean Cardinale, Associate Professor,	AU Institutional Biosafety	2785	cardinale@alfred.edu
Scott Misture, Inamori Professor	Radiation Safety Officer	2438	misture@alfred.edu
Brian Dodge, Director Physical Plant	AU Physical Plant	2154	peckham@alfred.edu
James Babcock, Dir. Physical Plant	NYSCC Maintenance	2460	babcock@alfred.edu
Marty Kallier, Specialist	Sponsored Research	2488	kalliemr@alfred.edu
Cheryld Emmons, Associate Professor	Animal Care and Use	2846	emmonsc@alfred.edu
Jana Atlas, Professor	Human Subject Research	2212	atlasj@alfred.edu
Giovina Lloyd, VP	Business and Finance	2388	lloydgm@alfred.edu
Lou Lichtman, Dean	College of LAS	2171	mcgee@alfred.edu
Alastair Cormack, Dean	College of Engineering	2422	cormack@alfred.edu

Chemical Hygiene Committee

Name	Division or Department	Phone Number	Email Address
Environmental Health and Safety Coordinator, Chair	Environmental Health & Safety	2196	envhealthsafety@alfred.edu
Chemistry Technician	Chemistry	2540	rossingtona@alfred.edu

Appendix B - Identification of Statutory and Non-Statutory Buildings Containing Laboratories

Statutory buildings:

Contact NYSCC Maintenance via email work order or phone 2460, from 7:00 a.m. to 3:30 p.m. After hours, call the phone # listed on emergency contact list posted near emergency phones located in NYSCC buildings.

Binns-Merrill Hall
Hall of Glass Science and Engineering
McMahon (Inamori) Engineering Building

Non-Statutory buildings:

Contact AU Physical Plant via email work order or phone 2154, from 7:30 a.m. to 4:30 p.m. After hours, call the Heating Plant at 2157.

Myers Hall
Science Center
Seidlin Engineering Annex
STEP Lab

Alfred University CHEMICAL HYGIENE PLAN
Appendix C - Glove Selection Chart

Chemical Resistance Gloves.
The following table is provided as a guide to the different types of glove materials and the chemicals they can be used against. When selecting chemical resistance gloves, be sure to consult the manufacturers' recommendations, especially if the gloved hand will be immersed in the chemical.

Type	Advantages	Disadvantages	Use Against
Natural rubber	Low cost, good physical properties, dexterity	Poor vs. oils, greases, organics. Frequently imported; may be poor quality	Bases, alcohols, dilute water solutions; fair vs. aldehydes, ketones.
Natural rubber blends	Low cost, dexterity, better chemical resistance than natural rubber vs. some chemicals	Physical properties frequently inferior to natural rubber	Same as natural rubber
Polyvinyl chloride (PVC)	Low cost, very good physical properties, medium cost, medium chemical resistance	Plasticizers can be stripped; frequently imported may be poor quality	Strong acids and bases, salts, other water solutions, alcohols
Neoprene	Medium cost, medium chemical resistance, medium physical properties	NA	Oxidizing acids, anilines, phenol, glycol ethers
Nitrile	Low cost, excellent physical properties, dexterity	Poor vs. benzene, methylene chloride, trichloroethylene, many ketones	Oils, greases, aliphatic chemicals, xylene, perchloroethylene, trichloroethane; fair vs. toluene
Butyl	Speciality glove, polar organics	Expensive, poor vs. hydrocarbons, chlorinated solvents	Glycol ethers, ketones, esters
Polyvinyl alcohol (PVA)	Specialty glove, resists a very broad range of organics, good physical properties	Very expensive, water sensitive, poor vs. light alcohols	Aliphatics, aromatics, chlorinated solvents, ketones (except acetone), esters, ethers
Fluoro-elastomer (Viton) ™ *	Specialty glove, organic solvents	Extremely expensive, poor physical properties, poor vs. some ketones, esters, amines	Aromatics, chlorinated solvents, also aliphatics and alcohols
Norfoil (Silver Shield)	Excellent chemical resistance	Poor fit, easily punctures, poor grip, stiff	Use for Hazmat work

*Trademark of DuPont Dow Elastomers

Glove Type and Chemical Use

*Limited service	VG= Very Good	G= Good	F=Fair	P=Poor (not recommended)

Chemical	Neoprene	Natural Latex or Rubber	Butyl	Nitrile Latex
*Acetaldehyde	VG	G	VG	G
Acetic acid	VG	VG	VG	VG
*Acetone	G	VG	VG	P
Ammonium hydroxide	VG	VG	VG	VG
*Amyl acetate	F	P	F	P
Aniline	G	F	F	P
*Benzaldehyde	F	F	G	G
*Benzene	F	F	F	P
Butyl acetate	G	F	F	P
Butyl alcohol	VG	VG	VG	VG
Carbon disulfide	F	F	F	F
*Carbon tetrachloride	F	P	P	G
Castor oil	F	P	F	VG
*Chlorobenzene	F	P	F	P
*Chloroform	G	P	P	P
Chloronaphthalene	F	P	F	F
Chromic Acid (50%)	F	P	F	F
Citric acid (10%)	VG	VG	VG	VG
Cyclohexanol	G	F	G	VG
*Dibutyl phthalate	G	P	G	G
Diesel fuel	G	P	P	VG
Diisobutyl ketone	P	F	G	P
Dimethylformamide	F	F	G	G
Dioctyl phthalate	G	P	F	VG
Dioxane	VG	G	G	G
Epoxy resins, dry	VG	VG	VG	VG
*Ethyl acetate	G	F	G	F
Ethyl alcohol	VG	VG	VG	VG
Ethyl ether	VG	G	VG	G
*Ethylene dichloride	F	P	F	P
Ethylene glycol	VG	VG	VG	VG

Formaldehyde	VG	VG	VG	VG
Chemical	**Neoprene**	**Natural Latex or Rubber**	**Butyl**	**Nitrile Latex**
Formic acid	VG	VG	VG	VG
Freon 11	G	P	F	G
Freon 12	G	P	F	G
Freon 21	G	P	F	G
Freon 22	G	P	F	G
*Furfural	G	G	G	G
Gasoline, leaded	G	P	F	VG
Gasoline, unleaded	G	P	F	VG
Glycerine	VG	VG	VG	VG
Hexane	F	P	P	G
Hydrochloric acid	VG	G	G	G
Hydrofluoric acid (48%)	VG	G	G	G
Hydrogen peroxide (30%)	G	G	G	G
Hydroquinone	G	G	G	F
Isooctane	F	P	P	VG
Isopropyl alcohol	VG	VG	VG	VG
Kerosene	VG	F	F	VG
Ketones	G	VG	VG	P
Lacquer thinners	G	F	F	P
Lactic acid (85%)	VG	VG	VG	VG
Lauric acid (36%)	VG	F	VG	VG
Lineoleic acid	VG	P	F	G
Linseed oil	VG	P	F	VG
Maleic acid	VG	VG	VG	VG
Methyl alcohol	VG	VG	VG	VG
Methylamine	F	F	G	G
Methyl bromide	G	F	G	F
*Methyl chloride	P	P	P	P
*Methyl ethyl ketone	G	G	VG	P
*Methyl isobutyl ketone	F	F	VG	P
Methyl methacrylate	G	G	VG	F
Monoethanolamine	VG	G	VG	VG
Morpholine	VG	VG	VG	G
Naphthalene	G	F	F	G

Naphthas, aliphatic	VG	F	F	VG
Chemical	**Neoprene**	**Natural Latex or Rubber**	**Butyl**	**Nitrile Latex**
Naphthas, aromatic	G	P	P	G
*Nitric acid	G	F	F	F
Nitromethane (95.5%)	F	P	F	F
Nitropropane (95.5%)	F	P	F	F
Octyl alcohol	VG	VG	VG	VG
Oleic acid	VG	F	G	VG
Oxalic acid	VG	VG	VG	VG
Palmitic acid	VG	VG	VG	VG
Perchloric acid (60%)	VG	F	G	G
Perchloroethylene	F	P	P	G
Petroleum distillates (naphtha)	G	P	P	VG
Phenol	VG	F	G	F
Phosphoric acid	VG	G	VG	VG
Potassium hydroxide	VG	VG	VG	VG
Propyl acetate	G	F	G	F
Propyl alcohol	VG	VG	VG	VG
Propyl alcohol (iso)	VG	VG	VG	VG
Sodium hydroxide	VG	VG	VG	VG
Styrene	P	P	P	F
Stryene (100%)	P	P	P	F
Sulfuric acid	G	G	G	G
Tannic acid (65%)	VG	VG	VG	VG
Tetrahydrofuran	P	F	F	F
*Toluene	F	P	P	F
Toluene diisocyanate	F	G	G	F
*Trichloroethylene	F	F	P	G
Triethanolamine	VG	G	G	VG
Tung oil	VG	P	F	VG
Turpentine	G	F	F	VG
*Xylene	P	P	P	F

***Limited service**	**VG= Very Good**	**G= Good**	**F=Fair**	**P=Poor (not recommended)**

ALFRED UNIVERSITY CHEMICAL HYGIENE PLAN
Appendix D - Particularly Hazardous Substance Use Form

CREATE A CHEMICAL CHECKLIST FOR LABS ORDERING A CHEMICAL FOR THE FIRST TIME

Before purchasing or for PHS already in inventory/use, please complete this form, attach to Prior Approval Form and send to EH&S. Do not purchase or use the substance until EH&S approval is granted.

LSF/PI _____ Phone_____ Building_____

Substance Information Chemical name _____ CAS #_____

☐ Carcinogen☑ on IARC, OSHA, NTP list
☐ Reproductive Toxins☑ mutagens, teratogens, embryotoxins
☐ High Acute Toxicity☑ oral $LD_{50} \leq 50$ mg/kg, skin $LD_{50} \leq 200$ mg, air $LC_{50} \leq 200$ppm or ≤ 2 mg/l.
☐ Explosive
☐ Toxic Gas☑
☐ P-List (Add Section on P-lists and the university's generator status if not followed

Estimated Rate of Use (e.g., grams/month) _____

Procedure Briefly describe how the material will be used.

Exposure Controls What exposure controls (ventilation, isolation, PPE) are required or recommended by the SDS for use of this PHS? Are they available at the location of use?

☐ Chemical fume hood ☐ **Yes** ☐ **No** ☐ Glove Box ☐ **Yes** ☐ **No**

☐ Vented gas cabinet ☐ **Yes** ☐ **No** ☐ Face shield ☐ **Yes** ☐ **No**

☐ Safety glasses ☐ **Yes** ☐ **No** ☐ Chemical splash goggles ☐ **Yes** ☐ **No**

☐ Gloves (type _____) ☐ **Yes** ☐ **No** ☐ Lab coat ☐ **Yes** ☐ **No**

☐ Respirator ☐ **Yes** ☐ **No** ☐ SCBA *(Respirators and SCBA require EHS approval)*

☐ Eyewash/shower ☐ **Yes** ☐ **No** ☐ Spill kit ☐ **Yes** ☐ **No** ☐ First aid kit ☐ **Yes** ☐ **No**

☐ Proper lab attire ☐ **Yes** ☐ **No** ☐ Other, please describe _____

Location of Designated Area building _____room_____

Designated area sign posted ☐ **Yes** ☐ **No**

Location Where Substance Will Be Stored _____

Certification/Authorization

I certify that I will only authorize the use of this PHS to employees working in my lab who have received the required training☑ and demonstrate the understanding and knowledge necessary for its safe and proper use.

LSF/PI_____ **Please submit this form to EH&S.**

EH&S approval_____ date_____ A copy will be returned to LSF/PI within two business days.

Submit site-specific SOP and SOP training documentation to EH&S.

ALFRED UNIVERSITY CHEMICAL HYGIENE PLAN
Appendix E - Employees Annual Site-Specific CHP Review Form

Insert signed form into CHP; employees review CHP and sign form annually.

Division/Lab _____

I hereby certify that I have read/reviewed the Division / lab Chemical Hygiene Plan.

- I certify that I have read, understand, and agree to follow the established CHP and all applicable regulations.
- I will also follow the established SOPs (LSF/PI responsibility) pertinent to my job
- I acknowledge that failure to comply will result in my lab being closed and locked-out by EH&S or Public Safety until I have corrected all violations of regulations, the CHP and SOP's.

Name (Please Print)	Signature	Date	Supervisor's Initials

Alfred University CHEMICAL HYGIENE PLAN
Appendix F - Site Specific Training Form and Sign-in Sheet

All site-specific training forms: retain original for lab/department file, send a copy to EH&S.

Date: **LSF/PI:**

Title and description of training:

I, the undersigned, have participated in this safety training session and fully understand the information provided.

Attendee's name	**Attendee's signature**

Alfred University CHEMICAL HYGIENE PLAN
Appendix G - LSF/PI Site Specific Authorization Form for Laboratory Employees

Attach completed form to site-specific SOP

Certification/Authorization

I certify that the undersigned employees working in my lab have received the required training☑ and demonstrate the understanding and knowledge of the procedures necessary for the safe use of the chemical(s) and/or proper operation of process/experiment/equipment listed below.

LSF/PI printed name_____ signature_____ Date_____

Building_____ Laboratory_____

Authorization for: _____

Name (Please Print)	Signature	Date

ALFRED UNIVERSITY CHEMICAL HYGIENE PLAN
Appendix H - Signs and Symptoms of Chemical Exposure

The decisions you make concerning the use of chemicals in the laboratory should be based on an objective analysis of the hazards, rather than merely the perception of the risks involved. In order to assess the hazards of a particular chemical, both the physical and health hazards of the chemical must be considered.
Before using any chemical, the safety data sheet (SDS) or other appropriate resource such as the NIOSH Pocket Guide to Chemical Hazards☑ should be reviewed to determine what conditions of use might pose a hazard. Once the hazards are known, the risk of an accident may be reduced significantly by using safe work practices.

Basic Toxicology
The health effects of hazardous chemicals are often less clear than the physical hazards. Data on the health effects of chemical exposure, especially from chronic exposure, are often incomplete. When discussing the health effects of chemicals, two terms are often used interchangeably - *toxicity* and *hazard*. However, the actual meanings of these words are quite different. *Toxicity* is an inherent property of a material, similar to its physical constants. It is the ability of a chemical substance to cause an undesirable effect in a biological system. *Hazard* is the likelihood that a material will exert its toxic effects *under the conditions of use*. Thus, with proper handling, highly toxic chemicals can be used safely. Conversely, less toxic chemicals can be extremely hazardous if handled improperly.
The actual health risk of a chemical is a function of the toxicity and the actual exposure. No matter how toxic the material may be, there is little risk involved unless it enters the body. An assessment of the toxicity of the chemicals and the possible routes of entry will help determine what protective measures should be taken.

ADD LSF/PI Lab Supervisor And Employee Safety Agreement
ADD Student Lab Safety Agreement
ADD Lab User Safety Agreement
ADD Student Safety Contract
ADD Chem 105/106 Lab Guidelines

Routes of Entry

- Inhalation
  - The respiratory tract is the most common route of entry for gases, vapors, particles, and aerosols (smoke, mists and fumes). These materials may be transported into the lungs and exert localized effects, or be absorbed into the bloodstream. Factors that influence the absorption of these materials may include the vapor pressure of the material, solubility, particle size, its concentration in the inhaled air, and the chemical properties of the material. The vapor pressure is an indicator of how quickly a substance evaporates into the air and how high the concentration in air can become – higher concentrations in air cause greater exposure in the lungs and greater absorption in the bloodstream.
  - Most chemicals have an odor that is perceptible at a certain concentration, referred to as the odor threshold; however, there is no relationship between odor and toxicity. There is considerable individual variability in the perception of odor. Olfactory fatigue may occur when exposed to high concentrations or after prolonged exposure to some substances. This may cause the odor to seem to diminish or disappear, while the danger of overexposure remains.

- Volatile hazardous materials should be used in a well-ventilated area, preferably a fume hood, to reduce the potential of exposure. Occasionally, ventilation may not be adequate and a fume hood may not be practical, necessitating the use of a respirator. The OSHA Respiratory Protection Standard☑ regulates the use of respirators; thus, use of a respirator is subject to prior review by EHS according to University policy. See *Personal Protective Equipment* ☑for more information.
- Symptoms of over-exposure may include headaches, increased mucus production, and eye, nose and throat irritation. Narcotic affects, including confusion, dizziness, drowsiness, or collapse, may result from exposure to some substances, particularly many solvents. In the event of exposure, close containers or otherwise increase ventilation, and move to fresh air. If symptoms persist, seek medical attention.

- Absorption Skin and Eye Contact

The simplest way for chemicals to enter the body is through direct contact with the skin or eyes.

- Skin contact with a chemical may result in a local reaction, such as a burn or rash, or absorption into the bloodstream. Absorption into the bloodstream may then allow the chemical to cause toxic effects on other parts of the body. The SDS usually includes information regarding whether or not skin absorption is a significant route of exposure. The absorption of a chemical through intact skin is influenced by the health of the skin and the properties of the chemical. Skin that is dry or cracked or has lacerations offers less resistance. Fat-soluble substances, such as many organic solvents, can easily penetrate skin and, in some instances, can alter the skin's ability to resist absorption of other substances. Wear gloves and other protective clothing to minimize skin exposure. See *Personal Protective Equipment*☑for more information.
- Symptoms of skin exposure include dry, whitened skin, redness and swelling, rashes or blisters, and itching. In the event of chemical contact on skin, rinse the affected area with water for at least 15 minutes, removing clothing while rinsing, if necessary. Seek medical attention if symptoms persist. Avoid use of solvents for washing skin. They remove the natural protective oils from the skin and can cause irritation and inflammation. In some cases, washing with a solvent may facilitate absorption of a toxic chemical.

- Chemical contact with eyes can be particularly dangerous, resulting in painful injury or loss of sight. Few substances are innocuous in contact with the eyes and because the eyes contain many blood vessels, they also can be a route for the rapid absorption of many chemicals. Wearing safety goggles or a face shield can reduce the risk of eye contact. Eyes that have been in contact with chemicals should be rinsed immediately with water continuously for at least 15 minutes. Contact lenses should be removed while rinsing—do not delay rinsing to remove the lenses.
- Symptoms of eye exposure may include irritation, pain, burning, and loss of vision. Seek medical attention as soon as possible.

- Ingestion
  - The gastrointestinal tract is another possible route of entry for toxic substances. Although direct ingestion of a laboratory chemical is unlikely, exposure may occur as a result of ingesting contaminated food or beverages, touching the mouth with contaminated fingers, or swallowing inhaled particles which have been cleared from the respiratory system. The possibility of exposure by this route may be reduced by not eating, drinking, smoking, or storing food in the laboratory, and by washing hands thoroughly after working with chemicals, even when gloves were worn. Direct ingestion may occur as a result of the outdated and dangerous practice of mouth pipetting. In the event of accidental ingestion, immediately call 911 or contact the Poison Control Center, at 9-1-800-222-1222 for instructions. Do not induce vomiting unless directed to do so by a health care provider.

- Symptoms may include burning, irritation to the gastrointestinal tract, nausea, vomiting. Absorption into the blood stream producing systemic injury is dependent on many factors including physical properties of the chemical and the speed at which it dissolves.

- Injection
  - The final possible route of exposure to chemicals is by accidental injection. Injection effectively bypasses the protection provided by intact skin and provides direct access to the bloodstream, thus, to internal organ systems. Injection may occur through mishaps with syringe needles, when handling animals, or through accidents with pipettes, broken glassware or other sharp objects that have been contaminated with toxic substances.
  - If accidental injection has occurred, wash the area with soap and water and seek medical attention, if necessary. Cautious use of any sharp object is always important. Substituting cannulas for syringes and wearing gloves may also reduce the possibility of injection.

Toxic Effects of Chemical Exposure

How a chemical exposure affects a person depends on many factors. The dose is the amount of a chemical that actually enters the body. The actual dose that a person receives depends on the concentration of the chemical and the frequency and duration of the exposure. The sum of all routes of exposure must be considered when determining the dose.
In addition to the dose, the outcome of exposure is determined by (1) the way the chemical enters the body, (2) the physical properties of the chemical, and (3) the susceptibility of the individual receiving the dose.

Toxic Effects of Chemicals
The toxic effects of a chemical may be *local* or *systemic*. Local injuries involve the area of the body in contact with the chemical and are typically caused by reactive or corrosive chemicals, such as strong acids, alkalis or oxidizing agents. Systemic injuries involve tissues or organs unrelated to or removed from the contact site when toxins have been transported through the bloodstream. For example, methanol that has been ingested may cause blindness, while a significant skin exposure to nitrobenzene may affect the central nervous system.

Certain chemicals may affect a target organ. For example, lead primarily affects the central nervous system, kidney and red blood cells; isocyanates may induce an allergic reaction (immune system); and chloroform may cause tumors in the liver and kidneys.

It is important to distinguish between acute and chronic exposure and toxicity. *Acute* toxicity results from a single, short exposure. Effects usually appear quickly and are often reversible. *Chronic* toxicity results from repeated exposure over a long period of time. Effects are usually delayed and gradual, and may be irreversible. For example, the acute effect of alcohol exposure (ingestion) is intoxication, while the chronic effect is cirrhosis of the liver. Acute and chronic effects are distinguished in the SDS, usually with more information about acute exposures than chronic.

Relatively few chemicals have been evaluated for chronic effects, given the complexity of that type of study. Chronic exposure may have very different effects than acute exposure. Usually, studies of chronic exposure evaluate its cancer causing potential or other long-term health problems.

Evaluating Toxicity Data – LD_{50}

Most estimates of human toxicity are based on animal studies, which may or may not relate to human toxicity. In most animal studies, the effect measured is usually death. This measure of toxicity is often expressed as an LD_{50} (lethal dose 50) – the dose required to kill 50% of the test population. The LD_{50} is usually measured in milligrams of the material per kilogram of body weight of the test animal. The concentration in air that kills half of the population is the LC_{50}.
To estimate a lethal dose for a human based on animal tests, the LD_{50} must be multiplied by the weight of an average person. Using this method, it is evident that just a few drops of a highly toxic substance, such as dioxin, may be lethal, while much larger quantities of a slightly toxic substance, such as acetone, would be necessary for the same effect.

Susceptibility of Individuals

Factors that influence the susceptibility of an individual to the effects of toxic substances include nutritional habits, physical condition, obesity, medical conditions, drinking and smoking, and pregnancy. Due to individual variation and uncertainties in estimating human health hazards, it is difficult to determine a dose of a chemical that is totally risk-free.
Regular exposure to some substances can lead to the development of an allergic rash, breathing difficulty, or other reactions. This phenomenon is referred to as *sensitization*. Over time, these effects may occur with exposure to smaller and smaller amounts of the chemical, but will disappear soon after the exposure stops. For reasons not fully understood, not everyone exposed to a sensitizer will experience this reaction. Examples of sensitizers include epoxy resins, nickel salts, isocyanates and formaldehyde.

Particularly Hazardous Substances

The OSHA Lab Standard ☑defines a particularly hazardous substance as "select carcinogens", reproductive toxins, and substances that have a high degree of acute toxicity. Further information about working with Particularly Hazardous Substances is outlined in Particularly Hazardous Substances. ☑Toxicity information may be found in Safety Data Sheets, under the "Health Hazard Data" section, on product labels, in the *Registry of Toxic Effects of Chemical Substances* ☑(RTECS-requires membership), or in many other sources listed in the SDS page.

Chemical Exposure Determination

OSHA establishes exposure limits for several hundred substances. Laboratory workers must not be exposed to substances in excess of the permissible exposure limits (PEL) specified in OSHA Subpart Z, *Toxic and Hazardous Substances*☑. PELs refer to airborne concentrations of substances averaged over an eight-hour day. Some substances also have "action levels" below the PEL requiring certain actions such as medical surveillance or routine air sampling.
The SDS for a particular substance indicates whether any of the chemicals are regulated through OSHA and, if so, the permissible exposure limit(s) for the regulated chemical(s).

Exposure Monitoring

Exposure monitoring must be conducted if there is reason to believe that exposure levels for a substance may routinely exceed either the action level or the PEL. EH&S and the LSF/PI may use professional judgment, based on the information available about the hazards of the substance and the available control measures, to determine whether exposure monitoring must be conducted. When necessary, exposure monitoring is conducted by a third party contractor according to established industrial hygiene practices. Results of the monitoring are made available to the individual monitored, his or her supervisor within 15 working days of the receipt of analytical results.

Based on the monitoring results, periodic air sampling may be scheduled at the discretion of EH&S, in accordance with applicable federal, state and local regulations. EH&S maintains records of all exposure monitoring results.

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Alfred University CHEMICAL HYGIENE PLAN
Appendix I - Hazard Assessment Form for Personal Protective Equipment

Send completed form to EH&S.

Date: _____ Department/Division: _____ Type of Lab(s): _____ Location(s):_____

Assessment conducted by: _____

Check all that apply	Task description	Description of hazards	Minimum Recommended PPE Use a chemical fume hood or other engineering controls whenever possible.	Specifics or additional PPE glove types☑, use of respirators, etc.
☐	Work with corrosive or organic liquids.	Severe to permanent skin or eye damage or scarring, possible loss of function, and/or loss or vision	Splash goggles, add Face shield with use of large volumes, Disposable chemical resistant gloves, Lab coat and other skin covered to ankles, wrists, throat, Closed shoes, socks.	
☐	Work with infrared emitting equipment, e.g., glassblowing, welding, brazing, IR emitting instrument or exposed diodes.	Corneal burns, cataracts, conjunctivitis, erythema.	Shaded (IR filter) glasses, goggles, or visor appropriate to the wavelength(s) and to potential for exposure	
☐	Spark-producing operations, e.g., metals grinding, welding,	Burns to hands, skins, eyes, hair, clothing.	Fire retardant apparel, gloves, Impact goggles. Keep hair covered, or tied away from sparks.	
☐	Machine operation activities likely to catch clothing, hair, or jewelry.	Skin/limb injury.	Bind vulnerable clothing/hair, remove jewelry	
☐	Metal working/grinding, Woodworking/grinding, Other operations likely to throw particles.	Eye impact injuries.	Safety glasses. No loose clothing, No jewelry	
☐	Handling, moving, pouring, or any use of cryogenic liquids, or close proximity to an open container of cryogen.	Skin or eye tissue damage.	Splash goggles, Insulated gloves, Lab coat or skin covered to ankles, wrists, throat, Closed shoes/socks	

Check all that apply	Task description	Description of hazards	Minimum Recommended PPE Use a chemical fume hood or other engineering controls whenever possible.	Specifics or additional PPE glove types☑, use of respirators, etc.
☐	Working with or around sources of ultraviolet radiation	Eye irritation or damage, erythema (sunburn).	UV blocking goggles, skin cover on all potentially exposed areas. When face sunburn potential exists, a filtering face shield is required.	
☐	Working with or around Class 3b or 4 lasers.	Skin irritation and/or damage, eye injury, vision loss.	Goggles appropriate to beam parameters, closed shoe, no jewelry/reflective items	
☐	Working with etiological agents, human blood, cells, tissue, body fluids or materials derived from these.	Infectious disease, e.g. human immunodeficiency virus (HIV), hepatitis B virus (HBV), hepatitis C virus (HCV).	Safety glasses, "exam" gloves, skin covered on all potentially exposed areas, Closed shoes/socks, Work at Biosafety Level II.	
☐	Work with or around hazardous solid. (Evaluate need for respiratory protection contact EHS)	Systemic poisoning, Reproductive effects, Eye, skin or mucous membrane irritation, damage.	Safety glasses/goggles, Disposable chemical resistant gloves, Lab coat, skin covered to wrists/ankles/throat, Closed shoes/socks	
☐	Work with or around PHS (requires designated work area)	Systemic poisoning, Toxic Reproductive effects, Eye, skin or mucous membrane irritation or damage, Blindness, Death	Rubber or plastic apron, Plastic arm coverings (for HF), Splash goggles under Face shield, Gloves chosen for substance, Lab coat, skin covered to wrists/ankles/throat, Closed shoes/socks.	
☐	**other**			

I certify that the above inspection was performed to the best of my knowledge and ability, based on the hazards present on

date_____ signature_____.
Submit copy of completed site-specific PPE training☑ documentation Appendix F☑ to EH&S.

Alfred University CHEMICAL HYGIENE PLAN
Appendix J - Peroxide Forming Chemicals

Time Limits for Safe Storage and Removal of Peroxide forming chemicals

This list is not all-inclusive; there are numerous other chemicals that can form peroxides. Be sure to read SDSs, chemical container labels and other chemical references to determine potential to form peroxides.

SAFE STORAGE TIME LIMITS FOR PEROXIDE FORMERS dispose of chemicals at time specified in this table	
Unopened chemicals from manufacturer	18 months or (expiration date)
Opened containers:	
Chemicals in Table A	3 months
Chemicals in Tables B and D	12 months
Uninhibited chemicals in Table C	Discard in 24 hours
Inhibited chemicals in Table C (Do not store under inert atmosphere)	12 months

A. Chemicals that form explosive levels of peroxides without concentration		
Butadiene[a]	Isopropyl ether	Sodium amide (sodamide)
Chloroprene[a]	Potassium metal	Tetrafluoroethylene[a]
Divinylacetylene	Potassium amide	Vinylidene chloride

B. Chemicals that form explosive levels of peroxides on concentration		
Acetal	Diethyl ether	4-Methyl-2-pentanol
Acetaldehyde	Diethylene glycol dimethyl ether (diglyme)	2-Pentanol
Benzyl alcohol	Dioxanes	4-Penten-1-ol
2-Butanol	Ethylene glycol dimethyl ether (glyme)	1-Phenylethanol
Cumene	4-Heptanol	2-Phenylethanol
2-Cyclohexen-1-ol	2-Hexanol	2-Propanol
Cyclohexene	Methylacetylene	Tetrahydrofuran
Decahydronaphthalene	3-Methyl-1-butanol	Tetrahydronaphthalene
Diacetylene	Methylcyclopentane	Vinyl ethers
Dicyclopentadiene	Methyl isobutyl ketone	Other secondary alcohols

C. Chemicals that may autopolymerize as a result of peroxide accumulation		
Acrylic acid[b]	Methyl methacrylate[b]	Vinyl chloride
Acrylonitrile[b]	Styrene	Vinylpyridine
Butadiene[c]	Tetrafluoroethylene[c]	Vinyladiene chloride
Chloroprene[c]		Vinyl acetate
Chlorotrifluoroethylene		Vinylacetylene

D. Chemicals that may form peroxides but cannot clearly be placed in sections A,B or C		
Acrolein	p-Chlorophenetole	4,5-Hexadien-2-yn-1-ol
Allyl ether[d]	Cyclooctene[d]	n-Hexyl ether
Allyl ethyl ether	Cyclopropyl methyl ether	o,p-Iodophenetole
Allyl phenyl ether	Diallyl ether[d]	Isoamyl benzyl ether[d]
p-(n-Amyloxy)benzoyl chloride	p-Di-n-butoxybenzene	Isoamyl ether[d]
n-Amyl ether	1,2-Dibenzyloxyethane[d]	Isobutyl vinyl ether
Benzyl n-butyl ether[d]	p-Dibenzyloxybenzene[d]	Isophorone[d]
Benzyl ether[d]	1,2-Dichloroethyl ethyl ether	B-Isopropoxypropionitrile[d]
Benzyl ethyl ether[d]	2,4-Dichlorophenetole	Isopropyl 2,4,5-trichloro-phenoxy- acetate
Benzyl methyl ether	Diethoxymethane[d]	Limonene
Benzyl 1-napthyl ether[d]	2,2-Diethoxypropane	1,5-p-Methadiene
1,2-Bis(2-chloroethoxy) Ethane	Diethyl ethoxymethylene-Malonate	Methyl p-(n-amyloxy)-benzoate
Bis(2 ethoxyethyl)ether	Diethyl fumarate[d]	4-Methyl-2-pentanone
Bis(2-(methoxyethoxy)-ethyl) ether	Diethyl acetal[d]	n-Methylphenetole
Bis(2-chloroethyl)ether	Diethyketene[f]	2-Methyltetrahydrofuran
Bis(2-ethoxyethyl)adipate	m,o,p-diethoxybenzene	3-Methoxy-1-butyl acetate
Bis(2-ethoxyethyl)phthalate	1,2-Diethoxyethane	2-Methoxyethanol
Bis(2-methoxyethyl)-Carbonate	Dimethoxymethane[d]	3-Methoxyethyl acetate
Bis(2-methoxyethyl) ether	1,1-Dimethoxyethane[d]	2-Methoxyethyl vinyl ether
Bis(2-methoxyethyl) Phthalate	Dimethylketene[f]	Methonxy-1,3,5,7-cyclo-octa-tetraene

A. Continued next page

D. Con't Chemicals that may form peroxides but cannot clearly be placed in sections A,B or C		
Bis(2-methoxymethyl) Adipate	3,3-Dimethoxypropene	B-Methoxypropionitrile
Bis(2-n-butoxyethyl) Phthalate	2,4-Dinitrophenetole	m-Nitrophenetole
Bis(2-phenoxyethyl) ether	1,3-Dioxepane[d]	1-Octene
Bis(4-chlorobutyl) ether	Di(1-propynyl)ether[f]	Oxybis(2-ethyl acetate)
Bis(chloromethyl) ether[e]	Di(2-propynyl)ether	Oxybis(2-ethyl benzoate)
2-Bromomethyl ethyl ether	Di-n-propoxymethane[d]	B,B-oxydipropionitrile
B-Bromophenetole	1,2-Epoxy-3-isopropoxy-propane[d]	1-Pentene
o-Bromophenetole	1,2-Epoxy-3-phenoxy-propane	Phenoxyacetyl chloride
p-Bromophenetole	p-Ethoxyacethophenone	a-Phenoxypropionyl chlorid
3-Bromopropyl phenyl ethe	2-Ethoxyethyl acetate	Phenyl o-propyl ether
1,3-Butadiyne	(2-Ethoxyethyl)-o-benzoyl benzoate	p-Phenylphenetone
Buten-3-yne	1-(2-Ethoxyethoxy)ethyl acetate	n-Propyl ether
tert-Butyl ethyl ether	1-Ethoxynaphthalene	n-Propyl isopropyl ether
tert-Butyl methyl ether	o,p-Ethoxyphenyl isocyanate	Sodium 8,11,14-eicosa-tetraenoate
n-Butyl phenyl ether	1-Ethoxy-2-propyne	Sodium ethoxyacetylide[f]
n-Butyl vinyl ether	3-Ethoxyopropionitrile	Tetrahydropyran
Chloroacetaldehyde diethylacetal[d]	2-Ethylacrylaldehyde oxim	Triethylene glycol diacetate
2-Chlorobutadiene	2-Ethylbutanol	Triethylene glycol diprop-ionate
1-(2-Chloroethoxy)-2-phen-oxyethane	Ethyl B-ethoxypropionate	1,3,3-Trimethoxypropene[d]
Chloroethylene	2-Ethylhexanal	1,1,2,3-Tetrachloro-1,3-butadiene
Chloromethyl methyl ether[e]	Ethyl vinyl ether	4-Vinyl cyclohexene
B-Chlorophenetole	Furan	Vinylene carbonate
o-Chlorophenetole	2,5-Hexadiyn-1-ol	Vinylidene chloride[d]

Notes: [a] When stored as a liquid monomer.

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

[c] 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 autopolymerize as a result of peroxide accumulation.

[d] These chemicals easily form peroxides and should probably be considered under Part B.

[e] OSHA - regulated carcinogen.

[f] Extremely reactive and unstable compound.

Removing Peroxides
Peroxides are particularly dangerous. These procedures should be carried out only by knowledgeable laboratory personnel.

Properly dispose of remaining materials as hazardous waste.

- Removal of peroxides with alumina:
  A 2 X 33 cm column filled with 80 g of 80 – mesh basic activated alumina is usually sufficient to remove all peroxides from 100 to 400 ml of solvent, whether water-soluble or water-insoluble. After passage thought the column, the solvent should be tested for peroxide content. Peroxides formed by air oxidation are usually decomposed by the alumina, not merely absorbed on it. However, for safety it is best to slurry the wet alumina with dilute acidic solution of ferrous sulfate before disposal as hazardous waste.

- Removal of peroxides with Molecular Sieves@:
  Reflux 100 ml of the solvent with 5 g of 4- to 8- mesh indicating activated 4A Molecular Sieves@ for several hours under nitrogen. The sieves are separated from the solvent and require no further treatment because the peroxides are destroyed during their interaction with the sieves.

- Removal of peroxides with ferrous sulfate:
  A solution of 6 g of $FeSO_4 \cdot 7H_2O$, 6 ml of concentrated sulfuric acid, and 11 ml of water is stirred with1 L of water-insoluble solvent until the solvent no longer gives a positive test for peroxides. Usually only a few minutes are required.
  Diacyl peroxides can be destroyed by this reagent as well as by aqueous sodium hydrogen sulfite, sodium hydroxide, or ammonia. However, diacyl peroxides with low solubility in water, such as dibenzoyl peroxide, react very slowly. A better reagent is a solution of sodium iodide or potassium iodide in glacial acetic acid.

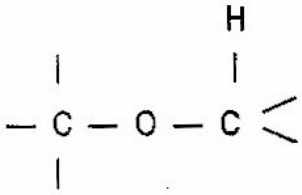
- Procedure for destruction of diacyl peroxides:
  For 0.01 mol of diacyl peroxide, 0.022 mol (10% excess) of sodium or potassium iodide is dissolved in 70 ml of glacial acetic acid, and the peroxide added gradually with stirring at room temperature. The solution is rapidly darkened by the formation of iodine. Let stand a minimum of 30 minutes before disposal as hazardous waste. Most dialkyl peroxides do not react readily at room temperature with ferrous sulfate, iodide, ammonia, or the other reagents mentioned above. However, these peroxides can be destroyed by a modification of the iodide procedure.

- Procedure for destruction of dialkyl peroxides:
  1 ml of 36% (w/v) hydrochloric acid is added to the above acetic acid/ potassium iodide solution as an accelerator, followed by 0.01 mol of the dialkyl peroxide. The solution is heated to 90 to 100° C on a steam bath over the course of 30 minutes and held at that temperature for 5 hours.

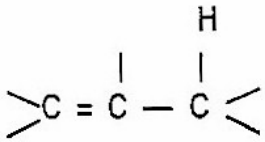
References: Prudent Practices in the Laboratory, National Research Council, 1995.
"Review of Safety Guidelines for Peroxidizable Organic Chemicals," Chemical Health and Safety, September/October 1996.

Below are diagrams of moieties that can form organic peroxides. These moieties are ranked from highest (1) to lowest (14) risk of forming potentially dangerous peroxide concentrations.

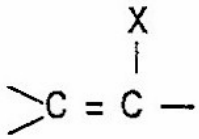
1. Ethers and acetals with α-hydrogen



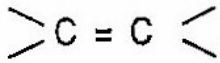
2. Alkenes with allylic hydrogen



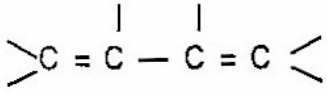
3. Chloroalkenes, fluoroalkenes



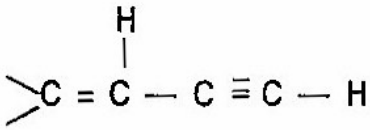
4. Vinyl halides, esters, ethers



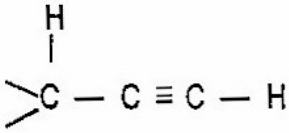
5. Dienes



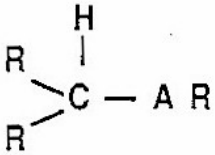
6. Vinylalkynes with α-hydrogen



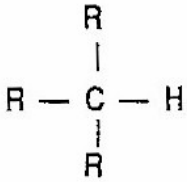
7. Alkylalkynes with α-hydrogen



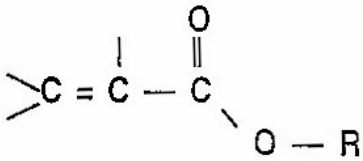
8. Alkylalkynes with tertiary α-hydrogen



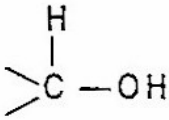
9. Alkanes and cycloalkanes with tertiary hydrogen



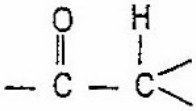
10. Acrylates, methacrylates



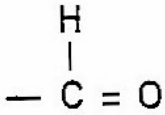
11. Secondary alcohols



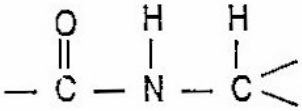
12. Ketones with α-hydrogen



13. Aldehydes



14. Ureas, amides, and lactams with α-hydrogen atom on a carbon attached to nitrogen



Appendix K - Segregation and Storage of Chemicals

Chemicals should be stored according to hazard class/characteristic and compatibility NOT alphabetically, or by carbon number, or by physical state, etc. Chemicals may be arranged alphabetically within their hazard class/characteristic and compatibility group.

- Incompatible chemicals☑ should be separated. Incompatibility information and the DOT hazard class is found on SDSs (Incompatibility or Reactivity section, Transportation Information section), container labels, and in other reference sources such as this NOAA site (excellent database) Reactivity worksheet☒.
  - The potential hazards of storing incompatible chemicals together include:
    - Generation of heat.
    - Possible fires and explosion.
    - Generation of toxic and/or flammable gases and vapors.
    - Formation of toxic compounds.
    - Formation of shock and/or friction sensitive compounds.
    - Violent polymerization.

A number of segregation schemes are found in the literature. When choosing a segregation scheme keep in mind that chemicals do not always fall neatly into one hazard class. Chemicals may display both physical and health hazards such as flammable liquid, corrosive or flammable liquid, poison.

- When a chemical fits in more than one hazard category, store the chemical according to the highest risk based on severity of consequences and likelihood.
  - **Fire is generally considered to be the highest risk category** therefore flammability/combustibility should be used as the foremost storage criteria.
- Use the various literature resources and the SDSs for determining the hazard characteristics of a compound.
- When you are making decisions on how to segregate, consider the:
  - Physical hazards of the chemical.
  - Health hazards of the chemical.
  - Chemical form (solid, liquid or gas).
  - Concentration of the chemical.
- Separate liquids from solids :
  - Separate all the chemicals into compatible groups. The separations, either by distance or physical barriers, should be enough to prevent the mixing of two incompatibles if a container is dropped and breaks a second container.
  - The following groups should be separated:
    - Chemicals showing hazards such as flammability, reproductive toxicity, or suspect and confirmed carcinogens :
      - Inorganic and organic flammables are separated. In addition, organic flammables are further separated into two classes based on compatibility.
      - Highly toxic and carcinogenic chemicals are stored in safety storage cabinets and carried back and forth from the storage cabinet to the hood in an unbreakable outer container.
    - Acids and bases:
      - Acids should be further separated into inorganic acids (hydrochloric, sulfuric) and organic acids (picric, acetic).
      - Concentrated acids should be stored in an acid storage cabinet.

        - Separate acids from active metals (such as sodium, magnesium, and potassium) and chemicals that generate toxic gases on contact with acids (such as inorganic cyanides and sulfides). Picric Acid can form explosive salts with many metals, or by itself when dry.
        - Store oxidizing acids (such as nitric acid (store separately), perchloric, and chromic acid) away from organic acids, and organic solvents.
        - Concentrated Perchloric acid should be stored in glass or plastic (polyethylene or polypropylene), keep secondary containers away from all organic and combustible materials (such as wooden shelves and paper).
        - Glacial acetic acid has a flash point of approximately 103 °F (39 °C) and is best stored as a flammable liquid.
        - **Store Hydrofluoric Acid in tightly closed polyethylene containers NOT glass containers.** See Appendix Q for hydrofluoric acid☑.
    - Oxidizing agents from reducing agents
    - Potentially explosive materials
    - Water reactive materials
    - Pyrophoric chemicals
    - Peroxide forming materials - these must be properly managed and disposed of within recommended time periods (Appendix J☑)
    - Materials which can react with themselves (Polymerization for example)
    - Incompatible chemicals☑ NOAA site excellent database Reactivity worksheet☒
    - Other chemicals can generally be grouped together (but compatibility must be considered).
    - Segregate compressed gases as follows:
        - Toxic gases
        - Flammable gases
        - Oxidizing and inert gases
- Use secondary containment (trays, bins, or plastic bags) to segregate chemical hazard classes (such as acids and bases) within the same cabinet or shelf unit.
    - However, even when using secondary containment:
        - **never** store oxidizers and flammables in the same cabinet or shelf unit,
        - **never** store compounds such as inorganic cyanides and acids in the same cabinet or shelf
- Once chemicals have been separated, train and ensure everyone in the lab knows the process and what system is being used. (Training form Appendix F☑)
- Identify where chemicals in each hazard class will be stored by labeling cabinets with signs, or hazard class labels. These can be purchased from a safety supply company, you can create your own, or download labels from the EH&S Signs and Labels web page.
- The basic DOT hazard classes for transportation and hazard class numbers are:

DOT Hazard Class Number	Hazard Class
Class 1	Explosives
Class 2	Compressed gases
Class 3	Flammable liquids
Class 4	Flammable solids
Class 5	Oxidizers
Class 6	Poisons
Class 7	Radioactive materials
Class 8	Corrosives
Class 9	Miscellaneous, store with Class 6

- The benefits of chemical segregation by hazard class include:
  - Safer chemical storage.
  - Understanding the hazards a chemical exhibits will increase your knowledge about the chemical.
  - Identifying potentially explosive chemicals.
  - Identifying multiple containers of the same chemical.

- A suggested compatible grouping and chemical storage segregation scheme is provided below. This scheme is not the only method of arranging these chemicals and is only offered as a convenience not as an endorsement by AU.

The Flinn Chemical & Biological Catalog Reference Manual suggests organic and inorganic groupings which are further sorted into a list of compatible families. This list is not all inclusive and is only intended to cover the chemicals found in an average laboratory.

	INORGANIC		***ORGANIC***
1	*Metals, Hydrides*	*1*	*Acids, Amino Acids, Anhydrides, Peracids*
2	*Acetates, Halides, Iodides, Sulfates, Sulfites, Thiosulfates, Phosphates, Halogens, Oxalates, Phthalates, Oleates*	*2*	*Alcohols, Glycols, Sugars, Amines, Amides, Imines, Imides*
3	*Amides, Nitrates, (except Ammonium Nitrate), Nitrites, Azides*	*3*	*Hydrocarbons, Esters, Aldehydes, Oils*
4	*Hydroxides, Oxides, Silicates, Carbonates, Carbon*	*4*	*Ethers, Ketones, Ketenes, Halogenated Hydrocarbons, Ethylene Oxide*
5	*Sulfides, Selenides, Phosphides, Carbides, Nitrides*	*5*	*Epoxy Compounds, Isocyanates*
6	*Chlorates, Bromates, Iodates, Chlorites, Hypochlorites, Perchlorates, Perchloric Acid, Peroxides, Hydrogen Peroxide*	*6*	*Peroxides, Hydroperoxides, Azides*
7	*Arsenates, Cyanides, Cyanates*	*7*	*Sulfides, Polysulfides, Sulfoxides, Nitriles*
8	*Borates, Chromates, Manganates, Permanganates, Molybdates, Vanadates*	*8*	*Phenols, Cresols*
9	*Acids (except Nitric Acid which is isolated and stored by itself)*	*9*	*Dyes, Stains, Indicators*
10	*Sulfur, Phosphorus, Arsenic, Phosphorus Pentoxide*	*10*	*Organic miscellaneous*
11	*Inorganic miscellaneous*		

Suggested Shelf Storage Patterns

boxes depict cabinets with/and/or shelves

Poisons Cabinet - locked

store severe poisons here

Inorganic Chemical Storage

INORGANIC #10 Sulfur, Phosphorus, Arsenic, Phosphorus Pentoxide	**INORGANIC # 7** Arsenates, Cyanides, Cyanates	
INORGANIC #2 Halides, Sulfates, Sulfites, Thiosulfates, Phosphates, Halogens, Acetates	**INORGANIC # 5** Sulfides, Selenides, Phosphides, Carbides, Nitrides	
INORGANIC #3 Amides, Nitrates, (except Ammonium Nitrate), Nitrites, Azides **ISOLATE AMMONIUM NITRATE FORM ALL OTHER SUBSTANCES**	**INORGANIC # 8** Borates, Chromates, Manganates, Permanganates	***ACID CABINET*** **INORGANIC # 9** Acids except Nitric unless your acid cabinet provides a separate compartment for Nitric Acid
INORGANIC #1 Metals, Hydrides **STORE AWAY FROM WATER STORE FLAMMABLE SOLIDS IN FLAMMABLES CABINET**	**INORGANIC # 6** Chlorates, Bromates, Iodates, Chlorites, Hypochlorites, Perchlorates, Perchloric Acid, Peroxides, Hydrogen Peroxide	
INORGANIC #4 Hydroxides, Oxides, Silicates, Carbonates, Carbon	**MISCELLANEOUS**	

Organic Chemical Storage

ORGANIC # 2 Alcohols, Glycols, Sugars, Amines, Amides, Imines, Imides **STORE FLAMMABLES IN A DEDICATED CABINET**	**ORGANIC # 8** Phenols, Cresols	
ORGANIC # 3 Hydrocarbons, Esters, Aldehydes,Oils, **STORE FLAMMABLES IN A DEDICATED CABINET**	**ORGANIC # 6** Peroxides, Hydroperoxides, Azides	
ORGANIC # 4 Ethers, Ketones, Ketenes, Halogenated Hydrocarbons, Ethylene Oxide **STORE FLAMMABLES IN A DEDICATED CABINET**	**ORGANIC # 1** Acids, Amino Acids, Anhydrides, Peracids **STORE *CERTAIN* ORGANIC ACIDS IN ACID CABINET**	***FLAMMABLE CABINET*** **ORGANIC # 2** Alcohols, Glycols, etc. **ORGANIC # 3** Hydrocarbons, etc. **ORGANIC # 4** Ethers, Ketones, etc. **ORGANIC # 9** Alcohol-based Indicators, etc.
ORGANIC # 5 Epoxy Compounds, Isocyanates	**ORGANIC # 9** Dyes, Stains, Indicators **STORE ALCHOOL-BASED SOLUTIONS IN FLAMMABLES CABINET**	
ORGANIC # 7 Sulfides, Polysulfides, Sulfoxides, Nitriles	**MISCELLANEOUS**	

ALFRED UNIVERSITY CHEMICAL HYGIENE PLAN
Appendix L – General Inventory Format

Alfred University	NOTE: Submit to EHS by June 15th annually	Year			
Chemical Inventory / List		Date:			
Faculty/P.I./Supervisor:		Individual Completing Inventory:			
Building	School/Office	Facility Type	Floor	Room #:	

Note: Quantity of chemical is completed only if the chemcial is a P-Listed substance or if 100 pounds or 55 gallons or more are stored on-hand at all times. Note: Some cells use drop-down selection. Ensure cover sheet has been signed prior to submitting to EHS. If product is in gallons use net weight of 8.4 pounds per gallon.

Chemical Name / Product Identifier (Required)	Manufacturer (Required)	This column available for individual use	Quantity	Unit (lbs. or oz. only)	Safety Data Sheet	Bar Code (if applicable)

ALFRED UNIVERSITY CHEMICAL HYGIENE PLAN
Appendix M - Incompatible Chemicals

Store and handle the substances in the left-hand column to avoid contact with those in the right-hand column. This list contains some of the chemicals commonly found in laboratories, but is not all inclusive. Incompatibility information for the specific chemical you are using can usually be found in the "Reactivity" or "Incompatibilities" section of the SDS or refer to Rapid Guide to Chemical Incompatibilities, by Pohanish and Greene.

CHEMICAL	INCOMPATIBLE WITH
Alkaline and alkaline earth metals, such as Sodium, Potassium, Cesium, Lithium, Magnesium, Calcium	Carbon dioxide, Carbon tetrachloride and other chlorinated hydrocarbons, any free acid or halogen. Do not use water, foam or dry chemical on fires involving these metals.
Acetic acid	Chromic acid, Nitric acid, hydroxyl compounds, Ethylene glycol, Perchloric acid, peroxides, permanganates.
Acetic anhydride	Chromic acid, Nitric acid, hydroxyl-containing compounds, Ethylene glycol, Perchloric acid, peroxides and permanganates.
Acetone	Concentrated Nitric and Sulfuric acid mixtures.
Acetylene	Copper, Silver, Mercury and halogens, Fluorine, Chlorine, Bromine.
Alkali & alkaline earth metals (such as powdered Aluminum or Magnesium, Calcium, Lithium, Sodium, Potassium)	Water, Carbon tetrachloride or other chlorinated hydrocarbons, Carbon dioxide, and halogens.
Aluminum alkyls	Halogenated hydrocarbons, water.
Ammonia (anhydrous)	Silver, Mercury, Chlorine, Calcium hypochlorite, Iodine, Bromine, Hydrogen fluoride, Chlorine dioxide, Hydrofluoric acid (anhydrous).
Ammonium nitrate	Acids, metal powders, flammable liquids, chlorates, nitrites, Sulfur, finely divided organics or combustibles.
Arsenical materials	Any reducing agent.
Azides	Acids.
Benzoyl peroxide	Chloroform, organic materials.
Bromine	Ammonia, Acetylene, Butadiene, Butane and other petroleum gases, Sodium carbide, Turpentine, Benzene and finely divided metals, Methane, Propane, Hydrogen.
Calcium carbide	Water (see also Acetylene).
Calcium hypochlorite	Methyl carbitol, Phenol, Glycerol, Nitromethane, Iron oxide, Ammonia, activated carbon.
Calcium oxide	Water.
Carbon, activated	Calcium hypochlorite, all oxidizing agents.

CHEMICAL	INCOMPATIBLE WITH
Carbon tetrachloride	Sodium.
Chlorates	Ammonium salts, acids, metal powders, Sulfur, finely divided organics or combustibles.
Chlorine	Ammonia, Acetylene, Butadiene, Butane, Propane, and other petroleum gases, Hydrogen, Sodium carbide, Turpentine, Benzene and finely divided metals, Methane.
Chlorine dioxide	Ammonia, Methane, Phosphine and Hydrogen sulfide.
Chlorosulfonic acid	Organic materials, water, powdered metals.
Chromic acid & Chromium trioxide	Acetic acid, Naphthalene, Camphor, Glycerin, Turpentine, alcohol and other flammable liquids, paper or cellulose.
Copper	Acetylene, Hydrogen peroxide, Ethylene
Cumene hydroperoxide	Acids, organic or mineral.
Cyanides	Acids.
Ethylene oxide	Acids, bases, Copper, Magnesium perchlorate.
Flammable liquids	Ammonium nitrate, Chromic acid, Hydrogen peroxide, Nitric acid, Sodium peroxide, halogens.
Fluorine	Almost all oxidizable substances.
Hydrocarbons (such as Bromine, Butane)	Fluorine, Chlorine, Chromic acid, Sodium peroxide.
Hydrocyanic acid	Nitric acid, alkalis.
Hydrofluoric acid (anhydrous)	Ammonia (aqueous or anhydrous).
Hydrogen peroxide	Copper, Chromium, Iron, most metals or their salts, any flammable liquid, combustible materials, Aniline, Nitromethane, alcohols, Acetone, organic materials, Aniline.
Hydrides	Water, air, Carbon dioxide, chlorinated hydrocarbons.
Hydrofluoric acid, anhydrous (Hydrogen fluoride)	Ammonia (anhydrous or aqueous), organic peroxides.
Hydrogen sulfide	Fuming Nitric acid, oxidizing gases.
Hydrocarbons (Benzene, Butane, Propane, Gasoline, Turpentine, etc.)	Fluorine, Chlorine, Bromine, Chromic acid, Sodium peroxide, fuming Nitric acid.
Hydroxylamine	Barium oxide, Lead dioxide, Phosphorus pentachloride and trichloride, Zinc, Potassium dichromate.
Hypochlorites	Acids, activated Carbon.
Iodine	Acetylene, Ammonia (anhydrous or aqueous),
Hydrogen.Sulfide	Fuming Nitric acid, oxidizing gases.
Maleic anhydride	Sodium hydroxide, Pyridine and other tertiary amines.
Mercury	Acetylene, Fulminic acid, Ammonia, Oxalic acid.
Nitrates	Acids, metal powders, flammable liquids, chlorates, sulfur, finely divided organics or combustibles, Sulfuric acid.
CHEMICAL	**INCOMPATIBLE WITH**

Nitric acid (concentrated)	Acetic acid, Aniline, Chromic acid, Hydrocyanic acid, Hydrogen sulfide, flammable liquids, flammable gases, nitratable substances, organic peroxides, chlorates, Copper, brass, any heavy metals.
Nitroparaffins	Inorganic bases, amines.
Oxygen	Oil, grease, Hydrogen, flammable liquids, solids, or gases.
Oxalic acid	Silver, mercury, organic peroxides.
Perchlorates	Acids.
Perchloric acid	Acetic anhydride, Bismuth and its alloys, alcohol, paper, wood, grease, oil, organic amines or antioxidants.
Peroxides, organic	Acids (organic or mineral); avoid friction, store cold.
Phosphorus (white)	Air, Oxygen, alkalis, reducing agents.
Phosphorus pentoxide	Propargyl alcohol.
Potassium	Carbon tetrachloride, Carbon dioxide, water.
Potassium chlorate	Acids, Sulfuric acid (see also chlorates).
Potassium perchlorate	Sulfuric & other acids (see also Perchloric acid, & chlorates).
Potassium permanganate	Glycerin, Ethylene glycol, Benzaldehyde, any free acid, Sulfuric acid.
Selenides	Reducing agents.
Silver	Acetylene, Oxalic acid, Tartaric acid, Fulminic acid, ammonium compounds.
Sodium	Carbon tetrachloride, Carbon dioxide, water. See alkaline metals (above).
Sodium amide	Air, water.
Sodium nitrate	Ammonium nitrate and other ammonium salts.
Sodium oxide	Water, any free acid.
Sodium peroxide	Any oxidizable substance, such as Ethanol, Methanol, glacial Acetic acid, Acetic anhydride, Benzaldehyde, Carbon disulfide, Glycerine, Ethylene glycol, Ethyl acetate, Methyl acetate and Furfural.
Sulfides	Acids.
Sulfuric acid	Chlorates, perchlorates, permanganates, organic peroxides. Potassium chlorate, Potassium perchlorate, Potassium permanganate (similar compounds of light metals, such as Sodium, Lithium).
Tellurides	Reducing agents.
UDMH (1,1-Dimethylhydrazine)	Oxidizing agents such as Hydrogen peroxide and fuming Nitric acid.
Zirconium	Prohibit water, Carbon tetrachloride, foam and dry chemical on zirconium fires.

Hydrofluoric Acid (CAS#7664-39-3), or HF, is one of the most aggressive and corrosive acids known and one of the most dangerous chemicals on our campus. It is used in a variety of applications including preparing plates for semiconductor research, mineral processing, metal finishing, etching glass and manufacturing of electrical components. **HF exposures require immediate specialized first aid and emergency medical treatment.**
Both anhydrous hydrofluoric acid (hydrogen fluoride) and its solutions are clear, colorless liquids. HF is similar to other acids in that the initial extent of a burn depends on the concentration, the temperature and the duration of contact with the acid.

Hydrofluoric Acid concerns

- HF is very aggressive physiologically because the fluoride ion readily penetrates the skin, causing destruction of deep tissue layers. Unlike other acids which are rapidly neutralized, this process may continue for days if left untreated. Skin contact with HF can cause serious, penetrating burns of the skin that may not be painful or visible for several hours.
- When exposed to air, concentrated solutions and anhydrous HF produce pungent vapors which are especially dangerous.

Signs and Symptoms of HF Exposure

Skin Exposure

Strong HF acid concentrations (over 50%), particularly anhydrous HF, cause immediate, severe, burning pain and a whitish discoloration of the skin that usually proceeds to blister formation.
In contrast to the immediate effects of concentrated HF, the effects of contact with more dilute solutions or their vapors may be delayed. Skin contact with acid concentrations in the 20% to 50% range may not produce clinical signs or symptoms for one to eight hours. With concentrations less than 20%, the latent period may be up to twenty-four hours.
The usual initial signs of a dilute solution HF burn are redness, swelling and blistering, accompanied by severe throbbing pain.
Burns larger than 25 square inches (160 square cm) may result in serious systemic toxicity.

Eye Contact

HF can cause severe eye burns with destruction or opacification of the cornea. Blindness may result from severe or untreated exposures.

Inhalation

Acute symptoms of inhalation may include coughing, choking, chest tightness, chills, fever and cyanosis (blue lips and skin). All individuals suspected of having inhaled HF should seek medical attention with observation for pulmonary effects. This includes any individuals with HF exposure to the head, chest or neck areas.
It has been reported that pulmonary edema may be delayed for several hours and even up to two days. For this reason, it is recommended that all individuals with such exposures be hospitalized for observation and/or treatment. If there is no initial upper respiratory irritation, significant inhalation exposure can generally be ruled out.

Ingestion

If HF is ingested, severe burns to the mouth, esophagus and stomach may occur. Ingestion of even small amounts of dilute HF has resulted in death.

Systemic Toxicity

The reaction of fluoride with body calcium is one of the major toxic effects and forms the basis for many treatment recommendations.
One of the most serious consequences of severe exposure to HF by any route is the marked lowering of serum calcium (hypocalcemia) and other metabolic changes, which may result in a

fatal outcome if not recognized and treated. Hypocalcemia should be considered a potential risk in all instances of inhalation or ingestion, and whenever skin burns exceed 25 square inches. Treatment for shock may also be required.

Using HF

The LSF/PI of a lab using HF must:

- Assign a Designated Work Area.
  In all labs that use HF, a chemical fume hood must be designated as the work area for HF. All work with HF **must** take place in the designated fume hood.
  - Post a highly visible "Designated Work area" sign, containing the information below, in a prominent position in the work area, usually on the front of the fume hood.

> **Danger – Designated Work Area**
> **for HYDROFLUORIC ACID (HF)**
> **all use of HF must take place in this designated work area**
>
> ***ONLY AUTHORIZED INDIVIDUALS USING PROPER PPE MAY WORKWITH HYDROFLUORIC ACID***
>
> For additional information contact AU EH&S 2190

- Ensure the following Emergency Equipment and Information is available.
  - Post phone location, emergency phone numbers, process shut down/evacuation procedures, first aid procedures
  - **Eyewash/shower** - The lab must be equipped with an eyewash/safety shower (may be located in hallway).
  - **First Aid Kit** - A HF first aid kit must be **immediately** available that includes 2.5% calcium gluconate gel; a liquid antacid, proper gloves. (replace these items with new stock annually)
  - **Spill Kit** - An HF spill kit must be available with calcium compounds such as calcium carbonate, calcium sulfate or calcium hydroxide and/or specific HF spill pillows along with proper PPE and other spill materials appropriate for HF spills. Sodium bicarbonate should never be used since it does not bind the fluoride ion and can generate toxic aerosols.
  - **SOP** - A SOP must be written for your specific application and posted or readily available near the designated area.
  - **SDS** - A hard copy of the SDS must be available. Provide EMT/transport personnel with HF SDS and other information for hospital.
- Provide proper Training. See Section 1.3.2.3 Employee Training☑
  - All users of HF, and all workers in a lab where HF is used, must be properly trained.
- Ensure proper Labeling.
  - Maintain original container labels and label all non-original, secondary containers according to AU labeling policies☑.
- Ensure proper PPE is available. The following PPE is required for HF use:
  - Rubber or plastic apron
  - Plastic arm coverings
  - Gloves – **do not use** latex gloves, always double glove with proper type of glove

- Incidental use - double glove with heavy 22 mm nitrile exam gloves and re-glove if any exposure to gloves
- Extended use – heavy neoprene or butyl rubber over nitrile or Silvershield®gloves PVC **or** See Glove Selection Chart☑ and/or SDS.
- Wash off gloves with water before removing them, discard used gloves, after rinsing with water, into a trash receptacle. If gloves are significantly contaminated with HF, discard into a hazardous waste disposal container to prevent secondary contamination to persons using regular trash receptacles.
- Thoroughly wash hands after glove removal and check hands for any sign of contamination.

- Splash goggles and a face shield
- Closed toed shoes that cover the foot, long pants, long sleeve shirt with a high neck (no low cut) and protective lab coat (wear clothes and shoes that cover as much skin as possible).
- Depending on the work involved, respiratory protection may be recommended; contact EH&S.

HF Storage

Store in tightly closed polyethylene containers, never glass. Use plastic secondary containment. Store HF containers in an acid cabinet labeled for HF storage. If the designated fume hood has an acid cabinet under it, store the HF there; do not store in the fume hood.

HF Safe Practice Guidelines

- Substitute a less hazardous substance for HF or use a less concentrated solution if possible.
- Never work alone with HF, use the buddy system.
- Use a plastic tray while working with HF for containment in case of a spill.
- Keep HF containers closed; HF vapors etch the hood sash glass making it hard to see through. If this occurs, consider replacing sash glass with a polycarbonate sash.
- Be sure you are properly trained.
- Wear proper PPE.
- Work with the fume hood☑ sash as low as proper flow rate allows (95-125fpm)
- Depending on the work involved, respiratory protection may be recommended. Contact EH&S at 2190 for more information.

What to Do for HF Exposure

Speed of treatment is of the utmost importance. Delay in first aid or medical treatment will likely result in greater damage. Victim should **yell for help then immediately start first aid procedures and immediately seek medical attention. Call for emergency assistance and transport to the hospital. Wear appropriate double gloves (not latex) to prevent secondary HF burn when assisting victim. Bring the SDS with you to the hospital.**

Skin Contact

1. Immediately start rinsing under safety shower or other water source and flush affected area thoroughly with large amounts of running water. Speed and thoroughness in washing off the acid is of primary importance.
2. Begin flushing even before removing contaminated clothing. Remove contaminated clothing while continuing to flush with water.

3. Rinse with large amounts of water for 5 minutes and then massage 2.5% Calcium gluconate gel into the affected area. If alone, call 911 at this time. **Note:** Wear proper double gloves to prevent a possible secondary HF burn when applying the calcium gluconate gel.
4. If 2.5% Calcium gluconate gel not available, continue rinsing until medical help arrives.
5. While the victim is rinsing, someone should call for emergency assistance.

Eye Contact

1. **Do not** rub eyes or keep eyes closed.
2. Immediately flush eyes for at least 15 minutes holding eyelids open and away from the eye, remove contact lenses if possible, but flushing should not be interrupted;
3. If alone, call for emergency assistance then resume flushing until medical personnel arrive. Medical personnel will remove contact lenses.

Do not apply Calcium gluconate gel to eyes.

Medical personnel should apply 1% calcium gluconate solution repeatedly to irrigate the eyes. Ice water compresses may be applied to the eyes while transporting the victim.

If someone else in the lab has suffered eye contamination, lead them to the eyewash and activate the unit, help start the flushing as outlined above then call for medical assistance and go back to assist the person until help arrives.

Inhalation

Immediately move victim to fresh air and call for emergency assistance

Ingestion **Call 911 and get immediate medical attention. Ingestion of HF is a life-threatening emergency.**

1. Drink large amounts of water as quickly as possible to dilute the acid. Do not induce vomiting. Do not give emetics or baking soda. Never give anything by mouth to an unconscious person.
2. Drink 10 ounces of milk of magnesia, Mylanta® or Maalox®.

HF Spill and Disposal HF-specific spill control materials are required for spills.

If HF is spilled leave the room and call for emergency assistance. If a very small spill occurs in the hood and you feel comfortable cleaning it up then:

- Wear the appropriate PPE for HF.
- Pour a calcium compound such as calcium carbonate or place a HF spill pillow on the spill and wait for it to soak up.
- Transfer the waste to a high quality plastic container (such as HDPE) that seals tightly, never use a glass container.
- Properly label, store and dispose of as hazardous waste according to AU procedures.
- Containers of HF may be hazardous when empty since they retain product residues.

References

1. Chemical Hygiene Plan, Cornell University, 5/25/05.
2. Hydrofluoric Acid Product Literature, Honeywell Inc.
3. Safety data sheet, Hydrofluoric Acid, 47-51%,ACC#11171, Fisher Scientific, 10/22/2007.
4. Safety data sheet, Hydrofluoric Acid #HF-0002, Honeywell, Inc., January 2004.
5. Woods Hole Oceanographic Institute Chemical Hygiene Plan, Hydrofluoric Acid - Safety Guideline, 6/27/05.
6. Recommended Medical Treatment for Hydrofluoric Acid Exposure Ver. 1.0, Honeywell Inc., May 2000.

Alfred University CHEMICAL HYGIENE PLAN
Appendix O - Perchloric Acid

Perchloric acid is a strong oxidizing acid that can react violently with organic materials. Perchloric acid can also explode if concentrated above 72%.

- For any work involving heated Perchloric Acid (such as in Perchloric Acid digestions), the work must be conducted in a special Perchloric Acid fume hood with a wash down function. If heated Perchloric Acid is used in a standard fume hood, the hot Perchloric Acid vapors can react with the metal in the hood ductwork to form shock sensitive metallic perchlorates.

As of September 2008, there are no approved Perchloric Acid hoods on campus.

- Due to the potential danger of Perchloric Acid, if possible, try to use alternate techniques that do not involve the use of Perchloric Acid. If you must use Perchloric Acid in your experiments, only purchase the smallest size container necessary

- Because Perchloric Acid is so reactive, it is also important to keep it stored separate from other chemicals, particularly organic solvents, organic acids, and oxidizers.

- Like all acids, but particularly with Perchloric Acid, secondary containment should be used for storage.

- All containers of Perchloric Acid should be inspected regularly for container integrity and the acid should be checked for discoloration. Discolored Perchloric Acid should be discarded as hazardous waste.

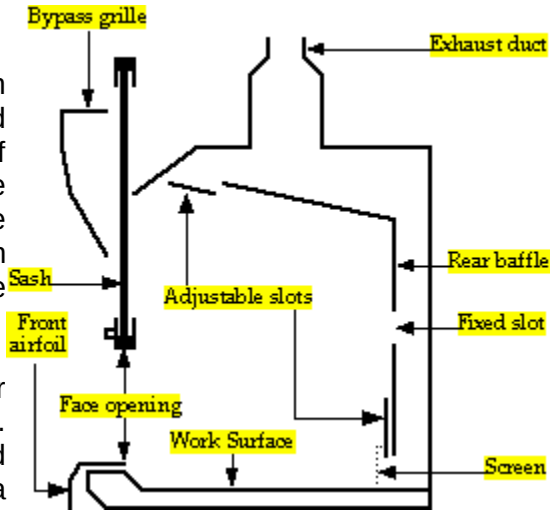
- When working with Perchloric Acid, be sure to remove all organic materials, such as solvents, from the immediate work area.

- Oxidizable substances must never be allowed to contact Perchloric Acid. This includes wooden bench tops or hood enclosures, which may become highly flammable after absorbing Perchloric Acid liquid or vapors, Beaker tongs, rather than rubber gloves, should be used when handling fuming Perchloric Acid.

Alfred University CHEMICAL HYGIENE PLAN
Appendix P - Chemical Fume Hoods and Other Local Ventilation Devices

The chemical fume hood is considered an important means of protection from hazardous chemical exposure. General room ventilation does not effectively protect laboratory personnel from inhalation of hazardous levels of chemical vapors, fumes and dusts. Therefore, laboratory personnel should/are required to use a chemical fume hood or other containment devices when working with potentially hazardous chemicals.
This appendix is intended to help laboratory workers understand the limitations and proper work practices for safely using fume hoods and other local ventilation devices.

- **How a Fume Hood Works**
  A fume hood is a ventilated enclosure in which gases, vapors and fumes are contained and diluted by an induced flow of air coming through the face of the hood. An exhaust fan situated on the top of the laboratory building pulls the air and airborne contaminants contained in the hood through ductwork and safely exhaust them to the atmosphere.



  The typical fume hood is equipped with an interior **baffle** and movable front **sash** (framed window). The sash travels the plane of the hood face and provides protection to the hood user by acting as a barrier between the worker and the experiment.

  The **slots** and **baffles** direct the air being exhausted. In many hoods, they may be adjusted to allow the most even flow. It is important that the baffles are not closed or blocked since this blocks the exhaust path.

  The **airfoil** or beveled frame around the hood face allows more even airflow into the hood by avoiding sharp curves that can create turbulence.

- **Fume Hood Operating Performance**

  - **Fume Hood Performance Checks**
    - Fume hoods are factory tested in accordance with ASHRAE/ANSI standard 110 before leaving the manufacturer to ensure proper performance and are installed according to manufacturer specifications.
      - AU Facilities perform preventative maintenance on fume hood motors, belts, controls, etc. on an annual basis. A maintenance record is kept at Heating Plant and NYSCC Maintenance.
    - EH&S will manage annual fume hood inspections for the following:
      - average face velocity of the hood and places a dated survey tag on hood,
        - places sash height markers at which the average face velocity is 80 fpm and 125 fpm,
      - air flow patterns and leakage using smoke test,
      - airflow direction indicators on hood sash, replaces indicator if missing,
      - 14 inch maximum height sash marker, replaces marker if missing,

    - spills, airflow blockage, disabled alarms and sash stops.
  - Laboratory personnel must evaluate hood before each use to:
    - verify airflow **into** the hood by making sure the airflow direction indicator is blowing **into** the hood. Also check any air monitoring device if the hood is equipped with one.
      - immediately report any malfunction to the LSF/PI or send a work order, requesting repair, to the proper facility.
      - place a dated "DO NOT USE" sign on the malfunctioning hood.
    - verify dated (within one year of current date) EH&S survey tag and sash markers are present.
      - if EH&S tag is missing or out of date or sash markers are missing – place a dated "DO NOT USE" sign on the malfunctioning hood and contact EH&S 2190.

- **Location**

  The location of the fume hood affects its efficiency. Ideally, fume hoods should be located in an area of minimal traffic. When a person walks by a fume hood, turbulence can be created causing contaminants to be drawn outside the hood. Also, if the air diffuser is located directly above the fume hood, air turbulence may be created causing contaminants to escape into the room. The air flow into the room has an effect on the fume hood. All doors should be closed to maintain the negative pressure of the lab with respect to the corridor. This ensures that any contaminants in the lab will be exhausted through the fume hood and not escape into the hallway.

- **Face velocity**

  The average velocity of the air drawn through the face of the hood is the face velocity. It is a measurement of containment efficiency.

  Face velocities that are either too low or too high reduce the containment efficiency of a fume hood placing the user at risk of exposure.

  Based on a number of studies and the recommendations of several laboratory safety guidance documents, the following face velocity criteria are recommended:

  - **Above 150** (fpm): Unacceptable for laboratory use.
  - **95-125** fpm: Provides adequate control of inhalation exposure to most hazardous substances, including radioactive materials and particularly hazardous substances☑.
  - **80-95** and **125-150** fpm: Adequate for manipulation of laboratory quantities of hazardous materials except radioactive materials and particularly hazardous substances.
  - **Below 80** fpm: Use approved by EHS on case by case basis, based on activities, placement of hood, smoke tests, etc.
    - Face velocity sensors and alarms

      Many of the newer hoods are equipped with sensors that will trigger an alarm if the face velocity falls below and acceptable work range. The alarm indicates:
      - the sash has been raised to a height at which the hood can no longer exhaust a sufficient amount of air,
      - the building air exhaust system is not working properly,
      - or there has been a power outage.
    - When a hood alarm sounds, no chemical work should be performed until the exhaust volume is increased.
      - Do not attempt to stop or disable hood alarms.
      - Place a dated "DO NOT USE" sign on the hood and send a work order to the proper university facility.

- **Sash position**
  - Do not work with hazardous chemicals with the sash positioned above the 14 inch mark.
  - For constant air volume hoods (CAV) without face velocity controls
    - sash must be properly positioned to produce the recommended face velocity, which often occurs only over a limited range of sash positions.
      - this range is determined and identified by markers placed by EH&S during fume hood testing.
      - keep sash closed when hood is not in use.
  - For hoods with face velocity controls
    - sash must be positioned at the height which registers the recommended face velocity on air flow meter.
    - it is imperative to keep the sash closed when the hood is not in use.
- **Air flow direction indicators**
  - A ribbon of light weight material such as tinsel, Teflon tape or Kim-wipe is taped to the bottom corner of the sash by EH&S during annual fume hood check. The indicator shows the direction of airflow, and is the only way to know for certain that air is being drawn **into** the hood. Sometimes the air flow is reversed by accident during maintenance.
  - Air flow indicators do not determine face velocity; they only indicate that air is being exhausted through the fume hood.
    - If inward movement is not detected, place a "DO NOT USE" sign on the hood and send a work order to the proper facility, AU Physical Plant☑ or NYSCC Maintenance☑.

- **Hood Types**

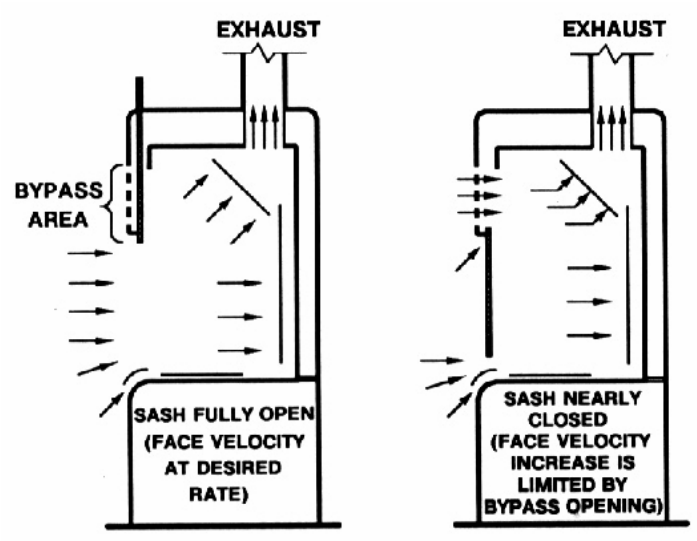
  There are many types of hoods, each with its own design and function. To identify which type of hood is present in your lab, a list of definitions describing hood features and their advantages and disadvantages is provided below.
  - **Constant air volume - Conventional hood**

    A constant air volume (CAV) hood is the traditional, older style, less elaborate hood design used for general protection of the lab worker. Because the amount of exhausted air is constant, the face velocity of a CAV hood is inversely proportional to the sash height. That is, the lower the sash, the higher the face velocity. CAV hoods can be installed with or without a bypass provision which is an additional opening for air supply into the hood.
    - **Conventional hood without a bypass**

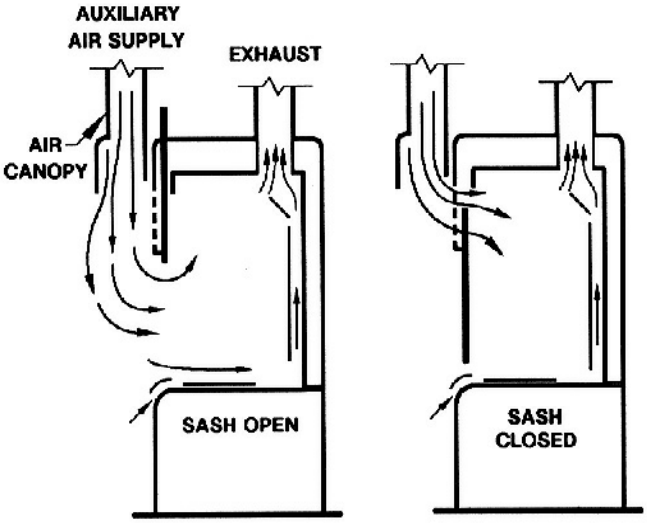
      Some conventional hoods do not have a provision for a bypass. They consist of an enclosed cabinet with a connection for an exhaust duct and a movable sash on the front.
    - **Conventional bypass fume hood**

      The bypass is located above the sash face opening and protected by a grille which helps to direct air flow. The bypass is intended to address the varying face velocities that create air turbulence leading to air spillage. The bypass limits the increase in face velocity as the sash nears the fully closed position, maintaining a relatively constant volume of exhaust air regardless of sash position.

CAV hoods



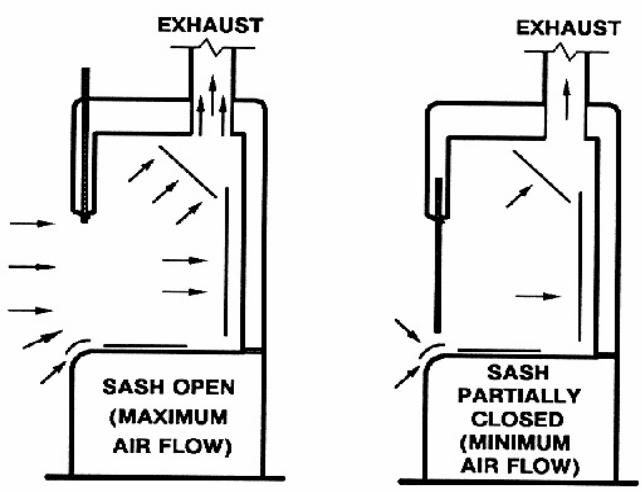
- **Auxiliary air hood**
  This type of fume hood, sometimes referred to as a makeup air fume hood, was developed as a variation on the bypass fume hood and reduces the amount of conditioned room air that is consumed. The auxiliary fume hood is a bypass hood with the addition of direct auxiliary air connection to provide unconditioned or partially conditioned outside makeup air. Auxiliary air hoods were designed to save heating and cooling energy costs, but tend to increase the mechanical and operational costs due to the additional ductwork, fans, and air tempering facilities. In general, installation of this type of hood is discouraged since the disadvantages usually outweigh the benefits.



- **Variable air volume (VAV) hood**
  A VAV hood maintains a constant face velocity regardless of sash position. VAV hoods are fitted with a face velocity control which varies the amount of air exhausted from the fume hood in response to the sash opening to maintain a constant face velocity. This control system significantly increases the hood's ability to protect against excess face velocity turbulence which leads to contaminated air spillage. VAV hoods reduce the total

quantity of supply and exhaust air to a space when not needed thereby reducing total operating costs.

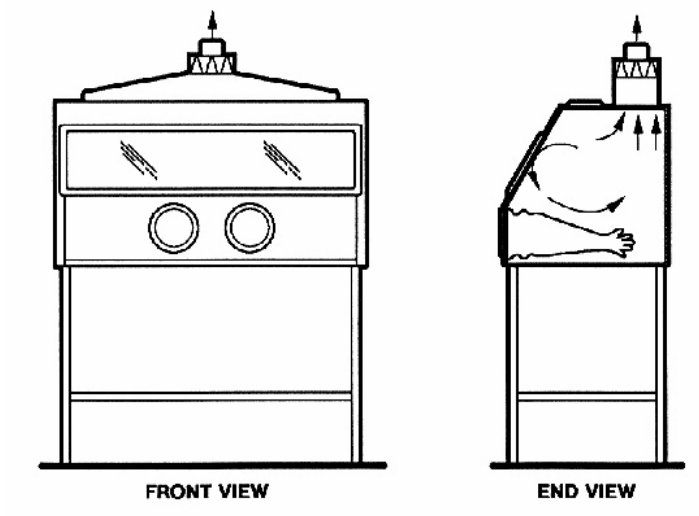
VAV hoods



- **Specialty Lab Exhaust Systems**
  - **Walk-in hoods**
    Walk-in hood sits directly on the floor and are characterized by a very tall and deep chamber that can accommodate large pieces of equipment. Walk-in hoods may be designed as conventional, bypass, auxiliary air, or VAV.
  - **Fume exhaust connections: "snorkels"**
    Fume exhaust duct connections, also called snorkels, elephant trunks or flex ducts, are designed to be somewhat mobile allowing the user to place it over the area needing ventilation. For optimal efficiency, these connections must be placed within six (6) inches of an experiment, process, or equipment. These funnel-shaped exhausts aid in the removal of contaminated or irritating air from the lab area to the outside.
  - **Canopy hoods**
    Canopy hoods are horizontal enclosures having an open central duct suspended above a work bench or other area. Canopy hoods are most often used to exhaust heat generated from an oven or an area that is too large to be enclosed within a fume hood. The major disadvantage with the canopy hood is that the contaminants are drawn directly past the user's breathing zone.
  - **Slot Hoods**
    There are many types of slot hoods, each suited for different types of operations. In general, a slot hood requires less airflow than a canopy hood and is much more effective than an elephant trunk or canopy hood, when installed properly.
    Slot hoods are best used for operations that require more working room than a fume hood and where a limited number of low toxicity chemicals are used. The placement of the opening(s) and the velocity of airflow are based on the application, particularly dependent upon the vapor density of the chemical(s).
    Examples of good uses for slot hoods are darkrooms and acid dipping operations.
  - **Downdraft Hoods**
    Downdraft hoods or downdraft tables are specially designed work areas with ventilation slots on the sides of the work area. This type of system is useful for animal perfusions and other uses of chemicals with vapor densities heavier than air.

- **Glove boxes**
  Glove boxes are used when the toxicity, radioactivity level, or oxygen reactivity of the substance pose too great a hazard for use within a fume hood. The major advantage of the glove box is protection for the worker and the product.

  Glovebox



- **Perchloric Acid and radioisotope fume hoods**
  Working with Perchloric Acid and/or volatile radioisotopes requires a specifically designed fume hood. Refer to Perchloric Acid Appendix O☑. Biology does have a hood approved for radioisotopes. As of September 2008, there is not a Perchloric Acid fume hood on campus.
- **Toxic Gas Cabinets**
  Highly toxic or odorous gases should be used and stored in gas cabinets. In the event of a leak or rupture, a gas cabinet will prevent the gas from contaminating the laboratory.
  Gas cabinets should be connected to laboratory exhaust ventilation using hard duct, rather than elephant tubing, since such tubing is more likely to develop leaks. Coaxial tubing should be used for delivering gas from the cylinder to the apparatus. Coaxial tubing consists of an internal tube containing the toxic gas, inside another tube. In between the two sets of tubing is nitrogen, which is maintained at a pressure higher than the delivery pressure of the toxic gas. This ensures that, in the event of a leak in the inner tubing, the gas will not leak into the room.
- **Flammable or corrosive material storage cabinets** may comprise the bottom supporting structure of the fume hood. They can be vented or non-vented enclosures used primarily for storage of flammable or corrosive materials. If vented, the storage cabinet must be connected to the hood exhaust. The corrosive storage cabinet is designed with a protective lining and secondary containment to inhibit chemical corrosion.

- **Safe Work Practices**
  The health and safety of laboratory personnel and building occupants is the primary goal of EH&S and laboratory management. Fume hoods, if installed and used properly, help achieve this goal by capturing harmful chemical vapors and airborne substances and exhausting them to the outside air.
  - To work safely with fume hoods:

- Follow proper procedures for working alone☑, unattended operations☑, and PHS☑.
- Know the hazards of the chemical and use work methods that help reduce exposure.
  - Substitute toxic chemicals with less hazardous materials whenever possible.
  - Perform all work at least six inches inside the hood.
  - Keep the hood sash as low as possible within the proper face velocity range.
  - Users face should never break the plane of the sash opening; view the procedure through the glass. Position the sash so that work is performed by extending the arms under the sash, keeping the glass between the worker and the chemical source.
- Do not move or remove sash markers.
- Do not override or disable sash stops or air monitoring alarms.
- Have a general awareness of the operation of your hood and be aware of any differences in visual or audible cues that may imply a change in function.
  - Keep lab doors closed to ensure negative room pressure to the corridor and proper air flow into the hood.
  - Keep the slots of the baffle free of obstruction.
  - Run cords and hoses underneath the airfoil.
  - Place equipment on 2 inch blocks to minimize turbulence and allow for proper air flow to the baffle.
  - Avoid rapid movements in front of the hood including opening and closing the sash rapidly and swift arm and body movements in front of or inside the hood. These actions may increase turbulence and reduce the effectiveness of fume hood containment.
- **A fume hood is <u>not</u> a storage area. Only equipment and chemicals being used in an ongoing experiment should be in the hood.**
- Keep sash closed when not in use to minimize energy usage.
- In the event of a hood failure during chemical use:
  - Turn off power to equipment in the hood.
  - Stabilize the chemical source as much as possible to minimize release.
  - Close hood sash.
  - Post a dated sign stating “hood failure, experiment in progress” to notify other occupants of the laboratory.
  - Notify the LSF/PI and/or send a work order to AU Physical Plant or NYSCC Maintenance.
  - If hazardous chemicals are released from the hood in a quantity that presents a fire hazard or high health hazard, evacuate the area and call for emergency assistance. If the released material presents a lower risk scenario (no fire hazard and/or lower health hazard), call EH&S.

- **Common Misuses and Limitations**

  Used appropriately, a fume hood can be a very effective device for containment hazardous materials, as well as providing some protection from splashes and minor explosions. Even so, the average fume hood does have several limitations.
  - **Particulates:** A fume hood is not designed to contain high velocity releases of particulate contaminants unless the sash is fully closed.
  - **Pressurized systems:** Gases or vapors escaping from pressurized systems may move at sufficient velocity to escape from the fume hood.
  - **Explosions:** A standard chemical fume hood is not capable of completely containing explosions, even when the sash is fully closed. If an explosion hazard exists, the user should provide anchored barriers, shields or enclosures of sufficient strength to deflect or contain it. Such barriers can significantly affect the airflow in the hood.

- **Perchloric Acid:** A conventional fume hood must not be used for Perchloric Acid. Perchloric Acid vapors can settle on ductwork, resulting in the deposition of perchlorate crystals. Perchlorates can accumulate on surfaces and have been known to detonate on contact, causing serious injury to researchers and maintenance personnel. Specialized perchloric acid hoods, made of stainless steel and equipped with a washdown system must be used for such work. As of September 2008, there is not a Perchloric Acid fume hood on campus.
- **Tubing for Exhaust:** Tubing is frequently used to channel exhaust to the hood from equipment located some distance away. This is not an effective control method.
- **Connections to the Exhaust System:** Occasionally, lab personnel may need local exhaust ventilation other than that provided by an existing fume hood. A new exhaust device/unit may not be connected to an existing fume hood without the explicit approval of the Physical Plant or NYSCC Maintenance facilities and EH&S. Adding even the simplest exhaust unit, without adequate evaluation and adjustment, will usually result in decreased performance of the existing hood and/or inadequate performance of the additional unit.
- **Microorganisms:** Do not use a chemical fume hood for work involving harmful microorganisms. See the AU Biosafety Manual (pending) for more information.
- **Highly Hazardous Substances:** A well designed fume hood will contain 0.999 - 0.9999% of the contaminants released within it when used properly. When working with highly dangerous substances needing more containment than a fume hood offers, consider using a glove box.
- **Pollution Control:** An unfiltered fume hood is not a pollution control device. All contaminants that are removed by the ventilating system are released directly into the atmosphere. Apparatus used in hoods should be fitted with condensers, traps or scrubbers to contain and collect waste solvents or toxic vapors or dusts.
- **Waste Disposal:** A fume hood should not be used for waste disposal. It is a violation of environmental regulations to intentionally send waste up the hood stack.

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ALFRED UNIVERSITY CHEMICAL HYGIENE PLAN
Appendix Q - Particularly Hazardous Substances

This list is not exhaustive. Please refer to the chemical SDS to determine whether a chemical is a carc

Hazardous waste No.	Chemical abstracts No.	Substance
P023	107-20-0	Acetaldehyde, chloro-
P002	591-08-2	Acetamide, N-(aminothioxomethyl)-
P057	640-19-7	Acetamide, 2-fluoro-
P058	62-74-8	Acetic acid, fluoro-, sodium salt
P002	591-08-2	1-Acetyl-2-thiourea
P003	107-02-8	Acrolein
P070	116-06-3	Aldicarb
P203	1646-88-4	Aldicarb sulfone.
P004	309-00-2	Aldrin
P005	107-18-6	Allyl alcohol
P006	20859-73-8	Aluminum phosphide (R,T)
P007	2763-96-4	5-(Aminomethyl)-3-isoxazolol
P008	504-24-5	4-Aminopyridine
P009	131-74-8	Ammonium picrate (R)
P119	7803-55-6	Ammonium vanadate
P099	506-61-6	Argentate(1-), bis(cyano-C)-, potassium
P010	7778-39-4	Arsenic acid H_3 AsO_4
P012	1327-53-3	Arsenic oxide As_2 O_3
P011	1303-28-2	Arsenic oxide As_2 O_5
P011	1303-28-2	Arsenic pentoxide
P012	1327-53-3	Arsenic trioxide
P038	692-42-2	Arsine, diethyl-
P036	696-28-6	Arsonous dichloride, phenyl-
P054	151-56-4	Aziridine
P067	75-55-8	Aziridine, 2-methyl-
P013	542-62-1	Barium cyanide
P024	106-47-8	Benzenamine, 4-chloro-
P077	100-01-6	Benzenamine, 4-nitro-
P028	100-44-7	Benzene, (chloromethyl)-
P042	51-43-4	1,2-Benzenediol, 4-[1-hydroxy-2-(methylamino)ethyl]-, (R)-

P046	122-09-8	Benzeneethanamine, alpha,alpha-dimethyl-
P014	108-98-5	Benzenethiol
P127	1563-66-2	7-Benzofuranol, 2,3-dihydro-2,2-dimethyl-, methylcarbamate.
P188	57-64-7	Benzoic acid, 2-hydroxy-, compd. with (3aS-cis)-1,2,3,3a,8,8a-hexahydro-1,3a,8-trimethylpyrrolo[2,3-b]indol-5-yl methylcarbamate ester (1:1).
P001	[1]81-81-2	2H-1-Benzopyran-2-one, 4-hydroxy-3-(3-oxo-1-phenylbutyl)-, & salts, when present at concentrations greater than 0.3%
P028	100-44-7	Benzyl chloride
P015	7440-41-7	Beryllium powder
P017	598-31-2	Bromoacetone
P018	357-57-3	Brucine
P045	39196-18-4	2-Butanone, 3,3-dimethyl-1-(methylthio)-, O-[(methylamino)carbonyl] oxime
P021	592-01-8	Calcium cyanide
P021	592-01-8	Calcium cyanide $Ca(CN)_2$
P189	55285-14-8	Carbamic acid, [(dibutylamino)- thio]methyl-, 2,3-dihydro-2,2-dimethyl- 7-benzofuranyl ester.
P191	644-64-4	Carbamic acid, dimethyl-, 1-[(dimethyl-amino)carbonyl]- 5-methyl-1H- pyrazol-3-yl ester.
P192	119-38-0	Carbamic acid, dimethyl-, 3-methyl-1- (1-methylethyl)-1H- pyrazol-5-yl ester.
P190	1129-41-5	Carbamic acid, methyl-, 3-methylphenyl ester.
P127	1563-66-2	Carbofuran.
P022	75-15-0	Carbon disulfide
P095	75-44-5	Carbonic dichloride
P189	55285-14-8	Carbosulfan.
P023	107-20-0	Chloroacetaldehyde
P024	106-47-8	p-Chloroaniline
P026	5344-82-1	1-(o-Chlorophenyl)thiourea

P027	542-76-7	3-Chloropropionitrile
P029	544-92-3	Copper cyanide
P029	544-92-3	Copper cyanide Cu(CN)
P202	64-00-6	m-Cumenyl methylcarbamate.
P030		Cyanides (soluble cyanide salts), not otherwise specified
P031	460-19-5	Cyanogen
P033	506-77-4	Cyanogen chloride
P033	506-77-4	Cyanogen chloride (CN)Cl
P034	131-89-5	2-Cyclohexyl-4,6-dinitrophenol
P016	542-88-1	Dichloromethyl ether
P036	696-28-6	Dichlorophenylarsine
P037	60-57-1	Dieldrin
P038	692-42-2	Diethylarsine
P041	311-45-5	Diethyl-p-nitrophenyl phosphate
P040	297-97-2	O,O-Diethyl O-pyrazinyl phosphorothioate
P043	55-91-4	Diisopropylfluorophosphate (DFP)
P004	309-00-2	1,4,5,8-Dimethanonaphthalene, 1,2,3,4,10,10-hexa-chloro-1,4,4a,5,8,8a,-hexahydro-, (1alpha,4alpha,4abeta,5alpha,8alpha,8abeta)-
P060	465-73-6	1,4,5,8-Dimethanonaphthalene, 1,2,3,4,10,10-hexa-chloro-1,4,4a,5,8,8a-hexahydro-, (1alpha,4alpha,4abeta,5beta,8beta,8abeta)-
P037	60-57-1	2,7:3,6-Dimethanonaphth[2,3-b]oxirene, 3,4,5,6,9,9-hexachloro-1a,2,2a,3,6,6a,7,7a-octahydro-, (1aalpha,2beta,2aalpha,3beta,6beta,6aalpha,7beta, 7aalpha)-
P051	[1]72-20-8	2,7:3,6-Dimethanonaphth [2,3-b]oxirene, 3,4,5,6,9,9-hexachloro-1a,2,2a,3,6,6a,7,7a-octahydro-, (1aalpha,2beta,2abeta,3alpha,6alpha,6abeta,7beta, 7aalpha)-, & metabolites
P044	60-51-5	Dimethoate
P046	122-09-8	alpha,alpha-Dimethylphenethylamine

P191	644-64-4	Dimetilan.
P047	[1]534-52-1	4,6-Dinitro-o-cresol, & salts
P048	51-28-5	2,4-Dinitrophenol
P020	88-85-7	Dinoseb
P085	152-16-9	Diphosphoramide, octamethyl-
P111	107-49-3	Diphosphoric acid, tetraethyl ester
P039	298-04-4	Disulfoton
P049	541-53-7	Dithiobiuret
P185	26419-73-8	1,3-Dithiolane-2-carboxaldehyde, 2,4-dimethyl-, O-[(methylamino)- carbonyl]oxime.
P050	115-29-7	Endosulfan
P088	145-73-3	Endothall
P051	72-20-8	Endrin
P051	72-20-8	Endrin, & metabolites
P042	51-43-4	Epinephrine
P031	460-19-5	Ethanedinitrile
P194	23135-22-0	Ethanimidothioic acid, 2-(dimethylamino)-N-[[(methylamino) carbonyl]oxy]-2-oxo-, methyl ester.
P066	16752-77-5	Ethanimidothioic acid, N-[[(methylamino)carbonyl]oxy]-, methyl ester
P101	107-12-0	Ethyl cyanide
P054	151-56-4	Ethyleneimine
P097	52-85-7	Famphur
P056	7782-41-4	Fluorine
P057	640-19-7	Fluoroacetamide
P058	62-74-8	Fluoroacetic acid, sodium salt
P198	23422-53-9	Formetanate hydrochloride.
P197	17702-57-7	Formparanate.
P065	628-86-4	Fulminic acid, mercury(2 +) salt (R,T)
P059	76-44-8	Heptachlor
P062	757-58-4	Hexaethyl tetraphosphate
P116	79-19-6	Hydrazinecarbothioamide
P068	60-34-4	Hydrazine, methyl-
P063	74-90-8	Hydrocyanic acid
P063	74-90-8	Hydrogen cyanide

P096	7803-51-2	Hydrogen phosphide
P060	465-73-6	Isodrin
P192	119-38-0	Isolan.
P202	64-00-6	3-Isopropylphenyl N-methylcarbamate.
P007	2763-96-4	3(2H)-Isoxazolone, 5-(aminomethyl)-
P196	15339-36-3	Manganese, bis(dimethylcarbamodithioato-S,S′)-,
P196	15339-36-3	Manganese dimethyldithiocarbamate.
P092	62-38-4	Mercury, (acetato-O)phenyl-
P065	628-86-4	Mercury fulminate (R,T)
P082	62-75-9	Methanamine, N-methyl-N-nitroso-
P064	624-83-9	Methane, isocyanato-
P016	542-88-1	Methane, oxybis[chloro-
P112	509-14-8	Methane, tetranitro- (R)
P118	75-70-7	Methanethiol, trichloro-
P198	23422-53-9	Methanimidamide, N,N-dimethyl-N′-[3-[[(methylamino)-carbonyl]oxy]phenyl]-, monohydrochloride.
P197	17702-57-7	Methanimidamide, N,N-dimethyl-N′-[2-methyl-4-[[(methylamino)carbonyl]oxy]phenyl]-
P050	115-29-7	6,9-Methano-2,4,3-benzodioxathiepin, 6,7,8,9,10,10- hexachloro-1,5,5a,6,9,9a-hexahydro-, 3-oxide
P059	76-44-8	4,7-Methano-1H-indene, 1,4,5,6,7,8,8-heptachloro- 3a,4,7,7a-tetrahydro-
P199	2032-65-7	Methiocarb.
P066	16752-77-5	Methomyl
P068	60-34-4	Methyl hydrazine
P064	624-83-9	Methyl isocyanate
P069	75-86-5	2-Methyllactonitrile
P071	298-00-0	Methyl parathion
P190	1129-41-5	Metolcarb.
P128	315-8-4	Mexacarbate.
P072	86-88-4	alpha-Naphthylthiourea
P073	13463-39-3	Nickel carbonyl
P073	13463-39-3	Nickel carbonyl $Ni(CO)_4$, (T-4)-

P074	557-19-7	Nickel cyanide
P074	557-19-7	Nickel cyanide $Ni(CN)_2$
P075	[1]54-11-5	Nicotine, & salts
P076	10102-43-9	Nitric oxide
P077	100-01-6	p-Nitroaniline
P078	10102-44-0	Nitrogen dioxide
P076	10102-43-9	Nitrogen oxide NO
P078	10102-44-0	Nitrogen oxide NO_2
P081	55-63-0	Nitroglycerine (R)
P082	62-75-9	N-Nitrosodimethylamine
P084	4549-40-0	N-Nitrosomethylvinylamine
P085	152-16-9	Octamethylpyrophosphoramide
P087	20816-12-0	Osmium oxide OsO_4, (T-4)-
P087	20816-12-0	Osmium tetroxide
P088	145-73-3	7-Oxabicyclo[2.2.1]heptane-2,3-dicarboxylic acid
P194	23135-22-0	Oxamyl.
P089	56-38-2	Parathion
P034	131-89-5	Phenol, 2-cyclohexyl-4,6-dinitro-
P048	51-28-5	Phenol, 2,4-dinitro-
P047	[1]534-52-1	Phenol, 2-methyl-4,6-dinitro-, & salts
P020	88-85-7	Phenol, 2-(1-methylpropyl)-4,6-dinitro-
P009	131-74-8	Phenol, 2,4,6-trinitro-, ammonium salt (R)
P128	315-18-4	Phenol, 4-(dimethylamino)-3,5-dimethyl-, methylcarbamate (ester).
P199	2032-65-7	Phenol, (3,5-dimethyl-4-(methylthio)-, methylcarbamate
P202	64-00-6	Phenol, 3-(1-methylethyl)-, methyl carbamate.
P201	2631-37-0	Phenol, 3-methyl-5-(1-methylethyl)-, methyl carbamate.
P092	62-38-4	Phenylmercury acetate
P093	103-85-5	Phenylthiourea
P094	298-02-2	Phorate
P095	75-44-5	Phosgene
P096	7803-51-2	Phosphine
P041	311-45-5	Phosphoric acid, diethyl 4-nitrophenyl ester

P039	298-04-4	Phosphorodithioic acid, O,O-diethyl S-[2-(ethylthio)ethyl] ester
P094	298-02-2	Phosphorodithioic acid, O,O-diethyl S-[(ethylthio)methyl] ester
P044	60-51-5	Phosphorodithioic acid, O,O-dimethyl S-[2-(methylamino)-2-oxoethyl] ester
P043	55-91-4	Phosphorofluoridic acid, bis(1-methylethyl) ester
P089	56-38-2	Phosphorothioic acid, O,O-diethyl O-(4-nitrophenyl) ester
P040	297-97-2	Phosphorothioic acid, O,O-diethyl O-pyrazinyl ester
P097	52-85-7	Phosphorothioic acid, O-[4-[(dimethylamino)sulfonyl]phenyl] O,O-dimethyl ester
P071	298-00-0	Phosphorothioic acid, O,O,-dimethyl O-(4-nitrophenyl) ester
P204	57-47-6	Physostigmine.
P188	57-64-7	Physostigmine salicylate.
P110	78-00-2	Plumbane, tetraethyl-
P098	151-50-8	Potassium cyanide
P098	151-50-8	Potassium cyanide K(CN)
P099	506-61-6	Potassium silver cyanide
P201	2631-37-0	Promecarb
P070	116-06-3	Propanal, 2-methyl-2-(methylthio)-, O-[(methylamino)carbonyl]oxime
P203	1646-88-4	Propanal, 2-methyl-2-(methyl-sulfonyl)-, O-[(methylamino)carbonyl] oxime.
P101	107-12-0	Propanenitrile
P027	542-76-7	Propanenitrile, 3-chloro-
P069	75-86-5	Propanenitrile, 2-hydroxy-2-methyl-
P081	55-63-0	1,2,3-Propanetriol, trinitrate (R)
P017	598-31-2	2-Propanone, 1-bromo-
P102	107-19-7	Propargyl alcohol
P003	107-02-8	2-Propenal
P005	107-18-6	2-Propen-1-ol
P067	75-55-8	1,2-Propylenimine
P102	107-19-7	2-Propyn-1-ol

P008	504-24-5	4-Pyridinamine
P075	[1]54-11-5	Pyridine, 3-(1-methyl-2-pyrrolidinyl)-, (S)-, & salts
P204	57-47-6	Pyrrolo[2,3-b]indol-5-ol, 1,2,3,3a,8,8a-hexahydro-1,3a,8-trimethyl-, methylcarbamate (ester), (3aS-cis)-.
P114	12039-52-0	Selenious acid, dithallium(1 +) salt
P103	630-10-4	Selenourea
P104	506-64-9	Silver cyanide
P104	506-64-9	Silver cyanide Ag(CN)
P105	26628-22-8	Sodium azide
P106	143-33-9	Sodium cyanide
P106	143-33-9	Sodium cyanide Na(CN)
P108	[1]57-24-9	Strychnidin-10-one, & salts
P018	357-57-3	Strychnidin-10-one, 2,3-dimethoxy-
P108	[1]57-24-9	Strychnine, & salts
P115	7446-18-6	Sulfuric acid, dithallium(1 +) salt
P109	3689-24-5	Tetraethyldithiopyrophosphate
P110	78-00-2	Tetraethyl lead
P111	107-49-3	Tetraethyl pyrophosphate
P112	509-14-8	Tetranitromethane (R)
P062	757-58-4	Tetraphosphoric acid, hexaethyl ester
P113	1314-32-5	Thallic oxide
P113	1314-32-5	Thallium oxide $Tl_2 O_3$
P114	12039-52-0	Thallium(I) selenite
P115	7446-18-6	Thallium(I) sulfate
P109	3689-24-5	Thiodiphosphoric acid, tetraethyl ester
P045	39196-18-4	Thiofanox
P049	541-53-7	Thioimidodicarbonic diamide $[(H_2 N)C(S)]_2 NH$
P014	108-98-5	Thiophenol
P116	79-19-6	Thiosemicarbazide
P026	5344-82-1	Thiourea, (2-chlorophenyl)-
P072	86-88-4	Thiourea, 1-naphthalenyl-
P093	103-85-5	Thiourea, phenyl-
P185	26419-73-8	Tirpate.
P123	8001-35-2	Toxaphene

P118	75-70-7	Trichloromethanethiol
P119	7803-55-6	Vanadic acid, ammonium salt
P120	1314-62-1	Vanadium oxide $V_2 O_5$
P120	1314-62-1	Vanadium pentoxide
P084	4549-40-0	Vinylamine, N-methyl-N-nitroso-
P001	[1]81-81-2	Warfarin, & salts, when present at concentrations greater than 0.3%
P205	137-30-4	Zinc, bis(dimethylcarbamodithioato-S,S′)-,
P121	557-21-1	Zinc cyanide
P121	557-21-1	Zinc cyanide $Zn(CN)_2$
P122	1314-84-7	Zinc phosphide $Zn_3 P_2$, when present at concentrations greater than 10% (R,T)
P205	137-30-4	Ziram.
P001	[1]81-81-2	2H-1-Benzopyran-2-one, 4-hydroxy-3-(3-oxo-1-phenylbutyl)-, & salts, when present at concentrations greater than 0.3%
P001	[1]81-81-2	Warfarin, & salts, when present at concentrations greater than 0.3%
P002	591-08-2	Acetamide, -(aminothioxomethyl)-
P002	591-08-2	1-Acetyl-2-thiourea
P003	107-02-8	Acrolein
P003	107-02-8	2-Propenal
P004	309-00-2	Aldrin
P004	309-00-2	1,4,5,8-Dimethanonaphthalene, 1,2,3,4,10,10-hexa-chloro-1,4,4a,5,8,8a,-hexahydro-, (1alpha,4alpha,4abeta,5alpha,8alpha,8abeta)-
P005	107-18-6	Allyl alcohol
P005	107-18-6	2-Propen-1-ol
P006	20859-73-8	Aluminum phosphide (R,T)
P007	2763-96-4	5-(Aminomethyl)-3-isoxazolol
P007	2763-96-4	3(2H)-Isoxazolone, 5-(aminomethyl)-
P008	504-24-5	4-Aminopyridine
P008	504-24-5	4-Pyridinamine
P009	131-74-8	Ammonium picrate (R)

P009	131-74-8	Phenol, 2,4,6-trinitro-, ammonium salt (R)
P010	7778-39-4	Arsenic acid H_3 AsO_4
P011	1303-28-2	Arsenic oxide As_2 O_5
P011	1303-28-2	Arsenic pentoxide
P012	1327-53-3	Arsenic oxide As_2 O_3
P012	1327-53-3	Arsenic trioxide
P013	542-62-1	Barium cyanide
P014	108-98-5	Benzenethiol
P014	108-98-5	Thiophenol
P015	7440-41-7	Beryllium powder
P016	542-88-1	Dichloromethyl ether
P016	542-88-1	Methane, oxybis[chloro-
P017	598-31-2	Bromoacetone
P017	598-31-2	2-Propanone, 1-bromo-
P018	357-57-3	Brucine
P018	357-57-3	Strychnidin-10-one, 2,3-dimethoxy-
P020	88-85-7	Dinoseb
P020	88-85-7	Phenol, 2-(1-methylpropyl)-4,6-dinitro-
P021	592-01-8	Calcium cyanide
P021	592-01-8	Calcium cyanide $Ca(CN)_2$
P022	75-15-0	Carbon disulfide
P023	107-20-0	Acetaldehyde, chloro-
P023	107-20-0	Chloroacetaldehyde
P024	106-47-8	Benzenamine, 4-chloro-
P024	106-47-8	p-Chloroaniline
P026	5344-82-1	1-(o-Chlorophenyl)thiourea
P026	5344-82-1	Thiourea, (2-chlorophenyl)-
P027	542-76-7	3-Chloropropionitrile
P027	542-76-7	Propanenitrile, 3-chloro-
P028	100-44-7	Benzene, (chloromethyl)-
P028	100-44-7	Benzyl chloride
P029	544-92-3	Copper cyanide
P029	544-92-3	Copper cyanide Cu(CN)
P030		Cyanides (soluble cyanide salts), not otherwise specified
P031	460-19-5	Cyanogen
P031	460-19-5	Ethanedinitrile

P033	506-77-4	Cyanogen chloride
P033	506-77-4	Cyanogen chloride (CN)Cl
P034	131-89-5	2-Cyclohexyl-4,6-dinitrophenol
P034	131-89-5	Phenol, 2-cyclohexyl-4,6-dinitro-
P036	696-28-6	Arsonous dichloride, phenyl-
P036	696-28-6	Dichlorophenylarsine
P037	60-57-1	Dieldrin
P037	60-57-1	2,7:3,6-Dimethanonaphth[2,3-b]oxirene, 3,4,5,6,9,9-hexachloro-1a,2,2a,3,6,6a,7,7a-octahydro-, (1aalpha,2beta,2aalpha,3beta,6beta,6aalpha,7beta, 7aalpha)-
P038	692-42-2	Arsine, diethyl-
P038	692-42-2	Diethylarsine
P039	298-04-4	Disulfoton
P039	298-04-4	Phosphorodithioic acid, O,O-diethyl S-[2-(ethylthio)ethyl] ester
P040	297-97-2	O,O-Diethyl O-pyrazinyl phosphorothioate
P040	297-97-2	Phosphorothioic acid, O,O-diethyl O-pyrazinyl ester
P041	311-45-5	Diethyl-p-nitrophenyl phosphate
P041	311-45-5	Phosphoric acid, diethyl 4-nitrophenyl ester
P042	51-43-4	1,2-Benzenediol, 4-[1-hydroxy-2-(methylamino)ethyl]-, (R)-
P042	51-43-4	Epinephrine
P043	55-91-4	Diisopropylfluorophosphate (DFP)
P043	55-91-4	Phosphorofluoridic acid, bis(1-methylethyl) ester
P044	60-51-5	Dimethoate
P044	60-51-5	Phosphorodithioic acid, O,O-dimethyl S-[2-(methyl amino)-2-oxoethyl] ester
P045	39196-18-4	2-Butanone, 3,3-dimethyl-1-(methylthio)-, O-[(methylamino)carbonyl] oxime
P045	39196-18-4	Thiofanox
P046	122-09-8	Benzeneethanamine, alpha,alpha-dimethyl-
P046	122-09-8	alpha,alpha-Dimethylphenethylamine
P047	[1]534-52-1	4,6-Dinitro-o-cresol, & salts

P047	[1]534-52-1	Phenol, 2-methyl-4,6-dinitro-, & salts
P048	51-28-5	2,4-Dinitrophenol
P048	51-28-5	Phenol, 2,4-dinitro-
P049	541-53-7	Dithiobiuret
P049	541-53-7	Thioimidodicarbonic diamide $[(H_2 N)C(S)]_2$ NH
P050	115-29-7	Endosulfan
P050	115-29-7	6,9-Methano-2,4,3-benzodioxathiepin, 6,7,8,9,10,10-hexachloro-1,5,5a,6,9,9a-hexahydro-, 3-oxide
P051	[1]72-20-8	2,7:3,6-Dimethanonaphth [2,3-b]oxirene, 3,4,5,6,9,9-hexachloro-1a,2,2a,3,6,6a,7,7a-octahydro-, (1aalpha,2beta,2abeta,3alpha,6alpha,6abeta,7beta, 7aalpha)-, & metabolites
P051	72-20-8	Endrin
P051	72-20-8	Endrin, & metabolites
P054	151-56-4	Aziridine
P054	151-56-4	Ethyleneimine
P056	7782-41-4	Fluorine
P057	640-19-7	Acetamide, 2-fluoro-
P057	640-19-7	Fluoroacetamide
P058	62-74-8	Acetic acid, fluoro-, sodium salt
P058	62-74-8	Fluoroacetic acid, sodium salt
P059	76-44-8	Heptachlor
P059	76-44-8	4,7-Methano-1H-indene, 1,4,5,6,7,8,8-heptachloro-3a,4,7,7a-tetrahydro-
P060	465-73-6	1,4,5,8-Dimethanonaphthalene, 1,2,3,4,10,10-hexa-chloro-1,4,4a,5,8,8a-hexahydro-, (1alpha,4alpha,4abeta,5beta,8beta,8abeta)-
P060	465-73-6	Isodrin
P062	757-58-4	Hexaethyl tetraphosphate
P062	757-58-4	Tetraphosphoric acid, hexaethyl ester
P063	74-90-8	Hydrocyanic acid
P063	74-90-8	Hydrogen cyanide
P064	624-83-9	Methane, isocyanato-
P064	624-83-9	Methyl isocyanate

P065	628-86-4	Fulminic acid, mercury(2 +) salt (R,T)
P065	628-86-4	Mercury fulminate (R,T)
P066	16752-77-5	Ethanimidothioic acid, N-[[(methylamino)carbonyl]oxy]-, methyl ester
P066	16752-77-5	Methomyl
P067	75-55-8	Aziridine, 2-methyl-
P067	75-55-8	1,2-Propylenimine
P068	60-34-4	Hydrazine, methyl-
P068	60-34-4	Methyl hydrazine
P069	75-86-5	2-Methyllactonitrile
P069	75-86-5	Propanenitrile, 2-hydroxy-2-methyl-
P070	116-06-3	Aldicarb
P070	116-06-3	Propanal, 2-methyl-2-(methylthio)-, O-[(methylamino)carbonyl]oxime
P071	298-00-0	Methyl parathion
P071	298-00-0	Phosphorothioic acid, O,O,-dimethyl O-(4-nitrophenyl) ester
P072	86-88-4	alpha-Naphthylthiourea
P072	86-88-4	Thiourea, 1-naphthalenyl-
P073	13463-39-3	Nickel carbonyl
P073	13463-39-3	Nickel carbonyl $Ni(CO)_4$, (T-4)-
P074	557-19-7	Nickel cyanide
P074	557-19-7	Nickel cyanide $Ni(CN)_2$
P075	[1]54-11-5	Nicotine, & salts
P075	[1]54-11-5	Pyridine, 3-(1-methyl-2-pyrrolidinyl)-, (S)-, & salts
P076	10102-43-9	Nitric oxide
P076	10102-43-9	Nitrogen oxide NO
P077	100-01-6	Benzenamine, 4-nitro-
P077	100-01-6	p-Nitroaniline
P078	10102-44-0	Nitrogen dioxide
P078	10102-44-0	Nitrogen oxide NO_2
P081	55-63-0	Nitroglycerine (R)
P081	55-63-0	1,2,3-Propanetriol, trinitrate (R)
P082	62-75-9	Methanamine, -methyl-N-nitroso-
P082	62-75-9	N-Nitrosodimethylamine
P084	4549-40-0	N-Nitrosomethylvinylamine

P084	4549-40-0	Vinylamine, -methyl-N-nitroso-
P085	152-16-9	Diphosphoramide, octamethyl-
P085	152-16-9	Octamethylpyrophosphoramide
P087	20816-12-0	Osmium oxide OsO_4, (T-4)-
P087	20816-12-0	Osmium tetroxide
P088	145-73-3	Endothall
P088	145-73-3	7-Oxabicyclo[2.2.1]heptane-2,3-dicarboxylic acid
P089	56-38-2	Parathion
P089	56-38-2	Phosphorothioic acid, O,O-diethyl O-(4-nitrophenyl) ester
P092	62-38-4	Mercury, (acetato-O)phenyl-
P092	62-38-4	Phenylmercury acetate
P093	103-85-5	Phenylthiourea
P093	103-85-5	Thiourea, phenyl-
P094	298-02-2	Phorate
P094	298-02-2	Phosphorodithioic acid, O,O-diethyl S-[(ethylthio)methyl] ester
P095	75-44-5	Carbonic dichloride
P095	75-44-5	Phosgene
P096	7803-51-2	Hydrogen phosphide
P096	7803-51-2	Phosphine
P097	52-85-7	Famphur
P097	52-85-7	Phosphorothioic acid, O-[4-[(dimethylamino)sulfonyl]phenyl] O,O-dimethyl ester
P098	151-50-8	Potassium cyanide
P098	151-50-8	Potassium cyanide K(CN)
P099	506-61-6	Argentate(1-), bis(cyano-C)-, potassium
P099	506-61-6	Potassium silver cyanide
P101	107-12-0	Ethyl cyanide
P101	107-12-0	Propanenitrile
P102	107-19-7	Propargyl alcohol
P102	107-19-7	2-Propyn-1-ol
P103	630-10-4	Selenourea
P104	506-64-9	Silver cyanide
P104	506-64-9	Silver cyanide Ag(CN)
P105	26628-22-8	Sodium azide

P106	143-33-9	Sodium cyanide
P106	143-33-9	Sodium cyanide Na(CN)
P108	[1]157-24-9	Strychnidin-10-one, & salts
P108	[1]157-24-9	Strychnine, & salts
P109	3689-24-5	Tetraethyldithiopyrophosphate
P109	3689-24-5	Thiodiphosphoric acid, tetraethyl ester
P110	78-00-2	Plumbane, tetraethyl-
P110	78-00-2	Tetraethyl lead
P111	107-49-3	Diphosphoric acid, tetraethyl ester
P111	107-49-3	Tetraethyl pyrophosphate
P112	509-14-8	Methane, tetranitro-(R)
P112	509-14-8	Tetranitromethane (R)
P113	1314-32-5	Thallic oxide
P113	1314-32-5	Thallium oxide $Tl_2 O_3$
P114	12039-52-0	Selenious acid, dithallium(1 +) salt
P114	12039-52-0	Tetraethyldithiopyrophosphate
P115	7446-18-6	Thiodiphosphoric acid, tetraethyl ester
P115	7446-18-6	Plumbane, tetraethyl-
P116	79-19-6	Tetraethyl lead
P116	79-19-6	Thiosemicarbazide
P118	75-70-7	Methanethiol, trichloro-
P118	75-70-7	Trichloromethanethiol
P119	7803-55-6	Ammonium vanadate
P119	7803-55-6	Vanadic acid, ammonium salt
P120	1314-62-1	Vanadium oxide V_2O_5
P120	1314-62-1	Vanadium pentoxide
P121	557-21-1	Zinc cyanide
P121	557-21-1	Zinc cyanide $Zn(CN)_2$
P122	1314-84-7	Zinc phosphide $Zn_3 P_2$, when present at concentrations greater than 10% (R,T)
P123	8001-35-2	Toxaphene
P127	1563-66-2	7-Benzofuranol, 2,3-dihydro-2,2-dimethyl-, methylcarbamate.
P127	1563-66-2	Carbofuran
P128	315-8-4	Mexacarbate

P128	315-18-4	Phenol, 4-(dimethylamino)-3,5-dimethyl-, methylcarbamate (ester)
P185	26419-73-8	1,3-Dithiolane-2-carboxaldehyde, 2,4-dimethyl-, O-[(methylamino)-carbonyl]oxime.
P185	26419-73-8	Tirpate
P188	57-64-7	Benzoic acid, 2-hydroxy-, compd. with (3aS-cis)-1,2,3,3a,8,8a-hexahydro-1,3a,8-trimethylpyrrolo[2,3-b]indol-5-yl methylcarbamate ester (1:1)
P188	57-64-7	Physostigmine salicylate
P189	55285-14-8	Carbamic acid, [(dibutylamino)-thio]methyl-, 2,3-dihydro-2,2-dimethyl-7-benzofuranyl ester
P189	55285-14-8	Carbosulfan
P190	1129-41-5	Carbamic acid, methyl-, 3-methylphenyl ester
P190	1129-41-5	Metolcarb
P191	644-64-4	Carbamic acid, dimethyl-, 1-[(dimethyl-amino)carbonyl]-5-methyl-1H-pyrazol-3-yl ester
P191	644-64-4	Dimetilan
P192	119-38-0	Carbamic acid, dimethyl-, 3-methyl-1-(1-methylethyl)-1H-pyrazol-5-yl ester
P192	119-38-0	Isolan
P194	23135-22-0	Ethanimidthioic acid, 2-(dimethylamino)-N-[[(methylamino) carbonyl]oxy]-2-oxo-, methyl ester
P194	23135-22-0	Oxamyl
P196	15339-36-3	Manganese, bis(dimethylcarbamodithioato-S,S′)-,
P196	15339-36-3	Manganese dimethyldithiocarbamate
P197	17702-57-7	Formparanate
P197	17702-57-7	Methanimidamide, N,N-dimethyl-N′-[2-methyl-4-[[(methylamino)carbonyl]oxy]phenyl]-
P198	23422-53-9	Formetanate hydrochloride
P198	23422-53-9	Methanimidamide, N,N-dimethyl-N′-[3-[[(methylamino)-carbonyl]oxy]phenyl]-monohydrochloride
P199	2032-65-7	Methiocarb

P199	2032-65-7	Phenol, (3,5-dimethyl-4-(methylthio)-, methylcarbamate
P201	2631-37-0	Phenol, 3-methyl-5-(1-methylethyl)-, methyl carbamate
P201	2631-37-0	Promecarb
P202	64-00-6	m-Cumenyl methylcarbamate
P202	64-00-6	3-Isopropylphenyl N-methylcarbamate
P202	64-00-6	Phenol, 3-(1-methylethyl)-, methyl carbamate
P203	1646-88-4	Aldicarb sulfone
P203	1646-88-4	Propanal, 2-methyl-2-(methyl-sulfonyl)-, O-[(methylamino)carbonyl] oxime
P204	57-47-6	Physostigmine
P204	57-47-6	Pyrrolo[2,3-b]indol-5-ol, 1,2,3,3a,8,8a-hexahydro-1,3a,8-trimethyl-, methylcarbamate (ester), (3aS-cis)-
P205	137-30-4	Zinc, bis(dimethylcarbamodithioato-S,S′)-,
P205	137-30-4	Ziram

ALFRED UNIVERSITY CHEMICAL HYGIENE PLAN
Appendix R - Some Common Laboratory Oxidizers

This list is not all-inclusive. To ensure the safe handling of all chemicals, be sure to read the chemical label, SDS and other chemical reference materials to determine the chemical properties and hazards.

Oxidizers react with other chemicals by giving off electrons and undergoing reduction.
Uncontrolled reactions of oxidizers may result in a fire or an explosion, causing severe personal injury and property damage. The intensity of the reaction depends on the oxidizing-reducing potential of the materials involved.

Use oxidizers with extreme care and caution. Follow all safe handling guidelines specified in the AU CHP and the chemical SDS.

Bleach
Bromates
Bromine
Butadiene
Chlorates
Chloric Acid
Chlorine
Chlorite
Chromates
Chromic Acid
Dichromates
Fluorine
Haloate
Halogens
Hydrogen Peroxide
Hypochlorites
Iodates
Mineral Acid
Nitrates
Nitric Acid
Nitrites
Nitrous oxide
Ozanates
Oxides
Oxygen
Oxygen difluoride
Ozone
Peracetic Acid
Perhaloate
Perborates
Percarbonates
Perchlorates
Perchloric Acid
Permanganates
Peroxides
Persulfates
Sodium Borate Perhydrate
Sulfuric Acid

Appendix S - Some Common Shock Sensitive and Explosive Chemicals

Shock sensitive refers to the susceptibility of a chemical to rapidly decompose or explode when struck, vibrated or otherwise agitated. Explosive chemicals are those chemicals which have a higher propensity to explode under a given set of circumstances than other chemicals (extreme heat, pressure, mixture with an incompatible chemical, etc.).
The label and SDS will indicate if a chemical is shock sensitive or explosive.
The chemicals listed below may be shock sensitive or explode under a given number of circumstances. This list is not all-inclusive.

2,4-dinitrophenylhydrazine (dry),
acetylene fulminate of mercury nitroguanidine

acetylides of heavy metal fulminate of silver nitroparaffins

amatex

amatol ethyl-tetryl organic nitramines

ammonal fulminating gold ozonides

ammonium nitrate fulminating mercury pentolite

ammonium perchlorate fulminating platinum perchlorates of heavy metals

ammonium picrate fulminating silver peroxide forming compounds

azides of heavy metals gelatinized nitrocellulose picramic acid

baratol guanyl picramide

benzoyl peroxide (dry) guanyl nitrsamino picric acid (dry)

calcium nitrate guanyltetrazene picratol

chlorate picryl sulphonic acid compounds with functional copper acetylide hydrazine

cyanuric triazide nitrated carbohydrate silver acetylide

cyclotrimethylenetrinitramine nitrated glucoside silver azide

di- and tri-nitro compounds, nitrocellulose tetranitromethane

dinitrophenol nitrogen triiodide

dinitrophenyl hydrazine nitrogen trichloride

dinitrotoluene nitroglycerin

ednatol nitroglycide

erythritol tetranitrate nitroglycol

ether

ethylene oxide nitrourea

groups diazo, nitroso, haloamine

Mixtures:

Germanium	tetracene
Hexanitrodiphenyamine	tetrytol
Hexanitrostilbene	trimethylolethane
hexogen	trimonite
hydrazoic acid	trinitroanisole
lead azide	trinitrobenzene
lead mononitroresorcinate	trinitrobenzoic acid
lead styphnate	trinitrocresol
mannitol hexanitrate	trinitroresorcinol
sodium picramate	tritonal
tetranitrocarbazole	urea nitrate

References: Safety data sheets, various chemical companies.

***ALFRED UNIVERSITY* CHEMICAL HYGIENE PLAN**
Appendix T - Unattended Operations Notification
To be completed by the person conducting the experiment

Warning!

UNATTENDED OPERATION IN PROGRESS
INVOLVING HAZARDOUS MATERIALS

This completed form serves as the warning/explanation sign which must be posted on the laboratory door or other conspicuous place out of the operation danger zone through the duration of the unattended operation. This completed form must be sent to EH&S☑ prior to the start of the operation.

Nature of the experiment in progress: _____

Chemicals in use: _____

Hazards present (electrical heat, etc.): _____

Name of person conducting experiment: _____

Contact number: _____

Secondary contact name and number: _____

Approval:
LSF/PI printed name _____signature _____date_____

ALFRED UNIVERSITY CHEMICAL HYGIENE PLAN
Appendix U - Checklist for Vacating Laboratories
Applies to All Individual or Shared Lab Space
Submit completed checklist to EH&S☑

Laboratory location: Building _____ Room(s) #_____

LSF/PI _____Division _____

Date laboratory will be vacated _____

Transfer lab responsibility to: _____

- **Notify EH&S and LSF/PI well in advance of planned departure or move.**
- **Obtain necessary packing materials, bottles, labels, boxes carts, etc.**
- **Wear proper PPE.**
- **Indicate N/A if item Not Applicable**

Chemicals/Gas Cylinders

☐ All containers of chemicals are properly labeled.
☐ All usable chemicals are properly inventoried and stored within lab space or returned to general storage
☐ Unusable chemicals are properly collected and managed and disposed of as non-hazardous or hazardous waste according to EPA, DEC, Alfred POTW, Allegany County Landfill and AU regulations and policies.
☐ Contact EH&S if unknown chemicals or gases are present.
☐ Return gas cylinders to supplier.
☐ Contact EH&S for gas cylinders that cannot be returned to supplier.

Controlled Substances

☐ Contact the DEA for disposal and permit transfer/deactivation instructions

Microorganisms, Cultures, Recombinant Organisms

☐ All biological waste including Regulated Medical Waste, Blood Borne Pathogen Waste is properly collected, managed and disposed of according to NYSDOH, NYSDEC, OSHA, Allegany County Landfill, and AU regulations and policies.
☐ If cultures are shipped to another facility, all shipping regulations must be followed.
☐ Cultures moved within the campus must be transported in a primary and secondary container.
☐ Transfer responsibility to: _____

Animal, Human and Plant Tissue

- ☐ Animals to be moved to another location on campus must be transported in covered cages. New location: _____
- ☐ Responsibility for animals remaining in the lab space is transferred to: _____.
- ☐ All animal waste (carcasses, parts, tissue, bedding) is collected, managed, and disposed of according to NYSDOH, NYSDEC, Allegany County Landfill, and AU regulations and policies.
- ☐ Formaldehyde/formalin preserved animals, parts or tissue is collected, managed and disposed or as chemical waste as specified in the above section.
- ☐ Human samples (including DNA, blood, etc.) are disposed of properly either as Regulated Medical Waste or Biosafety Level 2 biological waste according to NYSDOH, OSHA, and AU regulations and policies.
- ☐ Plants and plant materials are disposed of properly according to AU regulations and policies.

Radioactive Materials

As of February 14, 2006, The Alfred University Radiation Safety Committee, supported by the Provost, established that Alfred University does not own any radioactive materials. The University still holds a New York State Radioactive Materials License; however, official requests have been made to suspend the license.

If you encounter any materials that you suspect are radioactive or are labeled as radioactive you should leave the materials undisturbed and contact the University Radiation Safety Officer, Scott Misture, in Binns-Merrill Hall room 117, X 2438. An immediate response will determine if the materials are in fact radioactive, and subsequently arrange for the removal of any radioactive materials.

Equipment and Lab Furniture

- ☐ All glassware is clean and returned to proper storage.
- ☐ All drawers, cabinets, refrigerators, fume hoods, bench tops, etc. are empty and clean; discarding general trash.
- ☐ All equipment and furniture has been cleaned, decontaminated and/or disinfected if necessary and is properly stored.
- ☐ Uncontaminated, unwanted, unusable electronics are labeled for electronic recycling – notify EH&S.
- ☐ Uncontaminated, non-working, non-electronic equipment has been labeled for metal recycling – contact Physical Plant for pick up.

If necessary, contact EH&S for information regarding contaminated equipment.

Mixed Hazards – chemical/radioactive/biological waste mixtures

- ☐ Contact EH&S if mixed waste is present.

Lab inspection

- ☐ **Contact EH&S 2190 for exit inspection**.

Division Clearance

Under my supervision, I certify that my staff and I have cleaned and decontaminated this laboratory as specified in this document.

LSF/PI_____ date_____

I verify that this lab has been cleaned and decontaminated as specified in this document.

Division Chair_____ date_____

Radiation Safety Officer Clearance (if applicable)

After inspection of this laboratory I certify this lab has been cleaned and decontaminated as specified in this document.

_____ date_____

EH&S Clearance

After inspection of this laboratory I certify this lab has been cleaned and decontaminated as specified in this document.

_____ date_____

ALFRED UNIVERSITY CHEMICAL HYGIENE PLAN

Appendix V - Prior Approval Form *Send/ Deliver completed form to EH&S*

LSF/ PI_____ Phone _____ Email_____

Location _____ Fax_____

Activity: ☐ Sponsored Research ☐ Institutionally Funded Research ☐ Academic Instruction ☐ Other_____

Signature of compliance contact person is required for each item below that is relevant to the approval request.

For Section I items: also complete PHS approval form☑ and attach to this form.
For Section II items: attach research proposal or a separate piece of paper with details to this form. Submit form with attachments to compliance contact person(s). Obtain signature(s) then submit form with attachments to EH&S.

Check all that apply in both Sections	**Contact Source** See Appendix A☑ for contact names	**Approval Signature**
Section I		
☐ Particularly Hazardous Substances	EH&S Coordinator	
☐ Explosives	EH&S Coordinator	
☐ Toxic gases	EH&S Coordinator	
Section II		
☐ Chemical treatment , storm or sanitary drain discharges	EH&S Coordinator	
☐ Use of Human Subjects	Human Subject Research Chair	
☐ Animal use	Animal Care and Use Chair	
☐ Recombinant DNA	AU Institutional Biosafety Chair	
☐ Genetically Modified Organisms	AU Institutional Biosafety Chair	
☐ Radioactive Materials, Radiation devices/ Lasers	Radiation Safety Officer	
☐ Etiological Agents and Toxins	AU Institutional Biosafety Chair	
☐ Renovation, construction or rental of space	Physical Plant AU or NYSCC	
☐ Expanded utility services or discharge to storm or sanitary drain to support proposed additional equipment (e.g. chemical fume hoods, air conditioning, biological safety cabinets, etc.)	Physical Plant AU or NYSCC	
☐ Modification to existing engineering controls	Physical Plant AU or NYSCC	
☐ Purchase or maintenance of equipment, apparatus, or furniture with funds NOT included in research proposal	Physical Plant AU or NYACC VP/ Director of Business and Finance	
☐ Additional costs for waste removal and clean up (recycling, hazardous waste, electronic waste, universal waste, etc.)	VP/ Director of Business and Finance, Academic Dean	
☐ Additional personnel or space that will require support beyond that provided in a research proposal	Academic Dean	

ALFRED UNIVERSITY CHEMICAL HYGIENE PLAN
Appendix W - Developing Site-Specific SOPs

Blank SOP forms for Chemical or Chemical Hazard Class SOP and Process/Experiment/Equipment follow after '[Instructions for completing site-specific SOP forms](#)☑'

The purpose of a laboratory (site) specific SOP is to ensure that laboratory workers know how to work safely with the highly hazardous chemicals and equipment that are used in a particular lab.

- It is the responsibility of the LSF/PI to write site-specific SOPs and ensure they are followed.

- A copy of the completed SOP must be sent to EH&S along with the site-specific training ☑documentation.
  - The use of electronic SOPs is encouraged to allow for electronic posting and sharing among laboratories.
  - When completing the electronic SOP form, use an ink color that will stand out from the form's black type.

- If an SOP is valid for multiple labs, the same SOP can be used as long as it modified to fit the particular laboratory.

- Three methods that can be used to write an SOP:
  - **By Process/Experiment/Equipment** such as distillation, synthesis, chromatography
    - If hazardous intermediates are created, consider specific precautions which should be noted. Pre-existing laboratory procedures or instructions do not have to be re-written, as long as all information required is within the existing plan. Complete first two pages of the SOP form and attach a copy of the existing material to the procedure detail section of the SOP or reference to the pre-written procedure and identify its location.
    - Photos may be inserted into Detail Section to show proper set up of glassware, etc.
  - **By Individual Chemical** such as acrylamide, formaldehyde, toluene
    - This approach may be most useful if a limited number of hazardous substances are used in the laboratory or if using a particularly hazardous substance.
  - **By Class of Chemical** such as organic solvents or peroxidizable chemicals

Instructions for Completing the Site-Specific Sop Forms

Choose proper site-specific SOP form **Chemical/Chemical Hazard class☑ or Process/Experiment/Equipment☑**

Location/Div means the building and room number(s) where the chemical used or process is performed/ Division or Department name

Name means the name of the process or experiment or equipment

Chemical means the full name of the chemical(s) used.

CAS number means the Chemical Abstract Service Registry number unique to that chemical.

Hazard Class means the hazard class of the chemical (carcinogen, reproductive toxins[2], flammable, toxic, corrosive…) .

Associated Hazards self explanatory

NFPA Rating National Fire Protection Association rating found on SDS and/or label. [1]

Chemical Precautions specifies precautions handling, use and storage of chemical(s)
Ex: incompatible or reactive with…. usable shelf life, etc. Be as specific as possible.

Purchasing purchase or current possession of PHS☑ requires prior approval☑ from EH&S.

Storage identifies specific storage area… "flammable cabinet to left of fume hood, room 312".

Security protocol detail procedure to secure chemical… "cabinet locked, etc.

Designated area means specific area where the PHS used. Specify security protocol for area.

Authorized personnel LSF/PI authorizes lab employee's use of chemical or performance of process, etc. when the LSF/PI is confident employee demonstrates the level of knowledge required to safely perform the procedure. Complete LSF/PI Site Specific Employee☑ Authorization Form and attach a copy to the SOP.

Training requirements See Employee training☒. The Lab Safety Training (every laboratory employee should have this training) and Site-specific training☑ boxes must always be checked. The check list of written programs and training provided is not inclusive; additional written materials or training may be added at the discretion of the person responsible for training. Retain training documentation records in the lab/department/Division training file; send copies of the completed Site-specific Training Form to EH&S.

Engineering/Ventilation Controls describe controls such as laboratory fume hoods, explosion shielding, interlocks or other safety features on equipment required to be used to reduce employees' exposure to hazardous chemicals and physical hazards.

Personal protective equipment requirements may vary greatly depending upon the chemicals in use. Please check all items that apply. If additional safety equipment or conditions are required, please record these items in "other". Please note the following:

- There is a requirement to use chemical splash goggles when corrosive liquids or other materials with a potential to splash the eyes or face are in use.
- Glove selection☑ is particularly critical for carcinogens and acutely toxic materials. Many glove selection charts are available and the SDSs for many chemicals make recommendations for the type of hand protection required. Refer to inserted links and Appendix C Glove selection☑. Call EH&S 2190 for assistance in glove selection if necessary. *Incidental contact* means the type and use of the glove to be worn when no contact with the chemical(s) is anticipated under normal conditions of use. *Extended contact* means the type and use of the glove to be worn when contact with the chemical(s) is anticipated, such as the immersion of the hands in a chemical when it is used as a cleaning agent, etc.
- Respirators are rarely needed in a lab setting. Generally speaking, all use of chemicals which pose an inhalation hazard must be conducted in a functional fume hood. *All use of respirators at AU must be approved by EH&S.* Call 2190 for assistance with respiratory protection if this is required for the chemical(s) in use.

- Shorts, tank tops, sandals, open toed shoes and other apparel that allow the arms, legs and feet to be exposed are prohibited when corrosives and other chemicals which pose a skin exposure hazard are in use.
- Long hair, jewelry and other items may present a hazard when hazardous chemicals and energized systems are in use. Remove jewelry and tie back long hair.

Emergency Controls means safety equipment or supplies needed in the immediate area.

Exposures Check N/A for process not using a hazardous chemical, otherwise list symptoms, first aid and other emergency procedures to be followed in the event that a person is exposed to the chemical(s) in use. The required information may be obtained from the SDS.

Emergency shutdown and evacuation procedures specify procedure for shutting down process or halting work with a hazardous chemical when an emergency occurs that requires evacuation of the lab or building.

Spills/Decontamination Check N/A for process not using any chemical, otherwise:
Spills describe procedures to be used in the event of a spill or other uncontrolled release of the chemical(s).
Decontamination procedures should be developed when necessary/possible: neutralization procedures or a detoxifying method. Please attach a copy of a detailed procedure.

Waste disposal be specific in describing proper waste storage and disposal procedures.

Phone numbers to be used in the event of an emergency. List **911**, **2108 AU Public Safety and EH&S 2190 for** all major spills, accidents damaging property (explosions, fires) and substantial personal injuries.

[1]NFPA is the National Fire Protection Association which has developed a system of rating the hazards of chemicals on a scale of 0-4 for health, flammability and reactivity. HMIS is a similar but proprietary system used by some chemical companies. The rating scales range from 0 for "no hazard" to 4 for "extremely hazardous" for each of the hazardous characteristics listed above. Many chemical company catalogs contain an explanation of the NFPA/HIMS rating system.

[2]The LD50, or Lethal Dose 50, is the mean amount of a chemical that will cause 50% of a population of test animals to die when the chemical is administered via a particular route of exposure for a specified length of time.

ALFRED UNIVERSITY Site-Specific Chemical SOP W-1

A copy of the completed SOP must be filed with EH&S 117 Myers Hall X 2190.

☐ **Chemical** or ☐ **Chemical Hazard Class**

Lab Location/Div: _____

Chemical name: _____ **Cas#**_____

Hazard Class: ☐ Reproductive Toxin ☐ High Acute Toxicity ☐ Carcinogen ☐ Flammable ☐ Corrosive ☐ Oxidizer/Reactive ☐ Peroxide former ☐ Other(describe)_____

NFPA Rating: Flammability: ____ Reactivity: ____ Health: ____ Specific Hazard_____

Chemical precautions: _____

Purchasing: ☐ N/A
Purchase (or current possession/use) of a PHS☑ must have prior approval☑ from EH&S before ordering. Complete PHS Approval Form☑ and Prior Approval Form☑ . A current SDS must be available. Quantities of this material will be limited to _____, or the smallest amount necessary to complete the experiment.

Storage: Chemical(s) are stored according to compatibility and label recommendations in _____. Security protocol for the area _____. Storage area will be regularly inspected by _____ to ensure safety.

Designated area: ☐ N/A
☐ Chemicals shall be used only in the following designated area:
Room _____ Building _____
☐ Designated area within lab (describe)_____
☐ Security protocol _____

Authorized personnel: ONLY personnel who have fulfilled the required training requirements☑ and have received approval from the LSF/PI are allowed to use the chemical or chemical class for which this SOP is written. Attach completed LSF/PI Site Specific Employee Authorization☑ Form to SOP.
☐ Other restrictions (describe) _____

Training requirements: The user must demonstrate competency and familiarity regarding the safe handling of this chemical prior to use. Training should include the following:
☐ Review of current SDS ☐ Review of the OSHA Lab Standard
☐ Review of Divisional safety manual ☐ Review of Chemical Hygiene Plan
X Site-specific training X Lab Safety training (EH&S)
☐ Respirator training ☐ Other (describe) _____

Engineering/Ventilation/Isolation Controls: ☐ none required
To be used to reduce employees' exposure to hazardous chemicals and physical hazards.
☐ Chemical Fume Hood ☐ Specialty Hood (describe) _____
☐ Glove box ☐ Vented gas cabinet ☐ Explosion Shield
☐ Other(describe) _____

Personal protective equipment: All personnel are required to wear the following personal protective equipment whenever using this chemical/process. *Check all that applies*:

☐ Safety glasses ☐ Chemical safety goggles ☐ Face shield
☐ Lab coat ☐ Rubber apron ☐ Tyvek clothing ☐ Respirator type_____
☐ Gloves type/use: Incidental Contact: _____ Extended Contact: _____
☐ Proper lab attire ☐ Other (describe) _____

Emergency Controls: ☐ First aid kit ☐ Spill kit ☐ Eyewash/Shower
☐ Other_____

Significant Routes of Chemical Exposures:

☐ Skin/eye contact- symptoms: First aid:	☐ Ingestion - symptoms: First aid:	☐ Inhalation – symptoms: First aid:

Emergency shutdown and evacuation procedures:

10. Spills/Decontamination:

☐ Spill cleanup:

☐ Decontamination:

11. Waste disposal: Person using this process is responsible for the safe collection, handling and storage of chemical waste managed in accordance with all government regulations and AU policies and procedures. Details:

Emergency numbers:

9-991 Medical, Fire, Police, Haz-Mat Spill Team
2190 Environmental Health and Safety
2108AU Public Safety
LSF/PI or Division Chair _____
Other applicable phone numbers _____

All lab injuries must be reported to the LSF/PI, "AU Accident Report" must be completed and sent to HR within 24 hours. Occurrence of three or more serious (life-threatening) accidents or one death must be reported immediately to EH&S as OSHA must be contacted immediately.

LSF/PI: printed name_____ **Date:** _____

Signature: _____ **Reviewed:** _____

ALFRED UNIVERSITY Site-Specific Process SOP W-2

A copy of the completed SOP must be filed with EH&S 117A Myers Hall X 2190.

☐ **Process** ☐ **Experiment** ☐ **Equipment**

Lab Location/Div: _____

Process/Exp/Equip **Name** _____

Associated Hazards:

☐ Cryogenic hazards ☐ Compressed gas hazards ☐ Electrical hazard
☐ High temperature ☐ Crush/Pinch hazards ☐ Radiation hazard
☐ Fire/explosion hazard ☐ Other(describe)_____
☐ Hazardous Chemical(s) used in process/experiment/equipment *if checked, check all that apply in box below*

Hazard Class(es)**:**
☐ Reproductive Toxin ☐ High Acute Toxicity ☐ Carcinogen
☐ Flammable ☐ Corrosive ☐ Oxidizer ☐ Peroxide former
☐ Other(describe)_____

NFPA Rating: Flammability: ____ Reactivity: ____ Health: ____ Specific Hazard_____
Enter highest number if more than one chemical is used in process

☐ Chemical purchase/possession requires prior approval☑.

☐ Quantity limited to_____

Chemical precautions _____

Chemical storage location _____

Security protocol _____

Designated area if using PHSs: ☐ N/A

Process/Experiment/Equipment shall be performed only in the following designated area:
Room# _____ Building _____
Designated area within lab (describe) _____
Security protocol _____

Authorized personnel: ONLY personnel who have fulfilled the required training requirements☑ and have received approval from the LSF/PI are allowed to perform the process, experiment or use the equipment for which this SOP is written. Attach completed LSF/PI Site Specific Employee Authorization Form☑ to SOP.
☐ Other restrictions (describe) _____

Training requirements: The user must demonstrate competency and familiarity regarding the safe performance of this process. Training☑ should include the following: *Check all that applies*:
☐ Review of current SDS ☐ Review of the OSHA Lab Standard
☐ Review of Divisional safety manual ☐ Review of Chemical Hygiene Plan
X Site-specific training X Lab Safety training (EH&S)
☐ Respirator training ☐ Other (describe) _____

Engineering/Ventilation/Isolation Controls: ☐ none required
To be used to reduce employees' exposure to hazardous chemicals and physical hazards.
☐ Chemical Fume Hood ☐ Specialty Hood (describe) _____
☐ Glove box ☐ Vented gas cabinet ☐ Explosion Shield
☐ Other(describe) _____

Personal protective equipment: All personnel are required to wear the following personal protective equipment whenever performing this process. *Check all that applies*:
☐ Safety glasses ☐ Chemical safety goggles ☐ Face shield
☐ Lab coat ☐ Rubber apron ☐ Tyvek clothing ☐ Respirator type_____
☐ Gloves type/use: Incidental Contact: _____ Extended Contact: _____
☐ Proper lab attire ☐ Other (describe) _____

Emergency Controls: ☐ First aid kit ☐ Spill kit ☐ Eyewash/Shower
☐ Other_____

Significant Routes of Chemical Exposures: ☐ N/A

☐ Skin/eye contact- symptoms: First aid:	☐ Ingestion - symptoms: First aid:	☐ Inhalation – symptoms: First aid:

Emergency shutdown/Evacuation procedures:

Spills/Decontamination: ☐ N/A
☐ Spill cleanup:

☐ Decontamination:

Waste disposal: The authorized person using this process is responsible for the safe collection, handling and storage of chemical waste managed in accordance with all government regulations and AU policies and procedures. Provide any process specific details.

Emergency numbers:
9-991 Medical, Fire, Police, Haz-Mat Spill Team
2190 Environmental Health and Safety
2108 AU Public Safety
LSF/PI or Division Chair _____
Other applicable phone numbers _____
All lab injuries must be reported to the LSF/PI, "AU Accident Report" must be completed and sent to HR within 24 hours. Occurrence of three or more serious (life-threatening) accidents or one death must be reported immediately to EH&S as OSHA must be contacted immediately.

Process Procedure: Provide details of process procedure; enter safety measures for each step if not already covered by the SOP information provided above.

Process Steps	Safety measures for each step

LSF/PI: printed name_____ **Date:** _____

Signature: _____ **Reviewed:** _____

ALFRED UNIVERSITY CHEMICAL HYGIENE PLAN
Appendix X - References

American National Standard for Emergency Eyewash and Shower Equipment, ANSI Z358.1-2014, American National Standards Institute, Inc., International Safety Equipment Association.

Chemical Hygiene Plans (online versions), or portions of, from the following Colleges and Universities:

Arizona State University
Boston University
California State University, Sacramento
California State University, San Marcos
Cornell University
Dickinson College
Ernest Orlando Lawrence Berkeley National Laboratory
Florida Atlantic University
Florida State University
Michigan State University
New Mexico State University
Northwestern University
Ohio State University
Oklahoma State University
Princeton University
Purdue University
Stanford University
SUNY at Stony Brook
University of California, Santa Barbara
University of Illinois at Chicago
University of Maryland
University of Medicine and Dentistry of NJ
University of Missouri, Rolla
University of Nevada, Reno
University of Rochester
Vanderbilt University
Woods Hole Oceanographic Institute

Flinn Chemical & Biological Catalog Reference Manual, Flinn Scientific, Inc., 2008

"Hydrofluoric Acid Product Literature", Honeywell Inc.

Safety data sheet, Hydrofluoric Acid, 47-51%,ACC#11171, Fisher Scientific, 10/22/2007.

Safety data sheet, Hydrofluoric Acid #HF-0002, Honeywell, Inc., January 2004.

Prudent Practices in the Laboratory, Handling and Disposal of Chemicals, Committee on Prudent Practices for Handling, Storage, and Disposal of Chemicals in Laboratories, Board on Chemical Sciences and Technology, Commission on Physical Sciences, Mathematics, and Applications, National Research Council, National Academy Press,1995.

"Review of Safety Guidelines for Peroxidizable Organic Chemicals," Chemical Health and Safety, September/October 1996.

"Recommended Medical Treatment for Hydrofluoric Acid Exposure", Ver. 1.0, Honeywell Inc., May 2000.

Safetygram #10, "Handling, Storage and Use of Compressed Gas Cylinders", Air Products and Chemicals, Inc., 2004.

ALFRED UNIVERSITY CHEMICAL HYGIENE PLAN
Appendix Y - Record of Changes

DATE	DESCRIPTION OF CHANGE (S)	PAGE No.
04/23/2009	Major revisions of 2007 version	Throughout doc.
02/06/2016	Major revisions of 2009 version	Throughout doc

Laboratory Specific Emergency Numbers

Add additional necessary numbers

Building _____ Room _____

LSF/PI _____ phone_____

2nd Contact _____ phone_____

3rd Contact _____ phone_____

Laboratory specific exit route and designated assembly area:

To call for emergency assistance:
Using a campus phone dial 911 then 2108 AU Public Safety or 2190 EH&S
Using a cell phone dial 911 then 607-871-2108 Public Safety or 607-871-2190 EH&S

If assisting chemically contaminated victims, PPE may be necessary.

EMERGENCY NUMBERS……from a campus phone ……..cell phone

Emergency – Fire/Police/Ambulance…….911 ……...911

Alfred University Public Safety……...2108…….607-871-2108

Environmental Health and Safety ……..…...2190…….607-871-2190

Radiation Safety ……..……2438……..……..607-871-2438

NYSCC Maintenance, Statutory……..... 2460…….607-871-2460

Physical Plant Non-Statutory……..……...2154…….607-871-2154

AU Wellness Center (Non-Emergency)…....2400…….607-871-2400

Poison Control Hotline……..…9-1-800-222-1222…….800-222-1222

Potential Hazards: _____